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АНГЛИЙСКИЙ ЯЗЫК

ДЛЯ ХИМИКОВ

Т. С. Петровская, И. Е. Рыманова, А. В. Макаровских

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Рекомендовано Учебно-методическим отделом среднего профессионального образования в качестве учебного пособия для студентов образовательных учреждений среднего профессионального образования

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***Авторы*:**

Петровская Татьяна Семеновна — доктор технических наук, доцент;

Рыманова Ирина Евгеньевна — старший преподаватель кафедры иностранных языков Института природных ресурсов Томского политехнического университета;

Макаровских Александра Викторовна — старший преподаватель кафедры иностранных языков Института природных ресурсов Томского политехнического университета.

***Рецензенты*:**

Высотова И. Е. — кандидат педагогических наук, декан факультета иностранных языков Томского государственного педагогического университета;

Мымрина Д. Ф. — кандидат филологических наук, доцент кафедры лингвистики и переводоведения Института международного образования и языковой коммуникации Томского политехнического университета;

Дубровская Н. В. — кандидат филологических наук, доцент кафедры лингвистики и лингводидактики факультета иностранных языков Томского государственного педагогического университета.

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В данном пособии реализуется коммуникативно-когнитивный подход; используется комбинация отечественных и зарубежных технологий преподавания иностранного языка в технической школе. Цель — развитие коммуникативных навыков общения в профессиональной сфере.

Соответствует актуальным требованиям Федерального государственного образовательного стандарта среднего профессионального образования и профессиональным требованиям.

Предназначено для студентов химико-технологических специальностей, изучающих английский язык на основе многоуровневого подхода.

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CONTENTS

ПРЕДИСЛОВИЕ ОТ РЕДАКЦИИ

Учебное пособие может быть рекомендовано учащимся колледжей химических специальностей со средним уровнем знаний английского языка. Издание имеет целью развитие у студентов навыков чтения, устной речи и письма.

Студент, освоивший программу дисциплины, согласно ФГОС СПО, должен обладать следующими компетенциями:

трудовые действия

- переводить тексты широкого профиля по специальности;
- вести беседу профессиональной направленности;
- делать доклады и презентации;

необходимые умения

- читать на английском языке литературу по специальности с целью поиска профессионально значимой информации;
- читать на английском языке формулы и описывать графики;

необходимые знания

- лексический и грамматический материал, изложенный в учебнике.

UNIT 1
Engineering Career

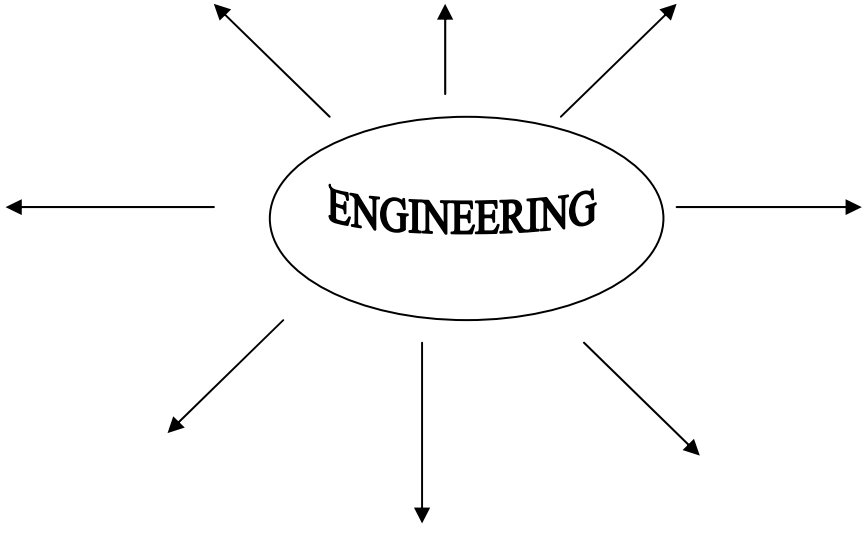
Engineers design, build, test and improve manufactured products.

"It is a great profession. There is the fascination of watching a figment of the imagination emerge through the aid of science to a plan on paper. Then it moves to realization in stone or metal or energy. Then it brings jobs and homes to men. Then it elevates the standard of living and adds to the comforts of life. That is the engineer's high privilege" .

Herbert Hoover, 31st President of the United States, 1963

STARTING UP

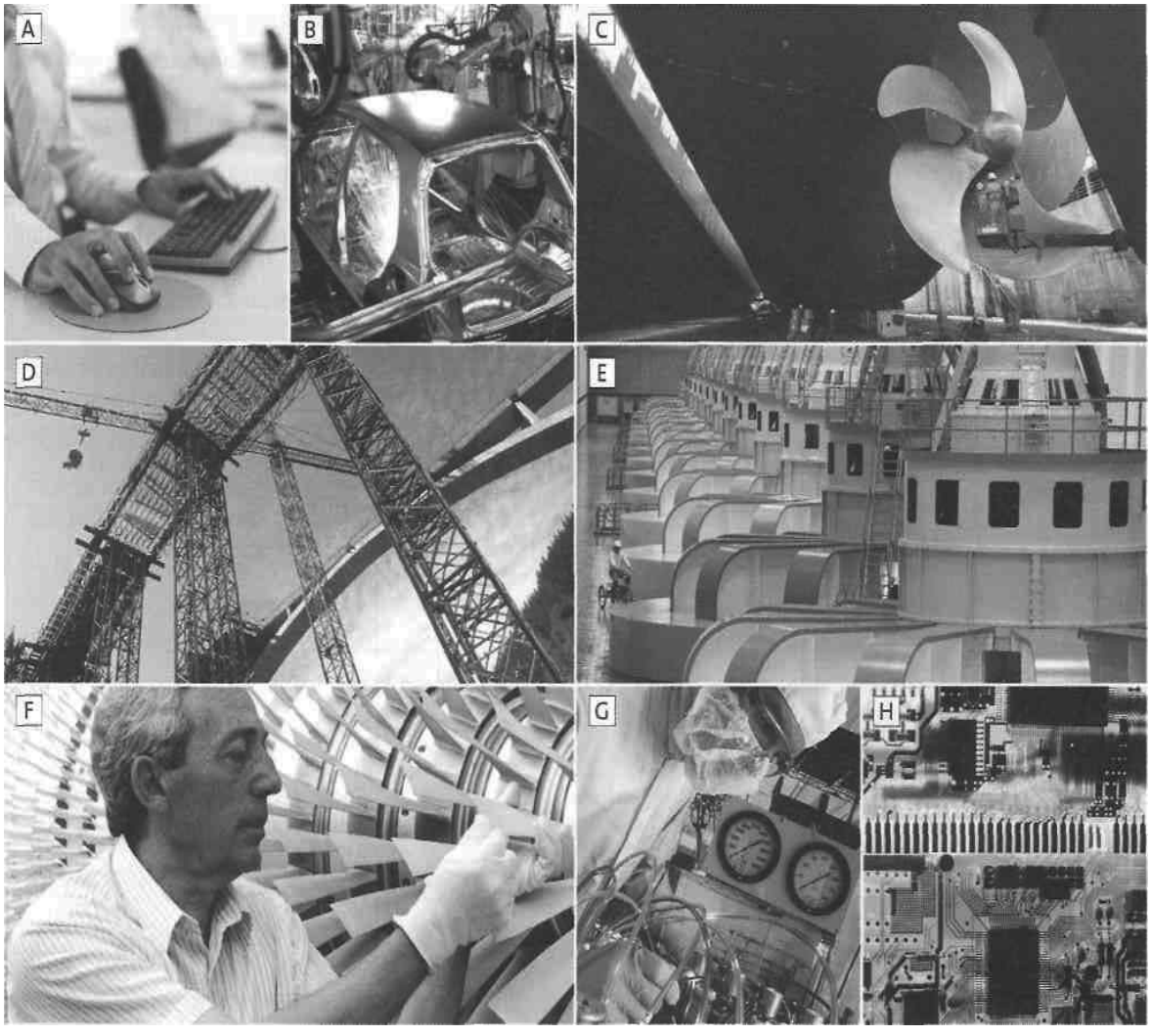
1. Work with a partner. In your own language, find some words to describe engineering. Compare your words with another pair and agree on six words. How do you say these words in English? Complete the diagram below using these English words to describe engineering.



2. Pictures A–H represent different branches of engineering. Match each picture to sentences 1–8.

1. Electrical engineering is about generating and supplying power.
2. Electronic engineering is about designing and making machines that use electric power.
3. Civil engineering is about designing, building, and looking after structures.
4. Marine engineering is applying engineering to take advantage of the sea.
5. Manufacturing engineering is about making useful things from raw materials.
6. Mechanical engineering is about designing and making all the parts of machines that move. That could mean rocket science or bike design – and everything in between.
7. Chemical engineering is about using the processes which change materials in a chemical or physical way. The science behind these processes helps to find out the best way to make the right products.
8. Information technology is about using computers for collecting, storing and sending information.

Technology 2. Student's book /Er.H. Glendinning. – Oxford: Oxford Uhiversity Press, 2007 (p. 14).



3. Work in groups of three or four. Make a list of as many other branches of engineering as you can. Try to explain them in English.

4. Answer these questions.

- Are there any people you know who work in one of the engineering fields mentioned above?
- What do they exactly do?
- What is the final product of their activity? How much is it effective/profitable?
- How did they start their engineering career? Is it successful?
- Would you like to have the same career? Why? Why not?

READING

 **5. Discuss these questions.**

- What is engineering?
- What does an engineer look like?
- What do engineers do?
- How do you choose your engineering major?

 **6. Now read the texts A, B and C and check your answers, but before reading match the words from column A with the words or words combinations from column B.**

A	**B**
1 potable	a field of working
2 VCR	b achievement
3 major	c suitable for drinking
4 manufacturing	d device
5 apply	e video cassette recorder
6 accomplishment	f production
7 appliance	g destruction
8 depletion	h use

 **7. Which of these statements are true? Give your guesses, then listen and check if you are right or wrong.**

1. To be an engineer is enough to have knowledge of the principles of mathematics, chemistry and physics. **T/F**
2. Everybody knows what a typical image of an engineer is. **T/F**
3. Engineers have contributed much to the development of our everyday life. **T/F**
4. If you are a civil engineer, your life is connected with building. **T/F**
5. If your aim is to keep human health in a good condition, you're a biomedical or an environmental engineer. **T/F**

Text A

What is Engineering?

Are you interested in making a **contribution** in the physical world? Are you good at solving problems? Do you like to understand how things work and how to make them better? Would you like to see your ideas for products become reality? If you answer yes to these questions, then odds are that you will want to become an engineer.

So, what exactly is an engineer? An engineer is someone who **applies** mathematics and the principles of science, especially chemistry and physics, to solve problems and meet the needs of society for products and services. Solving these problems and finding new solutions require creativity and persistence.

You may be concerned that you don't meet the stereotypical image of an engineer. Actually, most people don't even know what engineers are, so when you ask them about their stereotypical image, they often tell you about their image of a scientist. The image is often of a white male with out-of-control hair, glasses with tape holding them together over his nose, wearing a white **lab coat** with a pocket protector (possibly filled with leaking pens) over a **plaid** shirt, pants that are too short, white socks, and untied shoes.

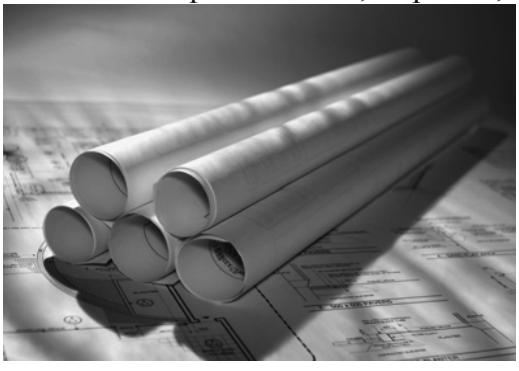
Engineers and engineering have been around for a long time, although many of the theorems that you will study during your years in college have been developed since the 1700s. The Egyptians were master engineers-witness the pyramids. The Romans built aqueducts to bring water into Rome, another significant engineering achievement. The Great Wall of China is a good example of a **man-made** feature on earth that is visible from space – this too is a great engineering accomplishment. Historically, most of the major engineering accomplishments have been in the field of what is called civil engineering today – although this is changing **rapidly**.

"Keys to Engineering Success" Jill S. Tietjen, Kristy A. Schloss

Text B

What do engineers do?

One of our engineering colleagues says that "Engineers make the world work". Engineers design and build bridges, buildings, and tunnels. They design, test, and analyze cars, pumps, and heating and air conditioning systems. They design, build, and manufacture space shuttles, airplanes, and helicopters. They design, operate, and **modify** power plants, gas pipelines, airports, and dams. They design computers, software, telecommunications devices, telephones (wireless and wired), fiber optics, and storage routing devices. They design the processes and equipment to manufacture VCR's, TV's, refrigerators, ovens, and toasters, as well as the appliances themselves. They create machines that cut fabrics to make our clothing, furniture, and draperies. Almost every product and process that you use in your daily life has been affected in some manner by an engineer.



You will find that engineers have had **input** into almost every activity that you undertake during the course of a typical day. Let's look at just a few of them.

- Engineers were involved in the design of your electric alarm clock – from it's display, to it's electrical connection, to the manufacturing of the battery that keeps

it working when the power is off, to the sound the alarm makes, to its size, its packaging, its ability to stay in one piece when dropped on the floor, the materials of which it is constructed, and its manufacturing. Engineers were also involved in the design of all of the related equipment and process controls for the manufacturing of the alarm clock.

- Your refrigerator has been designed to be energy **efficient** and not to release chemicals into the atmosphere that are believed to cause depletion of the ozone layer. It turns itself on and off as dictated by its **internal thermostat**. If you have a frostless model, a fan turns on regularly to keep the frost from **adhering** to the walls. All of these features were designed, tested, and manufactured to specifications that were established by engineers.
- The streets and roads you use to get from your home to school and work were designed and built by engineers. The water you drink and bathe in was made potable by engineers.

"Keys to Engineering Success" Jill S. Tietjen, Kristy A. Schloss

Text C

Choosing a Major

How will you choose your engineering major?
First, think about where you interests lie and what types of courses you like. What is it that you would spend your time doing, if you didn't have to do all of the other things in your life? What do you look forward to doing? How do you see yourself spending your time in your job after you **graduate**?

- Maybe you want to spend most of your time outside building roads, bridges, or buildings. If so, you probably want to look into civil or construction engineering.
- If your dream has always been associated with designing cars, then you may want to consider mechanical engineering.
- If your interests lie with computers, you have several choices, depending on your specific interest relative to computers. Do you want to make the computer itself, what is referred to as the hardware? Then you want to consider electrical or computer engineering. Does the process of logic and computer programming fascinate you? This is the software part, and you want to pursue either software or computer engineering or computer science.
- If you really want to **enhance** health and the human body through the design and application of equipment, then biomedical engineering could be for you.
- If chemistry fascinates you, you ought to look into chemical engineering.
- If you simply want to help clean up the environment – making clean water and clean air the order of the day for all citizens of the world – consider environmental engineering.

"Keys to Engineering Success" Jill S. Tietjen, Kristy A. Schloss (p. 8).

8. Look at the following words in bold in the texts and try to explain them. Consult the dictionary if necessary.

contribution, applies, lab coat, plaid, man-made, rapidly, modify, input, efficient, internal thermostat, adhering, graduate, enhance

9. Fill in the words from the list below. Use the words only once.

process, environment, contribution, major, principles, outside, to solve, interests, image, computer, theorems, to undertake, depletion, engineers, to modify

1) to make a(n) _____ in the physical world
2) to apply the _____ of science
3) _____ the problems
4) a(n) _____ of a scientist
5) to study the _____
6) _____ airports
7) _____ an activity
8) _____ controls
9) _____ of the ozone layer
10) established by _____
11) to choose a(n) _____
12) to spend time _____
13) _____ lie with computers
14) the process of _____ programming
15) to clean up the _____

10. Fill in the correct preposition, then make sentences using the completed phrases.

1) to be interested _____
2) to be good _____
3) to have input _____
4) to be involved _____
5) to release _____ the atmosphere
6) to turn _____
7) to look forward _____
8) to be associated _____
9) interests lie _____ smth
10) to depend _____
11) to clean _____ the environment
12) to be referred _____

11. Fill in the synonyms from the texts instead of the words in brackets.

1. An engineer is someone who _____ the principles of science to solve problems. **(uses)**
2. Most of the major engineering _____ have been civil engineering. **(achievements)**
3. This is changing _____. **(quickly)**
4. Engineers have _____ almost every activity. **(contributed to)**
5. The water you drink was made _____. **(suitable for drinking)**
6. What will you do after _____? **(finishing the university)**

PROFESSIONAL LANGUAGE DEVELOPMENT

12. Word Stress
Mark the stressed part of each word as in the example.
Example: *engine engineer engineering*

machine	mechanics	technical	science	chemistry
machinery	mechanic	technician	scientific	chemical
	mechanical	technology	scientist	chemist

13. Complete the table using the words below. There is an example.

mechanic, science, technical, chemistry, mechanics, scientific, technology, chemical, mechanical, scientist, technician, chemist, machine

Subject	People & Jobs	Thing	Adjective
1) engineering	engineer	engine	engineering
2)			
3)			
4)			
5)			

14. Match the branches of engineering with their definitions.

1) Aerospace (or aeronautical or astronautical) engineers	a) design, test, and analyze equipment and materials used in treating medical conditions. Such equipment and materials include artificial joints and body parts, surgical tools, scanning equipment, and breathing and heart monitors
2) Agricultural engineers	b) are involved with the production and delivery of electricity, telecommunications, cable, electronics, control systems, and digital systems
3) Architectural engineers	c) design products and systems to solve environmental problems, particularly cleaning up (or keeping clean) the air, water and land (including cleaning up oil spills in the ocean)
4) Biomedical engineers	d) plan, design, and construct buildings, dams, airports, water and wastewater treatment and distribution systems, mass transit systems including roads and bridges, and drainage systems
5) Chemical engineers	e) design, develop, and implement new and existing technologies in airplanes, space vehicles, and helicopters. These engineers are also involved in control and guidance systems, information systems, and instruments used for navigation of aircraft
6) Civil engineers	f) become involved in aspects of discovering and recovering minerals from the earth

7) Computer engineers	g) design, test, and analyze machines, structures, and devices including cars, pumps, heating, ventilation and cooling systems, combustion systems, and sports equipment (such as bicycles and skis)
8) Electrical/electronic engineers	h) are involved in ensuring the discovery, recovery, processing, and delivery of oil and gas
9) Environmental engineers	i) become involved in every aspect of food production, including processing, storage, handling, and distribution
10) Geological engineers	j) work with architects on buildings and focus on safety, costs, constructability, and sound construction methods: They work on building systems including illumination and heating, ventilation, and air conditioning
11) Marine or ocean engineers	k) design, develop and implement projects relating to the nuclear industry, from nuclear power plants for electric power industry to nautical propulsion systems for the U.S. Navy
12) Mechanical engineers	l) design harbors, underwater machines, and offshore drilling platforms. They specifically take into account the additional factors that must be considered in designing and manufacturing for the ocean environment, including wave motion, currents, temperature variations, and chemical and biological factors
13) Nuclear engineers	m) plan, design, and operate facilities that take ideas from scientists and translate them into large-scale commercial plants to meet the needs of society
14) Petroleum engineers	n) design, construct, and operate computer hardware and software systems

15. For questions 1–15, read this text and decide which answer A, B, C or D best fits each space.

Each educational programme **1**_____ four engineering profiles according to types of engineering activities, such as research engineer, design engineer, industrial engineer and field engineer. These four **2**_____ engineering activities form rather a circle than a line. Thereby, a field engineer **3**_____ the activity performed by research, design and industrial engineers. The activity of a field engineer **4**_____ like this stimulates the **5**_____ of science, engineering, technological and social progress. The four kinds of engineering activity not only complement but also **6**_____ each other. Any engineering activity includes **7**_____. The activity of research engineers is impossible without a clear idea of **8**_____, technological capabilities and operational requirements for products. Many of engineering problems thread all stages of engineering activity and can be successively solved as a result of cooperative efforts of all engineering types of activity. Today engineering activity requires knowledge in related disciplines not only allied but also in other **9**_____ and engineering fields. Having acquired this kind of knowledge an engineer will be capable to change the field of his activity and work at the **10**_____ between professions.

1)	**A** includes	**B** means	**C** involves	**D** implies
2)	**A** additional	**B** extra	**C** complementary	**D** supplementary
3)	**A** directs	**B** channels	**C** levels at	**D** aims at
4)	**A** performed	**B** introduced	**C** shown	**D** given
5)	**A** development	**B** increase	**C** rise	**D** decrease
6)	**A** fill	**B** interpenetrate	**C** saturate	**D** imbue
7)	**A** search	**B** survey	**C** research	**D** exploration
8)	**A** features	**B** properties	**C** qualities	**D** characteristics
9)	**A** educational	**B** technological	**C** research	**D** scientific
10)	**A** connection	**B** link	**C** interface	**D** unit

16. Use the words given in capitals to form the words that fit in the spaces.

Creativity in Engineering

Creation of new **1**_____ is one of the **2**_____ forms of creativity. What concerns engineering and many other **3**_____, new knowledge is not the final purpose of creativity. The more **4**_____ a problem is the more difficult will be a solution, the more dedicated should be creativity. Creativity **5**_____ a routine work, for example to make standard **6**_____. Then routine work in creativity will take **7**_____ time, and the main attention will be **8**_____ to creativity. Creativity is the **9**_____ of engineering activity. A **10**_____ form of engineering creativity is **11**_____ and rationalization activities which may result in **12**_____.

KNOW, HIGH
CREATE
COMPLICATE
IMPLY
CALCULATE
SUFFICIENT
PAY, BASE
TYPE
INVENT
DISCOVER

SPEAKING

17. Work in pairs. Choose two jobs from the list below that you would like to do. Then choose two which you would not like to do. Come to an agreement in your pair and explain your choice.

Aerospace Engineer
Agricultural Engineer
Biomedical Engineer
Chemical Engineer
Civil Engineer
Electrical Engineer
Electronic Engineer
Environmental Engineer
IT Engineer
Materials Engineer
Mechanical Engineer
Nuclear Engineer
Petroleum Engineer
Public Health Engineer
Sound Technician
Special Effects Technician
Telecommunications Technician
Transport Engineer

18. a) Look at these pictures carefully and define the types of engineering (use activity 17 for help). In groups of 3 or 4 discuss advantages and disadvantages of each type.

(1)

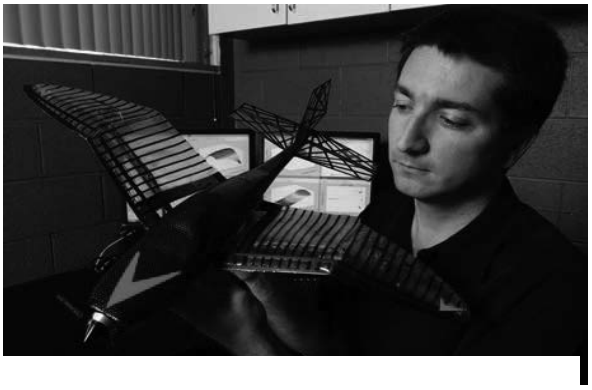
(2)

(3)

(4)

(5)

(6)



b) Choose any picture you like and prepare the description of this picture for your group-mates to guess.

c) Choose any picture you like and give a talk about this picture for as long as you can. Whose talk will be the longest?

19. There are considered to be four basic types of engineering: chemical, civil, electrical and mechanical. In groups discuss the following questions:

- Why do you think these types are basic?
- Are they related to each other? If yes, in which way?
- What is common between these types of engineering?
- Is your future career connected to any of them? In which way?

20. a) Fill in the table below.

	Chemical engineering	**Civil engineering**	**Electrical engineering**	**Mechanical engineering**
Activity			producing, delivering	
Products/services provided				
Industries it can be met in	chemical, petrochemical, food-processing, forestry and pharmaceutical		biomedical engineering and digital signal processing	metallurgy and materials; machine design; systems engineering; plant design; construction, and operation; environmental engineering
Advantages				
Disadvantages				

b) Divide into 4 groups, each group chooses one of the types of engineering mentioned in the table and prepare a 2 minute discussion. Use the information from the table.

PROJECT WORK

"Exploring Engineering Careers"

21. Choose a field of engineering and learn about it. Find a professional working in the field. Go interview the person. Make a presentation to the class on what this type of engineer does.

WRITING

22. Write a composition (approximately 120–180 words):

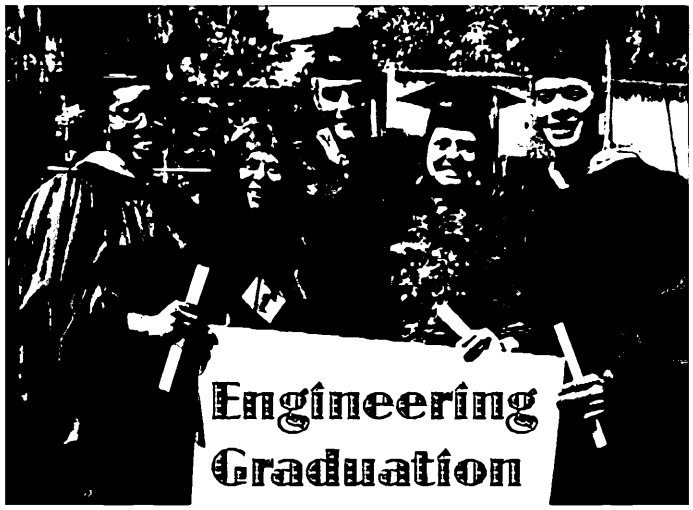
"Engineering is my future profession: it's advantages & disadvantages".

CHECKLIST

Assess your progress in this unit. Tick (✓) the statements which are true.

- ☐ I can name different types of engineering.
- ☐ I can present an image of an engineer.
- ☐ I can talk about engineers' activities.
- ☐ I know advantages and disadvantages of engineering profession.

UNIT 2
Engineering Education



Engineering education is a component of national strategic interests of the Russian Federation as well as the fact that engineers play key roles in both social and economic spheres of the society in the context of transition to stability.

Russian Association for Engineering Education

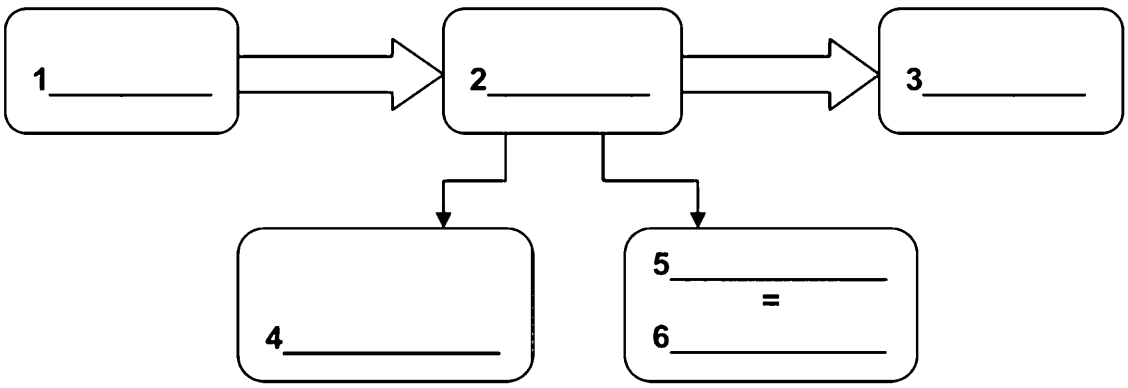
STARTING UP

1. Discuss these questions in groups.

- What does engineering career start with?
- How do you imagine the structure of engineering education?
- Which level of this structure is the most important for your future career?
- What are your plans in education? Which level will be final for you?
- Would you like to be a member of any engineering society/association?

2. Put the following levels of education according to the diagram below.

PhD *school* *Bachelor's Degree* *university* *Master's Degree* *engineering society*



3. a) Complete the names of "six engineering societies" according to their abbreviations. Use the words below.

education, electrical, civil, mechanical, petroleum, chemical

1) the American Society of _____ Engineers (**ASCE**)
2) the American Institute of Mining, Metallurgical and _____ Engineers (**AIMMPE**)
3) the American Society of _____ Engineers (**ASME**)
4) the American Institute of _____ Engineers (**AIEE**)
5) the American Society for Engineering _____ (**ASEE**)
6) the American Institute of _____ Engineers (**AIChE**)

b) Are there similar societies or institutes in Russia?

READING

4. Match the words from column A with their definitions from column B.

1) PhD	a) oral test
2) undergraduate	b) to explore
3) postgrad/postgraduate	c) Doctor of Philosophy
4) to research	d) student
5) supervisor	e) student getting a Master's or PhD degree
6) viva	f) person who encourages and helps a postgrad in his research work

5. You are going to read the text about postgraduate studying. Choose the most suitable heading from the list A–G for each paragraph (1–7). Then listen and check your answers.

A Whatever happens, it will be time well spent
B Public speaking is not so bad
C Not everything goes to plan
D The step up is large
E Lecturers can help enormously
F Success as an undergraduate does not guarantee success later
G The first discovery is a deep-rooted passion for your subject

ANOTHER DISCOVERY CHANNEL

"You make more than just scientific findings as a postgrad".
Matthew Killeya has a PhD in statistics

Here's one thing we learned: no two scientists have the same experience during their master's or PhD. *New Scientist* has talked to a wide range of prominent researchers about their postgraduate years, and discovered a great deal about their personal journeys to the top flight of science. So from the moment you decide to commit to further study through to life afterwards, here's what to expect as a postgrad.

1

The main thing any undergraduate realises when they decide to commit to a PhD or master's is just how much they love their discipline.
Discovering this is good news, of course: a consuming interest in your subject is probably the most important ingredient for success.
However, just like the difference between falling in love and tying the knot, a passion for your subject does not necessarily come at the same time as knowing you want to commit to years more of study.
Do not worry if you are not completely confident that you are making the right decision – sometimes that doesn't come until later.

2

Success as an undergraduate does not necessarily transfer to the next level, especially to a PhD. Moving from the confines of undergrad exercises with known solutions to the potentially unbounded problems you will explore in a doctorate requires motivation, curiosity, creativity, imagination and stubbornness. If your undergraduate course has an option to do a project or dissertation module, grasp the opportunity with both hands. This is your best chance to get a feel for postgrad life.

3

Many students who go on to do a master's or PhD do so thanks to a gatekeeper – a lecturer or professor who recognises their potential and helps set them on their journey. If there is somebody in your department encouraging you, then take it as definite sign that you might be well suited.
Do not be shy of looking beyond your department for advice. If you are enjoying a fascinating part of your subject that is beyond the scope of your lectures, why not take an advice and get in touch with the relevant researcher at another university?
Further down the line, choose your supervisor carefully: that relationship is the keystone of postgrad study – particularly in PhDs. Ask yourself if you would want a hands-on supervisor who you see most days, or whether you would prefer one who communicates monthly via Post-it notes in your pigeon-hole? Try to visit a department before applying, and ask students what it's like working for the various professors.

4

In the first few weeks of postgrad life, it is easy to feel somewhat awestruck by your supervisor and your peers. Put bluntly, there will be a lot of people around you who know a lot of stuff you do not. Nodding and smiling can be a useful skill.

A year's worth of fretting before comprehending what your supervisor is talking about is not uncommon.

"It was a massive shock, being thrown into the deep end of research", – says Marcus Du Sautoy, professor of mathematics at the University of Oxford.

Listen carefully, note everything down and think about it in your own time. Sometimes a comment from your supervisor that confused you can come into its own months later.

It is important to be ambitious but also realistic. "Many students expect to be doing fundamental research from day one, and in most cases this is unrealistic", – says Wendy Hall, professor of computer science at the University of Southampton. "You have a lot to learn and will spend considerable time reading about what others are doing".

5

It is easy to reach the second year of a research-based postgraduate placement and feel you have not achieved much. In a PhD, this is when you start to make your research your own. Starting to apply your knowledge to proper, independent research can be a shock.

Expect to have setbacks and failures. Everybody struggles – if all your experiments worked first time, then your supervisor would more than likely become suspicious.

Some things will be out of your control and you will need to make the best of it.

6

Somewhere along the way, you will probably attend academic conferences. This is a chance to meet some of the top people in the field and get some fresh perspectives on your work.

If you do not like talking in public, then this is the time to sort it out. Speaking about something you are passionate about can do wonders for the nerves. Writing a talk forces you to think about the structure and main messages of your thesis, which of course will help you write and present the thing later on.

In a PhD, one of the final hurdles is an oral defence of your thesis – or viva – to two experts in the field. It may be a two to three-hour grilling but, on the bright side, it is also a rare opportunity to talk non-stop about your research to people who will actually listen.

7

Towards the end, things unexpectedly start to fall into place and make sense. After months of toiling away on a handful of very specific problems, you come up for air and see where your work fits into the scientific endeavour. Your thesis becomes the story of a period of your life. Step back and you will see you have achieved a lot.

As long as you are interested in the subject, a postgraduate degree will be hard work but ultimately gratifying.

And if you later find yourself picking your completed thesis off the shelf and caressing it like a small pet, do not worry – this is entirely normal behaviour.

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6. Make a short story about your estimated postgrad study using the words below. Use as many words from the list as possible.

research, discover(y), science, scientist, discipline, subject, study, lecture(r), professor, dissertation, thesis, department, supervisor, viva, academic/scientific conference

PROFESSIONAL LANGUAGE DEVELOPMENT

7. Use the words given in capitals to form the words that fit in the spaces.

Master's Degree A master's degree is an academic degree **1**_____ to individuals who have **2**_____ study demonstrating a mastery or high-order overview of a specific field of study or area of professional practice. Within the area studied, graduates are posited to possess advanced **3**_____ of a specialized body of **4**_____ and applied topics; high order skills in analysis, critical **5**_____ or **6**_____ application; and the **7**_____ to solve complex problems and think rigorously and **8**_____.	**GRANT** **UNDERGO** **KNOW** **THEORY** **EVALUATE** **PROFESSION** **ABLE** **INDEPENDENT**

8. Fill in the gaps using the words in the box.

advance, undergraduates, equip, capabilities, application, grant, specialty, science, combine, industry

Master's degree in engineering

Traditional and master's degree in engineering programs **1**_____ students with in-depth knowledge and skills in a particular engineering **2**_____, expanding on the proficiency they gained as **3**_____. And students can design their master in engineering studies as either a platform for real-world **4**_____ or a future in academics.

Depending on the college or university, master's-level engineering programs will **5**_____ graduates with either a Master of **6**_____ in Engineering (MS or MSE) or a Master of Engineering (MEng).

With the detailed training that a traditional or online master's degree in engineering provides, graduates can **7**_____ their careers to higher-level technical or management positions, depending on their organization and **8**_____. Some master's students might choose to **9**_____ their engineering training with graduate-level business course work in an effort to demonstrate the breadth of their knowledge and **10**_____.

SPEAKING

9. Take a look at the 6 statements stated by people having PhD. Agree or disagree with them, prove your opinion.

"WISDOM IN A NUTSHELL"

(1) "In any creative endeavour you need a break, whether it is scientific research or anything else. The harder you work at it the more likely you are to get the break you want". *Harry Kroto, Professor of Chemistry, Florida State University*	**(2)** "The movie scientist who shouts 'eureka' is far from reality. You have to be passionate about your subject and willing to endure months of drudgery". *Mike Benton, Professor of vertebrate palaeontology, University of Bristol*
(3) "Often research doesn't go as expected. I discovered pulsars about two years into my PhD. It was too late to change the title of my thesis, so they appeared in the appendix". *Jocelyn Bell Burnell, Professor of physics, University of Oxford*	**(4)** "Find an understanding spouse that won't let you quit when the going gets tough. My wife earned at least half my doctorate". *Paul Nahin, Professor emeritus of electrical engineering, University of New Hampshire*
(5) "Surround yourself with smarter colleagues and listen and learn from them". *Mike Owen, head of the Biopharmaceuticals Centre*	**(6)** "Think carefully about who you choose as your supervisor. It can be very inspirational to be supervised by a well-known professor, but nowadays academics can be abroad a lot. You need someone to talk to about your research on an everyday basis". *Wendy Hall, Professor of computer science, University of Southampton*

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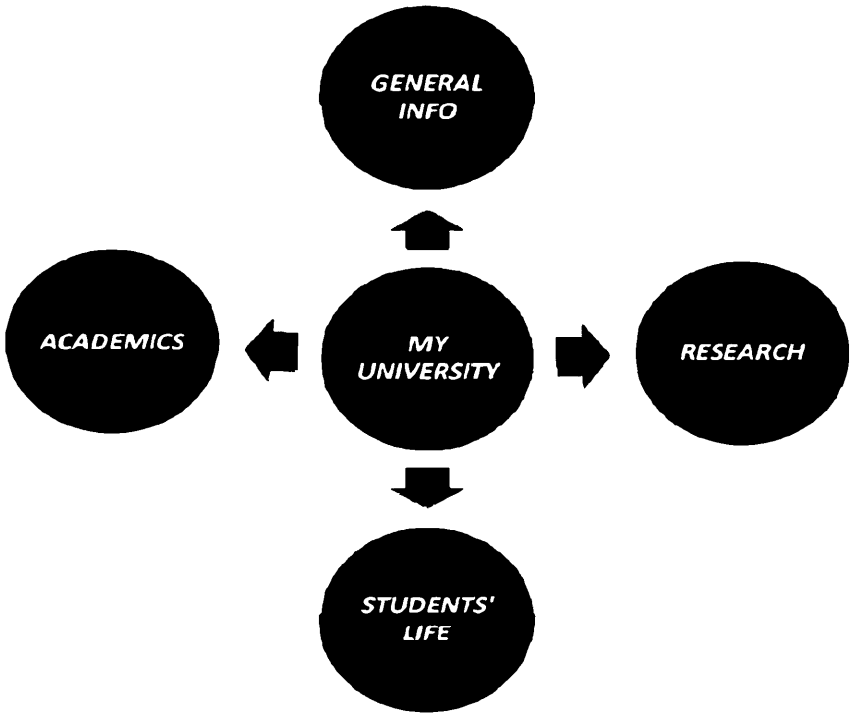
PROJECT WORK

"Why did I choose this university?"



10. You are going to present your university. Choose one of the aspects from the diagram above (*general info, students' life, academics* and *research*) and prepare a 3–5 minute presentation. Use the English version of your university site to help.

WRITING

11. Write a letter to your foreign pen-friend (approximately 100–150 words).

In your letter:

- tell about your university
- invite him/her to study here

CHECKLIST

Assess your progress in this unit. Tick (✓) the statements which are true.

- ☐ I know the structure of engineering education.
- ☐ I can present my university.
- ☐ I know the advantages of PhD degree.

UNIT 3
Are you good for this job?

"It is all one to me if a man comes from Sing Sing or Harvard. We hire a man, not his history"*
(*a famous US prison)
Henry Ford (1863–1947), American car manufacturer

STARTING UP

1. In your opinion, which factors below are important for getting a job? Choose the seven most important.

age	*contacts and connections*	*hobbies*	*qualifications*
sex	*experience*	*intelligence*	*references*
appearance	*family background*	*marital status*	*sickness record*
astrological sign	*handwriting*	*personality*	*blood group*

2. What characteristics from the list can you choose for a chemical engineer? Can you add anything?

interpersonal dealings	*communications ability*	*organizational capability*
balance between family and work	*technical skills*	*leadership ability*

READING

3. Discuss in pairs these questions.

- Did engineers change from the past time?
- What does the 21st-century engineer look like?

4. Now listen to the text. What does it say about the question above? Then scan the text and compare your answer.

5. Read the text and give the headings for the paragraphs (A–C).

21ST-CENTURY ENGINEERS MOVING AT INTERNET TIME

A	

The Internet. Global markets. Time compression. Competitiveness. We increasingly live in a connected world where packets of information whiz around the globe at the speed of light. Not long ago, the engineer of the Cold War prepared for work by immersing

himself in a narrow technical discipline, expecting to work his entire career for one of a small number of gigantic employers on some specialized subsystem of a defense-related or smokestack megaproject.

Today's engineer is on a different planet. He or she faces a life filled with multiple project assignments with an almost interchangeable array of employers, clients, startups, and established firms; these assignments require an extraordinarily broad set of technical, business, and interpersonal skills performed as part of ever-changing and shifting interdisciplinary teams.

B	

This change in work life has been as rapid as it has been dramatic, and the job here is to survey those nontechnical skills essential to being a successful engineer in the 21st century. As opposed to the Cold War engineer, we call the ideal engineer of our times an *entrepreneurial engineer,* and here we interpret the word *entrepreneur* quite broadly.

In the traditional sense of the word, today's engineer *is* more likely to find him or herself as part of a startup, replete with 13-hour workdays, a Blackberry, and stock options. But even when today's engineer works in more traditional settings, he or she is likely to find that both the job itself and effective career management require a more venturesome attitude and approach. Increased competition places enormous pressure on companies to continue to improve and innovate in creating new product lines, acquiring new customers, adopting new technology, and implementing better business practices. In larger companies, words have been coined to describe this need, *entrepreneurship* or *corporate entrepreneurship.* However, this pervasive orientation toward opportunity, innovation, and reward is now also necessary in the management of one's own career.

C	

In times past, employers took a paternalistic view of employees, managing their remuneration, health benefits, and retirement over the course of an entire career. Those days are largely gone, and today's engineer must take charge of his or her career by seeking a challenging sequence of work experiences that help build a marketable portfolio of diverse skills. Entrepreneurial engineers meet the challenges of changing times as opportunities, seeking challenging and rewarding work together with an appropriate balance of intellectual, financial, professional, and personal growth.

"Keys to Engineering Success" Jill S. Tietjen, Kristy A. Schloss

6. Read the article again and answer these questions.

- What is the entrepreneurial engineer?
- What advantages and disadvantages do the engineer of the Cold War and today's engineer have?
- Do you agree that an engineer needs to be skilled in matters nontechnical?
- How to select the best candidates for the position of chemical engineer?

7. Read the following competencies for the entrepreneurial engineer and give your comments.

1. Seek the joy of engineering.
2. Examine personal motivation and set goals.
3. Master time and space.
4. Write fast, revise well, and practice BPR (the elements of background purpose, and road map).
5. Prepare and deliver effective presentations.
6. Understand and practice good human relations.
7. Act ethically in matters large, small, and engineering.
8. Master the pervasive team.
9. Understand leadership, culture, and the organization of organizations.
10. Assess technology opportunities

8. Match the competencies for the entrepreneurial engineer from activity 7 with the definitions below and compare with your suppositions.

A. ... is popular with many engineers.
Writing process can be improved by separating writing from revision, and we examine a number of specific techniques including free writing, quick planning, and cut-and-paste revision to help us separate these two writing functions. Writing content can be improved by understanding three key elements that are common to almost all business writing. These elements – background, purpose, and road map, or BPR for short – can and should be iterated at different levels of a document.

B. Understanding organizations and leadership at a somewhat higher level is also important to the entrepreneurial engineer for two reasons. First, knowing good organizations and leadership helps us pick the best work opportunities. Second, an orientation toward opportunity often results in the need to lead an existing or new organization.
A common feature of good organizations is that they think good thoughts about their employees; bad organizations tend to distrust theirs.

C. Effective human relations are especially important in an increasingly interconnected world. The world of people can seem a lot less predictable to engineers accustomed to Newtonian models of physical systems, but engineers can find modeling guidance – and success in their relationships – by using a variation on the golden rule we call the other-eyes principle. This principle recommends that we predict or anticipate the behavior of others by considering our own reaction to a similar set of circumstances. Although not infallible, such modeling is often a good first-order guide to predicting the response of others. Along the way, we consider the importance of questions, salesmanship, praise, and passion in successful interpersonal relations. The downside of criticism is visited as is the need for admission of wrongdoing and apology.

D. Teamwork has become integrated into the fabric of modern organizational life as a result of the quality revolution, but effective teamwork is difficult as many of us know from our early experiences with "group projects" in school. In group work, it becomes difficult to coordinate interrelated pieces of a project, and individuals can sometimes be uncooperative or even shirk their responsibilities. A clearheaded approach to teamwork acknowledges these difficulties and then designs team rules, discussion protocols, and other procedures to facilitate effective meetings and team activity. Our approach combines quantitative and qualitative models in a quest to create more effective teams.

E. It is useful to consider a number of sources of ethical thought and reasoning, including religious or cultural norms, an innate moral sense, maximization of societal utility, and consistency. Each of these viewpoints is helpful, and each has been challenged by ethical skeptics over the years.
Practice on small matters is the surest way to doing the right thing when the big issues arise. In other words, our approach seeks success in *microethics* or ethical behavior in small, everyday matters. If we are unable to behave ethically when the stakes are small, it seems unlikely that we will be able to behave ethically when the rewards of unethical behavior are great.

F. Understanding personal motivation and setting goals may be thought of as the strategic level of managing yourself. Time and storage management is the tactical level of being personally organized. How one neurial Engineer: Ready for the 21st Century spends one's day and where one puts one's stuff are basic to sustaining a high level of personal productivity, but a haphazard approach to these matters is all too common. Fortunately, significant improvements in time utilization can be achieved through the development of a few key habits. Primary among these are the disciplined use of (1) a calendar, (2) a to-do list, and (3) a systematic filing system (both paper and electronic).

G. Technology opportunity assessment and planning are challenging activities that require the entrepreneurial engineer to imagine new opportunities, match them to markets, and determine whether they are both technologically and financially feasible. As an educational experience, working on a technology opportunity assessment or a business plan is the quickest way for the entrepreneurial engineer to bootstrap him- or herself into understanding the importance of sustainable competitive advantage, customers, marketing, pricing, costs, and value at the core of the business side of engineering.

H. The terms aren't often used in the same sentence, which is a shame because a proper understanding of engineering leads us to understand how multifaceted the learning and practice of engineering can be. Some of the confusion is the result of two historical inversions in perspective, and another portion of misunderstanding comes because engineering is wedged between business and science. A closer reading of history and understanding the fundamental tug-of-war that engineers face help us understand the essence and joy of being an engineer more deeply.

I. Understanding what motivates a person in his or her professional life is fundamentally important and difficult. Many people think that they simply work for the money, and indeed financial remuneration can be a factor in career choices, but a more reliable guide to a life of fulfilling work is found in the term *engagement.* Instead of seeking money

directly, another approach is to seek work that is so engrossing that time flies because it is so much fun. Incidentally, the fun of engagement can lead to sufficient time on task and professional growth that the person also gains a substantial income along the way.

J. PowerPoint presentations are now a way of business life, but giving a slide presentation is different than giving a speech. By preparing and treating Powerpoint slides as note cards we share with our audience, the process of preparing and delivering a presentation is simplified. The rules of presentation organization are remarkably similar to the BPR rule of effective writing, and indeed good writing leads to good presenting and vice versa. Add some guidelines and concern for effective slide layout and presentation.

"Keys to Engineering Success" Jill S. Tietjen, Kristy A. Schloss

9. Choose five the most important competencies for you as a future engineer; compare your ideas within a group.

PROFESSIONAL LANGUAGE DEVELOPMENT

10. Use the list of words or word combinations to fill in the gaps in the text "Problem Solving".

prototypes
potential solutions
reduce the risk
appropriate experience
establish the cause
applied mathematics
careful analysis
core contradiction
full-scale production
forensic engineering

Problem solving

Engineers use their knowledge of science, mathematics, logic, and **1**_____to find suitable solutions to a problem. Engineering is considered a branch of **2**_____ and science. Creating an appropriate mathematical model of a problem allows them to analyze it (sometimes definitively), and to test **3**_____.

Usually multiple reasonable solutions exist, so engineers must evaluate the different design choices on their merits and choose the solution that best meets their requirements. Genrich Altshuller, after gathering statistics on a large number of patents, suggested that compromises are at the heart of "low-level" engineering designs, while at a higher level the best design is one which eliminates the **4**_____ causing the problem.

Engineers typically attempt to predict how well their designs will perform to their specifications prior to **5**_____. They use, among other things: **6**_____, scale

models, simulations, destructive tests, nondestructive tests, and stress tests. Testing ensures that products will perform as expected.

Engineers as professionals take seriously their responsibility to produce designs that will perform as expected and will not cause unintended harm to the public at large. Engineers typically include a factor of safety in their designs to **7**_____ of unexpected failure. However, the greater the safety factor, the less efficient the design may be.

The study of failed products is known as **8**_____, and can help the product designer in evaluating his or her design in the light of real conditions. The discipline is of greatest value after disasters, such as bridge collapses, when **9**_____ is needed to **10**_____ or causes of the failure.

11. Choose the right engineering abilities below for each category in the Table. The number of abilities is in brackets.

1. The ability to maintain a sound theoretical approach in enabling the introduction of new technology.
2. The ability to assess and manage risks.
3. Use a wide range of tools, techniques, and equipment (including software) appropriate to their specific discipline.
4. Use laboratory and workshop equipment to generate valuable data.
5. Develop, promote and apply safe systems of work.
6. Communicate effectively, using both written and oral methods.
7. Use Information Technology effectively.
8. Manage resources and time.
9. Independent of mind, with intellectual integrity, particularly in respect of ethical issues.
10. Enthusiastic, in the application of their knowledge, understanding and skills in pursuit of the practice of engineering.
11. Specialist knowledge.
12. Business and Management techniques.
13. Understanding of professional and ethical responsibilities.
14. The ability to apply professional judgement, balancing issues of costs, benefits, safety, quality, etc.
15. Understanding of the impact of engineering solutions on society.
16. Awareness of relevant contemporary issues.
17. The ability to solve engineering problems, design systems, etc. through creative and innovative thinking.
18. The ability to apply mathematical, scientific and technological tools.
19. The ability to analyse and interpret data and, when necessary, design experiments to gain new data.
20. Work in a multi-disciplinary team.
21. Undertake lifelong learning for continuing professional development.
22. Creative, particularly in the design process.
23. Analytical in the formulation and solutions of problems.
24. Innovative, in the solution of engineering problems.
25. Self-motivated.

Knowledge & Understanding	An Engineer should be able to demonstrate (5):
Intellectual Abilities	An Engineer should be able to demonstrate (6):
Practical Skills	An Engineer should be able to (3):
General Transferable Skills	An Engineer should be able to (5):
Qualities	An Engineer should be (6):

SPEAKING

12. Complete the table with the adjectives below. What other words can you add?

astute bright calm clever easy-going hard-working moody neurotic punctual quick-tempered reliable responsible sharp slow

Intelligence and ability	Emotional stability	Conscientiousness

13. Take a look at the blocks of personal qualities from activity 12 again. How can you correspond them to chemical engineers? Give your examples for each block.

14. a) Complete the table with personal and professional abilities. Use the list below. Give the reasons.

	Research engineer	Design engineer	Industrial engineer	Field engineer
Personal and professional abilities				

Professional abilities:

- research ability
- creativity
- handling numbers
- ability to extract the need in an engineering decision and formulate engineering problem
- ability to design engineering decision
- ability to apply knowledge in chemistry and fundamental and engineering sciences
- ability to use the existing and developing technological methods, technologies and instruments
- professional and ethic responsibility of an engineer
- ability to effective communication
- ability to a cross-disciplinary teaming
- ability to manage and lead engineering developments
- ability to effective learning and improving his/her qualifications during the whole life

b) Discuss in a group.

- What ability can you add?
- What kind of professional activity are you going to choose?
- What kind of ability have you already got?

15. Role play the following situation. Work in groups of 3 or 4.
Imagine that each of you is a member of the Board of Directors of some Chemical Corporation. Discuss necessary qualities for a new position. Use adverts in Appendix for help.

1. Choose any chemical company of your future speciality.
2. Think of a position in this company or you may use the following position list:
    - Lab Assistant
    - Senior Engineer
    - Plastics Applications Chemist
    - Manager of Production Department
    - Manager of Sales Department
    - Head of Chemical Engineering Department

WRITING

16. Design your own job advertisement for the position mentioned above. Follow the plan below.

- company overview
- job description
- job requirements (Education, Years of Experience, Basic Qualifications, Preferred Skills)

CHECKLIST

Assess your progress in this unit. Tick (✓) the statements which are true.

- ☐ I know competencies for the entrepreneurial engineer.
- ☐ I can talk about skills and professional abilities of engineers.
- ☐ I know job requirements for engineering positions.

UNIT 4
Engineering Ethics

> *"...engineers shall hold paramount the safety, health and welfare of the public and protect the environment in performance of their professional duties".*
> American Institute of Chemical Engineers

STARTING UP

1. Discuss these questions.

- What is the purpose of a business, in your opinion? Is it just to make money?
- What do you mean by these phrases?

  a) business ethics **b)** a code of ethics/of good practice

- What is engineering ethics?

2. Rank the professions below according to how ethical you think they are.

accountant	*engineer*	*lawyer*	*police officer*
banker	*estate agent*	*nurse*	*teacher*
car sales executive	*journalist*	*dentist*	*taxi driver*

3. Discuss this list of unethical activities below. In your opinion, which are the worst? Are any common in your country?

1) Avoiding paying tax 2) Claiming extra expenses 3) Using work facilities for private purposes (for example, personal phone calls) 4) Accepting praise for someone else's ideas or work 5) Selling a defective product (for example, a second-hand car)	6) Using your influence to get jobs for relatives 7) Ringing in sick when you are not ill 8) Taking extended lunch breaks 9) Giving good references to people you want to get rid of 10) Employing people illegally

4. Fill in the gaps with the words or word combinations below.

impact *standard of professional behavior* *impartiality* *highest standards* *ethical conduct* *welfare*

Code of Ethics for Engineers

Engineering is an important and learned profession. As members of this profession, engineers are expected to exhibit the **1**_____ of honesty and integrity. Engineering has a direct and vital **2**_____ on the quality of life for all people. Accordingly, the services provided by engineers require honesty, **3**_____, fairness, and equity, and must be dedicated to the protection of the public health, safety, and **4**_____. Engineers must perform under a **5**_____ that requires adherence to the highest principles of **6**_____.

READING

5. Discuss these questions in groups.

- What is the main goal of engineers in their activity?
- What are the main professional obligations of engineers from your point of view?
- Which activities of engineers in work or business can be considered to be unethical?

6. Now read the following list of "professional obligations of engineers". Define the key statements in each point of the list and fill in the table below.

ENGINEERS	
SHOULD DO	***SHOULD NOT DO***

Professional Obligations

1. Engineers shall be guided in all their relations by the highest standards of honesty and **integrity**.

A. Engineers shall **acknowledge** their errors and shall not **distort** or alter the facts.

B. Engineers shall advise their clients or employers when they believe a project will not be successful.

C. Engineers shall not accept outside employment to the **detriment** of their regular work or interest. Before accepting any outside engineering employment, they will notify their employers.

D. Engineers shall not attempt to attract an engineer from another employer by false or misleading pretenses.

E. Engineers shall not promote their own interest at the expense of the **dignity** and integrity of the profession.

2. Engineers shall at all times **strive** to serve the public interest.

A. Engineers are encouraged to participate in civic affairs; career guidance for youths; and work for the advancement of the safety, health, and well-being of their community.

B. Engineers shall not complete, sign, or seal plans and/or specifications that are not in conformity with applicable engineering standards. If the client or employer insists on such unprofessional conduct, they shall notify the proper authorities and withdraw from further service on the project.

C. Engineers are encouraged to extend public knowledge and appreciation of engineering and its achievements.

D. Engineers are encouraged to adhere to the principles of **sustainable** development in order to protect the environment for future generations.

3. Engineers shall avoid all conduct or practice that **deceives** the public.

A. Engineers shall avoid the use of statements containing a material misrepresentation of fact or omitting a material fact.

B. Consistent with the foregoing, engineers may advertise for recruitment of personnel.

C. Consistent with the foregoing, engineers may prepare articles for the lay or technical press, but such articles shall not imply credit to the author for work performed by others.

4. Engineers shall not **disclose**, without consent, confidential information concerning the business affairs or technical processes of any present or former client or employer, or public body on which they serve.

A. Engineers shall not, without the consent of all interested parties, promote or arrange for new employment or practice in connection with a specific project for which the engineer has gained particular and specialized knowledge.

B. Engineers shall not, without the consent of all interested parties, participate in or represent an adversary interest in connection with a specific project or proceeding in which the engineer has gained particular specialized knowledge on behalf of a former client or employer.

5. Engineers shall not be influenced in their professional duties by conflicting interests.

A. Engineers shall not accept financial or other considerations, including free engineering designs, from material or equipment **suppliers** for specifying their product.

B. Engineers shall not accept commissions or allowances, directly or indirectly, from contractors or other parties dealing with clients or employers of the engineer in connection with work for which the engineer is responsible.

6. Engineers shall not attempt to **obtain** employment or **advancement** or professional engagements by untruthfully criticizing other engineers, or by other improper or questionable methods.

A. Engineers shall not request, propose, or accept a commission on a contingent basis under circumstances in which their judgment may be compromised.

B. Engineers in salaried positions shall accept part-time engineering work only to the extent consistent with policies of the employer and in accordance with ethical considerations.

C. Engineers shall not, without consent, use equipment, supplies, laboratory, or office facilities of an employer to carry on outside private practice.

7. Engineers shall not attempt to injure, maliciously or falsely, directly or indirectly, the professional reputation, prospects, practice, or employment of other engineers. Engineers who believe others are guilty of unethical or illegal practice shall present such information to the proper authority for action.

A. Engineers in private practice shall not review the work of another engineer for the same client, except with the knowledge of such engineer, or unless the connection of such engineer with the work has been terminated.

B. Engineers in governmental, industrial, or educational employ are entitled to review and evaluate the work of other engineers when so required by their employment duties.

C. Engineers in sales or industrial employ are entitled to make engineering comparisons of represented products with products of other suppliers.

8. Engineers shall accept personal responsibility for their professional activities, provided, however, that engineers may seek **indemnification** for services arising out of their practice for other than gross **negligence**, where the engineer's interests cannot otherwise be protected.

A. Engineers shall conform with state registration laws in the practice of engineering.

B. Engineers shall not use association with a non-engineer, a corporation, or partnership as a "cloak" for unethical acts.

9. Engineers shall give credit for engineering work to those to whom credit is due, and will recognize the proprietary interests of others.

A. Engineers shall, whenever possible, name the person or persons who may be individually responsible for designs, inventions, writings, or other **accomplishments**.

B. Engineers using designs supplied by a client recognize that the designs remain the property of the client and may not be duplicated by the engineer for others without express permission.

C. Engineers, before undertaking work for others in connection with which the engineer may make improvements, plans, designs, inventions, or other records that may **justify** copyrights or patents, should enter into a positive agreement regarding ownership.

D. Engineers' designs, data, records, and notes referring exclusively to an employer's work are the employer's property. The employer should indemnify the engineer for use of the information for any purpose other than the original purpose.
E. Engineers shall continue their professional development throughout their careers and should keep current in their specialty fields by engaging in professional practice, participating in continuing education courses, reading in the technical literature, and attending professional meetings and seminars.

http://www.nspe.org/Ethics/CodeofEthics/index.html (17.10.2012)

7. Look at the following words in bold in the texts and try to explain them. Consult the dictionary if necessary.

integrity, to acknowledge, to distort, detriment, dignity, to strive, sustainable, to deceive, to disclose, supplier, to obtain, advancement, indemnification, negligence, accomplishment, to justify

8. Fill in the words from the list below. Use the words only once.

detriment, to serve, to notify, private, to duplicate, to acknowledge, expense, affairs, ethical, to evaluate

1) to _____ one's errors
2) to the _____ of one's work or interests
3) to promote one's own interests at the _____ of smth.
4) to _____ the public interest
5) to participate in civic _____
6) to _____ the proper authorities
7) in accordance with _____ considerations
8) to carry on outside _____ practice
9) to _____ the work of other engineers
10) to _____ the design without permission

9. Fill in the correct preposition, then make sentences using the completed phrases.

1) conformity _____
2) to insist _____
3) to withdraw _____
4) consistent _____ the foregoing
5) _____ consent
6) to participate _____
7) _____ connection _____
8) _____ behalf of smb.
9) _____ circumstances
10) accordance _____
11) to conform _____
12) to engage _____

 *LISTENING*

10. Discuss the following questions.

- Is it important for companies to have a written code of ethics?
- Is it more important for some industries than others to have a code of ethics?

11. Claire Bebbington is External Affairs Manager for a division of BP (British Petroleum). Listen to the first part of the interview. Decide whether these statements are true or false, according to Claire.

1. The issue of ethics is simple. **T/F**
2. If a company puts its code of ethics in writing, it is more likely to act on it. **T/F**
3. Following up a code of ethics is difficult. **T/F**

12. Listen again to the first part of the interview. Complete the two extracts below.

"Firstly, it makes a _____ to certain good _____ and so it's a way of communicating the importance of _____ to all of it's employees and partners".

"If you express these things in _____, especially, then you can be held _____ for them".

13. a) Now listen to the second part of the interview. Complete the question that Claire asks.

"When does a facilitation _____ become a _____?"

b) What examples does she give to illustrate the question?

c) In groups discuss the meaning of the question.

14. Listen to 7 *"fundamental canons"* describing engineer's activity from the point of view of ethics and fill in the gaps with the synonyms for the words in brackets.

1. Engineers shall hold paramount the safety, health and welfare of the public and shall _____ with the principles of sustainable development in the performance of their professional duties. **(try to satisfy)**
2. Engineers shall _____ services only in areas of their competence. **(fulfill)**
3. Engineers shall _____ public statements only in an objective and truthful manner. **(distribute)**
4. Engineers shall act in professional matters for each employer or client as _____ agents or trustees, and shall avoid conflicts of interest. **(conscientious)**
5. Engineers shall build their professional reputation on the _____ of their services and shall not compete unfairly with others. **(quality)**

6. Engineers shall act in such a manner as to _____ the honor, integrity, and dignity of the engineering profession and shall act with zero-tolerance for bribery, fraud, and corruption. **(maintain and improve)**
7. Engineers shall continue their professional development throughout their careers, and shall _____ opportunities for the professional development of those engineers under their supervision. **(give)**

PROFESSIONAL LANGUAGE DEVELOPMENT

15. The sets of words and phrases below are related either to *honesty* or to *dishonesty*. Find the odd word in each line.

1	trustworthy	law -abiding	crooked
2	a slush fund	a sweetener	compensation
3	insider trading	industrial espionage	disclosure
4	a whistleblower	a swindler	a conman
5	a bribe	a bonus	a commission
6	fraud	deceit	integrity

16. Complete these sentences with words and phrases from activity 15. Choose from the first set to complete sentence 1, from the second set to complete sentence 2, and so on.

1. Our company does nothing illegal. We are very _____.
2. We've got _____ which is used in countries where it is difficult to do business without offering bribes.
3. Their car looked so much like our new model. We suspect _____.
4. They fired him because he was _____. He informed the press that the company was using under-age workers in the factory.
5. He denied accepting _____ when he gave the contract to the most expensive supplier.
6. I admire our chairman. He's a man of his word and is greatly respected for his _____.

17. Match the verbs and nouns in the table below to make word partnerships. Sometimes there is more than one possibility.

	companies	contracts	crimes	documents	laws	products	regulations	sanctions
boycott	✓					✓		
breach								
break								
commit								
falsify								
impose								

18. Match the verb to the correct preposition.

accuse	somebody	**for** damages
charge		**for** selling dangerous goods
prosecute		**of** offering bribes
sentence		**to** three years in prison
sue		**with** breaking guidelines

19. a) Match the following prefixes to the verbs to describe some unethical business activities. The number of times that each prefix is used is given in brackets.

For example: *misinform*

de – (1)	dis – (1)	mis – (5)	over – (3)	under – (1)

book, charge, credit, fraud, inform, lead, mine, price, represent, treat, use

b) Now match the words you have made above to the following nouns.
For example: *misinform consumers*

a company	competitors	confidence	consumers	customers
facts	goods	information	people seats	staff

20. Choose the correct definition for the words and phrases in italics in these dialogues.

1) A: Was the company prosecuted for polluting the environment?
B: Yes, but they were found not guilty because of a *loophole* in the law.
a) clause **b)** gap **c)** case

2) A: How do the high taxes affect people in your country?
B: Well for one thing there's a growth in the *black economy* and it's worrying the government.
a) working underground **b)** night work **c)** working and not paying tax

3) A: What happened to John?
B: He was found guilty of *tax evasion* and sent to prison for three years.
a) not paying enough tax **b)** paying tax for another person
c) paying the wrong tax

4) A: What do unethical companies do when they get large amounts of money illegally?
B: Well, *money laundering* is quite common. It's very hard for the authorities to prove where the money has come from.
a) investing in property **b)** keeping money in cash
c) hiding the origin of money

5) I want durable products, but let's face it – *built-in obsolescence* is typical of most products these days.
a) very short guarantee **b)** designed not to last very long
b) difficult to use

SPEAKING

21. Discuss these questions.

1. There is a proverb, "When in Rome, do as the Romans do". What does the proverb mean? Do you agree with this advice?
2. Would you continue to do business with someone if you disapproved of their private life? Why? Why not? Give examples of behavior which would cause you to stop doing business with someone.
3. Some engineering societies are addressing *environmental protection* as a stand-alone question of ethics. Do you agree with this statement?

22. Work in groups. Discuss the ethical questions below. A different person should lead the discussion of each issue.

1) You have a shortlist of people for the post of Sales Manager. One of the female candidates is clearly the best qualified person for the job. However, you know that some of your best customers would prefer a man. If you appoint a woman you will probably lose some sales. What should you do?

2) Your company, a large multinational, has a new advertising campaign which stresses its honesty, fairness and ethical business behavior. It has factories in several countries where wages are very low. At present it is paying workers the local market rate. Should you increase their wages?

3) A colleague in a company which tests medical equipment has been making bad mistakes recently at work. This is because she has a serious illness. You are her friend and the only person at work who knows this. She has asked you to keep it a secret. What should you do?

4) You are directors of a potato snack manufacturing company. Research has shown that any price increase causes an immediate dip in sales (although sales recover within six months). It has been suggested that you could maximize your profits by simply reducing the weight of the product in the packets and maintaining the current price. What should you do?

23. Do you agree with this statement? Give your reasons.

"If we face a recession we should not lay off employees. The company should sacrifice a profit. It's management's risk and management's responsibility. Employees are not guilty; why should they suffer?"

Akio Morita (1921–1999), co-founder of Sony

24. Get acquainted with information below. In groups choose two points from the list and think of the situation concerning (chemical) engineers.

There are several other ethical issues that engineers may face. Some have to do with technical practice, but many others have to do with broader considerations of business conduct. These include:

- Quality
- Ensuring legal compliance
- Conflict of interest
- Bribery and kickbacks
- Treatment of confidential or proprietary information
- Consideration of the employer's assets
- Relationships with clients, consultants, competitors, and contractors
- Gifts, meals, services, and entertainment
- Outside employment/activities (Moonlighting)

25. Role play this situation.

You are senior managers at medical drugs manufacturing. Your company is losing market share. You strongly suspect your main rival is using unfair methods to promote its products.

For example, you are almost sure that your rival has been:

a) making cash payments to main dealers
b) offering expensive gifts to important customers

Hold a meeting to consider how to solve the problem.

PROJECT WORK

"Code of good practice"

26. You are a president of a chemical company. Create a written *"Code of good practice"* for your engineers, think of the design and present it to your employees.

WRITING

27. As one of the senior managers at medical drugs manufacturing prepare a written report on the results of the meeting. Put there the following:

- problem description in short
- ways of problem solving
- measures to prevent similar problems in future

CHECKLIST

Assess your progress in this unit. Tick (✓) the statements which are true.

- ☐ I can distinguish ethical engineering activities from unethical ones.
- ☐ I know what "Code of Ethics for Engineers" performs.
- ☐ I can talk about professional obligations of engineers.

UNIT 5
Company Structure and Corporate Culture

STARTING UP

1. Discuss these questions.

- What do you think "company" means?
- What do you think "*global company*" mean?
- What global companies can you think of?
- What industries are they in?

2. Listen and fill in the missing information.

Companies are involved in many activities, for example **1**_____, in a range of different industries, such as **2**_____. Many well-known companies are **3**_____, these are companies which **4**_____ in a number of countries. Multinationals often have a complicated structure. There is usually **5**_____. This company owns other companies or parts of other companies. These other companies are called **6**_____.

3. Look at the table and match the information from columns A, B and C.

A	B	C
Company logo	**Company activities**	**Country**
YARA	**(1)** ...specialized in processing and machining of small ceramic technical parts. The company is based in Marnay near the Swiss border. It benefits by the famous know how and skills from watch making industry. This traditional experience combined with technology allow to manufacture more than 6 000 000 parts per year mainly used for exportation.	**a) Germany**
HXK National Chemical Company	**(2) "National Chemical Company"** Group of Companies combines manufacturing complex of raw materials, finished goods and the Company which develops own brands in the non-food market	**b) America**

	(3) ... a chemical company converting energy and nitrogen from the air into useful products for farmers and industrial customers and is the leading supplier of mineral fertilizers.Its marketing network covers all continents, with local activities in 50 countries and sales to more than 120 ones. The company employs around 6 800 people worldwide	**c) Russia**
	(4) ... the world's largest chemical company, ahead of Dow and DuPont. It has more than 150 major manufacturing facilities and does business worldwide through six business segments: plastics (including polyolefins and polystyrene), performance products (value-added chemicals and dyes), chemicals (plasticizers solvents), oil and gas exploration and production (through subsidiary Wintershall AG), functional solutions (catalysts, coatings, and construction chemicals), and agricultural products (additives, herbicides and fertilizers)	**d) France**
	(5) ...multinational corporation headquartered in Midland, Michigan. As of 2007, it is the second largest chemical manufacturer in the world (after BASF). It is a provider of plastics, chemicals, and agricultural products with presence in more than 175 countries and employing 46 000 people worldwide. It is the world's largest producer of plastics, including polystyrene, polyurethanes, polyethylene, polypropylene, and synthetic rubbers. It is also a major producer of the chemicals calcium chloride, ethylene oxide, and various acrylates, surfactants, and cellulose resins. It produces many agricultural chemicals	**e) Norway**

4. Work in groups. Find the answers to the following questions:

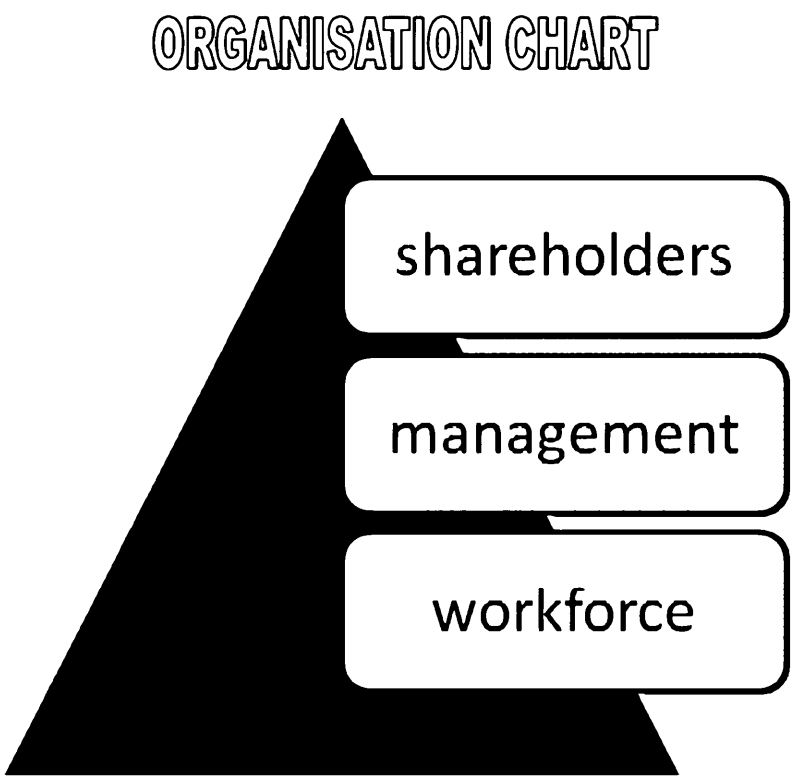
- What does the company produce or provide?
- Where did the company start?
- Where does the company operate?
- Who are it's main competitors ?

5. Listen, then complete the passage below using the appropriate word or phrase from the box below.

chairperson	*senior managers*	*managing director*	
Board of Directors	*management*	*workforce*	*shareholders*
	organization chart		

Most companies are made up of three groups of people: the 1_____ (who provide the capital), the **2**_____and the **3**_____. The management structure of a typical company is shown in this **4**_____.
At the top of the company hierarchy is the **5**_____, headed by the **6**_____ (or president). The board is responsible for making policy decisions and for determining the company's strategy. It will usually appoint a **7**_____ (or chief executive officer) who has overall responsibility for the running of the business. **8**_____ or line managers head the various departments or functions within the company.

6. Take a look at the organization chart below and enlarge it according to the info from activity 5.



READING

7. Here are some ideas for creating a good working environment. Which do you consider a) crazy? b) good for motivating staff?

- dressing in strange clothes at meetings
- having no individual offices
- having no dress code
- unisex toilets
- organising company holidays
- having nursery or daycare centres
- encouraging managers to invite staff home for dinner
- buying birthday presents for staff
- keeping small animals and birds at head office
- supplying flowers regularly for all offices
- having kitchen corners

8. You are going to read an article about BASF. Choose the most suitable heading from the list A–F for each part (1–5).

A Pension provision for parents
B Promoting Work-Life-Balance
C Nursing care for family members
D Returning to employment – welcome back!
E Daycare centers

1	

Helping employees to balance career and family commitments is part of our sustainable human resources policy in Germany.We are therefore further increasing our efforts in this area: with more daycare facilities for children, improved pension provisions for parents, family caregiving models for family members and seminars for employees returning from parenthood. These measures are part of the "GENERATIONS@WORK" program we have established to address the challenges of demographic change. The existing service provisions such as daycare centers, part-time working models or vacation programs are thus being further extended to help our employees maintain an even better balance between career and family commitments.

2	

We want to make it easier for parents to return to work sooner and are continuously extending our range of care services for our employees' children. Our employees can already take advantage of the facilities offered by our two BASF daycare centers "LuKids North" and "LuKids South" which offer 60 places for the children of BASF's employees.

Since January 14th 2008, "LuKids adhoc" offers our employees the opportunity to place their children in safe hands, if their own childcare arrangements are cancelled unexpectedly at short notice. 20 places are available for employee's children. The new facility is able to care for children aged from six months to ten years daily from 7 a.m. to 6 p.m.

3	

Another element of BASF's family-friendly policy is a supplementary parenthood contribution in the company pension. In this way, BASF aims to compensate the effect of the dormant employment status on the company pension for the first year of parenthood. This company contribution is also paid provided the employee is paying his/her membership contribution to BASF's retirement pension and will be continuing his/her employment after the end of parenthood.

4	

Demographic trends mean that in the years ahead the issue of combining caregiving and career will become increasingly important for employees and thus also for the company. We are already responding to this trend by offering a range of services that can be adapted to meet future needs. This includes caregiver counseling and a course entitled "Nursing care in the family". Our employees can also reduce their working hours to allow them to care for relatives. There is also the possibility of unpaid release from employment for up to two years to care for family members requiring frequent or constant care.

5	

We have something else to offer for employees returning from parenthood: A few months before recommencing work, returners to employment are prepared for their return to work with a seminar. Participation in the event, which is offered four times annually, is voluntary. The program includes presentations about how BASF has developed in the time-out period as well as tips about self and time management and ways of reconciling the sometimes conflicting demands of career and family.

http://www.basf.com (05.04.2010)

9. Discuss in groups.

- Would you like to work in a company like BASF?
- Which ideas mentioned in activity 4 are used by the German company BASF?
- Are BASF's corporate ideas good for motivating staff?
- Which ideas to motivate the staff would you like to introduce for BASF?

PROFESSIONAL LANGUAGE DEVELOPMENT

10. Write the nouns in the verb forms.

Nouns	*Verbs*
1 production product	
2 providers, provision	
3 development	
4 marketing, market	
5 advertisement	

11. Use a verb or noun from the table to fill the gaps. (Use one noun twice.)

There are usually several different departments in a company, and they all need to work together to make the company successful. Companies offer products or services to the consumer in a competitive **1**_____. In the manufacturing sector **2**_____development is a key activity. Companies **3**_____new products and launch them on the **4**_____. They try to keep the cost of **5**_____ low to stay competitive. It is essential to **6**_____ the product and to tell the consumer about it.

12. Make ten common business expressions with the words below. For example: *sleeping partner, annual general meeting*. Use some words more than once.

annual	company	exchange	meeting	private	stock
assets	unlimited	general	of	public	trader
board	debts	liability	partner	sleeping	
business	directors	limited	personal	sole	

13. What type of organization is each of these? Choose the right word from the box.

limited company	partnership	sole owner / freelancer
public limited company	corporation	

1. A group of engineers who work together to provide consultancy and design services. There are no outside shareholders.
2. A large British engineering company with 30 000 employees. Its shares are bought and sold on the stock market.
3. An American engineering company with outside shareholders.
4. An engineer who works by herself providing consultancy. She works from home and visits clients in their offices.
5. An independent British engineering company with 20 employees. It was founded by three engineers, who are shareholders and directors of the company. There are five other shareholders who do not work for the company.

14. Complete a–g using each word around *'manage'* and *'organize'* from the box once only.

manager managing management managerial	organize organization organizational

a) Can you learn how to be a _____, or are you born one?

b) The company became a world-wide _____ in just twenty years.

c) In Britain the Chief Executive Qfficer (CEO) is called the _____director.

d) An _____chart shows the structure of the entire company.

e) The firm went bankrupt because of bad _____ .

f) I'd like you to _____ those dies in alphabetical order, please.

g) It was the most difficult _____ decision she had ever had to make.

15. Look at the department names in the box below.

Production	Sales and Marketing	Research and Development
Finance	Human Resources /Personnel	

Read these sentences and decide which of these departments each speaker works in.

a) "Well, we deal with the workforce needs of the firm: selection and recruitment of staff; pay, training, and so on". _____.

b) "We listen to customers and identify their needs; we're responsible for establishing sales plans and targets for the different sales forces. We also deal with advertising",

_____.

c) "We work on new products and improve old ones. We have to keep up to date with what is going on in the outside world and have close contact with Marketing and Production". _____

d) "We're responsible for the manufacturing of our products and for trying to find ways of improving quality. We deal with suppliers and make sure that we have enough components in stock".____

e) "Our department is concerned with the day-to-day running of the money side of the company. We have to estimate costs and prices, deal with the accounts, and produce budgets and cash flow forecasts", _____

16. Which divisions would you expect the following people to work in?

a) assembly-line worker _____
b) graduate trainee _____
c) accounts clerk _____
d) sales executive _____
e) office supervisor _____
f) scientist _____
g) personnel officer _____
h) foreman _____

17. Complete the sentences using the prepositions in the box below.

in for with to of

1. The foreman is _____ charge _____ the workers in his section.
2. The production manager reports _____ the managing director. She is responsible _____ the smooth running of production.
3. Janet works _____ computers. She deals _____customer support.
4. The personnel officer is responsible _____ the managing director.

18. Choose one word or phrase from the box to complete each sentence.

boss Chief Executive Officer colleague customer director investor leader manager opposite number ~~owner~~ shareholder supplier

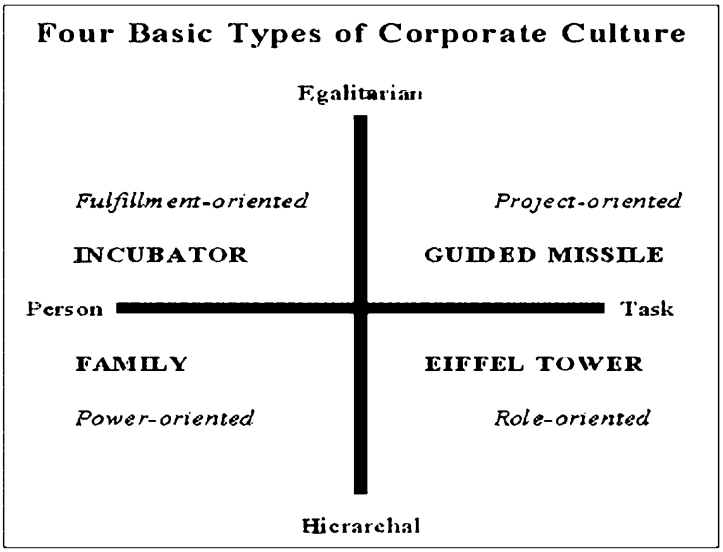
1. My name's John Power. Chemical Enterprises belongs to me. I'm the *owner*. I also manage the company myself. I'm the _____.
2. I'm John Power's sister. I sit on the Board of his company. I'm a _____.
3. I'm Mr Power's secretary. He's my _____.
4. I hold equity in this company. I am a (5) _____.
5. John Power is a friend of mine. I have put some of my own money into Chemical Enterprises. I'm an _____.
6. I buy things from this company. I'm a _____.
7. This company buys things from me. I'm a _____.
8. I'm the head of a team in the technical department. I'm a team _____ .
9. I have lunch every day with the woman at the desk next to mine. She is my _____.
10. I'm the marketing director of Chemitry Asia Pacific. Jim Poom is the marketing director of Chemical Europe. He's my _____.
11. I work for Power Enterprises. I head a department of about 50 people. I'm a _____.

SPEAKING

19. Listen to the text about four basic types of corporate culture and fill in the table.

Types of company	Role of leader	Role of everyone	Function of organization	Most commonly found in ...	Type of company
Incubator			The function of the organisation is to enable people to fulfil their potential		
Guided Missle					Typical of large, decentralised companies
Family	The leader is seen as a father-figure				
Eiffel Tower		Everyone is replaceable			

20. Using the diagram below and the information from the table, in groups prepare a description for each type of corporate culture and present it to your groupmates.



21. Role play the following situation: *"Designing an advertising brochure"*

All of you are the members of the work group for designing an advertising brochure. Present your ideas according to the role cards:

Card A – Production Manager
Card B – Finance Manager
Card C – Sales & Marketing Manager
Card D – Human Resources Manager
Card E – R&D Manager
Card F – supervisor of the work group

PROJECT WORK

"Perfect Company"

22. You are going to prepare and give a presentation about the company which you should invent. Work individually or in pairs and follow the outline:

1. What does your company produce?
2. What is it called?
3. What kind of public image do you have?
4. What is your company structure?
5. How many people do you employ?
6. Where are your headquarters?
7. Do you have offices in other countries? if so, where?
8. What is your turnover; market share and net profits? Who is your main competitor?
9. Are you growing, shrinking or holding steady?
10. What are your most promising products and/or markets?
11. What problems are you having and how are you dealing with them?
12. What are your employment policies?
    - dress code
    - timetables/hours of work
    - relations with clients
    - conduct at work (good facilities, opportunity to express your opinions, "interesting" and "enjoyable" work, flexitime, adequate payment, perks(e. g. discounts on travel and more company social events), receiving end-of-year bonuses).

WRITING

23. Wite a letter to your pen-friend about a company you are willing to start. Use the outline from activity 22 to help.

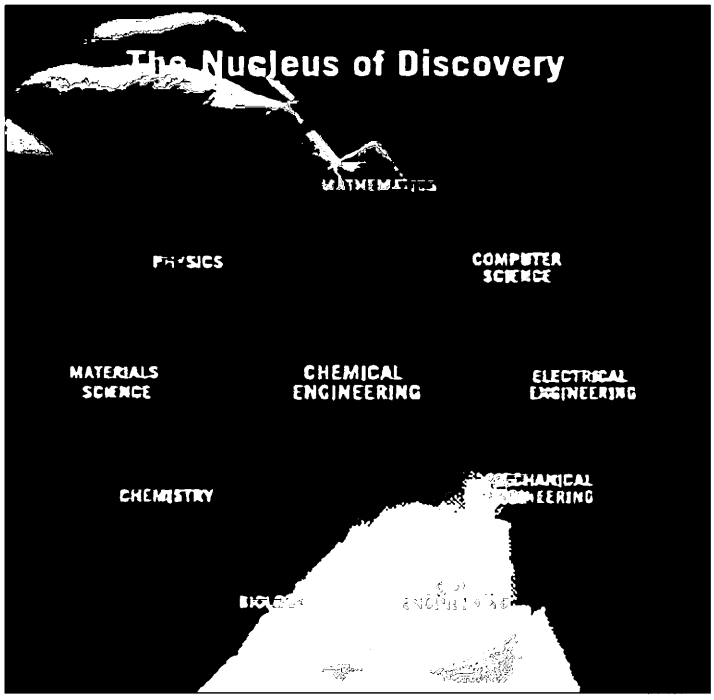
CHECKLIST

Assess your progress in this unit. Tick (✓) the statements which are true.

- ☐ I know global companies in chemical industry.
- ☐ I know the basics of company structure.
- ☐ I can talk about basic types of corporate culture.
- ☐ I can present the image of engineering company.

UNIT 6
Chemical Engineering

STARTING UP



1. Look at the picture and agree or disagree with the statement *"chemical engineering is the nucleus of discovery".*

2. Discuss these questions.

- How is chemical engineering connected with scientific fields given in the picture?
- Which of these fields do you study at TPU?
- What do you expect from being a chemical engineer? Are there any future prospects in your career as a chemical engineer?

3. Fill in the words or word combinations from the list below.

chemistry, mathematics, chemical engineer, engineering, physics, physical science, materials, research and development, chemicals

Chemical engineering is the branch of **1**_____ that deals with the application of **2**_____ (c. g. **3**_____ and **4**_____), with **5**_____, to the process of converting raw **6**_____ or **7**_____ into more useful or valuable forms. As well as producing useful materials, chemical engineering is also concerned with pioneering valuable new materials and techniques; an important form of **8**_____. A person employed in this field is called a **9**_____.

READING

4. Read the sentences, then listen and fill in the missing information. Skim the texts (A and B) and check your answers.

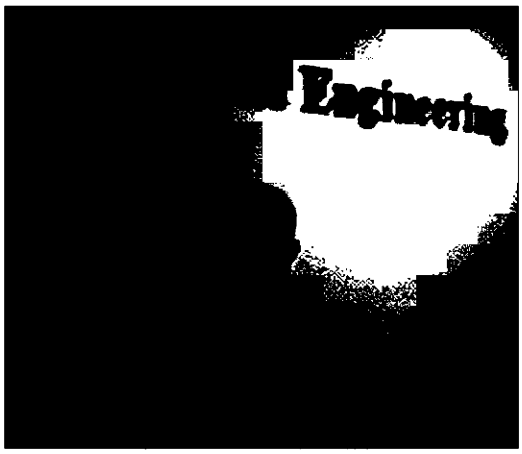
1. Chemical engineers do much more with chemistry than just make _____.
2. The "Big Four" engineering fields consist of civil, _____, electrical, and chemical engineers.
3. Chemical engineers concern themselves with the chemical processes that turn _____ into valuable products.

5. Scan the texts (A and B) for the information you need to complete the following statements.

- It is true that chemical engineers are comfortable with chemistry and …
- Chemical engineers should use such necessary skills as …

Text A

So what is a Chemical Engineer?



It is true that chemical engineers are comfortable with chemistry, but they do much more with this knowledge than just make **chemicals**. In fact, the term "chemical engineer" is not even intended to describe the type of work a chemical engineer performs. Instead it is meant to reveal what makes the field different from the other branches of engineering.

All engineers employ mathematics, physics, and the engineering art to overcome technical problems in a safe and economical fashion. Yet, it is the chemical engineer alone that draws upon the vast and powerful science of chemistry to solve a wide range of problems. The strong technical and social ties that bind chemistry and chemical engineering are unique in the fields of science and technology. This **marriage** between chemists and chemical engineers has been beneficial to both sides and has rightfully brought the envy of the other engineering fields.

The breadth of scientific and technical knowledge inherent in the profession has caused some to describe the chemical engineer as the "*universal engineer*". Despite a title that suggests a profession composed of **narrow specialists**, chemical engineers are actually extremely **versatile** and able to handle a wide range of technical problems.

http://www.members.tripod.com/historycheme/h_whatis.html (17.10.2012)

Text B

Chemical Engineering Today & Tomorrow

The "Big Four" engineering fields consist of civil, mechanical, electrical, and chemical engineers. Of these, chemical engineers are numerically the smallest group. However, this relatively small group holds a very **prominent** position in many industries, and chemical engineers are, on average, the highest paid of the "Big Four". Additionally, many chemical engineers have found their way into upper management. A chemical engineer is either currently, or has previously, occupied the CEO position for: *3M, Du Pont, General Electric, Dow Chemical, Exxon, BASF, Gulf Oil, Texaco, and B.F. Goodrich.* Even a former director of the CIA, John M. Deutch, was a chemical engineer by training.
More typically, chemical engineers concern themselves with the chemical processes that turn **raw materials** into valuable products. The necessary skills **encompass** all aspects of design, testing, scale-up, operation, control, and optimization, and require a detailed understanding of the various "unit operations", such as distillation, mixing, and biological processes, which make these **conversions** possible. Chemical engineering science **utilizes** mass, momentum, and energy transfer along with thermodynamics and chemical kinetics to analyze and improve on these "unit operations".

http://www.members.tripod.com/historycheme/h_whatis.html (17.10.2012)

6. Look at the following words in bold in the texts and try to explain them. Consult the dictionary if necessary.

chemicals, marriage, narrow specialist, versatile, prominent, raw materials, encompass, conversion, to utilize

7. Fill in the words from the list below. Use the words only once.

ties, conversions, universal, recognized, to utilize, range, valuable, to overcome, understanding, branches

1) to solve a wide _____ of problems
2) strong technical and social _____
3) to turn raw materials into _____ products
4) to make _____ possible
5) _____ technical problems
6) to describe the chemical engineer as the _____ engineer
7) to require a detailed_____
8) to be_____ all over the world
9) different_____ of chemical technology
10) _____ natural resources

8. Fill in the correct preposition, then make sentences using the completed phrases.

1) to be comfortable _____
2) to be different _____
3) to draw _____
4) marriage _____
5) to consist _____
6) _____ average
7) to turn smth _____ smth
8) _____ the faculty
9) to lead _____
10) to be trained _____

PROFESSIONAL LANGUAGE DEVELOPMENT

9. Match the product types of chemical industry with their examples.

Product Type	**Examples**
1) inorganic products	a silica brick, frit
2) organic products	b polyethylene, Bakelite, polyester
3) ceramic products	c nitroglycerin, ammonium nitrate, nitrocellulose
4) petrochemicals	d acrylonitrile, phenol, ethylene oxide, urea
5) agrochemicals	e ammonia, nitrogen, sodium hydroxide, sulfuric acid
6) polymers	f benzene, ethylene, styrene
7) elastomers	g fertilizers, insecticides, herbicides
8) oleochemicals	h benzyl benzoate, coumarin, vanillin
9) explosives	i polyisoprene, neoprene, polyurethane
10) fragrances and flavors	j lard, soybean oil, stearic acid

10. Fill in the words from the list below.

organic, polymers, elastomers, oleochemicals, explosives, chemical processes, refining, chemical reactions, manufacture, solvents

As accepted by chemical engineers, the chemical industry involves the use of **1** _____ such as **2**_____ and **3**_____ methods to produce a wide variety of solid, liquid, and gaseous materials. Most of these products are used in **4** _____ of other items, although a smaller number are used directly by consumers. **5**_____, pesticides, lye, washing soda, and portland cement are a few examples of product used by consumers. The industry includes manufacturers of inorganic- and **6**_____-industrial chemicals, ceramic products, petrochemicals, agrochemicals, **7** _____ and rubber (**8**_____), **9**_____ (oils, fats, and waxes), **10**_____, fragrances and flavors. Although the pharmaceutical industry is often considered a chemical industry, it has many different characteristics that put it in a separate category. Other closely related industries include petroleum, glass, paint, ink, sealant, adhesive, and food processing manufacturers.

11. Read the text below and look carefully at each line. Some of the lines are correct, and some have a word which should not be there or incorrect. If a line is correct, put a tick (✓). If a line has a word which should not be there, write the word or correct the mistake.

Chemical Engineering degree

1_____ A Chemical Engineering degree can provide you an excellent starting
point to launch a variety rewarding careers. Chemical Engineers are at the
2_____ forefront of technology and their role in modern society is becoming
increasingly important. Chemical Engineers design, implement and
supervise industrial processes where matter undergoes change. This could
3_____ be in the pharmaceutical, pulp and paper, food or plastics industries
example; anywhere where a transformation of matter occurs. Chemical
4_____ Engineers also play major role in the new, emerging field of
nanotechnology with applications in the development of new materials,
5_____ and devices. They also develop new processes prevent pollutants from
being released into our environment or to remove them after they are
6_____ already there. They decrease our energy use increasing the efficiency in
our fossil fuel refining plants, or by experimenting with new forms of
7_____ energy generation and storage. Increasingly Chemical Engineers are
becoming involved in the control, manipulation and production of
8_____ biological systems as well, which have many important applications in the
area of health care and food production for example.

12. Use the words given in capitals to form the words that fit in the spaces.

Chemical processes such as chemical **1**_____ are used in chemical plants to form new substances in various types of reaction vessels. In many cases the reactions are conducted in special corrosion **2**_____ equipment at elevated temperatures and pressures with the use of catalysts. The products of these reactions are **3**_____ using a variety of techniques including distillation especially fractional **4**_____, precipitation, crystallization, adsorption, filtration, sublimation, and drying. The processes and product are usually tested during and after manufacture by dedicated **5**_____ and on-site quality control laboratories to insure safe operation and to assure that the product will meet required **6**_____. The products are packaged and delivered by many methods, including pipelines, tank-cars, and tank-trucks (for both solids and **7**_____), cylinders, drums, bottles, and boxes. Chemical companies often have a research and development laboratory for **8**_____ and testing products and processes. These facilities may include pilot plants, and such research facilities may be **9**_____ at a site separate from the production plant(s).

REACT

RESIST

SEPARATE
DISTILLATE

INSTRUMENT

SPECIFY

LIQUIFY

DEVELOP

LOCATE

 ***SPEAKING***

13. Choose 5 the most important engineering activities you would prefer to do and explain your choice.

- *Pre-project analysis*
- *Decision making*
- *Showing results*
- *Search for engineering decisions*
- *Inventions*
- *Invention algorithm*
- *Engineering forecast*
- *Engineering research*
- *Designing*
- *Computerized designing*
- *Technological synthesis*

14. a) Take a look at the list of the *"Top Ten Greatest Chemical Engineering contributions"* and choose the most suitable definition for each of them from the list below.

A *"the plastic age"*
B *"wonder drugs for the masses"*
C *"yes, it's cool"*
D *"it's what's for dinner"*
E *"running on synthetic rubber"*
F *"as large as life"*
G *"the human reactor"*
H *"a sheep's best friend"*
I *"we all have to live here"*
J *"black gold, Texas tea"*

"Top Ten Greatest Chemical Engineering contributions" (according to the American Institute of Chemical Engineers):

1. Splitting the Atom _____
2. Plastics _____
3. Health care equipment, techniques, and even artificial organs _____
4. Wonder drugs made in quantities to save many lives _____
5. Synthetic fibers _____
6. Liquified air/separation of oxygen and nitrogen _____
7. Environmental solutions to waste and pollution _____
8. Food: fertilizers, processing, packaging _____
9. Petrochemicals _____
10. Synthetic rubber _____

b) Give your comments on these definitions. Do you agree with this top list? If not, make your own list and prepare your arguments.

15. Imagine you work for a chemical enterprise manufacturing one of the products from the list below. Choose the product and persuade your partner that manufacturing of this product is the most profitable and necessary for people.

- *Petroleum refining* (gasoline, heating oil, jet fuel, asphalt)
- *Commodity chemicals* (sulfuric acid, oxygen, ammonia, caustic soda)
- *Petrochemicals* (methanol, acetone, ethylene glycol)
- *Polymers and plastics* (nylon, polyethylene, polyurethane foam, synthetic rubber, Plexiglas)
- *Pharmaceuticals* (antibiotics, analgesics, antidepressants)
- *Electronic materials* (high-purity silicon, photovoltaics)
- *Processed foods* (sugar, instant coffee, frozen orange juice)
- *Paints and pigments*
- *Agricultural chemicals* (fertilizers, pesticides, crop sterilants)
- *Personal care products* (toothpaste, cosmetics, deodorants)
- *Inks and dyes*
- *Environmental remediation and hazardous waste disposal*
- *Energy production* (fuel cells, nuclear fuel processing, thermal solar power)

PROJECT WORK

"My specialty"

16. Prepare your own Hotlist for presentation of your specialty.
17. Use your Hotlist to make presentation of your specialty.

WRITING

18. Prepare a written description of your specialty.

CHECKLIST

Assess your progress in this unit. Tick (✓) the statements which are true.

- ☐ I can give a definition for chemical engineering.
- ☐ I can talk about the most important engineering activities.
- ☐ I can list the greatest chemical engineering contributions.

UNIT 7
OBJECTS OF CHEMICAL ENGINEERING

STARTING UP

1. Complete the names of chemical Majors in Chemistry and Chemical Engineering using the words or word combinations from the list below.

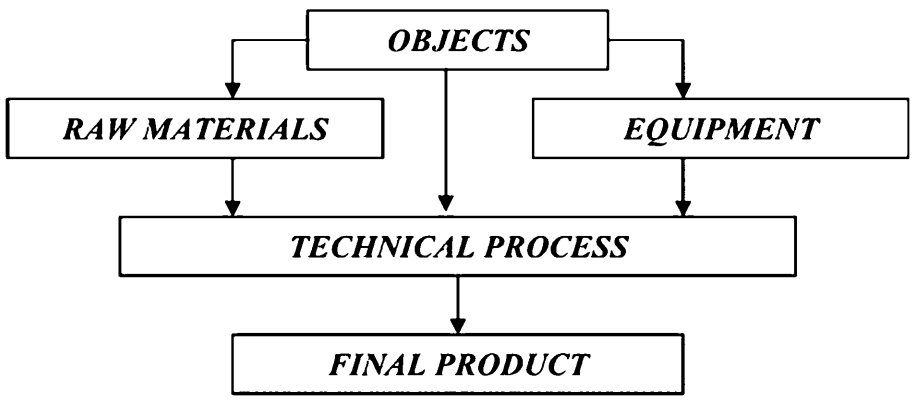
refractory, composite, mineral, biomedical, inorganic, substances, natural, solid, synthesis, metals

1. Technology of Basic _____ Synthesis
2. Technology of _____ Fertilizers
3. Corrosion and Protection of _____
4. Technology of Basic Organic and Petrochemical _____
5. Technology of _____ Energy Products
6. Technology of Carbon and _____ Materials
7. Technology of Oil and _____ Gases
8. Chemistry and Technology of Bioactive _____
9. Technology of _____ Preparations
10. Technology of _____ Materials

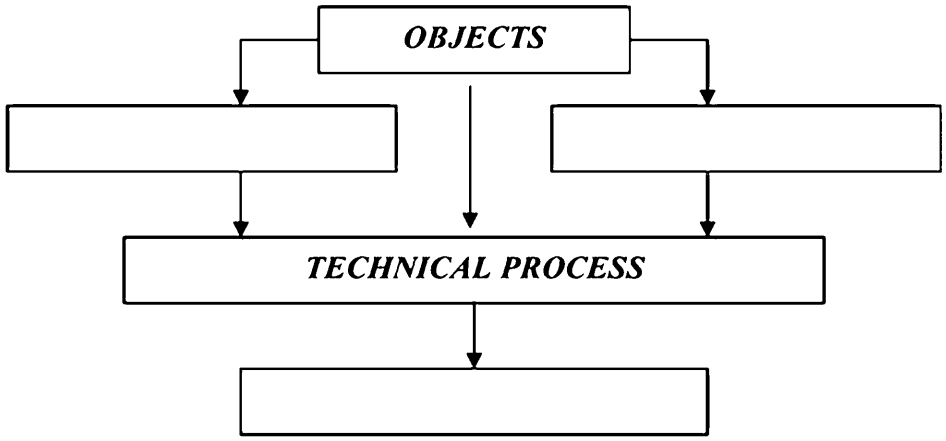
2. Answer these questions.

- What is the name of your Major?
- Which word/words of this name is/are defining?
- What is the object of your working in chemical engineering?
- Can you give any examples of products you will manufacture?
- What do you need for manufacturing these products?

3. Give your comments on the scheme below.



4. Complete the similar scheme using the names of objects applied and used in a supposed manufacturing. Give your comments.



READING

5. Answer the questions.

- What chemical companies in Russia or other countries do you know?
- Can you give their names and products they manufacture?
- What are the largest producers in chemical industry?

6. You are going to read an article about chemical industry. Six sentences have been removed from the article. Choose from the sentences A–G the one which fits each gap (1–6). There is one extra sentence which you do not need to use.

Chemical industry

The chemical industry comprises the companies that produce industrial chemicals. It is central to modern world economy, converting raw materials (oil, natural gas, air, water, metals, minerals) into more than 70 000 different products. Polymers and plastics, especially polyethylene, polypropylene, polyvinyl chloride, polyethylene terephthalate, polystyrene and polycarbonate comprise about 80 % of the industry's output worldwide. **(1)**_____. The chemical industry itself consumes 26 percent of its own output. Major industrial customers use rubber and plastic products, textiles, apparel, petroleum refining, pulp and paper, and primary metals. **(2)**_____. The largest corporate producers worldwide, with plants in numerous countries, are BASF,

Dow, Shell, Bayer, INEOS, ExxonMobil, DuPont, and Mitsubishi, along with thousands of smaller firms.

(3)_____. They operate internationally with more than 2800 facilities outside the U.S. and 1700 foreign subsidiaries or affiliates. The U.S. chemical output is $ 400 billion a year. The U.S. industry records large trade surpluses and employs more than a million people in the United States alone. The chemical industry is also the second largest consumer of energy in manufacturing and spends over $ 5 billion annually on pollution abatement.

In Europe, especially Germany, the chemical, plastics and rubber sectors are among the largest industrial sectors. **(4)**_____. Since 2000 the chemical sector alone has represented 2/3 of the entire manufacturing trade surplus of the EU. **(5)**_____.

The chemical industry has shown rapid growth for more than fifty years. The fastest growing areas have been in the manufacture of synthetic organic polymers used as plastics, fibres and elastomers. **(6)**_____. The European Community remains the largest producer followed by the USA and Japan.

The traditional dominance of chemical production by the Triad countries is being challenged by changes in feedstock availability and price, labour cost, energy cost, differential rates of economic growth and environmental pressures. Instrumental in the changing structure of the global chemical industry has been the growth in China, India, Korea, the Middle East, South East Asia, Nigeria, Trinidad, Thailand, Brazil, Venezuela, and Indonesia.

http://en.wikipedia.org/wiki/Chemical_industry (17.10.2012)

A	In the U.S. there are 170 major chemical companies.
B	Chemicals are used to make a wide variety of consumer goods, as well as thousands inputs to agriculture, manufacturing, construction, and service industries.
C	Historically and presently the chemical industry has been concentrated in three areas of the world: Western Europe, North America and Japan – so called the Triad.
D	Alcoa is the world's leading producer of primary aluminum, fabricated aluminum, and alumina and is active in all major aspects of the industry.
E	Chemicals are nearly a $ 2 trillion global enterprise, and the EU and U.S. chemical companies are the world's largest producers.
F	Together they generate about 3,2 million jobs in more than 60 000 companies.
G	The chemical sector accounts for 12 % of the EU manufacturing industry's added value.

7. Find necessary information in the text above. Fill in the table below.

Raw materials in Chemical Industry	
Products of Chemical Industry	
Main chemical producers worldwide	

8. a) On the Internet find the information to complete the table below.

Company	Country	Headquarters	Products	Chemical sales, billions
BASF	Germany	Ludwigshafen	?	$ 53,2
Dow Chemical	the USA	Midland, Mich.	?	$ 46,3
Shell Chemicals	The Netherlands/ The UK	?	?	$ 35
Bayer	Germany	Leverkusen	?	$ 34,1
INEOS	The UK	Lyndhurst	?	$ 33
ExxonMobil	the USA	Irving, Texas	?	$ 31,2
DuPont	?	Wilmington	?	$ 28,5
Mitsubishi Chemical	Japan	Tokyo	?	$ 21,9
Sumitomo Chemical	Japan	Tokyo	?	$ 14,1
Air Liquide	France	Paris	?	$ 13

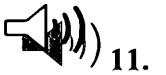
b) Can you provide similar information about any chemical company of the Russian Federation? Do you know any Russian chemical companies which are known worldwide?

9. Discuss these questions.

- Do we consider a chemical plant as an object of Chemical Engineering or that of Chemical Industry?
- Is geographical location of a chemical plant important from the business point of view?
- What are peculiarities of possible plant location?

10. Match a word in column A with a word in column B. Make a sentence using these word combinations.

	A	B
1	conductive	a) supply
2	plant	b) facilities
3	raw	c) supply
4	energy	d) survey
5	transportation	e) survey
6	water	f) conditions
7	preliminary	g) environment
8	market	h) personnel
9	labor	i) materials



11. Listen and make a list of factors which have influence on selecting the plant site.

12. Read the text and check your answers.

Selection of plant location for establishing a chemical industry

The geographical location of the plant contributes a lot to the success of any chemical business venture. Utmost care and judgment is required to select the plant site, and many different factors must be considered while selecting the plant site.

The plant site should be ideally located where the cost of production and distribution can be at a minimum level. Also there has to be a good scope for plant expansion and a conducive environment, safe living conditions for easy plant operation. But other factors, such as safe living conditions for plant personnel as well as the surrounding community are also important.

The major factors in the selection of chemical plant sites are raw materials, markets, energy supply, climate, transportation facilities, and water supply. For a preliminary survey, the first four factors should be considered. On the basis of raw materials availability, market survey, energy supply, and climate, acceptable locations can usually be reduced to one or two general geographical regions.

In the second step, the effects of transportation facilities and water supply are taken into account. This permits reduction of the possible plant location to few general target areas. These areas can be reduced further by considering all the factors that have an influence on plant location.

As a third step, a detailed analysis of the remaining sites can be made, exact data on items such as freight rates, labor conditions, tax rates, price of land, and general local conditions can be obtained. The various sites can be inspected and appraised on the basis of all the factors influencing the final decision. The final decision on selecting the plant site should take into consideration all the factors that can affect the ultimate success of the overall plant operation.

The choice of the final site should be based on a detailed survey of various geographical areas, and ultimately, on the advantages and disadvantages of available real estate. An initial outline regarding the plant location should be obtained before a design project reaches the detailed estimate stage, and a firm location should be established upon completion of the detailed estimate design. The factors that must be evaluated in a plant location study indicate the need for a vast amount of information.

http://www.goarticles.com/cgi-bin/showa.cgi?C=1193530 (05.04.2010)

PROFESSIONAL LANGUAGE DEVELOPMENT

13. Use the words given in capitals to form the words that fit in the spaces.

Chemical process industry

An industry, abbreviated CPI, in which the raw materials undergo chemical **1**_____ during their processing into finished products, as well as (or instead of) the physical conversions common to industry in general. In the chemical process industry the products differ **2**_____ from the raw materials as a result of **3**_____ one or more chemical **4**_____ during the manufacturing process. The chemical process industries broadly include the traditional chemical industries, both organic and inorganic; the petroleum industry; the petrochemical industry, which produces the **5**_____ of plastics, synthetic fibers, and synthetic rubber from petroleum and natural-gas raw materials; and a series of allied **6**_____ in which chemical processing plays a substantial part. While the chemical process industries are primarily the realm of the chemical engineer and the **7**_____, they also involve a wide range of other **8**_____, engineering, and economic specialists.	**CONVERT** **CHEMICAL** **UNDERGO** **REACT** **MAJOR** **INDUSTRY** **CHEMISTRY** **SCIENCE**

14. Distribute Industries from the list below according to the Majors given in the Table.

The prominent Chemical Process Industries

1. adhesive
2. biochemical engineering
3. biomedical chemical engineering
4. cement
5. ceramics
6. coal chemicals
7. coal gasification
8. coal liquefaction
9. distilled spirits
10. dyeing
11. electrochemical process
12. explosive
13. fat and oil
14. fermentation
15. fertilizer
16. food manufacturing
17. fuel gas
18. glass
19. graphite
20. hydrocracking
21. insecticide
22. lime (industry)
23. manufactured fiber
24. nuclear chemical engineering
25. nuclear fuels
26. paper
27. petrochemical
28. petroleum processing and refining
29. petroleum products
30. plastics processing
31. polymer
32. rubber
33. water softening

Table

Technology of Basic Inorganic Synthesis	
Technology of Mineral Fertilizers	
Technology of Basic Organic and Petrochemical Synthesis	
Technology of Solid Energy Products	
Technology of Carbon and Composite Materials	
Technology of Oil and Natural Gases	
Technology of Biomedical Preparations	
Technology of Refractory Materials	
Chemistry and Technology of Bioactive Substances	
Corrosion and Protection of Metals	

SPEAKING

15. Take a look at the following factors in selecting a plant site and prepare your comments about each one.

1. Raw materials availability
2. Energy availability
3. Meteorological data
4. Market study
5. Transportation facilities
6. Water supply
7. Waste disposal
8. Labor supply
9. Taxation and legal restrictions
10. Site characteristics
11. Safety and Environmental measures
12. Community factors

16. Imagine you intend to start a chemical production. In pairs, discuss the following:

- the product(s) you plan to produce
- the type of chemical (petrochemical, pharmaceutical, etc.) plant
- plant location (*why this site?*)

PROJECT WORK

"Chemical Plant – General Info"

17. Prepare a short presentation following the plan:

- kind of industry
- industry/plant location
- product/product range of industry (final product)

WRITING

18. Write a report to your managing director about your *"plant location"* following the factors mentioned in activity 15.

CHECKLIST

Assess your progress in this unit. Tick (✓) the statements which are true.

- ☐ I know different kinds of chemical industry.
- ☐ I know how to select chemical plant location.
- ☐ I can talk about product range of chemical industry.

UNIT 8
FUNCTIONS AND APPLICATIONS OF CHEMICAL OBJECTS

STARTING UP

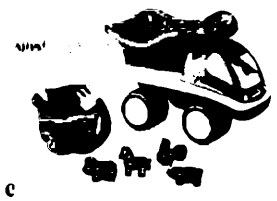
1. Look at the objects (a-h) below. What are the objects made from?


a


b


c


d


e


f


g


h

2. Complete the Table below and find out the properties and applications for each object. Compare your Table with partner's one.

	Objects	Materials	Properties	Material application
1	glasses and bottles	glass	clear, hard, brittle	windows, bottles, glasses
2				

3. Make sentences using the words in the Table.

EXAMPLE *Glass is clear and hard. That is why it is used in the production of windows, bottles and glasses. But glass objects can be broken easily, because they are brittle.*

READING

4. Listen to the text and answer the question 'What are the main product categories in chemical industry?'

5. Read the text and design a scheme or diagram for presenting the products of Chemical Industry.

Product Category Breakdown

Sales of the chemical business can be divided into a few broad categories, including basic chemicals (about 35 to 37 percent of the dollar output), life sciences (30 percent), specialty chemicals (20 to 25 percent) and consumer products (about 10 percent).

Basic chemicals is a broad chemical category including polymers, bulk petrochemicals and intermediates, other derivatives and basic industrials, inorganic chemicals, and fertilizers. Typical growth rates for basic chemicals are about 0,5 to 0,7 times GDP (Gross Domestic Product). The major markets for plastics are packaging, followed by home construction, containers, appliances, pipe, transportation, toys, and games. The largest-volume polymer product, polyethylene (PE), is used mainly in packaging films and other markets such as milk bottles, containers, and pipe. Polyvinyl chloride (PVC), another large-volume product, is principally used to make pipe for construction markets as well as siding and, to a much smaller extent, transportation and packaging materials. Polypropylene (PP), similar in volume to PVC, is used in markets ranging from packaging, appliances, and containers to clothing and carpeting. Polystyrene (PS), another large-volume plastic, is used principally for appliances and packaging as well as toys and recreation. The leading man-made fibers include polyester, nylon, polypropylene, and acrylics, with applications including apparel, home furnishings, and other industrial and consumer use. The principal raw materials for polymers are bulk petrochemicals.

Chemicals in the bulk petrochemicals and intermediates are primarily made from liquefied petroleum gas (LPG), natural gas, and crude oil. Their sales volume is close to 30 percent of overall basic chemicals. Typical large-volume products include ethylene, propylene, benzene, toluene, xylenes, methanol, vinyl chloride monomer (VCM), styrene, butadiene, and ethylene oxide. These chemicals are the starting points for most polymers and other organic chemicals as well as much of the specialty chemicals category.

Other derivatives and basic industrials include synthetic rubber, surfactants, dyes and pigments, turpentine, resins, carbon black, explosives, and rubber products and contribute about 20 percent of the basic chemicals' external sales. Inorganic chemicals (about 12 percent of the revenue output) make up the oldest of the chemical categories. Products include salt, chlorine, caustic soda, soda ash, acids (such as nitric, phosphoric, and sulfuric), titanium dioxide, and hydrogen peroxide. Fertilizers are the smallest category (about 6 percent) and include phosphates, ammonia, and potash chemicals.

Life sciences (about 30 percent of the dollar output of the chemistry business) includes differentiated chemical and biological substances, pharmaceuticals, diagnostics, animal health products, vitamins, and crop protection chemicals. While much smaller in volume than other chemical sectors, their products tend to have very high prices – over ten dollars per pound – growth rates of 1,5 to 6 times GDP, and research and development spending from 15

to 25 percent of sales. Life science products are usually produced with very high specifications and are closely scrutinized by government agencies such as the Food and Drug Administration. Crop protection chemicals, about 10 percent of this category, include herbicides, insecticides, and fungicides.

Specialty chemicals is a category of relatively high valued, rapidly growing chemicals with diverse end product markets. They are generally characterized by their innovative aspects. Products are sold for what they can do rather than for what chemicals they contain. Products include electronic chemicals, industrial gases, adhesives and sealants as well as coatings, industrial and institutional cleaning chemicals, and catalysts. Coatings make up about 15 percent of specialty chemicals sales, with other products ranging from 10 to 13 percent.

Consumer products include direct sale of chemical products such as soaps, detergents, and cosmetics. Typical growth rates are 0,8 to 1,0 times GDP.

http://en.wikipedia.org/wiki/Chemical_industry#Products (17.10.2012)

6. What category do the products of planned manufacture refer to? List them and present as a scheme.

PROFESSIONAL LANGUAGE DEVELOPMENT

7 Scan the table below to find materials which are:

1. soft
2. ductile
3. malleable
4. tough
5. scratch-resistant
6. conductive and malleable
7. durable and hard
8. stiff and brittle
9. ductile and corrosion-resistant
10. heat-resistant and chemical-resistant

Materials	Properties	Uses
Metals		
Aluminium	Light, soft, ductile, highly conductive, corrosion-resistant	Aircraft, engine components, foil, cooking utensils
Copper	Very malleable, tough and ductile, highly conductive, corrosion-resistant	Electric wiring, PCBs (printed circuit board), tubing
Brass (65 % copper, 35 % zinc)	Very corrosion-resistant. Casts well, easily machined. Can be work hardened. Good conductor	Valves, taps, castings, ship fittings, electrical contacts
Mild steel (iron with 0,15 % to 0..3 % carbon)	High strength, ductile, tough, fairly malleable. Cannot be hardened and tempered. Low cost. Poor corrosion resistance	General purpose
High carbon steel (iron with 0,7 % to 1,4 % carbon)	Hardest of the carbon steels but less ductile and malleable. Can be hardened and tempered	Cutting tools such as drills, files, saws

Thermoplastics		
ABS	High impact strength and toughness, scratch-resistant, light and durable	Safety helmets, car components, telephones, kitchenware
Acrylic	Stiff, hard, very durable, clear, can be polished easily. Can be formed easily	Aircraft canopies, baths, double glazing
Nylon	Hard, tough, wear-resistant, self-lubricatine	Bearings, gears, casings for power tools
Thermosetting plastics		
Epoxy resin	High strength when reinforced, good chemical and wear resistance	Adhesives, encapsulation of electronic components
Polyester resin	Stiff, hard, brittle. Good chemical and heat resistance	Moulding, boat and car bodies
Urea formaldehyde	Stiff, hard, strong, brittle, heat-resistant, and a good electrical insulator	Electrical fittings, adhesives

English for Electrical and Mechanical Engineering / Er.H.Glendinning (p. 23)

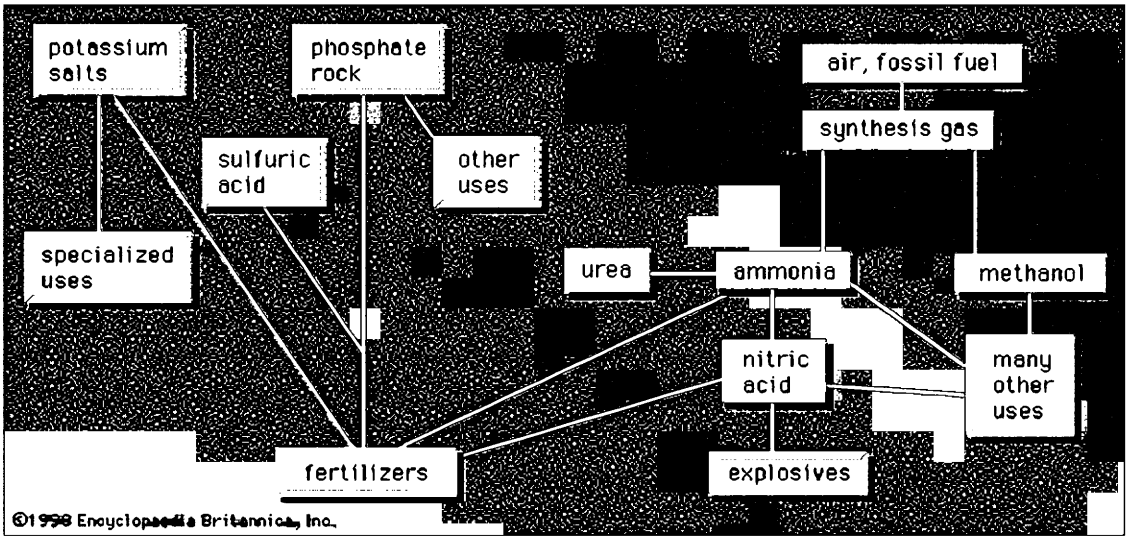
8. Scan the table to find:

1. A metal used to make aircraft.
2. Plastics used for adhesives.
3. Steel which can be hardened.
4. An alloy suitable for castings.
5. A plastic with very low friction.
6. A material suitable for safety helmets.
7. A metal suitable for a salt-water environment.
8. A metal for general construction use but which should be protected from corrosion.
9. A plastic for car bodies.
10. A metal used for the conductors in printed circuit boards.

SPEAKING

9. What chemical objects are presented in the Figure below? Tell about these objects using the following phrases from the previous text.

...can be divided into	*The principal raw materials for polymers are...*
including	*to be primarily made from ...*
The major markets for ... are...	*to be usually produced with...*
to be used mainly in...	*to tend to have...*
to be principally used to make...	*to be generally characterized...*
to be used in markets ranging from...	*to be sold for...*
with applications including...	



10. Enlarge this diagram to present objects planned to be used in your business.

PROJECT WORK

"Our Production"

11. Choose a product you are going to demonstrate in your Power Point presentation. Give detailed description of this product following the plan below.

a) Name of a product

b) Physical properties:

- Materials (plastic, steel, cotton, polyester, wood, polystyrene, leather, metal...)
- Dimensions (length, width/depth, height, weight, volume/capacity)
- Shape and colour (rectangular, circular, L-shaped, curved, cylindrical, in the shape of a...)
- Chemical properties
- Features (high-quality, advanced design, economical, easy to use, reliable, efficient)

c) Application /Use

WRITING

12. Design an advertisement of your product and present it to your group.

CHECKLIST

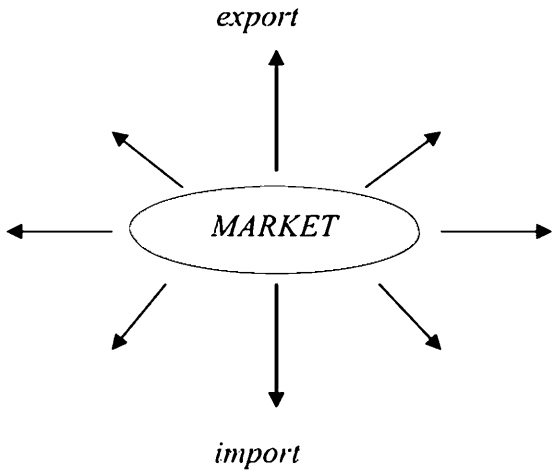
Assess your progress in this unit. Tick (✓) the statements which are true.

- ☐ I know key terms for physical and chemical properties of products.
- ☐ I know how to describe chemical products (weight, shape, colour, etc).
- ☐ I can present a chemical product.
- ☐ I use search skills to know more about uses of chemical industry products.

UNIT 9
CHEMICAL INDUSTRY MARKETS

STARTING UP

1. What associations come to your mind when you see the word "market"? Complete the diagram below with your ideas.



2. Answer these questions.

- Think of some of the things you own (for example, clothes, TV, car). Which are imported? Where were they made?
- What are your country's major imports and exports? Do you think products made in your country are better than products made in other countries?
- Which of the words or phrases in brackets best represents the idea of *quality*? (reliable, well-known, value for money, expensive, long-lasting, well-made)

3. a) Work in pairs. Try to sell something you have got with you at the moment (watch, pen, book, etc.) to your partner.

b) Discuss these questions.

- Were you pleased with the outcome of the negotiation above?
- What strategy or tactics did your partner use to achieve his/her objective?

4. a) Answer the questions and then compare your answers with the information given below.

1) What makes a good negotiation?
2) What makes a good negotiator?

A successful *negotiation* is when two people (or teams) reach agreement on something which they are both happy with. There should not be a winner and a loser. The negotiation should end with both people getting what they want (win-win).
To be a good *negotiator* takes a lot of skills and preparation. You need to:

- understand what is a good result for the other team as well as yourself
- have a clear idea of your objectives
- be willing to compromise on your objectives
- be sure what your priorities are – what is most important to you
- have a strategy – a plan of what you are going to do and say
- listen carefully to the other people – what they say, and how they say it
- be well-prepared

b) Underline the words in the text above that mean:

1) to accept less than you want in order to reach agreement;
2) the final situation at the end of the discussion;
3) a plan that you use to achieve something;
4) the most important things you want to do.

5. Discuss in pairs.

When was the last time you complained about something – something you had bought or a service you had received? Can you remember what you said? How was your complaint handled? Were you satisfied?

What sort of person are you:

1) the kind who never complains?
2) the kind who complains quietly, but does not insist?
3) the kind who complains quietly, politely, but firmly?
4) the kind who shouts and threatens to scream if he/she doesn't get what he/she wants?

READING

6. Match the following.

1) oil refining industry	a) биодизельное топливо
2) pulp and paper industry	b) цветная и черная металлургия
3) match and textile industries	c) нефтеперерабатывающая промышленность
4) non-ferrous and ferrous metallurgy	d) антигололедные реагенты
5) manufacture of synthetic rubbers and latex	e) целлюлозно-бумажная промышленность
6) anti-icing reagents	f) спичечная и текстильная отрасли
7) biodiesel fuel	g) производство синтетических каучуков и латексов

7. Give English equivalents for the following.

1) ООО "Сода-хлорат"
2) промышленное предприятие
3) разнообразный ассортимент химической продукции
4) сложнейшие процессы
5) уникальный
6) повышение конкурентоспособности
7) ориентированность на требования клиентов и потребителей
8) надежный партнер как в России, так и за ее пределами
9) разработка перспективных технологий
10) постоянное совершенствование существующих производств
11) улучшение качества выпускаемой продукции
12) установление новых связей с отечественными и зарубежными партнерами

Read the text below and compare your equivalents with those given in the text below.

"Soda-Chlorate" limited liability company was founded in 1999. Today it is a large, dynamically developing Russian industrial enterprise which produces a wide range of chemicals.

The enterprise is a complex of technological productions realizing the most complicated processes of basic chemistry and electrochemistry, some of them being unique in Russia.

The basis of these manufacturing sites is the production of such chemicals as potassium hydroxide (KOH), potassium chlorate ($KClO_3$), sodium metasilicate pentahydrate ($Na_2SiO_3*5H_2O$), and others.

The goods made by "Soda-Chlorate" limited company are widely used in chemical, oil refining, pulp and paper, match and textile industries, non-ferrous and ferrous metallurgy, manufacture of synthetic rubbers and latex, anti-icing reagents, biodiesel fuel and other applications.

To supply consumers with high-quality products and increase competitiveness the company staff aims at the corporate and functional company development. As a customer-oriented company the enterprise has gained the reputation of a reliable partner both in Russia and abroad.

Aims incorporated in the strategy of the company development are reached thanks to a stable working base and a solidary creative staff providing for the unity of financial, production and technical, marketing and research activities. Permanent research and development of promising technologies for the new products manufacturing, renewal of the productions list, and the product quality improvement help promote the company development.

http://soda.perm.ru/eng/index.shtml (17.10.2012)

8. The "Soda-Chlorate" Company manufactures the following chemicals:

1) SODIUM METASILICATE PENTAHYDRATE
2) POTASSIUM HYDROXIDE
3) POTASSIUM HYDROXIDE (liquid)
4) SODIUM METASILICATE NONANHYDRATE
5) POTASSIUM CHLORATE
6) POTASSIUM-LITHIUM ELECTROLYTE
7) CAUSTIC SODA GLASS
8) SODIUM HYPOCHLORITE
9) POTASSIUM GLASS

As a supplier this company places specific information about these products on the company site (*http://soda.perm.ru*). Find out appropriate information about each product mentioned above to complete the table below.

Chemical name	
Synonym & Trade Name	
Chemical formula	
Empirical Formula	
Molecular Mass	
Specifications	
Application	
Packing	
Transportation	
Storage Warranty	

PROFESSIONAL LANGUAGE DEVELOPMENT

9. a) Match the first halves of the sentences to the second halves.

1.	We're trying to break into	a)	all regulations if you want the delivery to go through without problems.
2.	You should carry out	b)	the delivery date, let us know as soon as possible.
3.	If you would like to place	c)	insurance cover for the shipment.
4.	If you can't meet	d)	a market survey before you make a major investment.
5.	They've quoted	e)	the Japanese market.
6.	Let us know if you want us to arrange	f)	an order, dial one now.
7.	It's essential to comply with	g)	us a very good price for the consignment.

b) Find verb + noun combinations in the sentences above. For example, *to break into a market.* Which of them is normally done by:

exporter?	importer?	exporter and importer?

10. Match the following.

1.	Brochures, leaflets and catalogues	a.	can attract the attention of potential customers.
2.	Displays in retail outlets (supermarkets, chain stores, etc.)	b.	to enable customers to see your products and talk to your representatives.
3.	Labels and presentation	c.	can ensure that your firm keeps a high profile and that people are aware of your good reputation and image.
4.	A stand or an exhibit	d.	can describe your product in more detail and give more info than an advertisement.
5.	Newspaper articles	e.	increase the impact of your product.
6.	Existing customers	f.	is informed by issuing press releases.
7.	PR	g.	tell their friends or colleagues about your product and hopefully recommend it to them.

11. Fill in the gaps using the words or word combinations below.

complaints relaunched long-lasting withdraw launched modified tests durability careless cancelled in transit inspection reliability failed to deliver orders incomplete

A year ago new air filters were **1**_____ in the market. The **2**_____ were made by many companies and the company-manufacturer seemed to be successful. But a few days later **3**_____ about the product were received. According to these complaints some of the goods were **4**_____ and others were damaged **5**_____ due to **6**_____ packing.
The sales manager had to **7**_____ them from sale. After proper **8**_____ and **9**_____ the filters were **10**_____ by engineers and finally **11**_____ in the market.
After that a lot more orders were placed, but the company-manufacturer **12**_____ filters on time and all the customers **13**_____ their orders.
In spite of new air filters had the high level of **14**_____ and **15**_____ the life of the products wasn't **16**_____.

LISTENING

12. A buyer for "Chemical Empire" is negotiating with a Sales Manager about pumps purchase. Listen and fill in the gaps.

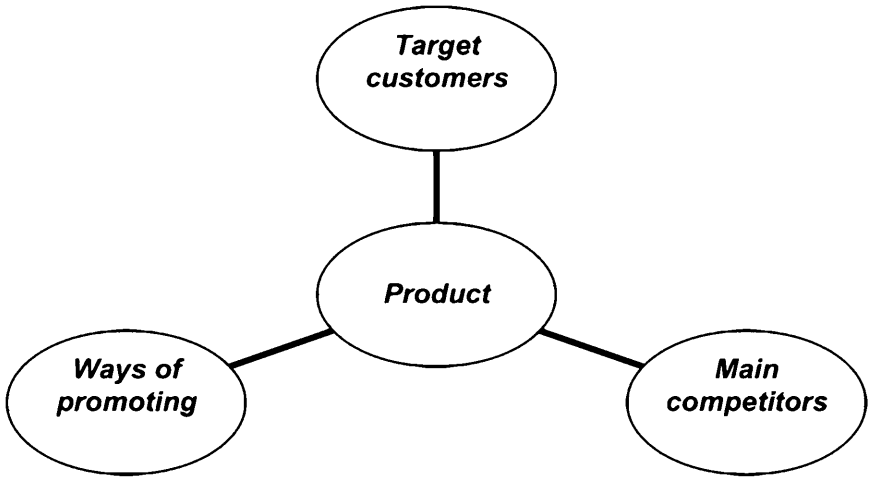
- So you would like to buy our pumps. What information exactly would you like to know?
- Firstly I'd like to ask you about **1**_____ of your product.
- Well, we have 2 main types of pumps. Pumps of type A are intended for pumping over **2**_____. Their power is about 3 kW. Pumps of type B are used to for viscous liquids and soles and their **3**_____ is 5 kW.
- That's wonderful! Could you tell about discounts? Does your company have any **4**_____?
- Certainly. If you buy 50 pumps you will get 10 % discount, and if you buy more than 100 pumps you'll get **5**_____ discount.
- And what about delivery?
- You will get pumps in **6**_____.
- What about **7**_____? Should I pay by letter of credit* or by bank draft?
- You may choose any way you like. But if you pay by banker's draft you will get **8**_____ free.
- OK. I'll buy 100 A-pumps.
- All right. It's nice to deal with you.

*A letter of credit (in foreign trade) is a written promise by an importer to pay the exporter's bank on a particular date or within 30 days after the goods have reached for the importer.

13. In pairs, act out the negotiation from activity 12.

SPEAKING

14. Work in groups. You are members of a creative group. Discuss the most effective *ways of promoting* a chemical product. Mention your *target customers* and *competitors*.



15. In pairs role play this negotiation.

A buyer	*A supplier*
You want to order 100 containers of potassium chlorate. The list price is US $ 200 per container. Try to negotiate a better price, discount, delivery and payment.	You offer a 3 % discount, delivery in six weeks by sea freight and ask for payment by bank draft.

16. In pairs role play the situation of buyer's complaints.

A buyer	*A supplier*
You are not satisfied with the order you have made. Complain about some filters (order № PV205) which have a number of defects (don't fit, not up to usual standard, etc.).	• Deal tactfully with the complaint • Show understanding • Get the facts • Promise action

PROJECT WORK

"Our markets"

17. Prepare a short presentation about a chemical product and design a Power Point presentation following a plan.

- main markets (suppliers, buyers, competitors)
- target customers (ways of promoting)

WRITING

18. Write an inquiry letter. Use Appendix for help.

19. Write a letter of complaint. Use Appendix for help.

CHECKLIST

Assess your progress in this unit. Tick (✓) the statements which are true.

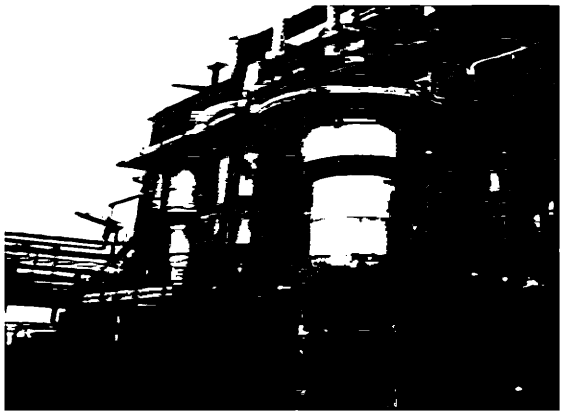
- ☐ I know who our existing and target customers are.
- ☐ I can name our main competitors.
- ☐ I can talk about the ways of promoting our product.
- ☐ I can negotiate about selling or purchasing a piece of equipment.
- ☐ I know how to write business letters (an inquiry letter, a letter of complaint)

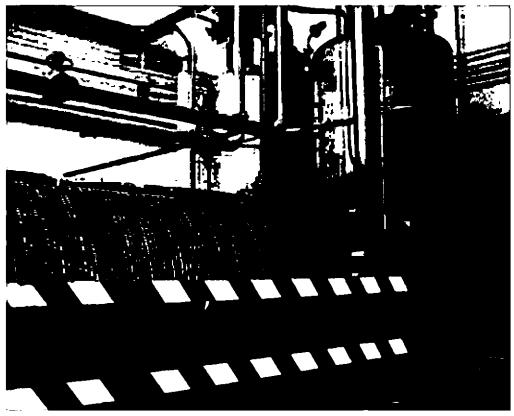
UNIT 10
MATERIALS IN CHEMICAL INDUSTRY

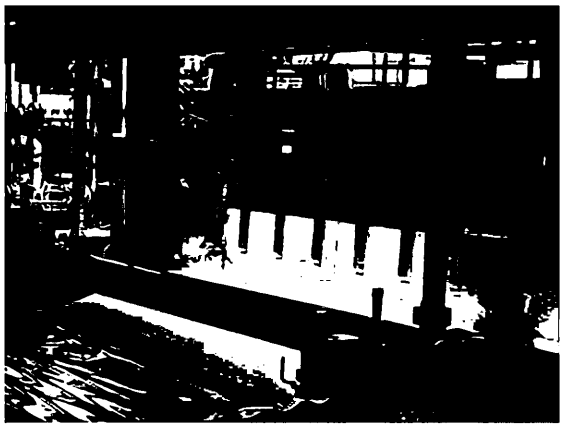
STARTING UP

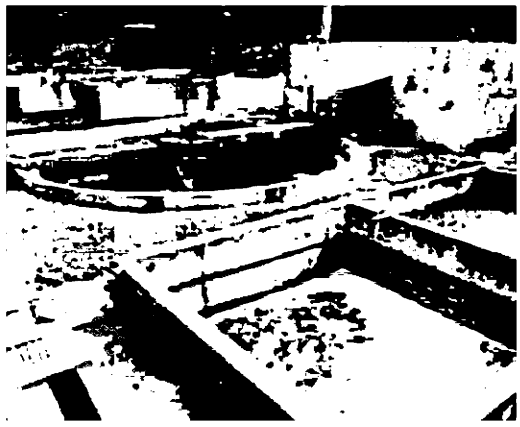
1. Look at the pictures below. What types of plants do you see?

1) Borosilicate Glass/ Soda Lime Plant
2) Benzene Extraction Plant
3) Sewage Treatment Plant
4) Hydrogen Plant

a 

b 

c 

d 

2. What products do these plants produce? What services do they provide? What raw materials are used for production?

READING

 **3. What materials in chemical industry do you know? What materials are used in your business? Listen to the text and make the list of materials.**

 **4. Read the text and give a name for each paragraph.**

Materials in industry

1	

Radical materials advances can drive the creation of new products or even new industries, but stable industries also employ materials scientists to make incremental improvements and to solve problems related to currently used materials. Industrial applications of materials science include materials design, cost-benefit tradeoffs in industrial production of materials, **processing techniques** (casting, rolling, welding, ion implantation, crystal growth, thin-film deposition, sintering, glassblowing, etc.), and analytical techniques (characterization techniques such as electron microscopy, x-ray diffraction, calorimetry, nuclear microscopy (HEFIB), Rutherford backscattering, neutron diffraction, small-angle X-ray scattering (SAXS), etc.).

Besides material characterization, the material scientist/engineer also deals with the **extraction of materials** and their **conversion** into useful forms. Thus ingot casting, foundry techniques, blast furnace extraction, and electrolytic extraction are all part of the required knowledge of a metallurgist/engineer.

2	

The study of **metal alloys** is a significant part of materials science. Of all the metallic alloys in use today, the alloys of iron (steel, stainless steel, cast iron, tool steel, alloy steels) make up the largest proportion both by quantity and commercial value. Iron alloyed with various proportions of carbon gives low, mid and high carbon steels. For the steels, the hardness and tensile strength of the steel is directly related to the amount of carbon present, with increasing carbon levels also leading to lower ductility and toughness. The addition of silicon and graphitization will produce cast irons (although some cast irons are made precisely with no graphitization). The addition of chromium, nickel and molybdenum to carbon steels (more than 10 %) gives us stainless steels.

Other significant metallic alloys are those of aluminium, titanium, copper and magnesium. Copper alloys have been known for a long time (since the Bronze Age), while the alloys of the other three metals have been developed relatively recently. Due to the chemical reactivity of these metals, the necessary electrolytic extraction processes have been developed relatively recently. The alloys of aluminium, titanium and magnesium are also known and valued for their high strength-to-weight ratios and, in the case of magnesium, their ability to provide electromagnetic shielding. These materials are ideal for situations where high strength-to-weight ratios are more important than bulk cost, such as in the aerospace industry and certain automotive engineering applications.

3	

Polymers and ceramics are also an important part of materials science. Polymers are the raw materials (the resins) used to make what we commonly call plastics. Plastics are really the final product, created after one or more polymers or **additives** have been added to a resin during processing, which is then shaped into a final form. Polymers which have been around, and which are in current widespread use, include polyethylene, polypropylene, PVC (polyvinyl-chloride), polystyrene, nylons, polyesters, acrylics, polyurethanes, and polycarbonates. Plastics are generally classified as "commodity", "specialty" and "engineering" plastics.

4	

Another application of material science in industry is the making of composite materials. Composite materials are structured materials composed of two or more macroscopic phases. An example would be steel-reinforced **concrete**; another can be seen in the "plastic" casings of television sets, cell-phones and so on. These plastic casings are usually a composite material made up of a thermoplastic matrix such as acrylonitrile-butadiene-styrene (ABS) in which calcium carbonate chalk, talc, glass fibres or carbon fibres have been added for added strength, bulk, or electro-static dispersion. These additions may be referred to as reinforcing fibres, or dispersants, depending on their purpose.

http://en.wikipedia.org/wiki/Materials_science (17.10.2012)

5. Look at the words/word combinations in bold and try to explain them.

6. Fill in the correct word from the list below and make up the sentences with these phrases.

cast processing material copper techniques stainless industrial electromagnetic electrolytic tensile

1 _____ techniques
2 _____ extraction
3 _____ application
4 _____ science
5 foundry _____
6 _____ steel
7 _____ iron
8 _____ strength
9) _____ alloys
10 _____ shielding

7. Make a list of materials and their application you can find in the text above and compare it with that of your partner.

8. Discuss in pairs how and where carbon can be used and present your ideas.

9. You are going to read a text about carbon application. Six sentences have been removed from the text. For each gap (1–6) choose one of (A–G) sentences which fits the text. There is one extra sentence which you do not need to use.

CARBON

Scientists, industry and consumers use different forms of carbon and carbon-containing compounds in many ways. Scientists use the carbon atom as the basic unit of mass and as a clue to the age of an object. **1**_____. In the form of diamond, carbon can cut most other substances and shine more brilliantly in jewelry than most other gems. Carbon compounds can be burned as fuel to heat food or homes, as well as from many different molecules for all sorts of human needs.

In 1961 the international unions of physicists and chemists agreed to use the mass of the isotope carbon-12 as the basis for atomic weights. Carbon-12 is defined to have an atomic mass of exactly 12 atomic mass units (AMU). The atomic mass of an element is the average mass of an atom of that element as compared to the mass of a carbon-12 atom.

Carbon-14 dating, a technique originated by American chemist Willard F. Libby in 1947, uses carbon to estimate the age of things that were once alive or artifacts made from them, such as wood sculptures or cloth. The carbon dioxide in the atmosphere includes one atom of radioactive carbon-14 for every 10^{12} (1000 billion) atoms of the nonradioactive carbon-12. While living, an organism contains this same ratio because it is continuously exchanging carbon with the atmosphere through photosynthesis or through eating and respiration. **2**_____. The radioactive isotope carbon-14 decays into nitrogen-14, and the carbon-14 concentration decreases with time. By measuring the carbon-14 to carbon-12 ratio in an archaeological sample, a scientist can estimate how much time has passed since the organism died.

Carbon has many industrial uses. At high temperatures, carbon combines with iron to make steel. The chemical composition of steel determines its physical properties. Carbon steel with about 1,5 percent carbon is used to make sheet steel and tools. **3**_____. High strength steel used for transportation equipment and structural beams contains about 0,25 percent carbon. Stainless steel for engine parts or kitchen utensils contains from 0,03 to 1,2 percent carbon. Carbon, in the form of coke, can also react with tin oxide and lead oxide to yield the pure metals tin and lead. Carbon black, made of fine particles of amorphous carbon, is produced by incomplete combustion of natural gas. It is mainly used as a filler and reinforcing agent for rubber.

Natural and synthetic diamonds can cut nearly every other known material. **4**_____. General Electric Company produced the first synthetic diamond in 1955. Today tiny synthetic diamonds are commonly used as abrasives. Producers of metal tools use lasers to heat carbon dioxide over a metal surface, making the carbon atoms coat the surface with a diamond film. This diamond coating can make cutting tools last much longer than untreated tools.

People burn fossil fuels to generate energy. Burning, or combustion is the reaction of a substance with oxygen to produce new substances and energy (in the form of heat). When coal burns, carbon reacts with oxygen to yield carbon dioxide and heat. **5**_____. Therefore, anthracite (containing the most

carbon) is the most valuable coal, and lignite (containing the least amount of carbon) is the least valuable. In petroleum, oil, and natural gas, burning releases energy when bonds between the atoms break and when carbon and hydrogen atoms recombine with oxygen to form carbon dioxide and water.

Carbon compounds are the basis of the synthetic organic chemicals, which account for many of the products of the chemical industry. Pharmaceuticals, pesticides, paints, and coatings are among the products made from synthetic organic chemicals. The synthetic fiber, synthetic rubber, and plastics industries depend upon the unique ability of carbon to form stable, long chains, or polymers, made from small organic molecules bonded together. **6**_____. All the plastics, from polyethylene terephthalate (PET) in soft drink bottles to polyvinyl chloride (PVC) in window frames to styrene in car parts, depend on the properties of carbon.

http://encarta.msn.com/encyclopedia (05.04.2010)

A	When an organism dies, exchange with the environment stops, and no additional carbon-14 is taken in.
B	The higher the carbon content, the greater the energy released in combustion.
C	Industries use carbon to make steel from iron, purify metals, and add strength to rubber.
D	Carbon-based polymers form synthetic fibers, such as nylon, rayon, and polyester.
E	Steel used for automobile and aircraft engine parts contains about 1 percent carbon.
F	The addition of chromium, nickel and molybdenum to carbon steels (more than 10 %) gives us stainless steels.
G	Gem cutters, surgeons, and manufacturers use diamond knives and drills.

10. Complete the table below according to the text.

Product	Product uses
steel	
diamonds	
energy	
polymers	

11. Using the text and table develop a figure on "Uses of carbon". Then present it.

PROFESSIONAL LANGUAGE DEVELOPMENT

12. Fill in *"inorganic"* or *"organic"*.

The industry includes manufacturers of **1**_____ and **2**_____ industrial chemicals: ceramic products, petrochemicals, agrochemicals, polymers and rubber (elastomers), oleochemicals (oils, fats, and waxes), explosives, fragrances and flavors.

Traditionally, **3**_____chemicals are considered to be of a mineral, not biological, origin. Complementarily, most organic compounds are traditionally viewed as being of biological origin.

4_____ can be formally defined with reference to what they are not – organic compounds. **5**_____ are those which contain carbon, although some carbon-containing compounds are traditionally considered inorganic. When considering **6**_____ chemistry and life, it is useful to recall that many species in nature are not compounds per se but are ions. Sodium chloride and phosphate ions are essential for life, as are some **7**_____ molecules such as carbonic acid, nitrogen, carbon dioxide, water and oxygen. Aside from these simple ions and molecules, virtually all species covered by bioinorganic chemistry contain carbon and can be considered organic or organometallic.

13. Choose the words from the box to fill in the gaps in the text below. Then listen and check your answers.

computers manufacturing buildings garment steelmaking substances distribution steel consumption production raw material finishing ore art construction stars cloth cotton

Materials are **1**_____ which are used to make different products with different properties used as inputs to **2**_____ or **3**_____or simply to create something new. Basically materials are the pieces required to make something else, from **4**_____ and **5**_____ to **6**_____ and **7**_____.

A material can be anything: a finished product in its own right or an unprocessed **8**_____. Raw materials are first extracted or harvested from the earth and divided into a form that can be easily transported and stored, then processed to produce semi-finished materials. These can be input into a new cycle of production and **9**_____ processes to create finished materials, ready for **10**_____, **11**_____ and **12**_____.

An example of a raw material is **13**_____, which is harvested from plants, and can then be processed into thread (also considered a raw material), which can then be woven into **14**_____, a semi-finished material. Cutting and sewing the fabric turns it into a **15**_____, which is the finished material. **16**_____ is another example – raw materials in the form of **17**_____ are mined, refined and processed into **18**_____, the semi-finished material. Steel is then used as an input in many other industries to make finished products.

14. Match the sub-fields of material science with the definitions.

Sub-fields of materials science	Definitions
1. Nanotechnology	**a)** the study of the way by which atoms in a solid fill space, the defects associated with crystal structures such as grain boundaries and dislocations, and the characterization of these structures and their relation to physical properties
2. Microtechnology	**b)** materials that are derived from and/or used with biological systems
3. Crystallography	**c)** materials such as semiconductors used to create integrated circuits, storage media, sensors, and other devices
4. Metallurgy	**d)** interactions and structures between solid-gas solid-liquid or solid-solid interfaces.
5. Biomaterials	**e)** the study of materials and processes and their interaction, allowing microfabrication of structures of micrometric dimensions, such as MicroElectroMechanical Systems (MEMS).
6. Electronic and magnetic materials	**f)** the study of the microstructures of high-temperature materials and refractories, including structural ceramics such as RCC, polycrystalline silicon carbide and transformation toughened ceramics
7. Tribology	**g)** the study of metals and their alloys, including their extraction, microstructure and processing
8) Surface science/Catalysis	**h)** the study of the wear of materials due to friction and other factors.
9) Ceramography	**i)** it is the creation and the study of materials whose structural properties are defined by their dimensions being less one hundred nanometers

SPEAKING

15. Discuss in pairs the main points of technical description of a (chemical) product.

16. Search for technical descriptions of H_2SO_4 and *HCl* in Appendix. Why are these points important to mention in technical description?

PROJECT WORK

"Technical Description"

17. Prepare a short presentation and design Power Point slides about a chemical product planned to be used in your business.

WRITING

18. Write the technical description of a (raw) material for a chosen technological process.

CHECKLIST

Assess your progress in this unit. Tick (✓) the statements which are true.

- ☐ I can present a (raw) material of chemical industry.
- ☐ I use search skills to know more about specifications and uses of materials in chemical industry.
- ☐ I can develop a technical description.

UNIT 11
TECHNOLOGICAL PROCESS IN CHEMICAL INDUSTRY: TOOLS AND EQUIPMENT

STARTING UP

1. What kinds of chemical equipment do you know?

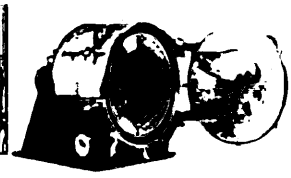
2. Choose words from the list to label the pictures.

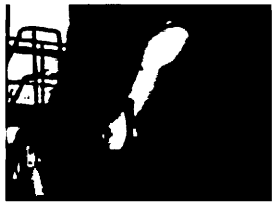
1. fraction distillation column
2. extruder
3. boilers
4. reactor
5) furnace
6) mixer
7) centrifuge
8) heat exchanger


A_____

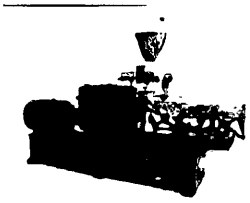

B_____


C_____


D_____


E_____


F_____


G_____


H_____

3. What are these kinds of equipment used for?

4. Listen to eight definitions and match them with equipment from activity 2.

READING

5. Answer the following questions.

- What is chemical engineering?
- What does this branch of engineering deal with?
- What processes in chemical engineering do you know?

6. Match the chemical terms with Russian equivalents.

1)	design	a)	сохранение вещества, материи
2)	diversity	b)	разнообразие
3)	grinding	c)	химическая реактивность
4)	the conservation of matter	d)	периодический (технологический) процесс
5)	chemical equilibrium	e)	проектирование
6)	chemical reactivity	f)	сборочный конвейер
7)	batch process	g)	химическое равновесие
8)	assembly-line	h)	измельчение

7. Listen and fill in the gaps. Read the text and try to explain these words/word combinations.

Chemical engineering

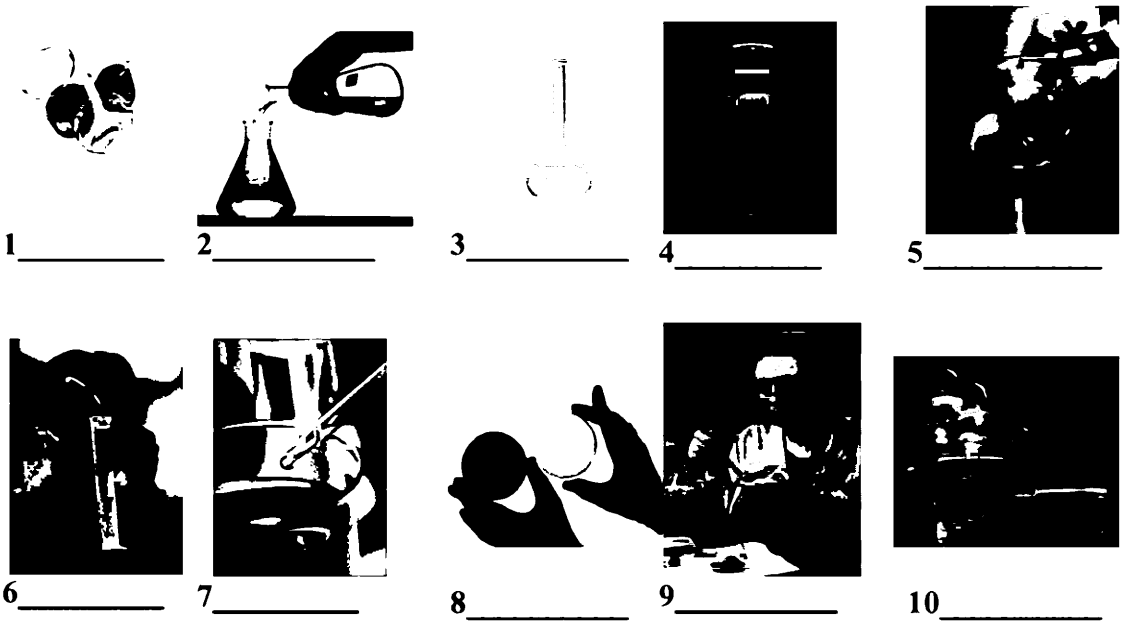
This branch of engineering is concerned with the **1**_____, construction, and management of factories in which the essential processes consist of chemical reactions. Because of the diversity of the materials dealt with, the practice, for more than 50 years, has been to analyze chemical engineering problems in terms of fundamental unit operations or unit processes such as the grinding or pulverizing of **2**_____ It is the task of the chemical engineer to select and specify the design that will best meet the particular requirements of production and the most **3**_____for the new applications.

With the advance of technology, the number of **4**_____increases, but such ones as distillation, crystallization, dissolution, filtration, and extraction are of continuing importance. In each unit operation engineers are concerned with four fundamentals: (1) the conservation of matter; (2) the conservation of energy; (3) the principles of chemical equilibrium; (4) the principles of chemical reactivity. Chemical engineers must organize the unit operations in their correct sequence, and they must consider the **5**_____of the overall process. Since a continuous, or **6**_____, operation is more economical than a batch process, and is frequently amenable to **7**_____, chemical engineers were among the first to incorporate automatic controls into their designs.

8. **Work in pairs and describe the following unit operations: *distillation, crystallization, dissolution, filtration* and *extraction*.**

9. **Read the following extracts about *chemistry lab glassware*. Match the pictures (1–10) with their definitions (A–J) and underline the names of the lab equipment you see in the pictures.**

What are these pieces of lab glassware used for?



1_____ 2_____ 3_____ 4_____ 5_____

6_____ 7_____ 8_____ 9_____ 10_____

A. Erlenmeyer flasks are used to measure, mix, and store liquids. The shape makes this flask very stable. They are one of the most common and useful pieces of chemistry lab glassware. Most Erlenmeyer flasks are made of borosilicate glass so that they can be heated over a flame or autoclaved. The most common sizes of Erlenmeyer flasks are 250 ml and 500 ml. However, they can be found in 50, 125, 250, 500, 1000 ml. You can seal them with a cork or stopper or place plastic or paraffin film or a watch glass on top of them.

B. No lab would be complete without beakers. Beakers are used for routine measuring and mixing in the lab. They are used to measure volumes to within 10 % accuracy. Most beakers are made from borosilicate glass, though other materials may be used. The flat bottom and spout allow this piece of glassware to be stable on the lab bench or hot plate, plus it's easy to pour a liquid without making a mess. Beakers are also easy to clean.

C. Test tubes are round-bottom cylinders, usually made of borosilicate glass so that they can withstand temperature changes and resist reaction with chemicals. In some cases, test tubes are made from plastic. Test tubes come in several sizes. The most common size is smaller than the test tube shown in this photo (18×150 mm is a standard lab test tube size). Sometimes test tubes are called culture tubes. A culture tube is a test tube without a lip.

D. Volumetric flasks are used to accurately prepare solutions for chemistry. This piece of glassware is characterized by a long neck with a line for measuring a specified volume. Volumetric flasks usually are made of borosilicate glass. They may have flat or round bottoms (usually flat). Typical sizes are 25, 50, 100, 250, 500, 1000 ml.

E. Graduated cylinders are used to measure volumes accurately. The can be used to calculate the density of an object if its mass is known. Graduated cylinders usually are made from borosilicate glass, though there are plastic cylinders, too. Common sizes are 10, 25, 50, 100, 250, 500, 1000 ml. Choose a cylinder such that the volume to be measured will be in the upper half of the container. This minimizes measurement error.

F. A Florence flask or boiling flask is a round-bottom borosilicate glass container with thick walls, capable of withstanding temperature changes. Never place hot glassware on a cold surface, such as a lab bench. It's important to inspect a Florence flask or any piece of glassware prior to heating or cooling and to wear safety goggles when changing the temperature of glass. Improperly heated glassware or weakened glass may shatter when the temperature is changed. Additionally, certain chemicals may weaken the glass.

G. Petri dishes come as a set, with a flat bottom dish and a flat lid that rests loosely over the bottom. The contents of the dish are exposed to air and light, but the air is exchanged by diffusion, preventing contamination of the contents by microorganisms. Petri dishes that are intended to be autoclaved are made from a borosilicate glass, such as Pyrex or Kimax. Single-use sterile or non-sterile plastic petri dishes also are available. Petri dishes commonly are used for culturing bacteria in a microbiology lab, containing small living specimens, and holding chemical samples.

H. A funnel is a conical piece of glass or plastic that is used to transfer chemicals from one container to another. Some funnels act as filters, either because of their design or because of filter paper or a sieve-placed on the funnel. There are several different types of funnels.

I. Glass bottles with ground glass stoppers are often used to store stock solutions of chemicals. To avoid contamination, it helps to use one bottle for one chemical. For example, the ammonium hydroxide bottle has to be used only for ammonium hydroxide.

J. Pipets (pipettes) are used to measure and transfer small volumes. There are many different types of pipets. Examples of pipet types include disposable, resuable, autoclavable, and manual. Pipets or pipettes are droppers calibrated to deliver a specific volume. Some pipets are marked like graduated cylinders. Other pipets are filled to a line to reliably deliver one volume again and again. Pipettes may be made of glass or plastic.

PROFESSIONAL LANGUAGE DEVELOPMENT

10. Match the tools and pieces of equipment with their functions.

Tools and equipments	Function
1. Oil Pre-Heaters	a) used to settle the output from the reactor into its separate fractions, typically methyl-esters and glycerol.
2. Biodiesel Reactor	b) to weigh out chemicals such as lye.
3. Methoxide Mixer	c) used to calculate the correct dosing of catalyst based on oil quality.
4. Settling Tanks	d) used for water removal and used to heat oil to correct temperature for transesterification.
5. Washing system	e) used to move oil from each aspect of the biodiesel process e. g. from reactor to a settling tank.
6. Final storage	f) used to mix lye and methanol for the tranesterification process.
7. Oil Storage	g) This can range from IBC's to underground / over ground storage tanks or even a fuel tanker for delivery to customer.
8. Transfer Pumps	h) used to batch correct quantities of methanol and oil. Many systems will use level indicators to achieve the same thing.
9. Scales	i) used to perform transesterification on pre heated feedstock oil and methoxide (Other catalysts can be used but methoxide is most common).
10. Flow meters	j) Once again storage for your feedstock oil, which could be IBC's or general storage tanks.
11. Titration testing equipment	k) used to purify biodiesel to commercial standards for use in modern diesel powered vehicles.
12. Centrifuge	l) used to recover methanol from produced biodiesel to raise quality and to recover methanol from glycerol. Methanol recovery can be considered as a product that can be re-used to lower costs and as one stage of the glycerol purification process.
13. Gas Chromatagraph	m) used at various stages of production to indicate quality is being maintained.
14. Particulate counters	n) used to analyze the quality of feedstock oil and to check quality of produced biodiesel
15. Methanol recovery system	o) can be used to remove water, and particles separate glycerol from biodiesel instead of settling.

11. Use the following vocabulary or your own ideas to complete the table below.

Ball Mill	*Dicer*	*Kettle*	*Reactor*
Blancher	*Dryer*	*Kiln*	*Refrigeration*
Boiler	*Dust Collector*	*Labeler*	*Ribbon Blender*
Briquetter	*Evaporator*	*Mill*	*Ribbon Mixer*
Centrifuge	*Filler*	*Mixer*	*Screen*
Compressor	*Filter*	*Pulper*	*Separator*
Conveyor	*Furnace*	*Raymond Mill*	*Solvent Distillation*
Crusher	*Heat Exchanger*	*Press*	*Tank*

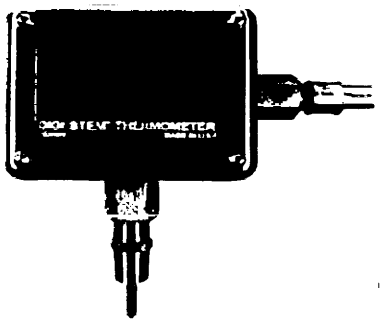
Cement Equipment	
Chemical Equipment	
Food Processing	
Industrial Processing	
Mining Equipment	
Pharmaceutical Equipment	
Water Treatment	

12. Fill in the gaps with the appropriate word from the list below.

specialists petroleum quality valves assurance building gas

At present JSC Sumy Frunze is one of leading machine- **1**_____ complexes in Europe manufacturing equipment for oil, gas and chemical industries. The unique types of chemical equipment, centrifuges, compressors and **2**_____ turbine driven centrifugal compressor packages, pumps and gas pipeline **3**_____, oil field equipment and drill collars is not a complete list of manufactured products. The huge production potential, high quality and professionalism of **4**_____, availability of advanced testing benches and Quality **5**_____ System valid in company, corresponding to ISO 9001 Standard, allow performing on reliable and high **6**_____ level any complex of works beginning with manufacture of the individual package up to construction of up-to-date **7**_____ refinery on EPC Contract terms.

13. Use the words given in capitals to form the words that fit in the spaces.



High Accuracy RTD (resistive temperature detector) Thermometer

The DST500 temperature **1**_____, and the DSX500 transmitter thermometers are wide range, high accuracy units designed for **2**_____ where accurate and reliable temperature monitoring and transmitting are critical. Both offer high precision temperature **3**_____ technology and feature a 1-in. high LCD display – readable from 30 ft. away. They are available in a **4**_____ of standard and custom built probe configurations including MIG standard tapered bulb for drop-in direct MIG **5**_____. The quick disconnect option allows the user to remove the probe and meter for calibration without **6**_____ the permanently installed cable. The adjustable angle probe option allows easy adjustment of the display for the best viewing option. Special **7**_____ can be supplied for tight fit installations. Temperature range is –328 °F to 1,472 °F (–200 °C to 800 °C).	**INDICATE** **APPLICATE** **MEASURE** **VARY** **REPLACE** **REMOVE** **CONFIGURATE**

SPEAKING

14. a) Study the following information about acetylene.

Acetylene

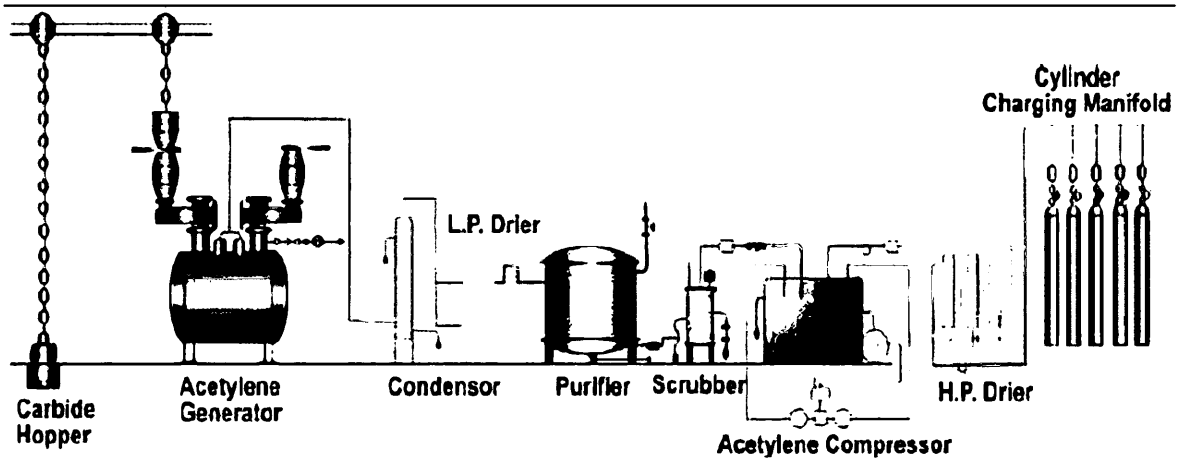
Acetylene (C_2H_2), a compound of carbon and hydrogen, is a colorless, highly flammable gas. It is slightly lighter than air and has a garlic-like odor. Acetylene is stored in high pressure cylinders filled with a porous material and containing acetone, into which the acetylene is dissolved. Unless dissolved in a solvent, acetylene will dissociate at pressures above 15 psig and form lamp black and hydrogen. Heat is generated with dissociation, which in turn, produces a danger of explosion. Acetylene is manufactured by the reaction of water with calcium carbide. It is also manufactured by thermal cracking of hydrocarbons, or by partial combustion of methane and oxygen.

b) In groups complete the table using the words/word combinations from the text above. See the examples in italics.

Process	Equipment	(Raw) material	Action
distillation	*gas heated reformer*	*gas* *sulfur compounds*	*to be compressed* *to be purified **by***

15. In pairs prepare a technical process description using a flowsheet, information from the table and the vocabulary below.

– *after that*	– *at high temperature*	– *to enter*	– *to be purified from impurities*
– *then*	– *at high pressure, etc.*	– *to come to*	– *to be cooled*
– *later*		– *to go to*	– *to be mixed with*
– *in the end*		– *to move*	– *to be heated*
– *at the end of the process*		– *to convert into*	
		– *to contact*	
		– *to come in contact*	
		– *to react with*	



FLOWSHEET OF ACETYLENE GAS PRODUCING

16. Complete the table with the names of appropriate pieces of equipment following the description of a technical process.

№	Equipment
1	CARBIDE HOPPER
2	
3	L.P. DRYER
4	
5	AMMONIA SCRUBBER
6	
7	H.P. DRYER
8	
9	ACETONE PUMP
10	

17. Work in pairs. What kind of tools and equipment can be used for each processing given below? Share this information with your group-mates.

inorganic and organic fertilizer processing
intermediates processing
petrochemical processing
pharmaceutical processing
plastics processing
resins processing
synthetic rubber processing
alkalis processing
medicinal chemical processing
soaps and detergents processing
paints and coatings processing
chemical preparation processing
ceramics processing
glass processing

PROJECT WORK

"Technological Process"

18. Design Power Point slides and prepare a short presentation about a technological process of a chemical product.

WRITING

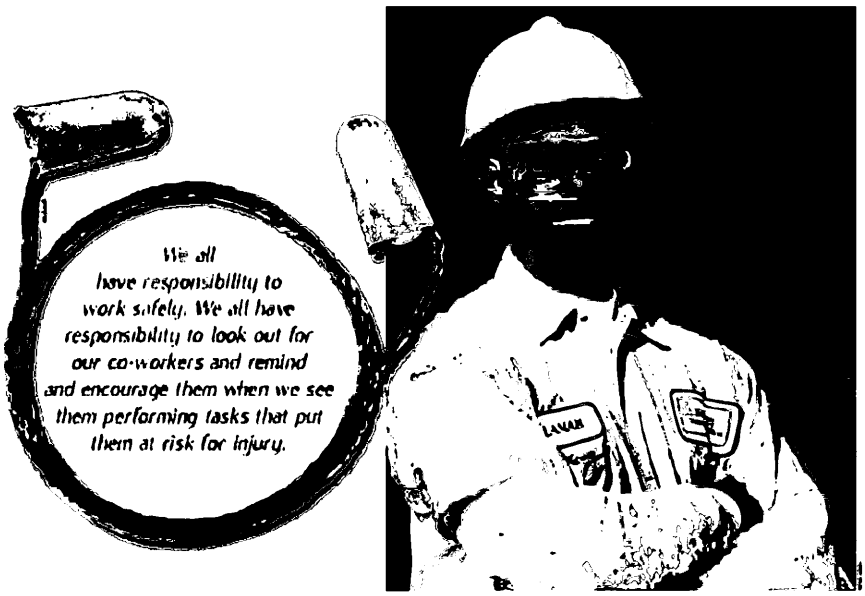
19. Develop a flowsheet and prepare a technological process description to obtain a chemical product.

CHECKLIST

Assess your progress in this unit. Tick (✓) the statements which are true.

☐ I use search skills to learn more about equipment used in a technological process.
☐ I can develop a flowsheet and describe a technological process.

UNIT 12
SAFETY AT WORK



"Better Safe than Sorry"
(a proverb)

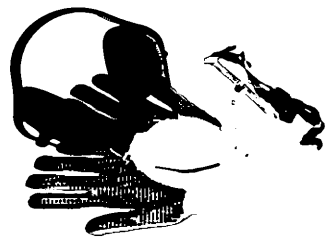
STARTING UP

1. **In pairs, list some of the potential dangers in your laboratory (lab), workshop or place of work.**

2. **How can the risk of these hazards be reduced? Complete the table below. Use the pictures below the table.**

Before working	During working	After working

3. Look at the picture on the right and say how the items in it can help while working in the lab or workshop. What other means of individual protection can you add?



4. What warning signs/labels do you know?

a) What do these warnings mean?

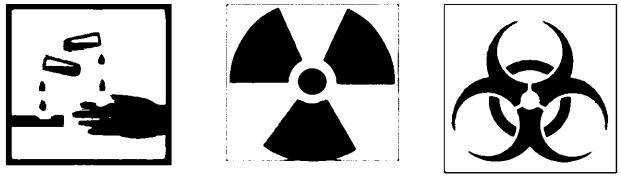
a) highly flammable
b) harmful
c) explosive
d) corrosive
e) oxidizing
f) toxic
g) environmental
h) biohazard
i) radioactive

b) Match each warning sign from the box below with the correct warnings above.

MAKE SURE YOU LEARN THE SIGNS!
THEY ARE FOR YOUR PROTECTION.

1_____ **4**_____ **7**_____

2_____ **5**_____ **8**_____



3_____ **6**_____ **9**_____

READING

 **5. Before reading discuss the following questions in pairs.**

- Are there any special safety rules/instructions or warnings for working in a chemistry lab? In chemical manufacturing? What are they?
- What are they made for?
- Are these rules always followed?
- What can happen if any of the safety rules is broken? Give an example.
- What should employees/company do in the case of accident?

 **6. Read the text "Chemistry Laboratory Safety Rules" and choose an appropriate heading for each passage.**

Chemistry Laboratory Safety Rules

Some rules are NOT made to be broken. That is true of-the rules used in a chemistry lab. They are really, truly for your safety and not your humiliation.
Read these and follow the recommendations for safe use and disposal of the material.

1	

You say, "But it's only water". Even if it is, how clean do you think that glassware *really* is? Using disposable pipettes? I know lots of people who rinse them and put them back! Learn to use the pipette bulb or automated pipetter. Don't pipette by mouth at home either. Gasoline and kerosene should be obvious, but people get hospitalized or die every year, right? I know someone who used his mouth to start the suction on a waterbed to drain it. Do you know what they put in some waterbed additives? Carbon-14. Mmmm... radiation. He couldn't retch fast enough! The lesson is that even seemingly harmless substances may be dangerous!

2	

A Material Safety Data Sheet (MSDS) should be available for every chemical you use in lab.

3	

No sandals, no clothes you love more than life, no contact lenses, and long pants are preferable to shorts or short skirts. Tie long hair back. Wear safety goggles and a lab coat. Even if you aren't clumsy, someone else in the lab probably is. If you take even a few chemistry courses you will probably see people set themselves on fire, spill acid on themselves, others, or notes, splash themselves in the eye, etc. Don't be the bad example to others, remembered for all time for something stupid!

4	

And know how to use it! Given that some people (possibly you) will need them, know the locations of the fire blanket, extinguishers, eyewash, and shower. Ask for demonstrations!

If the eyewash hasn't been used in a while the discoloration of the water is usually sufficient to inspire use of safety glasses.

5	

For many chemicals, if you can smell them then you are exposing yourself to a dose that can harm you! If the safety information says that a chemical should only be used inside a fume hood, then don't use it anywhere else. This isn't cooking class – don't taste your experiments!

6	

Some chemicals can be washed down the drain, while others require a different method of disposal. If a chemical can go in the sink, be sure to wash it away rather than risk an unexpected reaction between chemical "leftovers" later.

7	

It's tempting, but oh so dangerous... just don't do it!

8	

Don't haphazardly mix chemicals! Pay attention to the order in which chemicals are to be added to each other and do not deviate from the instructions. Even chemicals that mix to produce seemingly safe products should be handled carefully. For example, hydrochloric acid and sodium hydroxide will give you salt water, but the reaction could break your glassware or splash the reactants onto you if you aren't careful!

9	

Not after lab, on the assumption that it will be neater. Put data directly in your lab book rather than transcribing from another source (e. g., notebook or lab partner). There are lots of reasons for this, but the practical one is that it is much harder for the data to get lost in your lab book. For some experiments, it may be helpful to take data *before* lab. No, I'm not telling you to dry-lab or cheat, but being able to project likely data will help you catch bad lab procedure before you are three hours or so into a project. Know what to expect. You should always read the experiment in advance.

http://chemistry.about.com/od/healthsafety/a/aa080104a.htm (17.10.2012)

A. Don't Taste or Sniff Chemicals
B. Do Not Pipette By Mouth – Never
C. Don't Casually Dispose of Chemicals Down the Drain
D. Read the Chemical Safety Information
E. Don't Eat or Drink in Lab
F Dress Appropriately (for chemistry lab, not fashion or the weather)
G. Don't Play Mad Scientist
H. Identify the Safety Equipment
I.. Take Data *During* Lab

7. Read the "Chemistry Laboratory Safety Rules" again and make the following quiz.

Chemistry Laboratory Safety Quiz

1. You should pipette by mouth.

A Always. It's a fast and efficient method of measuring liquids.
B Only when you can't find a pipette bulb or think it might be dirty.
C Only when you are sure your instructor, lab assistant, or co-worker isn't looking.
D Never. And if you thought about answering yes to any other the other choices should be slapped.

2. When you are finished using a Bunsen burner you should:

A Leave it on for the next person to use. It's the only considerate choice.
B Cover the burner with an inverted beaker to suffocate the flame. It works well for candles, too.
C Pull off the hose connecting the burner to the gas. The burner won't have gas, so it won't be on fire.
D Turn off the gas. Duh!

3. If you feel dizzy or sick while working near the fume hood you should:

A Head out to grab a cola or a snack. Maybe it's low blood sugar. Don't tell anyone – why bother them.
B Meh, no big deal. Do nothing. Fume hoods always protect you from harmful chemicals. The sooner you get finished the sooner you can leave.
C Report your symptoms to whoever is responsible for that fume hood. It might be nothing, but on the other hand, maybe the hood wasn't functioning properly and you were exposed to something. Look up the MSDS for whatever was in the hood, too. Leave the lab, after contacting the proper person.

4. If you catch on fire you should:

A Panic. Yelling FIRE at the top of your lungs to let others know about the danger is good. Be sure to run as quickly as possible to blow out the flame.
B Water fixes everything. Head for the nearest safety shower and drown the flame.
C Pull the fire alarm and look for help. Hope the fire doesn't burn you too badly before you can take some form of action.
D Smother the flame. Those blankets in the lab are there for a reason. Some fire doesn't really care about water, but all flames need oxygen. Get help, too. You weren't working alone in the lab though, right?

5. Your glassware is clean enough to eat, therefore you poured water into a beaker to quench your thirst. Too bad you didn't label it. You should:

A Go on with your business. Are you saying there is some safety issue here? I scoff at you!

B Just be really careful about keeping it separate from other beakers filled with clear liquid. Hydrochloric acid.. water.. there is a difference, but I can smell the acid before I drink it.

C Label it before you forget which beaker it is. You're sure there are no residual chemicals in the glassware and positive nothing could accidentally splash into your drink.

D Look back to an earlier answer about how you should be slapped for stupidity. Food and drinks don't belong in the lab.

6. You really want to impress a certain person in your lab. You should:

A Be sure to wear contacts, not glasses, and just be really careful about chemical fumes. Got long hair? Don't tie it back, flaunt it. Nice legs? Wear something short, with sandals to show off those toes. Also, impress him or her by doing something daring in the lab. Choose something involving fire.

B Ditch the lab coat and goggles. Dress to impress. There's no way the person can tell your fashion sense when you cover it with safety gear.

C Hey.. lab coats are cool! Only ditch the goggles.

D Impress him or her with how incredibly competent you are in the lab. That includes your ability to follow safe lab procedures.

7. You are really curious about chemistry and chemical reactions. You wonder what would happen if you mixed chemicals in a different way or introduced something new into a procedure. You should:

A Stomp that curiosity down. Chemists do what they are told. Nothing more, nothing less.

B Run with it. Mix and match chemicals to your heart's desire. What's the worst that could happen? Explosion? You laugh. Toxic fumes? As if.

C Get the Nobel prize for your brilliance. But first.. let's try things and see how they work. But as for the scientific method and making predictions? That's for sissies.

D Be applauded for your curiosity, imagination, and quest for innovation, but be very, very careful about altering procedures. If it's a lab experiment for a grade, don't deviate from the procedure. Otherwise, make a prediction about what could happen based on your observations. Research possible reactions and consequences before playing mix and match in the lab.

8. There is a container on the lab bench containing some unknown chemical. You should:

A Dump it, wash the glassware. Some people are slobs.
B Move it out of the way in case it is dangerous. Otherwise, not your problem.
C Leave it. The rightful owner will claim it eventually.
D Find your lab supervisor and ask what to do. If you *are* the lab supervisor, remove the container (noting its location), hunt down the offender, and try to get some idea what could be in the beaker so you know how to dispose of it.

9. If you break a mercury thermometer, or otherwise spill mercury, you should:

A Leave it for others to find. Accidents happen. It's pretty obvious it was mercury. No big deal.
B Grab some paper towels, clean it up, and throw it away. Problem solved.
C Clean it up, being sure to throw away the mercury-contaminated items wherever heavy metals go. Don't bother anyone about the spill though. What they don't know can't hurt them.
D Leave it alone, but call your instructor or lab assistant over immediately to deal with the spill. You're alone? Call whoever is responsible for lab accidents. Only clean up the spill if you have been trained to deal with mercury. Don't pretend like it didn't happen.

10. You see someone in your lab engaged in an unsafe lab practice. You should:

A Point and laugh. They will clue in and change their behavior from the humiliation.
B Point and laugh and tell the person what an idiot he or she is being, and why the lab practice is unsafe.
C Ignore them. Not your problem.
D Nicely, politely point out the possible danger and how to avoid it. You're non confrontational? Find someone with more courage who can tactfully correct the problem. (Ok, maybe if it's pipetting by mouth or thwacking the cap on an ether bottle with a screwdriver the second answer is worth considering.)

http://chemistry.about.com/library/weekly/blsafetyquiz.htm
(17.10.2012)

8. Listen the company information on safety and answer these questions. Then read the company document and check your answers.

1 Who is this document for?
a) managers; b) lab assistants/chemists; c) all employees;
d) injured employees

2 Who wrote this document?
a) technician; b) manager; c) company safety officer/supervisor;
d) medical staff; e) trade union representative

3 What is the writer's intention?
a) to prevent accidents; b) to ensure speedy help for injured employees;
c) to protect the company; d) to warn about dangers

Accident investigation

Whenever an accident occurs that results in an injury (medical case), damage of equipment and material, or both, prompt accident investigation by the immediate manager is required. A written preliminary investigation will be completed by the end of the particular shift or business day on which the accident occurred.

In no event should there be a delay of more than 24 hours. Failure to comply with this requirement may subject the immediate manager to disciplinary action up to and including discharge.

Without adequate accident investigation data the Company may be subjected to costs, claims, and legal action for which it has no defence.

As a minimum, the preliminary accident investigation report will include the following:

1. Name, occupation, and sex of injured worker.
2. Place and date/time of accident.
3. Description of how the accident happened.
4. Immediate causes of the accident – unsafe acts and unsafe conditions.
5. Contributing causes – manager safety performance, level of worker training, inadequate job procedure, poor protective maintenance, etc.
6. Witness(es) – name and department.
7. Corrective action taken – when.

The employee who was injured and any employee(s) who witnessed the incident should be separately interviewed as soon as possible. A copy of the report must be submitted to the Manager – Human Resources for review. Another copy of the report is to be retained for a period of not less than the injured employee's length of employment plus five (5) years.

English for Electrical and Mechanical Engineering./ Er.H.Glendinning (p. 52)

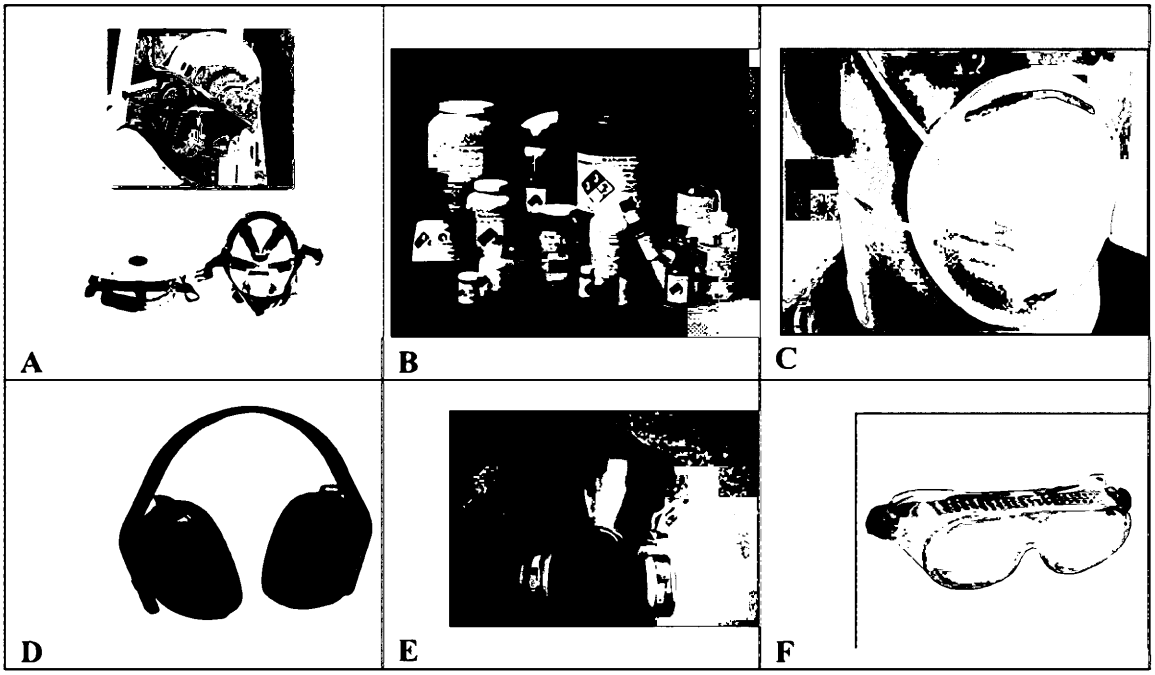
9. Study this brief report of an accident. In which points does it not meet company policy on reporting accidents?

To:	**Name Department & Location Date** Manager Human Resources 17 May
From:	**Name Department & Location Tel.** D. Taylor Chemistry lab 6200
Subject	Preliminary Report, Accident, 12 May While introducing a new chemical into a procedure on Tuesday, last week, Kenneth Oliver, lab assistant, received an injury to his eye. He was taken to the Eye Hospital where he was operated on. I believe the accident was due to carelessness.

PROFESSIONAL LANGUAGE DEVELOPMENT

10. Match safety equipment with those in pictures.

1 respiratory mask_____
2 face mask/gas mask _____
3 lab coat _____
4 hard hat _____
5 safety sign _____
6 gloves _____
7 goggles _____
8 ear defenders _____
9 chemical containers _____



11. Fill in the gaps with the words or word combinations given below.

flammable, radiation, No Open Flames, combustible, nonpotable, chemical containers, corrosive, toxic, biohazard, electricity, functional, explosive

1) _____ materials are usually strong acids or bases. They represent a hazard to your skin, and often to mucous membranes through inhalation of vapors. Pay attention to the proper storage container for these materials. In addition, these materials are reactive.

2) _____ materials are those which can catch fire readily.

3) This is the symbol for _____ or poisonous materials.

4) This symbol indicates a _____ hazard.

5) This is the symbol for a _____, or a material which represents a threat to cellular materials or living organisms.

6) If you see a _____ sign, this usually implies there is a flammable or combustible material nearby.

7) This sign warns of live _____.

8) This sign warns of _____ materials.

9) The Fire Extinguisher sign should mark the position of a _____ fire extinguisher.

10) The _____ water sign lets you know the water is not approved for drinking.

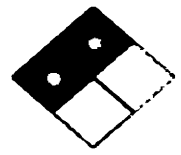
11) This symbol accompanies _____ materials.

12) The hazard label is found on _____. It indicates health hazard, flammability and other cautions associated with the chemical.

12. In activity 11, find a suitable description for each of the signs below and give your ideas about the names of these signs.







A_____ B_____ C_____ D_____ E_____

13. a) Match the words from the box with the words below to make right word combinations. Use each word only once.

blanket, assistant, coat, sign, extinguisher, rules, supervisor, fumes, equipment, materials

1 **lab** a) _____ b) _____ c) _____	2 **fire** d) _____ e) _____
3 **safety** f) _____ g) _____ h) _____	4 **toxic** i) _____ j) _____

b) Make your own sentences with these word combinations.

14. Find the synonyms in column B for the words in column A.

A	B
1 combustible	a) symbol/label
2 poisonous	b) oxidizing
3 danger	c) potable
4 sign	d) toxic
5 drinking	c) hazard

15. Using the suffixes below form the words in the table from the given ones. Use each suffix only ones.

-ty, -er, -ous, -ity, -al, -(t)ion, -able, -ive

Noun	Adjective	Verb/adjective	Noun
1 explosion		1 radiate	
2 flame		2 electrical	
3 chemistry		3 extinguish	
4 hazard		4 save	

SPEAKING

16. Compare the pictures (A and B, C and D). What is common among them and what is different while working in a chemistry lab?

A

B

C

D

17. Tell your partner about a lab accident that has recently happened. Mention the following:

- what exactly has happened
- who was injured; if the injury was serious or not
- what was done to prevent an accident
- what was done to avoid another accident

18. a) In pairs, prepare a description the situation of a lab accident, or you may use the situation you have discussed in activity 17.

b) Now you are going to make an accident investigation of another pair. Find out all necessary facts for making a brief report of an accident (minimum information for your report you can find in activity 8 "Reading").

c) After investigation you must prepare a brief report of an accident. Use activity 9 as a model.

19. In pairs, discuss the following situations. In the lab, what you should do if you:

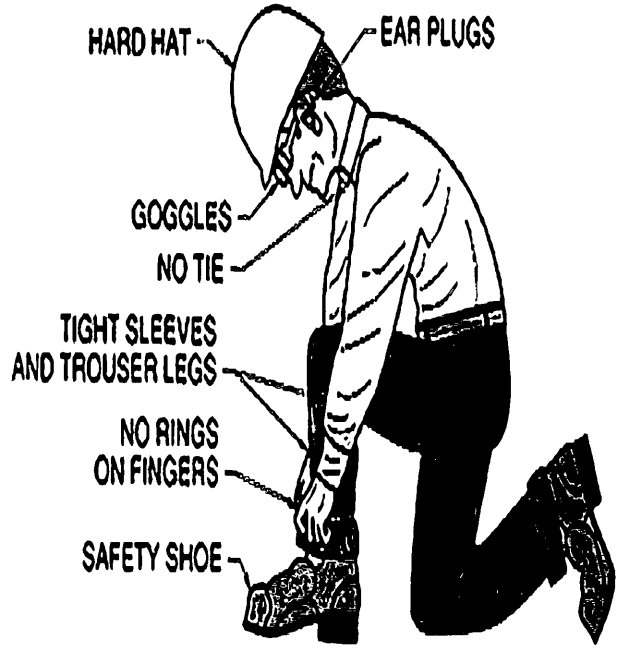
- feel dizzy/sick
- catch on fire
- mix wrong chemicals
- break a mercury thermometer/spill mercury

20. Work in groups. In each group, the two of you will be performers and the rest are the audience.

Performers	**Audience**
Imagine you work in a lab or workshop. So you know the safety rules quite well. That's why you were asked to give a short lecture for younger employees. In pair, prepare a mini lecture on the base of the leaflets (A and B) below. Use *Imperative* and modal verbs *must, should*, etc. during your talking.	Imagine you are young employees. You are to start working in a lab or workshop. But you don't know the safety rules very well. So, as an audience you should listen to the performers carefully and ask questions on the topic.

Leaflet A

Leaflet B



PROJECT WORK

"Safety at my workplace"

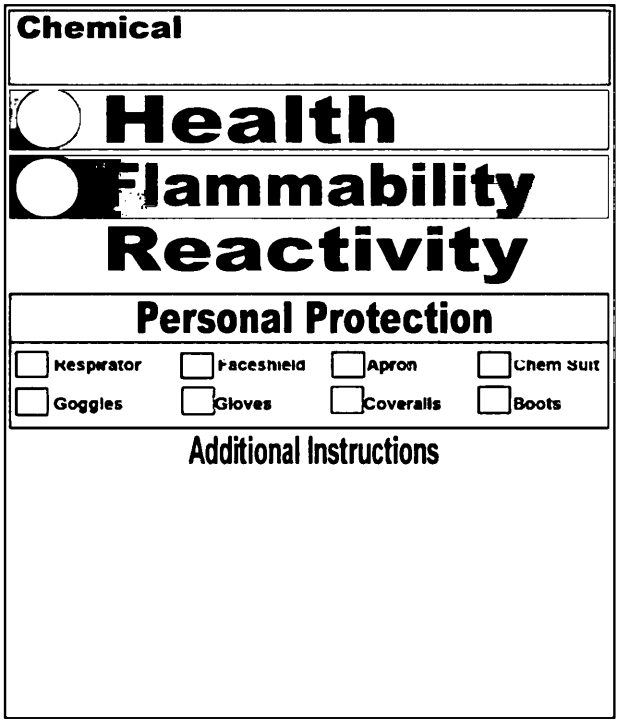
21. Prepare a short presentation and design a Power Point slide following a plan:

- type of activity provided;
- necessary warnings (for example safety signs);
- necessary means of personal protection;
- additional instructions.

WRITING

22. In order to avoid any accidents design a safety leaflet for your future laboratory (on your specialty). You can use the leaflet below for writing safety rules as a model. You should provide the following information:

- type of activity provided in this lab
- necessary warnings (for example safety signs)
- necessary means of personal protection
- additional instructions



CHECKLIST

Assess your progress in this unit. Tick (✓) the statements which are true.

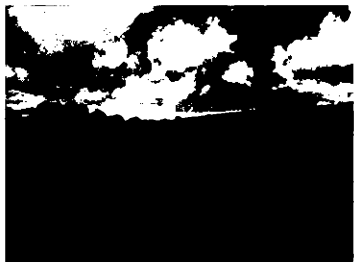
- ☐ I can recognize and name different safety signs.
- ☐ I know chemistry lab safety rules.
- ☐ I can talk about personal means of protection at the lab.

UNIT 13
RESOURCE SAVING

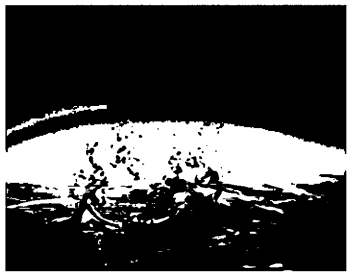
STARTING UP

1. **Everybody knows that there are such natural resources as *minerals, energy, land, water* and *biota*. Take a look at the following pictures displaying natural resources (A–E) and match them with the names.**

A _____ B _____ C _____


D _____ E _____

2. **Here's a list of ideas to help to reduce our consumption. Skim the list and give your comments. You are welcome to expand this list if you have any energy or resource saving tips.**

- Power down electrical equipment (computers, monitors, printers, multifunction machines, etc.) when not in use.
- Unplug unused equipment when practical.
- Use duplex printing as default on capable printers/copiers.
- Turn off your lights when you leave your office.
- Scan and email documents instead of copying or faxing.
- Turn down your thermostat during winter and up during summer. This tip is particularly useful when you will be out of your office for extended periods of time, like over the weekend or on vacation.
- Keep a recycle box in your office and next to copiers and printers; use it for non-confidential paper disposal. When it fills up, empty it into one of the building recycling containers.

http://facstaff.grad.uiowa.edu/Energy-Resource-Saving (17.10.2012)

READING

3. **Before reading explain the meaning of the following statement *"The less evaporation there is, the less rainfall there is and the whole system dries up".***

4. **Scan the article and find answers for the questions.**

- How many Earth's resources do people consume nowadays? What are they?
- What is the result of this consumption?
- What are the most reasonable ways of solving the problem of ravening resources?

Earth suffers as we gobble up resources

ALMOST one-quarter of nature's resources are being **gobbled** up by a single **species**, and it's not difficult to guess which one. Based on figures for the year 2000, the most recent available, humans **appropriate** 24 per cent of the Earth's production capacity that would otherwise have gone to nature.

The result is a gradual **depletion** of species and **habitats** as we take more of their resources for ourselves. Things could get even worse if we grow more plants like palm oil and rapeseed for biofuels to ease our reliance on fossil fuels.

That is the message from a team led by Helmut Haberl of Klagenfurt University in Vienna, Austria. Haberl and colleagues analysed UN Food and Agriculture Organization data on agricultural land use in 161 countries covering 97,4 per cent of farmland. By comparing carbon **consumption** through human activity with the amount of carbon consumed overall, Haberl's team found that humans use some 15,6 trillion kilograms of carbon **annually**. Half was soaked up by growing crops. Another 7 per cent went up in smoke as fires lit by humans, and the rest was used up in a variety of other ways "Things could get even worse if we grow more plants like palm oil and rapeseed for biofuels to ease our reliance on fossil fuels" related to industrialisation, such as transport *(Proceedings of the National Academy of Sciences)*.

Haberl says that the Earth can just about **cope** if we meet future needs by producing food more efficiently. This could be done by intensifying agriculture on roughly the same amount of land as we use now. But we're asking for trouble, he says, if we **expand** production of biofuels, as the only **fertile** land available is tropical **rainforests**.

"If we want **full-scale** replacement of fossil fuels by biofuels, this would have dramatic **implications** for ecosystems", – says Haberl. He warns that some projections **foresee** four or fivefold increases in biofuel production. "This would at least double the overall amount of biomass harvested, which is about 30 per cent above ground at present, but would increase to 40 or 50 per cent to meet these biofuel targets", – he says.

This would mean clearing what remains of the world's rainforests in countries such as Brazil and Argentina. As well as **wiping out** thousands of species, this would have **devastating** effects on the climate, he says. Unlike farmland, forests help to seed rainfall because they have high evaporation rates.

"The less **evaporation** there is, the less rainfall there is and the whole system dries up", – he says. **Andy Coghlan**

7 July 2007/NewScientist/15

5. Look at the following words in bold in the texts and try to explain them. Consult the dictionary if necessary.

To gobble up, species, to appropriate, depletion, habitat, consumption, annually, to cope, to expand, fertile, rainforest, full-scale, implication, to foresee, to wipe out, devastating, evaporation.

6. Fill in the gaps with the words from the list below. Use the words only once. Make up your own sentences with these phrases.

oil replacement figures production fuels depletion devastating reliance implications fires tropical targets

1) based on _____
2) gradual _____of species and habitats
3) palm _____
4) to cause _____ on ecosystems
5) fossil _____
6) _____lit by humans
7) to expand _____of biofuels
8) _____rainforests
9) full-scale _____
10) dramatic _____for
11) to meet the biofuel _____
12) _____effects on the climate

PROFESSIONAL LANGUAGE DEVELOPMENT

7. Choose the words from the box and fill in the gaps.

valuable petroleum extraction renewable coal tax on consumption raw materials natural forestry fossil fuels natural gas

Natural resources (economically referred to as **land** or **1**_____) are naturally forming substances that are considered **2**_____in their relatively unmodified (**3**_____) form. Thus, mining, **4**_____, fishing, hunting and **5**_____ are generally considered natural-resource industries.

Natural resources are mostly classified into **6**_____ and non-renewable resources. Sometimes resources are classified as non-renewable even if they are technically renewable, just not easily renewed within a reasonable amount of time, such as **7**_____.

Some non-renewable resources can be renewable but take an extremely long time to renew. Fossil fuels, for example, take millions of years to form and so are not practically considered "renewable". Different non-renewable resources like oil, **8**_____, **9**_____ etc. have different levels of demand from different sectors like transportation and residences with each resource specializing for each sector. Many environmentalists propose a **10**_____ of non renewable resources. Non-renewable resources cannot be replaced or can only be replaced over thousands or millions of years.

8. Listen and fill in the gaps.

Mining is the extraction of **1**_____ or other **2**_____ materials from the earth, usually from an **3**_____ body, vein or (coal) seam. Materials recovered by mining include **4**_____, **5**_____, iron, uranium, **6**_____, **7**_____, limestone, oil shale, rock salt and potash. Any material that cannot be grown through **8**_____ processes, or created **9**_____ in a **10**_____or **11**_____, is usually mined. Mining in a wider sense comprises extraction of any non-renewable resource (e. g., petroleum, **12**_____ or even **13**_____).

Forestry is the **14**_____ and **15**_____ of managing forests, tree plantations, and related natural resources. *Silviculture*, a related science, involves the growing and tending of trees and forests. Modern forestry generally concerns itself with: assisting forests to provide timber as raw material for **16**_____ products; **17**_____; natural water quality management; recreation; **18**_____ and community protection; employment; aesthetically appealing landscapes; **19**_____ management; watershed management; erosion control; and a "sink" for atmospheric **20**_____.

9. Use the words given in capitals to form the words that fit in the spaces.

Resource Saving	
Resources are limited and we need to handle them **1**_____ and responsibly. New resource saving potential along the textile value-chain is worth **2**_____. The environmental impact of textile production is **3**_____ due to the vast quantity of water required and the variety of chemicals used that generates wastes. BASF offers **4**_____ that bring the same desired effect using fewer amounts of chemicals. Moreover, solutions that increase the **5**_____ of a process can result in saving water and energy, as well as time and costs. Global **6**_____ is becoming increasingly fierce, while at the same time the textile industry is confronted with ever **7**_____ environmental standards and regulation. **8**_____ is definitely the key driving force leading the textile industry towards a stronger future. Yet for long-term success one must meet the growing demand for eco-efficient solutions. Only those who meet both environmental and economic challenges remain **9**_____. Eco-efficiency means how environmentally **10**_____ and economic a product or process is. At BASF, we call such products or processes that meet both environmental and economical requirements "eco-efficient" solutions.	**REASON** **EXPLORE** **CONSIDER** **PRODUCE** **EFFICIENT** **COMPETE** **STRICT** **INNOVATE** **COMPETITION** **FRIEND**

SPEAKING

10. a) Complete the table.

	Product/service provided	Is there a risk of extinction/exhaust?	Measures to take
Mining			
Forestry			
Oil			
Coal			
Natural gas			

b) In pairs on the base of the table prepare a short presentation about each natural resource or natural-resource industry.

11. Give your comments on the eco-efficient solutions which are offered by BASF company. Do you think these solutions are really efficient? Why?/Why not?

What BASF offers – Eco-efficient Solutions:

- **Cyclanon® XC-W:** After-soaping agent for reactive-dyed cellulose fibers. Compared to the conventional process, it considerably shortens the processing time, saving both water and energy.
- **Cyclanon® ECO:** After-cleaning agent for dyed polyester fibers. Significant savings in time, water and energy can be achieved.
- **Purista®:** Freshness-enhancing finish for cellulose textiles, such as cotton and blends. It combats odor-causing bacteria so garments stay fresher for longer. In addition, consumers have the choice to reduce the

PROJECT WORK

"Resource Saving"

12. Design a Power Point slide about resource saving and eco-efficient solutions of your manufacture and prepare a short presentation.

WRITING

13. Suggest the ways of resource saving and eco-efficient solutions in accordance with your manufacture and present them in a report for your managing director.

CHECKLIST

Assess your progress in this unit. Tick (✓) the statements which are true.

- ☐ I can talk about the problems of nature resources consumption.
- ☐ I know the ways of resource saving.
- ☐ I can suggest eco-efficient solutions.

UNIT 14
WASTE DISPOSAL

STARTING UP

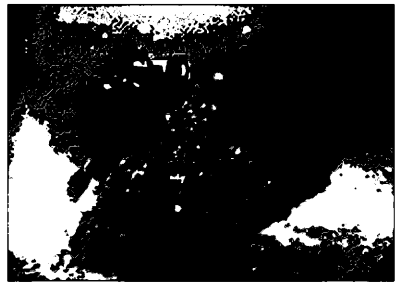
1. Answer the questions.

- What kind of environmental pollution do you know?
- How can people protect the environment?
- What waste disposal methods can you name?

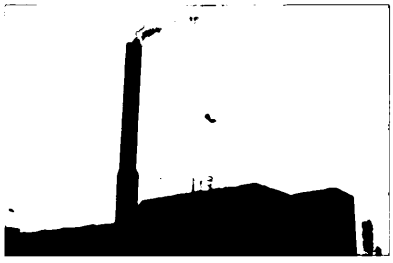
2. Take a look at the following pictures displaying different waste disposal methods and match them with the names.

1. Incineration
2. Sanitary Landfill
3) Hazardous waste containers
4) Ocean dumping
5) Recycling
6) Open dumping/landfill

A _____

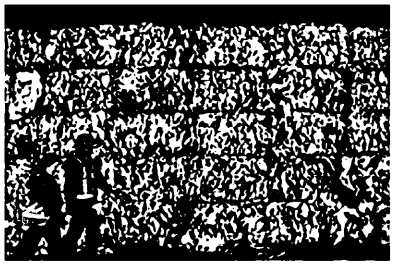


B _____

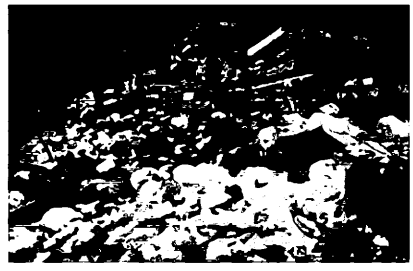


C _____

D _____



E _____



F _____

3. Listen to the definitions and match them with different waste disposal methods given above.

READING

4. You are going to read the text about hazardous waste and its disposal. Think of the most suitable heading for each paragraph (1–3).

1	

The Resource Conservation and Recovery Act (RCRA), enacted in 1976, defines hazardous waste as a liquid, solid, sludge, or containerized gas waste substance that due to its quantity, concentration, or chemical properties may cause significant threats to human health or the environment if managed improperly. U.S. legislation considers a waste hazardous if it is corrosive, flammable, unstable, or toxic. Sources of hazardous waste may include industry, research, medical, household, chemical producers, agriculture, and mining, as well as many others.

Most hazardous waste comes from industrial sources. The EPA specifies four different categories of hazardous waste that are subject to regulation: hazardous wastes from nonspecific sources involved in industrial processes such as spent halogenated solvents; hazardous wastes from specific industrial sources, such as untreated wastewater from the production of the herbicide 2,4-dichlorophenoxyacetic acid (2,4,-d); commercial chemical products that may be discarded (such as benzene) used in the manufacture of drugs, detergents, lubricants, dyes and pesticides; and wastes that are classified as toxic, such as vinyl chloride. Hazardous waste from many industrial processes include solvents such as methylene chloride, a probable carcinogen that is commonly used in paint removers. Trichloroethylene, a solvent that has been found in groundwater is monitored and regulated in drinking water in the United States. Drinking or breathing high levels of trichloroethylene can lead to damage of the liver, lung, and nervous system. In many industries the sludge remaining after treatment of wastewater accounts for much of the generated hazardous waste. Sludges and wastewater from electroplating operations commonly contain cadmium, copper, lead, and nickel. These heavy metals are found in the sediment of Lake Huron and have been associated with degradation of benthos and planktonic communities. Heavy metals can impact the health of humans and wildlife in a variety of ways: lead interferes with the nervous system and can lead to learning disabilities in children and cadmium accumulates in humans and animals and can lead to kidney disfunction. Household products that contain hazardous ingredients are not regulated under RCRA but should be disposed of separately from municipal garbage following label instructions. Household hazardous waste (HHW) can include used motor oil, paint thinners and removers, wood preservers, batteries, fluorescent lights that contain mercury, and unused pesticides.

The U.S. Environmental Protection Agency (EPA) and state regulatory agencies collect information about the generation, management, and final disposal of hazardous wastes regulated under RCRA. This report gives detailed data on hazardous waste generation and waste management practices for treatment, storage, and disposal facilities.

2	

Recycling and waste minimization may be the best ways to deal with hazardous waste. Waste minimization reduces the volume of waste generated, whereas recycling means that less hazardous waste requires disposal. Techniques for waste minimization may include audits, better inventory management, production process/equipment modifications, and operational/maintenance procedures. Raw material changes, volume reductions, nonhazardous material substitutions, reuse, or recovery also reduce hazardous waste production. For example biodegradable, nontoxic lactate esters are solvents manufactured from renewable carbohydrate sources that can be substituted for toxic halogenated solvents.

The EPA's Industrial Toxics Project is a nonregulatory program initiated in 1990 to achieve, voluntarily, overall reductions for seventeen toxic chemicals reported in the government's Toxics Release Inventory (TRI), including cadmium, lead, mercury, trichloroethylene, and toluene. The recycling of waste through waste exchanges is one aspect of industrial ecology and another way to address the issue of hazardous waste disposal. For example the sludge that accumulates in scrubbers removing sulfur dioxide from power plant smokestacks contains calcium sulfate, which can be recycled in wallboard. Waste exchange also promotes the use of one company's waste as another company's raw material. Waste exchanges typically list both available and desired materials. Several regional waste exchanges exist, as well as exchanges within small geographic regions. Some exchanges charge for their services, whereas others are supported by grants.

3	

Workers wearing hazardous materials suits, neutralizing hazardous materials.

Disposal options for hazardous waste include landfills, injection wells, incineration, and bioremediation, as well as several others. The greatest concern with the disposal of hazardous waste in landfills or injection wells is that toxic substances will leak into surrounding groundwater. Groundwater is a major source of drinking water worldwide and once it is contaminated, pollutants are extremely difficult and costly to remove. In some instances, it is impossible to remove groundwater contamination. The ideal disposal method is the destruction and conversion of hazardous waste to a non-hazardous form. New technology for hazardous and mixed low-level radioactive waste conversion includes a high-temperature plasma torch that converts low-level radioactive wastes to environmentally safe glass. Conversion to environmentally safe substances can be very expensive for some types of hazardous wastes and technically impossible for others, creating the need for alternative disposal methods.

The most common form of hazardous waste disposal in the United States is landfilling. Hazardous waste landfills are highly regulated and are required to include clay liners, monitoring wells, and groundwater barriers. The 1984 Hazardous Solid Waste

Amendments require the monitoring of groundwater near landfills for thirty years. Injection wells may be used to inject hazardous waste deep into the earth, but problems result with aquifer contamination and the ultimate fate of the hazardous waste after injection is unknown.

Incineration may be an effective way to convert hazardous waste into a nonhazardous form while greatly decreasing its volume. The waste is burned and converted into carbon dioxide, water, and inorganic by-products. The problems associated with incineration are high capital and operating costs, and the disposal of ash, which may contain hazardous substances. In addition, incinerating wastes can cause mercury and dioxin air pollution. Bioremediation may also be used *in situ* or *ex situ* to convert hazardous wastes to nontoxic by-products using microorganisms and natural degradation processes. Biodegradation requires very long treatment times and it may be difficult to control or enhance natural degradation processes. Phytoremediation, the process by which plants absorb and in some cases degrade hazardous substances in the environment, is being investigated as an emerging cleanup technology. For example poplar trees have been shown to break down the herbicide atrazine, mustard plants will remove lead from soil, and the alpine pennycress plant will take large amounts of heavy metals and also uranium from soil.

When hazardous waste is to be transported off-site for disposal, the waste generator prepares a shipping document called a manifest. This form must accompany the waste to its final destination and is used to track the waste's movements from "cradle to grave".

http://www.pollutionissues.com/Fo-Hi/Hazardous-Waste.html (17.10.2012)

5. Answer the questions according to the text.

- What can be hazardous waste?
- If managed improperly, what may cause significant threats to human health or the environment?
- When is waste considered to be hazardous?
- What are the sources of hazardous waste?
- What is waste exchange as an aspect of industrial ecology?
- What is the ideal disposal method?
- What is the most common form of hazardous waste disposal in the United States?

6. Complete the table below in accordance with the text.

Method of waste disposal	Principle of working	Examples (if mentioned)	Problems associated with the method
Landfill			
Injection well			
Incineration			
Bioremediation			
Transportation off-site			

7. **a) Find the meaning of the following abbreviations in the text: *RCRA, EPA.***
b) Are there similar agencies or acts in Russia? Find the information and tell to your group-mates.

PROFESSIONAL LANGUAGE DEVELOPMENT

8. **For questions 1–15, read the text below and think of the word which best fits each space. Use only one word in each space. There is an example at the beginning (0).**

DEALING WITH WASTE PLASTIC

Every year people throw **(0)** *away* millions of tonnes of plastic bottles, boxes and wrapping. These create huge mountains of waste **(1)** _____ are extremely hard to get **(2)** _____ of. Now, a new recycling process promises to reduce this problem by turning old plastic **(3)** _____ new. Scientists have taken **(4)** _____ long time to develop their ideas because waste plastic has always been a bigger problem **(5)** _____ substances like waste paper. You can bury plastic, but it is years **(6)** _____ it breaks down. If you burn it, it just becomes another form of pollution. A **(7)** _____ products, for example bottles, can be re-used but it is expensive or difficult to do this **(8)** _____ a lot of plastic products. Now a group of companies has developed a new method **(9)** _____ recycling that could save almost **(10)** _____ plastic waste. The advantage of the new process is that nearly every type of waste plastic can be used: it does **(11)** _____ have to be sorted. In addition, labels and ink may be left **(12)** _____ the products. Everything is simply mixed together **(13)** _____ heated to more than 400 degrees centigrade **(14)** _____ that it melts. It is then cooled, producing a waxy substance that can be used to make new plastic products such as bags, bottles and, among **(15)** _____ things, computer hardware.

9. **Use the words given in capitals to form the words that fit in the spaces.**

Recycling steel cans

Cans made of steel are very easy to remove from domestic rubbish because steel is the only common metal that is **1**_____ to magnets. Many waste removal authorities have taken advantage of this fact and have **2**_____ large magnets, which, to put it simply, pull all steel containers out of the general **3**_____ rubbish. The system is known as "magnetic **4**_____" and it has two great advantages.
Firstly, **5**_____ most recycling schemes, the recycling of steel cans through "magnetic extraction" requires almost no effort from the public. As long as you throw your used steel can into the rubbish bin, it will be collected and then the waste removal authority will do the rest.
Other **6**_____ cannot be recycled **7**_____ the public collect the material and take it, usually by car, to a central collection point. This often uses up more energy in petrol than is eventually saved by recycling the material.
8_____, local authorities actually save public money through

ATTRACT
INSTALL
HOUSE
EXTRACT
LIKE
PACKAGE;
LESS
SECOND

recovering used steel cans. Magnetic extraction equipment is simple and cheap, and the steel that has been saved is 9_____ to companies who re-use it for making new steel products. As the value of the metal is 10_____ than the cost of magnetic extraction, the process has financial benefits. **SELL** **GREAT**

So, magnetic recycling of steel cans from waste saves you time, effort and money, as well as saving energy for us all.

SPEAKING

10. Work in pairs. Imagine you are guests on *"National Geographic"* channel. Prepare a short comment on advantages and disadvantages of one of the waste disposal methods given below and present your ideas. As a conclusion, come to an agreement about the most efficient methods of waste disposal.

Methods of waste disposal

[redacted]

Advantages:

- convenient
- inexpensive
- source of nutrients, shelter and breeding

Disadvantages:

- ocean overburdened
- destruction of food sources
- killing of plankton
- desalination

[redacted]

Advantages:

- volume can increase with little addition of people/equipment
- filled land can be reused for other community purposes

Disadvantages:

- completed landfill areas can settle and requires maintenance
- requires proper planning, design, and operation

[redacted]RATION

Advantages:

- requires minimum land
- can be operated in any weather
- produces stable odor-free residue
- refuse volume is reduced by half

Disadvantages:

- expensive to build and operate
- high energy requirement
- requires skilled personnel and continuous maintenance
- unsightly – smell, waste, vermin

OPEN DUMPING

Advantages:

- inexpensive

Disadvantages:

- health-hazard – insects, rodents etc.
- damage due to air pollution
- ground water and run-off pollution

RECYCLING

Advantages:

- key to providing a liviable environment for the future

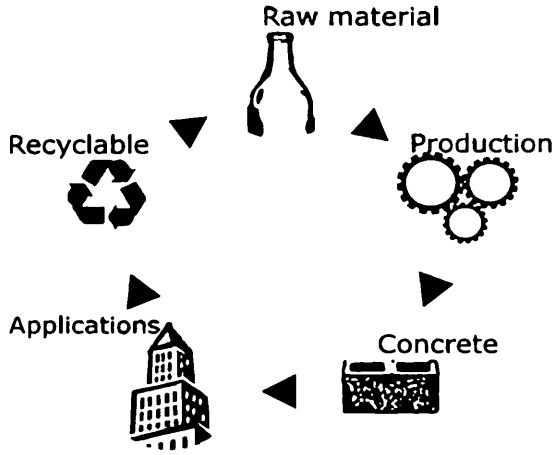
Disadvantages:

- expensive
- some wastes cannot be recycled
- technological push needed
- separation of useful material from waste difficult

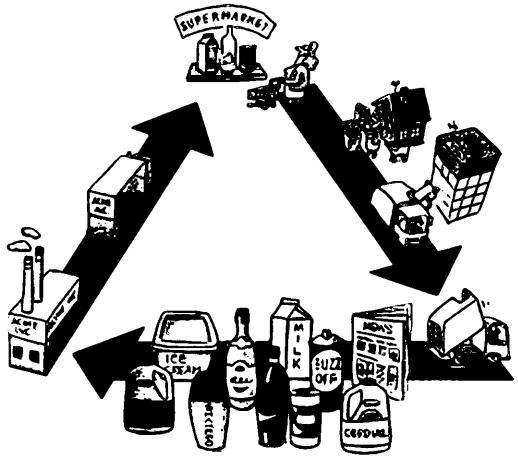
http://www.gdrc.org/uem/waste/disposal.html (17.10.2012)

11. Take a look at the product cycling charts (A and B). Give your comments on one of the charts.

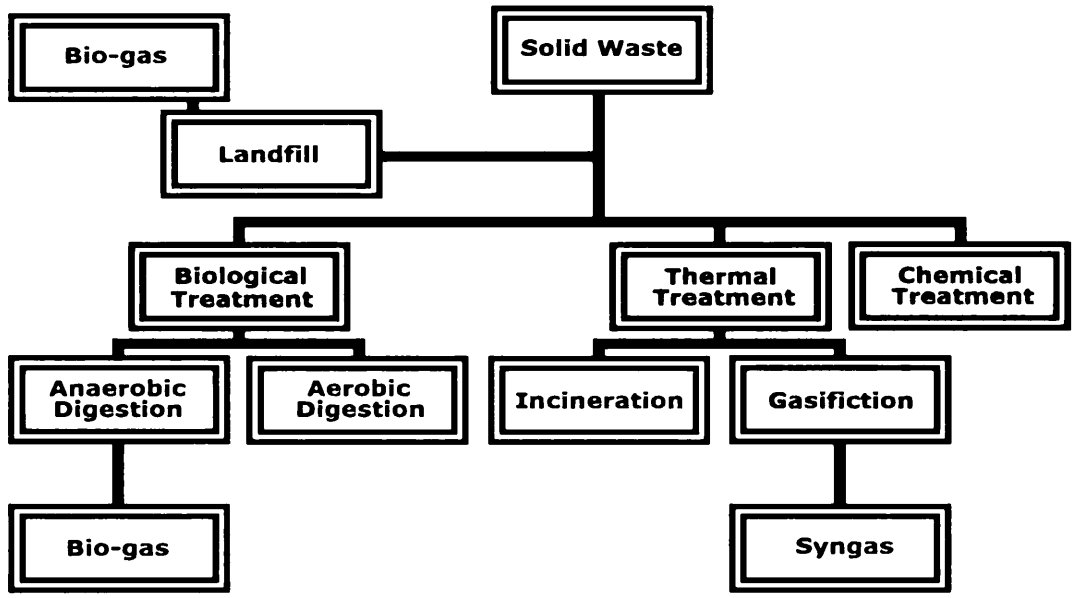
A



B



12. **You are going to participate in the conference "Clean our planet!". Your report is about different methods of waste disposal. Prepare your speech on the base of the chart below and present it to your group-mates.**



PROJECT WORK

"Waste disposal"

13. **Design a Power Point slide about waste disposal of your manufacture and prepare a short presentation.**

WRITING

14. **You are going to participate in the conference "Clean our planet!". Your report is about methods of chemical waste disposal. Write down the report.**

CHECKLIST

Assess your progress in this unit. Tick (✓) the statements which are true.

- ☐ I know how to deal with different kinds of waste.
- ☐ I can talk about different methods of waste disposal.
- ☐ I can use search skills to know how to deal with the waste of my production.

UNIT 15
INNOVATIONS IN CHEMICAL ENGINEERING

STARTING UP

1. What inventions associated with chemistry do you know?

2. Match the following inventions with the names of great scientists.

A Boyle-Mariotte law
B Valency theory
C the main law of thermochemistry
D Molecular theory
E Periodic law
F thermal gas expansion law ("law of definite amount of heat")

(1) Avogadro _____

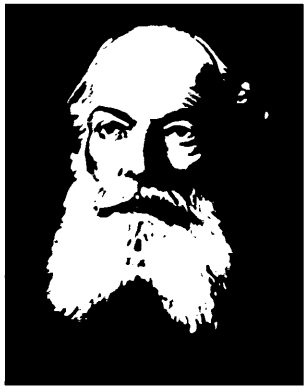
(2) Boyle _____

(3) Gay-Lussac _____

(4) Mendeleyev _____

(5) Hess _____

(6) Kekule _____



3. Choose one invention for presenting within a group.

READING

4. Take a look at the title of the text and say what it is about. Then read the text to check your guesses.

5. What field does this innovation refer to?

Sunburn detection is hot work

UK scientists have developed UV-sensitive indicators that change colour when there is a danger of sunburn.

Over 70 000 people in the UK are diagnosed with skin cancer each year and sunburn is a contributing **factor**. The signs of sunburn can take four to eight hours to develop, by which time the skin is already damaged. While there are several UV **dosimeters** on the market, most are unable to distinguish between different skin types. Also, they show a gradual colour change in response to sun exposure, which makes identifying the sunburn risk difficult. Andrew Mills and colleagues from the University of Strathclyde, Glasgow, have created what they claim is a simple, inexpensive, unambiguous sunburn **indicator** that can be tuned to different skin types.

Mills' indicator uses a UV-driven acid-release agent coupled to a pH-indicating dye. Sunlight decomposes the acid-release agent leading to protonation of the dye, which causes a striking colour change. The length of time before the colour changes can be altered by using different **acid-release agents** or dyes, explains Mills, meaning that the indicator could be varied for use on all skin types.

As an alternative to this indicator, Mills has also made a blue indicator based on a tin oxide photocatalyst, which reduces a dye and becomes colourless on exposure to sunlight. "The inorganic **pigment materials** match the way the skin absorbs UV **radiation**", – says Mills.

"It is the simplicity of the chemistry, and its ability to work on all skin types, that makes this research so **effective**", – comments Peter Robertson, an expert in photocatalysis at the Robert Gordon University, Aberdeen, UK. He adds how "gratifying it is to see academic science coming up with a **solution** that is going to have an impact on society".

Mills says he is optimistic that these indicators will become commercially available but adds that the greatest challenge will be getting our sun-loving society to accept them.

Nicola Wise

http://www.rsc.org/Publishing/ChemTech/Volume/2009/04/sunburn.asp (17.10.2012)

6. Look at the words in bold in the text above and try to explain them.

7. Fill in the correct word from the box. Use each word only once.

photocatalyst	*exposure*	*radiation*		*challenge*	
pigment	*agent*	*factor*	*colour*	*skin*	*science*

1) contributing _____
2) _____cancer
3) sun _____
4) acid-release _____
5) _____change
6) a tin oxide _____
7) _____ materials
8) UV _____
9) academic _____
10) greatest _____

8. (a) Discuss advantages and disadvantages of the sunburn detection method. Is it really innovative?

(b) Give your ideas how to protect skin from UV radiation.

9. You are going to listen to the interview with a professor of Queen's University Belfast, UK – A Prasanna de Silva. Listen and complete the interview according to professor's answers.

1. *What led you to specialise in supramolecular chemistry?*

A	

2. *Your research helped develop blood diagnostic cassettes. How does this chemistry work?*

B	

3. *You have said in the past that you persuade molecules to perform arithmetic operations. What do you mean by this?*

C	

4. *What is the next big thing that you would like to tackle in your lab*

D	

5. *What is hot at the moment in your research area?*

E	

6. *Which scientist, current or historic, do you most admire and why?*

F	

7. *If you weren't a scientist, what would you do?*

G	

10. What innovations in your university do you know? In pairs role play the interview.

PROFESSIONAL LANGUAGE DEVELOPMENT

11. Complete the table below with appropriate forms of the words.

verb	noun (thing)	noun (person)	adjective
develop			
	design		–
		inventor	
	innovation		
			productive
create			
	–	pioneer	
patent			

12. The words below can be used to describe inventions or new ideas. Which have a positive meaning? Which have a negative meaning?

efficient brilliant ingenious revolutionary ridiculous viable beneficial ground-breaking clever uneconomical impractical useless marketable pointless feasible

positive	negative

13. Read the text and fill in the blanks with words from the list below.

Ultraviolet light photochemistry domestic hydrogen
bugs chemicals sewage germ-free bug-killing

Photochemistry

Scientists have found new ways to shed light on the old problem of pollution – by using

1_____ lamps to eradicate bacteria.

They have discovered that if sewage or other effluent is mixed with titanium dioxide, the basic ingredient of paint, and then exposed to ultra-violet **2** _____, the result is annihilation of all **3** _____.

This startlingly simple and cheap technique was revealed at last month's British Association for the Advancement of Science meeting in Swansea when researchers outlined their latest discoveries in the rapidly expanding field of **4** _____, the study of compounds that react to light.

The ultraviolet project, a spin-off from research aimed at producing **5** _____ fuel from sea water, has widespread applications. For example, simple, yet highly effective devices for removing legionella bacteria from office air conditioning systems could be built this way, said Dr Andrew Mills of Swansea University. In addition, pilot

6 _____ plants that use ultraviolet light are already being tested in America and Britain.

There are two parts to the **7** _____ system. Firstly, titanium dioxide is mixed in water. Then, when ultraviolet light is shone on the mixture, the titanium dioxide becomes energized and begins to oxidize chemicals it comes in contact with.

"Any bacteria that touch the granules are mineralized", – said Dr Mills, who presented the keynote Kelvin Lecture at the association meeting in Swansea. "It is an extremely simple but powerful effect".

The action produced is similar to that of household bleach, which one day could be replaced by ultraviolet light, he added.

"One idea is to use ultraviolet light to make the **8** _____ toilets of the future. The toilet would be coated in titanium dioxide and then an ultra-violet light would shine when the seat is put down, just as a fridge light comes on when its door is opened. Bacteria wouldn't have a chance".

This last idea may seem a trifle eccentric. Nevertheless, several major companies, including Unilever, have recently begun research on ultraviolet-powered

9 _____ appliances, though most of this effort has concentrated on developing washing machines. Instead of using heat and detergents to break down and remove dirt on clothes, ultra-violet light would do the job.

Apart from saving on electricity, such devices would avoid the use of poisonous chemicals, like bleach, or detergents that have harmful environmental effects. "That is the real motive of our research", – added Dr Mills. "Light-powered devices will free us from using damaging **10** _____, and also from having to generate electricity to provide heat – and that will have a considerable number of benefits, particularly for the environment".

14. **Read the text about Alta Chemical (a leading global manufacturer of adhesives, printing inks, specialty polymers and other materials). Use the words given in capitals to form the words that fit in the spaces.**

Technology and Innovation	
Our success in **1**_____ is primarily based in the close collaboration of our technicians, polymer **2** _____, and scientists in interdisciplinary project teams. Our R&D culture incorporates internal collaboration with **3** _____, sales and **4**_____ but also external collaboration with research and industry partners. This carefully balanced **5** _____ network is our quality base for acquiring, handling and **6** _____ new know-how in the form of *Basic Research*, *Material Science*, *Products*. In the past few years Alta Chemical **7** _____ a number of new technologies platforms which already have lead to new products and still hold potential for further **8** _____. The latest technologies and facilities are deployed to satisfy **9** _____ the specific needs of every individual customer. Make use of it and achieve **10** _____ success.	**INNOVATE** **CHEMISTRY** **PRODUCT** **MARKET** **WORK** **GENERATE** **DEVELOP** **DEVELOP** **SUCCESS** **COMMERCE**

SPEAKING

15. a) **Work in groups of three. Make a list of at least five chemical products which are manufactured on a large scale.**
    b) **Choose one from your list and try to explain to the others in your group how it is made using your own knowledge of the process.**

Useful language
I think... happens next. You've forgotten about... What about... ?

PROJECT WORK

"Innovations in chemical industry"

16. **Use your search skills to find information about any inventions/innovations in chemical industry. Design a Power Point slide about it and prepare a short presentation.**

WRITING

17. Develop a report where you are going to describe the innovative idea you have found before in detail. You should put the following info in your report:

- the field of using
- the author of invention/innovation
- the year of invention/innovation
- details of birth of invention/innovation
- how the invention/innovation is used/applied
- your attitude/opinion to this invention/innovation

CHECKLIST

Assess your progress in this unit. Tick (✓) the statements which are true.

☐ I can give the names of great scientists and their inventions and innovations in chemical engineering.

☐ I use search skills to know more about inventions and innovations in chemical industry.

WORDLISTS

Unit 1

Accomplishment = achievement
Appliance = device
Application
Bioengineering
Career
Chemistry
Contribution
Creativity
Cybernetics
Engineer
Engineering
Environment
Equipment
Experiment
Field of working/activity
Household appliance
Manufacturer
Manufacturing = Production
Mathematics
Object
Physics
Power
Prominent = important
Versatile
To apply = to use
To build
To contribute
To create
To deal with
To design
To enable
To improve = to enhance
To manufacture = to produce
To meet quality standards
To modify
To solve the problem

Unit 2

Bachelor Degree
Department = faculty
Graduate
Graduation
Higher education
Major
Master Degree
Postgraduate
Science
Scientific
Scientist
Society
Undergraduate = student of university
To graduate from

Unit 3

(job) interview
(job) requirements
(work) experience
a probationary period
ability = capability
astute
candidate = applicant
competitiveness
conscientious
CV = resume
diverse
employee
employer
entrepreneur
family background
financial growth
highly-qualified
industry
intellectual growth
interchangeable
interpersonal relations
lab assistant
leadership
marital status
personal growth
personality = personal qualities
position = post
professional growth
qualifications
qualitative
quantitative
references
reliable
responsible
skills
teamwork
technology opportunity assessment
trainee
to apply for a job
to attend a job interview
to hire = to employ = to recruit
to immerse oneself in smth.
to look for/search/seek a job
to look forward to
to offer a job
to set goals
to shirk the responsibilities

Unit 4

bribery
code of ethics = code of good practice
conscientiousness
corruption
dignity
engineering ethics
fraud
honor = integrity
responsibility
strict

Unit 5

(business) debts
advertising
Board of Directors
business suit
chairperson = chairman = president
colleague
competitor
corporate culture
department
dress code
facilities
formal
Human Resources = Personnel Department
headquarters = head office
informal = casual
limited company = corporation
managing director = chief executive officer
organization chart
partnership
personal assets
private limited company
public limited company
research and development (R&D)
shareholder
shares
smart casual
sole trader
staff
stock exchange/market
subsidiary
supplier = provider
welfare
work conditions/terms
work environment
workforce
worldwide
to achieve (company) goals
to be equal
to be responsible for = to be in charge of
to consist of
to elect
to go bankrupt
to include
to participate in = to take part in
to provide the capital
to run = to manage a company
to set up = to start business/a company
to vote

Unit 6

Compound
Experiment
Lab coat
Process
Product
Raw materials
Refractory
Solution
Substance
Technology
To analyze

Unit 7

Chemical industries

distilled spirits
dyeing
explosive
fat and oil
fertilizer
food manufacturing
fuel gas
nuclear fuels
paper
petrochemical
petroleum processing and refining
polymer

Factors in selecting a plant site

energy supply
raw materials availability
transportation facilities
waste disposal
water supply

Unit 8

Materials

aluminium
brass
ceramics
clay
clay loam
copper
epoxy resin
glass
high carbon steel
mild steel
nylon
oil products
organic and inorganic compounds
plastic
polyester resin
rubber
urea
formaldehyde

Chemical properties

chemical resistant
chemically stable
fire and toxic hazards are high
flammable
heat of combustion
oxidation resistant
reactive with water
resistant to alkalis and weak acids
soluble
thermal stable
to evaporate quickly
to leave little residue

Physical properties

adhesive
brittle
durable
elastic
electrical insulator
electrical resistant
flexible
hard
heat-resistant
high wear-resistant
highly conductive
impermeable
nonmagnetic
permeable
prone to thermal shock
refractory
scratch-resistant
scrub resistant
self-lubricatine
thermal insulator
tough
transparent
water absorption
water repellent
wear-resistant
to be hardened and tempered
to be lighter than water
to have compressive strength and absorption
to have high viscosity

Unit 9

assembly
(target) customer (buyer/client)
bank draft
case/container/tank/drum/pallet
charges=expenses
competitor
complaint
component/item
consignment = shipment
consumer
contract terms
customs
damaged
defect/fault
delivery
delivery delay
deliveries are held up
demand
discount
durability
export
failed
faulty
flaws
goods/services
guarantee/warranty
import
in bulk = wholesale
incomplete
inquiry letter
insurance
in transit
letter of complaint
license
load
long-lasting
negotiation
payment
price
reliability
sales representative
standard of quality
storage warranty
supplier
supply
warehouse
to assemble
to be in demand
to buy = to purchase
to cancel the order
to carry out a market
to complain of smth.
to cover insurance
to deliver
to fail to deliver on time
to insist on
to inspect properly
to launch
to load
to meet a delivery date
to negotiate
to offer/an offer
to order/an order
to pack carelessly
to pay
to place an order
to quote a price
to relaunch
to retail
to send = to dispatch
to supply
to unload
to withdraw from sale

Unit 10

Materials

Abrasive
ABS = acrylonitrile-butadiene-styrene
Acrylic
Brass
Carbon black
Carbon fiber
Cast iron
Cloth/fabric
Concrete
Diamond
Fossil fuel
Glass fiber
High carbon steel
lignite
Low carbon steel
Mid carbon steel
Ore
Polyester
Polyethylene
Polypropylene
Polystyrene
Polyurethane
PVC = polyvinyl chloride
Rayon
Stainless steel
Steel
Steel-reinforced concrete
Tool steel

Processing techniques

Casting
Glassblowing
Sintering
Thin-film deposition
Welding
Blast furnace
Boiling point
Carbon dioxide (CO_2)
Colourless
Combustion = burning
Conversion
Corrosive
Density
Destructive
Diamond film/coating
Extraction
Gem
Melting point
Molecular mass
Irreversible
Molecule
Odorless
Particle
Pungent odor
Shielding
Tensile strength

Unit 11

Equipment

Assembly-line
Beaker
Belt conveyor
Boiler
Centrifuge
Chemistry lab glassware
Crusher
Dryer
Engine
Flask
Fraction distillation column/rectifying column
Funnel
Furnace
(gas) pipeline
Graduated cylinder
Heat exchanger
Kiln
Mill
Mixer
Petri dish
Pipet/pipette
Purifier
Reactor
Scales
Screen
Scrubber
Separator/classifier
Settling tank
Tank/vessel/capacity
Test tube

Accuracy
Accurate
Appropriate equipment
Batch process
Catalyst
Conservation of energy
Continuous process
Dissolution
Distillation
Diversity
Equilibrium
Grinding
Mixture
Pressure
Unit operation
Up-to-date
to measure
to mix
to rectify/distillate/purify
to separate
to store
to transfer heat

Unit 12

Bunsen burner
Caution
Hazard
Hazardous
Injury
Lab accident
Poison
Poisonous
To avoid
To catch on fire
To feel dizzy
To feel sick
To prevent (from)
To mix wrong chemicals

Warning signs

biohazard
corrosive
environmental
explosive
harmful
highly flammable
oxidizing
radioactive
toxic

Safety equipment/clothes

(fire) extinguisher
ear defenders
face mask/gas mask
fire blanket
gloves
goggles
hard hat
lab coat
respiratory mask/respirator

Unit 13

Agriculture
Annually
Artificial
Biota
Consumption
Depletion
Devastating
Disposal
Evaporation
Habitat
Harvest
Implication
Precious metal
Rainforest
Reasonable
Recycle box
Recycling container
Renewable natural recourses
Resource saving
Species
Valuable
Wildlife
To consume
To cope with
To expand
To gobble up
To take measures

Unit 14

Aerobic/anaerobic digestion
Biological/thermal/chemical treatment
Bioremediation
By-product
Carbohydrate
Contamination
Environmental pollution
Groundwater
Hazardous waste
Household
Incineration
Injection well Ocean dumping
Open dumping
Pollutant
Recycling
Reuse = recovery
(Sanitary) Landfill
Waste disposal
To protect the environment
To recycle
To threat to human health/the environment

Unit 15

Beneficial
Blueprint
Brainwave
Breakthrough/Discovery
Brilliant
Copyright
Efficient
Feasible
Genious
Ground-Breaking
Hi-Tech (Products)
Impractical
Ingenious
Innovation
Innovative
Invention
Inventive
Marketable
Obsolete
Patent ['Paetnt] (N, V)
Patentee [Peitn'ti:]
Pioneer
Pointless
Proprietary
Prototype
R&D(Dept.)
Research Centre
Revolutionary
Revolutionary
Ridiculous
Royalty
Uneconomical
Up-To-Date
Viable
to Create
to Design
to Develop
to Innovate

APPENDICES

UNIT 3

Appendix 1

Advert 1

ASSISTANT TO THE HEAD – CHEMICAL & BIOMOLECULAR ENGINEERING

The **Department of Chemical & Biomolecular Engineering** in the School of Chemical Sciences at the University of Illinois at Urbana-Champaign seeks qualified candidates for an Assistant to the Head who will help in coordinating affairs for the department's 15–20 faculty, 100 graduate students, and 350 undergraduate students. This full time academic professional position will be responsible for supervising the activities of three departmental secretaries, working with the Head to determine course offerings and teaching assignments, and coordinating certain mechanical aspects of the graduate and undergraduate degree programs. Additionally, the position will work with the Head to help set departmental financial priorities and to monitor account balances, approve major departmental purchases, and assign fellowships to graduate students and scholarships to undergraduate students.

Qualified candidates will possess a Bachelor's degree. Professional work experience with financial matters and employee supervision is required. Position requires considerable organizational skills, ability to multi-task, and facility in working with many people.

Salary: Commensurate with qualifications.

Starting date: As soon as possible after closing date of October 29 2007.

Closing Date: For full consideration, all application materials (including cover letter, resume, and 3 letters of reference) must be received by the closing date of October 29 2007. Applicants may be interviewed before the closing date; however, no hiring decision will be made until after that date.

Application: Department of Chemical & Biomolecular Engineering prefers that applications be submitted online. To submit an application electronically, go to http://www.scs.uiuc.edu/scs_applicants/ and follow the instructions. A cover letter, resume, and three letters of recommendation must be submitted. We strongly recommend that you fill out the online application form as soon as you have assembled the names and email addresses of 3 references. This will create your application file, after which you (and your letter writers) will be able to upload application documents and reference letters until the closing date. If necessary, applications and letters of reference can be emailed to cbowser@uiuc.edu or mailed (with email address) to:

Attn: Assistant to the Head Search Committee
Chemical and Biomolecular Engineering
114 RAL 600 S. Mathews Ave. Urbana, IL 61801 217-244-9214

Minorities, women, and other designated class members are encouraged to apply.

Advert 2

Plastics Applications Chemist

Company Overview:
As a leader in the oilfield services industry, Baker Hughes offers opportunities for qualified people who want to grow in our high performance organization. Baker Hughes' seven divisions provide products and services for oil and gas wells. Our leading technologies – and our ability to apply them safely and effectively – create value for our customers and our shareholders. Engineers, scientists, technicians and business professionals can make their careers at Baker Hughes in research, development, manufacturing, field operations, sales, finance, IT, marketing and human resources.

Job Description:
As a leader in the oilfield services industry, Baker Hughes offers opportunities for qualified people who want to grow in our high performance organization. Baker Hughes seven divisions provide products and services for oil and gas wells. Our leading technologies and our ability to apply them safely and effectively create value for our customers and our shareholders. Engineers, scientists, technicians and business professionals can make their careers at Baker Hughes in research, development, manufacturing, field operations, sales, finance, IT, marketing and human resources.

Responsibilities:
Plans, conducts and directs research and /or development work on complex projects necessitating the origination and application of new and unique approaches. Projects involve moderate capital expenditures. May be lead chemist/scientist on challenging project with some functional supervision. May participate in vendor interface. Plans, conducts and supervises assignments. Reviews progress and evaluates results. May have personnel responsibilities. May represent the organization in outside discussions and technical forums. Operates with broader latitude in making autonomous decisions. Handles special projects, as assigned.

Skill Requirements:
Knowledge of analyses and research and development efforts involved in the possible application of new chemical/ research projects, products and technology within specific field.

Education/Experience:
Bachelor's of Science Degree with 10+ years experience or Master's of Science Degree with 7+ years experience or PhD in science discipline with 3+ years experience.
See above / gj–hh
4 Year Degree
At least 5 year(s)

Advert 3

Sr Engineer/Scientist
Posted by:Sharp Laboratories of America

Job ID: W124486 **Date Listed:** 11/12/2007
Location: United States **Job Type:** Full Time
Salary: Not Specified **Hourly:** Not Specified

Degree Required: Doctorate

General Comments:

Sharp Labs of America is part of Sharp Corporation's global research and development network. As a corporate research lab, Sharp Labs has become a leader in the industry by foreseeing trends and creating advanced technologies in areas such as flat panel displays, consumer electronics and digital information technology.

SHARP Laboratories of America Inc. is seeking a Senior Engineer/Scientist
The initial duration of this position will be 3 years.

The successful candidate in this position will provide support in bioanalytical sciences in the area of development of a family of monolithic biosensing devises for detection of wide range of analytes.

Responsibilities of this position will include the following:

- Primary Engineer/Scientist focusing on bio-functionalization of MEM's and microelectrode devices for label-free, real time immunoassay, assay optimization, and data analysis.
- Develop robust assay techniques that can be implemented on a portable electronic platform.
- Carry out daily activities in a technical team working on development of new biosensor platform
- Bio-assay design, implementation and optimization; generate proof of concept for industry partners
- Support successful completion of academic and industry partner interactions
- Hands-on participation in technology development and generation of novel intellectual property
- Some domestic and international travel required.

Requirements of this position include:

- Ph.D. in Molecular Biology, Biochemistry, or related field
- 8 years of R&D experience, including 2+ years of developing bioanalytical instrumentation in an industry setting, will consider BS with more than 8 years industrial experience in the same area
- Hands-on knowledge in immunoassay development and DNA/RNA manipulation
- Experience developing commercial assay technologies, protocols, kits, and instruments
- Interpret and integrate experimental results with project objectives
- Evaluation of related processes and materials
- Strong oral and written communication skills including command of English language adequate to communicate technical information
- Experience working in a multidisciplinary environment
- Proven experience in customer interactions and research collaborations

Sharp is an equal opportunity employer m/f/d/v

For immediate consideration, please send your resume to: resumes@sharplabs.com
L.Strickland, Sharp Labs of America, 5750 NW Pacific Rim Blvd., Camas, WA 98607
Fax: 360-817-7544

Appendix 2

FIFTY FIVE FAVORITE EMPLOYER QUESTIONS

1. What are your long-range and short-range goals and objectives, when and why did you establish these goals, and how are you preparing yourself to achieve them?
2. What specific goals, other than those related to your occupation, have you established for yourself for the next ten years?
3. What do you see yourself doing five years from now?
4. What do you really want to do in life?
5. What are your long-range career objectives?
6. How do you plan to achieve your career goals?
7. What are the most important rewards you expect in your career?
8. What do you expect to be earning in five years?
9. Why did you choose the career for which you are preparing?
10. Which is more important to you, the money or the type of job?
11. What do you consider to be your greatest strengths and weaknesses?
12. How would you describe yourself?
13. How do you think a friend or professor who knows you would describe you?
14. What motivates you to put forth your greatest efforts?
15. How has your college experience prepared you for a career?
16. Why should I hire you?
17. What qualifications do you have that make you think you will be successful?
18. How do you determine or evaluate success?
19. What do you think it takes to be successful in a company like ours?
20. In what ways do you think you can make a contribution to our company?
21. What qualities should a successful manager possess?
22. Describe the relationship that should exist between a supervisor and those reporting to him or her.
31. What changes would you make in your college or university? Why?
32. Do you have plans for continued study? An advanced degree?
33. Do you think that your grades are a good indication of your academic achievement?
34. What have you learned from participation in extracurricular activities?
35. In what kind of a work environment are you most comfortable?
36. How do you work under pressure?
37. In what part-time or summer jobs have you been most interested? Why?
38. How would you describe the ideal job for you following graduation?
39. Why did you decide to seek a position with this company?
40. What do you know about our company?
41. What two or three things are most important to you in your job?
42. Are you seeking employment in a company of a certain size? Why?
43. What criteria are you using to evaluate the company for which you hope to work?
44. Do you have a geographical preference? Why?
45. Will you relocate? Does relocation bother you?
46. Are you willing to travel?
47. Are you willing to spend at least six months as a trainee?
48. Why do you think you might like to live in the community in which our company is located?
49. What major problem have you encountered and how did you deal with it?
50. What have you learned from your mistakes?
51. Tell me about yourself.
52. Why do you want to work in this field?
53. Give me an example of a problem you have solved.
54. Think of a time when you had to contact a

23. What two or three accomplishments have given you the most satisfaction? Why?

24. Describe your most rewarding college experience.

25. If you were hiring a graduate for this position, what qualities would you look for?

26. Why did you select your college or university?

27. What led you to choose your field of major study?

28. What college subjects did you like most? Why?

29. What college subjects did you like least? Why?

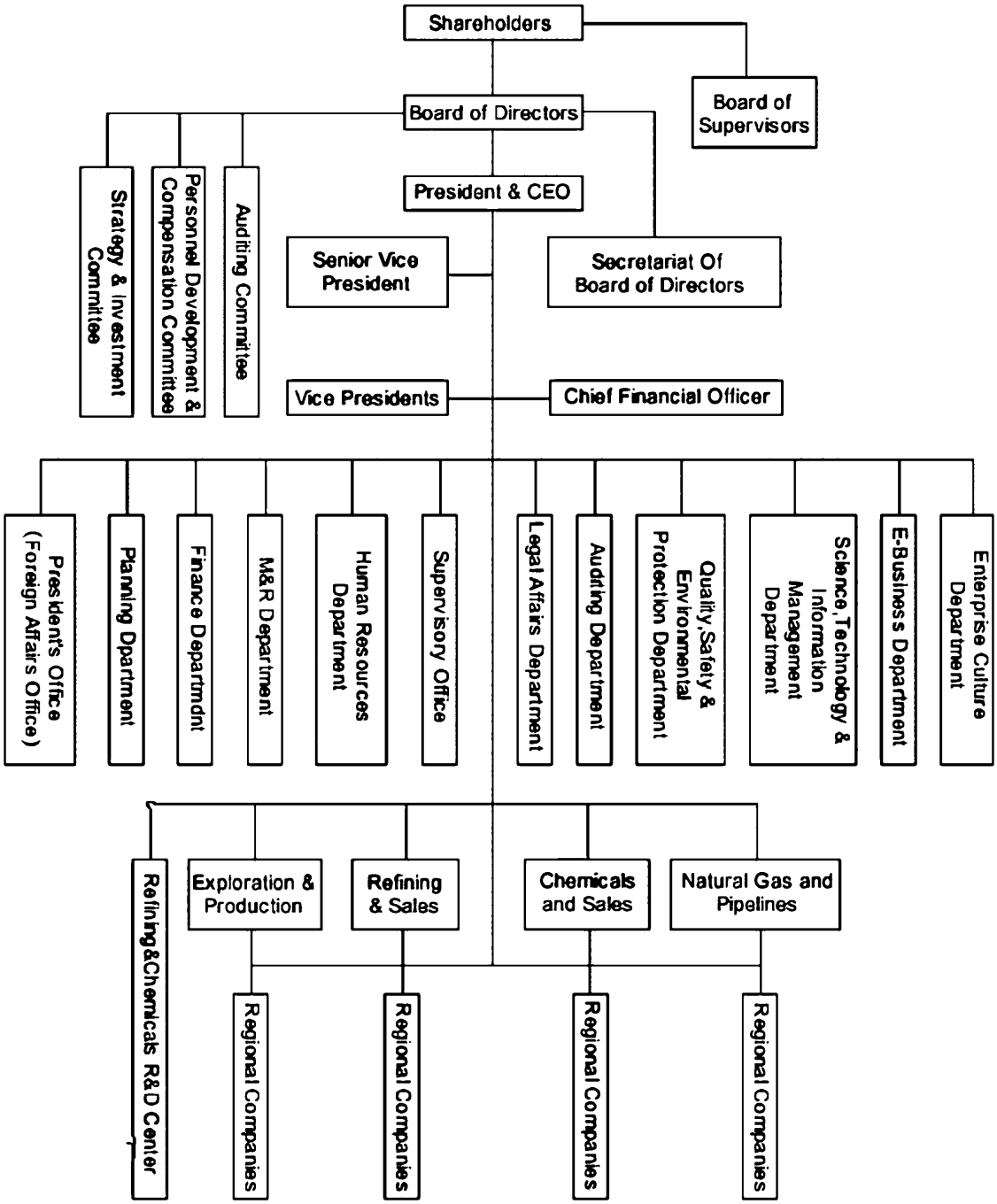
30. If you could do so, how would you plan your academic study differently? Why?

stranger and persuade him/her to do something. What was the situation? What did you do? What happened?

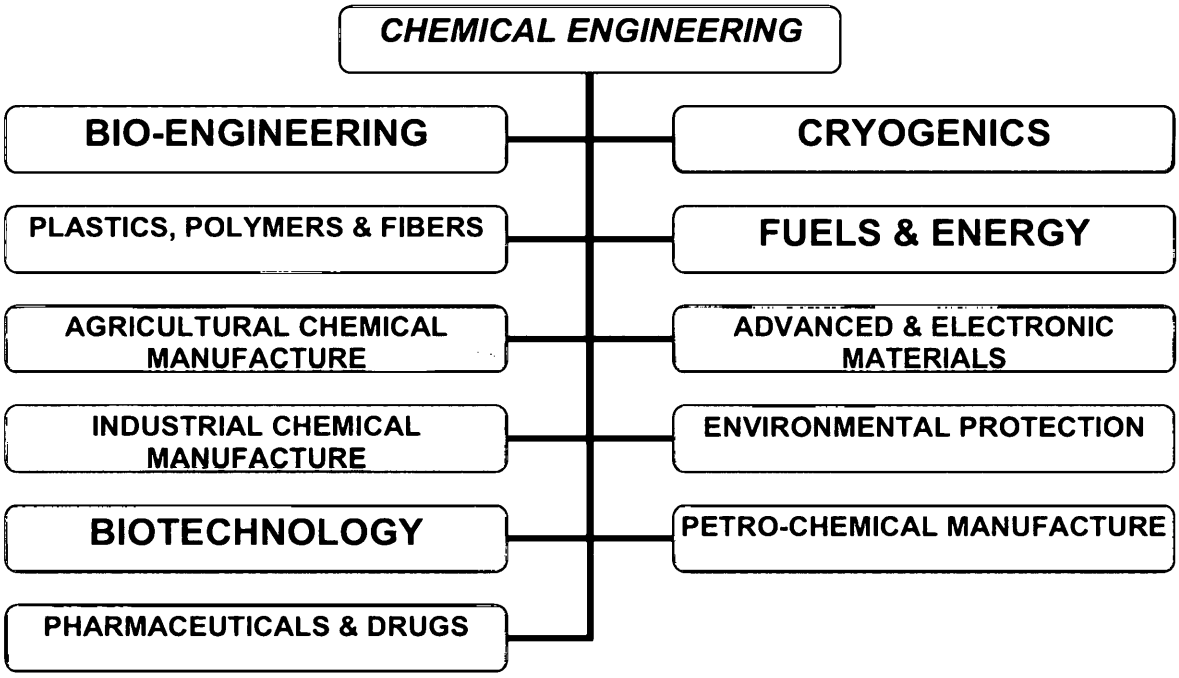
55. Think of when someone was angry with you or there was conflict. What was the situation? What did you do? What were the results?

UNIT 5

Organisation Chart



UNIT 6



Bio-Engineering	Body Implants, Kidney Machines, Artificial Body Organs, Synthetic Protein, Enzyme Catalysis
Cryogenics	Freeze Drying, Liquid Hydrogen, Oxygen and Nitrogen, Liquid Natural Gas, Food Preservation
Plastics, Polymers & Fibers	Nylon, Polyethylene, Polypropylene, Phenolics, Vinyls, Polyester, Polyacrylate, Polystyrene
Agricultural Chemical Manufacture	Fertilizers, Plant Hormones, Herbicides-Fungicides, Insecticides
Advanced & Electrical Materials	Ceramics, Vapor Deposition, Composites
Fuels & Energy	Solar Cells, Coal Gasification, Nuclear Isotopes, Synthetic Lubricants, Synthetic Natural Gas, Petroleum Refining, Liquid Natural Gas
Industrial Chemical Manufacture	Acids, Organics, Alkalis, Salts
Environmental Protection	Water Reuse, Sewage Treatment, Stack-Gas Scrubbers, Industrial Waste Treatment, Recycling Processes, Catalytic Mufflers
Petro-Chemical Manufacture	Styrene, Ketones, Acetic Acid, Ethers-Esters, Alcohols-Antifreeze, Vinyl Chloride, Propylene, Ethylene
Pharmaceuticals & Drugs	Mycins, Germicides, Vaccines, Vitamins, Penicillins, Sufas
Biotechnology	Production, Genetic Manufacturing, Purification

UNIT 9

Appendix 1
Inquiry letter sample

NIPI-OIL

The sales manager,
Harper & Grant Ltd.,
Great West Road,
London, W. 25

Lebedeva Street,
Tomsk

5th March, 2008

Dear Sir/Madame,

We are a Russian company who is interested in the oil sector in your country.

We have knowledge that your company is working in that sector and we are wondering whether we will be able to do business together.

We are interested in the new pumps advertised by you in the current number of the "Chemical Industry" magazine (issue № 23, page 18), and we should like some more information.

As we would like to import pumps from your country, we'd like to know what exactly the type of pumps you sell (type, power, size, value, advantages, disadvantages, etc.).

Besides, we would like to know if your company has got previous experience in exporting pumps, if there are any restrictions to import pumps from your country (license, permits, quantitative restrictions, etc.) and what the transport your company usually uses.

If you have any doubt, do not hesitate to contact us in order to solve the problems. We speak Russian and English.

We should be grateful to receive a prompt reply as we are in the process of replacing our pumps throughout the firm.

Yours faithfully,
Julia Afanasyeva
NIPI-OIL

Appendix 2
Letter of complaint

Your Address
Your City, State, Zip Code
(Your e-mail if sending via e-mail)

Date

Name of Contact Person (if available)
Title (if available)
Company Name
Consumer Complaint Division (if you have no specific contact)
Street Address
City, State, Zip Code

Dear **(Contact Person or Organization Name)**:

Re: **(account number, if applicable)**

On **(date)**, I **(bought, leased, rented, or had repaired)** a **(name of the product, with serial or model number or service performed)** at **(location, date and other important details of the transaction)**.

Unfortunately, your product **(or service)** has not performed well **(or the service was inadequate)** because **(state the problem)**. I am disappointed because **(explain the problem: for example, the product does not work properly, the service was not performed correctly, I was billed the wrong amount, something was not disclosed clearly or was misrepresented, etc.)**.

To resolve the problem, I would appreciate your **(state the specific action you want–money back, charge card credit, repair, exchange, etc.)** Enclosed are copies **(do not send originals)** of my records **(include receipts, guarantees, warranties, canceled checks, contracts, model and serial numbers, and any other documents)**.

I look forward to your reply and a resolution to my problem and will wait until **(set a time limit)** before seeking help from a consumer protection agency or Better Business Bureau. Please contact me at the above address or by phone at **(home and/or office numbers with area code)**.

Sincerely,

Your name

Enclosure(s)

UNIT 10

Appendix 1

Product description (HCl)

Hydrochloric acid chem. pure 38 % is a clear, colorless liquid having a pungent odor and a hydrogen chloride content of at least 37 %.

Chemical name	Hydrochloric acid, aqueous hydrogen chloride, hydrogen chloride solution
Chemical nature	Solution of hydrogen chloride in water
Trade name	Hydrochloric acid chem. pure 38 %
Ingredient	Hydrogen chloride
Chemical formula	HCl
Relative molar mass	36,46 g/mol
CAS No.	7647-01-0
EINECS No.	231-595-7
INDEX No.	017-002-01-X (for Hydrochloric acid) 017-002-00-2 (for Hydrogen chloride)

Form supplied and packaging
Supplied in rubber-coated railroad tank cars and tank trucks. Marketing only within Europe.

Properties
At concentrations of over 35 % Hydrochloric acid give of fumes and have a pungent odor on contact with atmospheric moisture when exposed to air. Miscible in all proportions with water.

	Hydrochloric acid chem. pure 38 %
Crystallization temperature	approx. – 28 °C
Initial boiling point	approx. 60 °C (36 % (m))
	approx. 40 °C (38 % (m))
Vapor pressure (20 °C)	140–285 mbar
Density (20 °C)	1,175–1,19 g / ml
pH	< 1
Viscosity (25 °C)	approx. 2 mPa × s

Product specification
Specification of hydrochloric acid chem. pure 38 %.

Certificate
Certificate DIN EN ISO 9001:2000

Storage
Storage areas for hydrochloric acid grades must be cool and capable of being well ventilated. Tanks which are rubber-coated, clad with plastics resistant to hydrochloric acid or provided with a nonporous coating and tanks made of plastic are suitable for storage.

Applications
Chemical and pharmaceutical industries, industrial chemicals sector: In the production of chemicals and intermediates; for analytical purposes; for the digestion of bleaching earths and clays; for the production of bone glues and acidic cleaning agents; for regeneration of ion exchangers.
Synthetic fibers industry: As an additive in precipitation baths for cuprammonium hydroxide filament yarn; for the acidification of cellulose after bleaching.
Leather industry: For to remove the lime and pickling.
Metalworking industry: For scouring and descaling metals.

Safety
Corrosive.
During the handling of these products the data and reference in the safety data sheet are to be considered. In addition the necessary caution and good industrial hygiene while handling chemicals have to been kept.

http://www.inorganics.basf.com (05.04.2010)

Appendix 2

Product description (H_2SO_4)

Colorless, nonflammable liquid.
Sulfuric acid techn. 96 % and sulfure acid monohydrate have an oily consistency and are very hygroscopic.
Production by oxidation of sulfur or by cleavage of contaminated sulfuric acids.

Chemical name	Sulfuric acid/ sulphuric acid, sulfuric acid monohydrate/ sulphuric acid monohydrate
Trade names	Sulfuric acid techn. 75 % Sulfuric acid techn. 96 % Sulfuric acid monohydrate
Chemical formula	H_2SO_4
Molecular weight	98,08 g/mol
CAS-No.	7664-93-9
EINECS-No.	231-639-5
INDEX-No.	016-020-00-8

Packaging/ Delivery
Transport by road tank truck, railroad tank car or ship. Marketed in Europe only.
Properties
Sulfuric acid is a strong acid which is miscible with water in all proportions. On mixing with water a great deal of heat evolved which may cause splashing of the acid. For that reason sulfuric acid should be added to water only slowly with constant stirring and monitoring of the temperature. It has a dehydrating (desiccating) effect with carbonization on many organic substances.

	Sulfuric acid techn. 75 %	Sulfuric acid techn. 96 %	Sulfuric acid monohydrate
Sulfuric acid content (g/ 100 g)	74–76	95,5–96,5	99–101
Melting point(°C)	от –35 до –10	от –25 до –15	ca. 10
Boiling point (°C, 1013 mbar)	165–170	300–320	315–250
Density (g/cm^3, 20 °C)	ca. 1,66	ca. 1,84	ca. 1,84
Viscosity (mPa x s, 20 °C)	8–9	22–23	25–26

Product specifications
Specification sulfuric techn. 75 %,
Specification sulfuric techn. 96 %,
Specification sulfuric acid monohydrate.
Storage
Sulfuric acid techn. 75 % Sulfuric acid techn. 96 %:
Store at temperatures above –5 °C.
Sulfuric acid monohydrate:
Store at temperatures above +15 °C.
Certificate
Certificate DIN EN ISO 9001:2000
Applications
Sulfuric acid monohydrate
Chemically pure sulfuric acid and sulfuric acid monohydrate:
Chemical and pharmaceutical industries: For the manufacture of products requiring particularly pure starting materials and auxiliaries. For analytical purposes.
Industrial chemicals Production of battery acid.
Sulfuric acid techn. 75 % and Sulfuric acid techn. 96 %
Fine chemicals: Production of phosphoric acid, phosphates, hydrogen chloride and hydrochloric acid; in the production of dyes and plastics; sulfonation and as an auxiliary in many syntheses, e. g. nitration reactions; production of hydrogen peroxide and other peroxides.
Industrial chemicals: In the production of explosives (nitration of glycerin, cellulose, toluene inter alia), production fuller's earth; in the production of gelatin and glue, and isolation of casein purification of gases in gas-making and coking plants. In soap production for the preliminary purification of the oil to be used for lipolysis. For the removal of fabric from rubber in recycling processes.
Leather industry: For pickling in chrome tanning.
Metal-working industry: For scouring and descaling, and brass bright dip.
Petroleum industry: For refining, purification of lubricants, paraffin and transformer oil, and alkylation of aliphatics.
Paper and pulp industry: For parchmentizing, and acidification after alkaline pulping.
Textile industry: Removal of dyes from recycled wool. Carbonization of wool.
Textile dyeing: As additive when dyeing with chrome and azo dyes.
Ore dressing: Disaggregation of zinc and copper ores prior to wet processing.
Safety
Causes serve burns.
During the handling of these products the data and reference in the safety data sheet are to be considered. In addition the necessary caution and good industrial hygiene while handling chemicals have to been kept.

http://www.inorganics.basf.com (05.04.2010)

UNIT 12

Appendix

Lab Safety Rules

These concepts may apply in any areas where hazardous chemicals are used or stored.

General

1. Safety takes precedence over all other considerations.
2. When performing dangerous chemical procedures, be sure there is someone in the immediate vicinity you can reach in case of emergency.
3. Know the location of eyewash fountains and emergency showers. Find out how to use them properly.
4. Before beginning a procedure, take a minute to investigate hazards involved; take all necessary safety precautions.
5. Store food products in separate non-lab refrigerators specifically reserved for that use.
6. Eating, drinking, and smoking is not permitted in laboratory areas. Break rooms should be available for that use.
7. Remove unsafe equipment from service. Report unsafe facilities or behavior to your supervisor.
8. Because unattended equipment and reactions are major causes of fire, floods, and explosions, double check utility connections. Anticipate hazards that would result from failure of electrical, water, or gas supply.
9. Use hose keepers on water condenser lines.

Personal Protection, Clothing, and Hair

10. Properly label all containers.
11. Wear approved eye and face protection suitable for the work at hand. Safety glasses or goggles should be worn at all times while working with chemicals at the counter or laboratory hood. A face shield should be worn when working with potentially eruptive substances.
12. Remind all visitors and non-lab staff to observe lab safety rules, including eye protection, while the laboratory.
13. Wear protective gloves and clothing whenever handling corrosive, toxic, or other hazardous chemicals. Wear closed-toe shoes at all times in the lab.
14. Check that guards are provided on moving parts of mechanical apparatus to prevent hazardous contact.
15. Maintain lab areas reasonably neat and uncluttered.
16. Use the fume hood for all operations involving harmful gases or fumes and for flammable or explosive materials. Check the hood to see that it is operating adequately and has been inspected within the last year.

17. Use a safety shield or barrier to protect against explosion, implosion, and flash fires when performing reactions with large volume of flammable liquids or unstable material.
18. Inspect glassware for cracks, sharp edges, and contamination before using. Broken or chipped glassware should be repaired and polished or discarded.
19. Always use a lubricant (e. g., water, glycerol) when inserting glass tubing into rubber stoppers or grommets. Protect hands in case tubing breaks.
20. Broken glass should be put in impervious containers that are large enough to completely contain the glass. These containers are to be placed into the building trash dumpsters by laboratory personnel.
21. Do not handle radioactive isotopes without oversight from the Radiation Safety Office.

Chemical Handling

22. Transport dangerous or flammable liquids in a safety pail or other adequate secondary containment. Prevent containers from tipping when transporting on a cart.
23. Take extra precautions when working with large quantities of reactants.
24. Use caution when adding anything to a strong acid, caustic, or oxidant. Add slowly.
25. When adding solids (boiling chips, charcoal, etc.) to a liquid, check that it isn't hot.
26. Use a pipet filler – not mouth suction – for all pipet work
27. Keep the mouth of any vessel being heated pointed away from any person (including yourself).
28. When working with biohazardous material, guard against infection by skin contact, inhalation of aerosols, and contamination of food and beverages.
29. Known carcinogens, mutagens, and teratogens should not be used or stored in normal laboratory situations. Such substances require extreme precaution, tight security, limited access, secondary containers, and other safety procedures; see the OSU Carcinogen Safety program.
30. Flammable liquids should only be heated with steam, hot water or a grounded heating mantle. Check the area for possible flames or electrical sparks.
31. All experiments involving volatile flammable liquids (e. g., diethyl ether) should be considered fire or explosive hazards.
32. When not in use, laboratory natural gas lines should be shut off at the line valve rather than at the equipment.
33. Whenever possible, position energized electrical equipment, or other devices that may emit sparks or flame, at least six inches above the floor.
34. Properly ground electrical equipment.
35. Laboratory electrical equipment should have a three-conductor cord that connects to a grounded electrical outlet, unless the equipment is dual-insulated.
36. Electrical wiring for experiments, processes, etc. should be done neatly, and must conform to electrical code requirements.
37. Store strong oxidants (e. g., nitrates, chlorates, perchlorates, peroxides) in a dry area apart from organic materials.
38. Use a specially designed wash-down laboratory hood for heated perchloric acid digestions.

Chemical Storage

39. Mark all flammable liquid containers with the label "flammable".
40. Whenever possible, store flammable solvents in NFPA-approved flammable liquid storage cabinets or approved solvent storage rooms.
41. If storing more than 10 gallons of flammable liquids in a laboratory, a flammable liquid cabinet MUST be used.
42. Pay careful attention to peroxide-forming compounds. Organic peroxides may detonate by shock, friction, or heat. Compounds with dangerous tendencies to form peroxides by reaction with oxygen (e. g., many ethers and other chemical clases) have a limited shelf life. They should be dated on opening, and should in no case be stored for longer than one year.
43. Keep caustics stored below eye level.
44. Keep glass containers of chemicals off the floor – unless they are inside protective containers or pans that are kick-proof.
45. Inventory chemicals periodically and discard old, no-longer-needed substances through the campus hazardous waste disposal program.
46. Report chemical inventory annually to EH&S for OR-OSHA and State inventory reporting purposes.
47. See *Safety Bulletin # 30* for more information on chemical storage.

Pressure and Vacuum Systems

48. Plan and provide for the possibility of explosion prior to conducting experiments that develop high pressure or vacuum.
49. Heat reactants only in a system with an approved pressure release.
50. Wait for pressure to be released before opening a pressurized vessel (autoclave, etc.).
51. Secure compressed gas cylinders in an upright position at all times to prevent from falling. Keep protective caps in place when moving or storing gas cylinders.
52. Regulators designed for specific cylinders are not interchangable.
53. Keep flammable gas cylinders away from exits and oxygen cylinders.
54. When moving cylinders with a lift truck or hand truck, make sure there is an approved rack or securing device.
55. **STOP HERE** Never use oxygen as a substitute for compressed air. Do not use oil on gauges or regulators for oxidizing gases. Oxygen under pressure reacts violently with oil or grease.
56. Never use compressed gas from a cylinder without a reduction of pressure through a suitable pressure regulator.
57. Pressure adjusting screws on regulators shall always be FULLY RELEASED BEFORE the regulator is attached to a cylinder. Always open the valves on cylinders slowly. Do not stand in front of pressure regulator gauge faces when opening cylinder valves.
58. Do not strike valves with tools, or use excessive force in making connections.
59. Avoid mixtures of acetylene and oxygen or air prior to use except at a standard torch.
60. Cylinders not provided with fixed hand wheel valves shall have keys or handles provided on valve stems at all times when cylinders are in use.

61. Cylinders should not be dropped, bumped violently, skidded or rolled horizontally. Compressed gas cylinders are high-pressure vessels and should be handled accordingly.
62. Do not store cylinders in direct sun, or in boiler or furnace rooms.

Container Handling

63. Properly label all containers. If unsure, check rule # 10 (above).
64. Before re-using any food container, first remove the original label completely.
65. Chemical transport containers are to be used for non-compatible chemicals or for food products at any time.
66. All containers should have a lid at all times except during an active experiment.
67. Refrigeration of flammable materials must be done in spark-proof or explosion-proof refrigerators.

Chemical Spills and Waste Disposal

68. Devise a plan to deal with small spills before one occurs. POST the plan in the lab and get appropriate equipment. Quickly and thoroughly clean up any liquid or solid chemical spill in the laboratory or area of operations. If any uncertainty exists, call Environmental Health & Safety (EH&S).
69. For large spills, contact EH&S to activate OSU's chemical spill response team.
70. Dispose of chemical wastes by approved methods only. Unwanted or no-longer-useful chemicals are chemical wastes. Contact EH&S for waste disposal guidelines.
71. Reagent bottles should be thoroughly cleaned of any hazardous material prior to disposal. Clean glass reagent bottles can usually be recycled.
72. Four simple steps to help comply with hazardous waste rules:
    - Perform a waste determination on all wastes (EH&S responsibility)
    - Label all waste containers with "waste" or "used", plus a chemical description, **BEFORE** adding waste.
    - Keep all waste containers closed except when adding waste.
    - Keep the waste in the room where it was generated.

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