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پارسه

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*“In the Name of God”*

# **TECHNICAL ENGLISH**

**for**

***Chemical Engineering  
Students***

***By: Dr. S. Ghazimoradi***

## SECTION 1 READING SKILLS

### Part A: General Rules

#### WHAT IS A PARAGRAPH?

A paragraph is a basic unit of organization in writing in which a group of related sentences develops one main idea. A paragraph can be as short as one sentence or as long ten sentences. The number of sentences is unimportant; however, the paragraph should be long enough to develop the main idea clearly.

The following model contains all of the elements of a good paragraph. Read it carefully two or three times and try to analyze its structure.

#### Model 1: Paragraph structure

##### Gold

Gold, a precious metal, is prized for two important characteristics. First of all, gold has a lustrous beauty that is resistant to corrosion. Therefore, it is suitable for jewelry, coins, and ornamental purposes. Gold never needs to be polished and will remain beautiful forever. For example, a Macedonian coin remains as untarnished today as the day it was minted twenty-three centuries ago. Another important characteristics of gold is its usefulness to industry and science. For many years, it has been used in hundreds of industrial applications. The most recent use of gold is in astronauts' suits. Astronauts wear gold-plated heat shields for protection outside the spaceship. In conclusion, gold is treasured not only for its beauty, but also for its utility.

#### THE THREE PARTS OF A PARAGRAPH

A paragraph has three major structural parts: a topic sentence, supporting sentences, and a controlling sentence.

The **topic sentence** states the main idea of the paragraph. It not only names the topic of the paragraph, but it also limits the topic to one or two areas that can be discussed completely in the space of a single paragraph. The specific area is called the controlling idea. Notice how the topic sentence of the model states both the topic and the controlling idea:

<b>Topic</b>	(Topic)	(Controlling Idea)
<b>Sentence</b>	<u>Gold, a precious metal, is prized for two important characteristics.</u>	

**Supporting sentences** develop the topic sentence. That is, they explain the topic sentence by giving reasons, examples, facts, statistics, and quotations. Some of the supporting sentences that explain the topic sentence about gold are:

#### Supporting

**Sentences** *First of all, gold has a lustrous beauty that is resistant to corrosion. For example, a Macedonian coin remains as untarnished today as the day it was minted twenty-three centuries ago.*  
*Another important characteristics of gold is its usefulness to industry and science.*  
*The most recent application of gold is in astronauts' suits.*

**The concluding** sentence signals the end of the paragraph and leaves the reader with important points to remember:

#### Concluding

**Sentence** *In conclusion, gold is treasured not only for its beauty, but also for its utility.*

## THE TOPIC SENTENCE

Every good paragraph has a topic sentence, which clearly states the topic and the controlling idea of the paragraph. It names the topic and then limits the topic to a specific area to be discussed in the space of a single paragraph. It is a complete sentence; that is, it contains a subject, a verb, and (usually) a complement. It is usually (but not always) the first sentence in the paragraph.

A topic sentence is the most important sentence in a paragraph. It briefly indicates what the paragraph is going to discuss. For this reason, the topic sentence is a helpful guide to both the writer and the reader. The writer can see what information to include (and what information to exclude). The reader can see what the paragraph is going to be about and is therefore better prepared to understand it.

The following examples show how a topic sentence states both the topic and the controlling idea in a complete sentence.

*Driving on freeways requires skill and alertness.*

*Gold, a precious metal is prized for two important characteristics.*

*Registering for college classes can be a frustrating experience for new students.*

## POSITION OF TOPIC SENTENCES

The topic sentence may be the first or last sentence in a paragraph. The topic sentence may also be the first and last sentence of the paragraph--"sandwich-style." A "sandwich-style" paragraph is especially helpful to your reader if the paragraph is very long. The second topic sentence in the "sandwich-style" paragraph also serves as a concluding sentence.

Study the following three paragraphs. Notice the different positions for the topic sentence in each. the topic sentences are Underlined.

### Model 2: Position of topic sentences

#### Hurricanes

Topic  
sentence

Hurricanes, which are also called cyclones, exert tremendous power. These violent storms are often a hundred miles in diameter, and their winds can reach velocities of seventy-five miles per hour or more. Furthermore, the strong winds and heavy rainfall that accompany them can completely destroy a small town in a couple of hours. The energy that is released by a hurricane in one day exceeds the total energy consumed by humankind throughout the world in one year.

#### Famous School "Failures"

Albert Einstein, one of the world's geniuses, failed his university entrance examinations on his first attempt. William Faulkner, one of America's noted writers, never finished college because he could not pass his English courses. Sir Winston Churchill, who is considered one of the masters of English language, had to have special tutoring in English during elementary school. These few examples show that failure in school does not always predict failure in life.

Topic  
Sentence

#### Synonyms

Topic  
Sentence

Synonyms, words that have the same basic meaning, do not always have the same emotional meaning. For example, the words "stingy" and "frugal" both mean "careful with money." However, to call a person stingy is an insult, while the word frugal has a much more positive connotation. Similarly, a person wants to be slender but not skinny, and aggressive, but not pushy. Therefore, you should be careful in choosing words because many so-called synonyms are not really synonymous at all.

Topic  
Sentence  
(conclusion)

### The Concluding Sentence

A concluding sentence is not absolutely necessary, but it is very often helpful to the reader because it signals the end of the paragraph and because it reminds him/her of your important points.

---

A concluding sentence serves three purposes:

1. It signals the end of the Paragraph. (Use an end-of-paragraph signal such as "In conclusion," "In summary," "Finally," etc.)
  2. It summarizes the main points of the paragraph.
  3. It gives a final comment on your topic and leaves the reader with the most important ideas to think about.
- 

The examples below demonstrates two different types of concluding sentences. The first one paraphrases the topic sentence; i.e., the concluding sentence repeats the main idea of the topic sentence in different words. The second example summarizes the two main points of the paragraph, which were not specifically stated in the topic sentence.

### Model 3: Concluding sentences

#### Synonyms

Synonyms, words that have the same basic meaning, do not always have the same emotional meaning. For example, the words "stingy" and "frugal" both mean "careful with money." However, to call a person stingy is an insult, while the word frugal has a much more positive connotation. Similarly, a person wants to be slender but not skinny, and aggressive, but not pushy. Therefore, you should be careful in choosing words because many so-called synonyms are not really synonymous at all.

#### Gold

Gold, a precious metal, is prized for two important characteristics. First of all, gold has a lustrous beauty that is resistant to corrosion. Therefore, it is suitable for jewelry, coins, and ornamental purposes. Gold never needs to be polished and will remain beautiful forever. For example, a Macedonian coin remains as untarnished today as the day it was minted twenty-three centuries ago. Another important characteristics of gold is its usefulness to industry and science. For many years, it has been used in hundreds of industrial applications. The most recent use of gold is in astronauts' suits. Astronauts wear gold-plated heat shields for protection outside the spaceship. In conclusion, gold is treasured not only for its beauty, but also for its utility.

### Review: What Is a Paragraph?

---

These are the important points you should have learned from this section:

1. A good topic sentence:
    - a. is a complete sentence with a subject, a verb, and generally a complement.
    - b. states both the topic and the controlling idea of the paragraph.
    - c. is neither too general nor too specific. It states the main idea clearly, but it does not give the specific details.
  2. A good concluding sentence:
    - a. signals the end of the paragraph.
    - b. summarizes the important points briefly.
-



## Part B: Strategies for the Reading Comprehension Questions

In this part of the test you will be given reading passages, and you will be asked two types of questions about the reading passages:

1. **Reading Comprehension** questions ask you to answer questions about the information given in the reading passages, including main idea questions, directly answered detail questions, and implied detail questions.
2. **Vocabulary** questions ask you to identify the meanings of vocabulary words in the reading passages. To answer these questions, you may have to know the meanings of the words. You can also identify the meanings of some of the words by understanding the context surrounding the words, by using structural clues to identify the meanings of the words, or by breaking down the unknown words into known word parts in order to identify them.

### GENERAL STRATEGIES

1. **Be familiar with the directions.** The directions on every test are the same, so it is not necessary to spend time reading the directions carefully when you take the test. You should be completely familiar with the directions before the day of the test.
2. **Do not spend too much time reading the passage!** You do not have time to read each reading passage in depth, and it is quite possible to answer the questions correctly without first reading the passages in depth. You do not need to understand every detail in each passage to answer the questions correctly. It is therefore a waste of time to read the passage with the intent of understanding every single detail before you try to answer the questions.
3. **Do not worry if a reading passage is on a topic that you are unfamiliar with.** All of the information that you need to answer the questions is included in the passages. You do not need any background knowledge to answer the questions.
4. **Find the section of the passage that deals with each question.** The question-type tells you exactly where to look in the passage to find correct answers.
  - For *main idea questions*, look at the first line of each paragraph.
  - For *directly and indirectly answered detail questions*, choose a key word in the question, and skim for that key word (or a related idea) in order in the passage.
  - For *vocabulary questions*, the question will tell you where the word is located in the passage.
  - For *overall review questions*, the answers are found anywhere in the passage.
5. **Carefully read the part of the passage that contains the answer.** The answer will probably be in the same sentence (or one sentence before or after) the key word or idea.
6. **Choose the best answer to each question from the four answer choices listed in your test booklet.** You can choose the best answer according to what is given in the appropriate section of the passage, eliminate definitely wrong answers, and mark your best guess on the answer sheet.

## Part C: Eight Keys to Vocabulary Building

### 1. Read as much as you can

By reading as many related texts (books, journals, reports, etc.) as you can, you will encounter new words and technical terms. You can guess the meanings of many of these words by their context - that is, you will get a clue to the meaning from the words that surround the new word. If you are still not sure, you can look up the word in an appropriate dictionary to check if you were right.

### 2. Use a dictionary

Buy a good comprehensive dictionary, preferably a university-level dictionary along with a dictionary of scientific and technical terms. The dictionary should be all in English, not a bilingual one. A good dictionary should include the following information about a word:

- its pronunciation
- its part of speech (noun, adjective, verb)
- a clear, simple definition
- an example of the word used in a sentence or phrase (if necessary)
- its origin (roots, prefix)

You can also use a pocket dictionary if you travel back and forth to classes.

### 3. Learn roots, prefixes, and suffixes

Roots and prefixes from Latin and Greek make up many English words. It has been estimated that more than half of all English words come from Latin and Greek. Prefixes are added to the beginning of a root and suffixes are added to the end to modify the meaning of words. Learning these will help you increase your vocabulary.

### 4. Learn from listening

Listening to good programs on the radio and television as well as to people who speak English well is another way of improving your vocabulary. Since you cannot always ask the speaker to tell you what a particular word means, write down the words and look them up later.

### 5. Use a dictionary of synonyms and antonyms

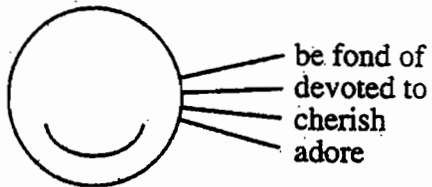
Synonyms are words that have almost the same meaning; antonyms are words that have almost the opposite meaning. Knowing the synonyms and antonyms of a word will expand your vocabulary. Some dictionaries of synonyms and antonyms explain each synonym and how it differs in meaning for other synonyms. Since no two words have the exact same meaning, this is very useful for you.

### 6. Make your own word list

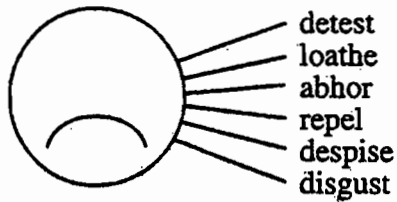
Get a notebook for your vocabulary study and use it to create your own word list. Whenever you read and come across a word you don't know, write it down in your notebook together with the sentence in which you found it. Try to work out the meaning of the word from its context. Then look the word up in a dictionary and write the definition in your notebook. Also, write down any other information such as the root of the word, and see how it is connected to the meaning. Lastly, write your own sentence using the word. Writing will help you remember the word and its meaning. Try to add a new word to your list every day.

### 7. Create your own theme groups

Words are easier to remember and learn when you group words with similar meanings under a theme.  
For example,



Then you can make another theme with the opposite.



### 8. Use your new words

Using your new words whether it be in speaking or writing is an important step in learning them.



## SECTION 2 M.Sc. EXAM's QUESTIONS

### 1) MSc Entrance Examinations (1376)

A) Select the best choice and mark it in your answer sheet.

1- It is not possible to proceed very far in the study of convection and fluid flow without defining a property which has an important bearing upon both, viscosity.

This implies that .....

- 1) Convection and fluid flow are both important properties when studying viscosity
- 2) Convection and fluid flow have bearing upon viscosity
- 3) Viscosity is an important property when studying convection and fluid flow
- 4) Without convection and fluid flow it is not possible to proceed with viscosity

2- Selectivity is defined as the percentage of the consumed reactant that forms the desired product and it will vary with the .....

- 1) degree of conversion
- 2) nature of reactants
- 3) nature of intermediates
- 4) quantity of products

3- When an incompressible fluid flows in a straight horizontal uniform pipe with a constant mass rate, the pressure of fluid decreases along the length of the pipe owing to friction.

The statement implies that .....

- 1) compression causes the pressure to increase on fluids flowing in straight pipes.
- 2) friction causes pressure decrease on incompressible fluids flowing in straight pipes.
- 3) friction causes the pressure to increase on incompressible fluids flowing.
- 4) the constant mass rate causes the pressure to increase on fluids flowing.

4- The only mode of heat transfer which does not require the presence of an intervening medium is .....

- 1) conduction
- 2) convection
- 3) conduction + convection
- 4) radiation

B) Read the following texts and answer the related questions.

Mixing is a much more difficult operation to study and describe than agitation. The patterns of flow of fluid velocity in an agitated vessel are complex but reasonably definite and reproducible. The power consumption is readily measured. The results of mixing studies, on the other hand, are seldom highly reproducible and depend, in large measures, on how mixing is defined by the particular experimenter.

5- The criteria for mixing are .....

- 1) exact
- 2) judgmental
- 3) theoretically-based
- 4) well-defined

6- The patterns of mixing are .....

- 1) constant
- 2) hard to define
- 3) indefinite
- 4) quite reproducible

7- The results of mixing studies are .....

- 1) always valid
- 2) worthless
- 3) easily-confirmed
- 4) definition-dependent

Surface condensers are employed where actual mixing of the condensate with condenser cooling water is not desired. In general, they are shell and tube condensers with the vapor on the shell side and cooling water in multipass flow on the tube side. Noncondensable gases are usually present in the vapor stream. These can be air, CO<sub>2</sub>, N<sub>2</sub>, or another gas which may have entered as dissolved gases in the liquid feed or occur because of decomposition in the solutions. These noncondensable gases may be vented from any well-cooled point in the condenser. If the vapor being condensed is below atmospheric pressure, the condensed liquid leaving the surface condenser can be removed by pumping and the noncondensable gases by a vacuum pump. Surface condensers are much more expensive and use more cooling water, so they are usually not used to cases where a direct-contact condenser is suitable.

**8- The fluid inside the pipe .....**

- |                            |                    |
|----------------------------|--------------------|
| 1) carries noncondensables | 2) is under vacuum |
| 3) is colder               | 4) is warmer       |

**9- Vacuum pump is used to .....**

- 1) push the cooling water over the pipes
- 2) push the condensate through the pipes
- 3) suck the gases through the pipes
- 4) suck CO<sub>2</sub>, N<sub>2</sub> over the pipes

**10- Direct contact condensers are used when .....**

- 1) there is not enough cooling water
- 2) there is plenty of cooling water
- 3) surface condensers are operated under vacuum
- 4) surface condensers are not cheaper

**2) MSc Entrance Examinations (1377)**

**Directions.** In this part of the test, each item consists of an incomplete sentence. Below the sentence are four choices, marked (1), (2), (3) and (4). You should find the one choice which best completes the sentence. Mark your choice on the answer sheet.

**1- A list of ..... appears at the end of each chapter of this book.**

- |               |                |
|---------------|----------------|
| 1) references | 2) refinements |
| 3) spirituals | 4) statistics  |

**2- He ..... his speech with a summary.**

- |              |              |
|--------------|--------------|
| 1) confused  | 2) concluded |
| 3) neglected | 4) notified  |

**3- Prices soared when war .....**

- |             |              |
|-------------|--------------|
| 1) went off | 2) went up   |
| 3) broke up | 4) broke out |

**4- The film ..... their attention completely.**

- |             |              |             |           |
|-------------|--------------|-------------|-----------|
| 1) absorbed | 2) abstained | 3) abridged | 4) abused |
|-------------|--------------|-------------|-----------|

5- Don't believe a word of what Nick told you about his adventure in Bangkok. It sounds very much to me like another of his ..... stories.

- 1) long                      2) short                      3) tall                      4) untold

### Part B

Which of these sentences are ungrammatical?

6-

- 1) The lawyer explained to us very carefully the language of the contract.
- 2) The thief gave up when he saw he is surrounded.
- 3) This plan is in line with their thinking.
- 4) Passers-by crowded round the policeman as he made his arrest.

7-

- 1) I've always held that compulsory education is a waste of time.
- 2) She succeeded to rise the top in his profession.
- 3) The death sentence is mandatory for drug smuggling in some countries.
- 4) You've got your sweater on back to front.

8-

- 1) Holding my nose, I managed to drink a spoonful of the horrible cough medicine.
- 2) To make the two changes in the design took only five minutes.
- 3) They argued for an hour about which one of them was to blame.
- 4) The magazine publisher whom I sent my manuscript wrote me an encouraging letter but did not buy the story.

### Part C: Reading Comprehension

The selection is followed by questions about the meaning of the material. You are to choose the one best answer to each question from the four choices given.

There is, perhaps, no other sport in the world quite so exciting as skiing. For viewers, it is a spectacle of unsurpassed beauty. For skiers, it is a vivid personal experience, a thrilling test of mind, muscle, and nerves. And more and more. Americans are discovering this thrill for themselves. Not too long ago, skiing had virtually no part in the American sports scene. If it were thought of at all, it was purely as a European sport. Then came the 1932 Winter Olympics at Lake Placid, New York. Americans got their first good look at skiing and made for the hills. Today ski trains make regular runs from out cities to the great, white outdoors. Lodges and chalets dot the mountain sides offering skiers the warmth of their firesides.

In addition to joy and exhilaration, skiing offers other attractions. It is a comparatively inexpensive sport and, for the young, the art of skiing is often mastered in a very short time.

The special thrill of skiing is well described by Buddy Werner. "It's all up to you." he says. "No teammates can help. You're alone. It's you against the snow, the mountains, the terrain, yourself. You're a warrior."

9- According to this article, skiing is probably the .....

- 1) least exciting sport in the world
- 2) least dangerous sport in the world
- 3) most exciting sport in the world
- 4) most dangerous sport in the world

10- To the spectator, skiing is .....

- 1) nerve-wracking
- 2) a spectacle of unsurpassed beauty
- 3) a thrilling test of muscle
- 4) a vivid personal experience

11- Skiing .....

- 1) became popular in America after 1932
- 2) has always been popular in America
- 3) has only recently become popular in Europe
- 4) can never become popular in America

12- By the expression "made for the hills," the author means that .....

- 1) Americans took up skiing
- 2) Americans were afraid of skiing
- 3) skiing became popular only in backwoods
- 4) The only place Americans could ski was in the Rock Mountains

13- One reason why skiing attracts sports lovers that it is relatively .....

- 1) monotonous
- 2) safe
- 3) enervating
- 4) inexpensive

14- Young people like skiing because .....

- 1) it is extremely dangerous
- 2) it takes a long time to learn
- 3) the skill can be mastered in a short time
- 4) skiers never get injured

15- According to Buddy Werner, the special thrill of lies is the fact that it .....

- 1) teaches one to gets along well in a group
- 2) makes good soldiers
- 3) is a team sport
- 4) pits the skier alone against the elements

A) Select the best choice and mark it in your answer sheet.

16- Most higher plants cannot make direct use of atmospheric nitrogen, but there are bacteria which can assimilate it.

- 1) accelerate
- 2) emulate
- 3) imitate
- 4) utilize

17- Some synthetic resins are made of long slender molecules which may be drawn out into threads and used as synthetic fibres.

- 1) bright
- 2) fragile
- 3) slim
- 4) tiny

18- Petroleum is a raw material for manufacturing of .....

- 1) carbon black
- 2) gasoline
- 3) sulphuric acid
- 4) sugar

19- Ultra-filtration ..... the dynamics of transport and thus, based on transport processes.

- 1) depends on
- 2) describes
- 3) is made of
- 4) is

20- Extraction and adsorption are ..... largely in thermodynamic terms.

- 1) described
- 2) interconnected
- 3) joined
- 4) made

21- Using ..... parts and fitting in a heat exchanger will reduce operating costs.

- 1) cheap
- 2) imported
- 3) original
- 4) standard

**22- Precipitation is a technique of chemical .....**

- 1) coagulation                      2) separation                      3) sedimentation                      4) sublimation

In the pharmaceutical industry greater emphasis, as a rule, is purity of the products than in any other industry except in certain cases in the nuclear industry. Another characteristic of the pharmaceutical industry is the use of life processes as a step in the manufacture of some products such as antibiotics, hormones, and fermentation products.

**23- Purity of products ..... in the nuclear industry.**

- 1) can be important                      2) is vital in all areas  
3) is not important                      4) should be considered

**24- Hormones and vitamins are produced by ..... processes.**

- 1) biological                      2) fermentation  
3) pharmaceutical                      4) using of life

Lime may be used for medicinal purpose, insecticides, and causticizing. Lime is indispensable for use with mortar and plaster and serves as a basic raw material in the production of calcium salts and for improving the quality of certain soils. The suitability of lime for any particular use depends on its composition and physical properties all of which can be controlled by the selection of the limestone and the details of the manufacturing process.

**25- Indispensable means .....**

- 1) acceptable                      2) adequate                      3) essential                      4) inexpensive

**26- Lime may be used as a soil conditioner in .....**

- 1) agriculture                      2) buildings                      3) calcium salts                      4) road constructions

**27- The composition of initial ..... has a great effect on the properties of lime produced.**

- 1) mortar                      2) plaster                      3) limestone                      4) soil

**28- One main advantage of sublimation is to .....**

- 1) apply low pressure                      2) avoid high temperature  
3) avoid low temperature                      4) destroy cell structure

**29- Ammonium chloride sublimation occurs at .....**

- 1) special condition  
2) 1 atm and 113.5°C  
3) high pressure and normal temperature  
4) atmospheric pressure and high temperature

**30- Pseudosublimation is the transformation of a .....**

- 1) liquid into solid                      2) vaporized liquid into solid  
3) solid into vapor                      4) solid vapor into solid

**3) MSc Entrance Examinations (1378)****A) Read the following texts and fill the blanks with proper words:**

1) With the plant designed, procurement, commissioning and .....(1) follow. These tasks are often undertaken by a contractor. If a go-ahead was given early, some of the major items will have been ordered before the .....(2) was complete because a 6-month-wait for equipment is not uncommon. After erection, the inside



of every vessel and pipe is cleaned and each item of equipment tested. Particular attention is paid to the .....(3) and safety trips.

The start-up of sulphuric acid plant is reasonably straight-forward. The reactors have to be brought up to .....(4) before introducing sulphur dioxide and they are heated slowly with dry air.

- |                   |                    |
|-------------------|--------------------|
| 1- 1) production  | 2) start-up        |
| 3) operation      | 4) maintenance     |
| 2- 1) plant       | 2) factory         |
| 3) basic design   | 4) detailed design |
| 3- 1) alarms      | 2) design          |
| 3) workers        | 4) transportation  |
| 4- 1) right floor | 2) temperature     |
| 3) normal height  | 4) date            |

2) With catalytic processes .....(5) often lie in reproducing the optimum reaction conditions on a full scale industrial application.

- |                     |                  |
|---------------------|------------------|
| 5- 1) the obsoletes | 2) the obstacles |
| 3) the obstetrics   | 4) the obscures  |

**B) Read the following passage and complete the following sentences.**

Hydrolysis of vegetable oil involves reactive liquid-liquid extraction. The direct saponification of oil creates problems with regard to recovery of glycerol. The hydrolysis of oil overcomes these difficulties and results in valuable intermediates like fatty acids and glycerol.

During hydrolysis of vegetable oils, three reversible reactions take place in the organic (or oil) phase. The reactions are elementary. The second and third reactions are instantaneous and the first reaction is rate limiting. Oil and aqueous phases attain equilibrium and exchange water and glycerol.

Water attains instantaneous equilibrium and a very high volumetric mass transfer coefficient is used. For the countercurrent operation, the reaction is assumed to be carried out in a spray column, where the water is added on the ascending oil phase and the oil phase holdup is assumed to be 98%.

The objective is to increase the glycerol production in the aqueous phase per unit reactor volume (or aqueous phase glycerol productivity, measured in  $\text{kg/m}^3 \cdot \text{hr}$  of glycerol). This requires simultaneous maximization of glyceride conversion in the oil phase and the transfer of glycerol to the aqueous phase. It can be shown that a countercurrent reactor results in the highest production of aqueous phase glycerol than the other two types of conventional designs, namely cocurrent flow and when both oil and aqueous phase are well mixed.

**6- In hydrolysis of vegetable oils ..... .**

- 1) first reaction is reversible and therefore has the fastest rate
- 2) second and third reactions are irreversible
- 3) first reaction is elementary and has the slowest rate
- 4) after exchanging water and glycerol, oil and aqueous phases reach equilibrium

**7- Saponification of vegetable oil .....**

- 1) can be performed via a reactive liquid-liquid extraction
- 2) is much more troublesome than hydrolysis process
- 3) produces valuable intermediates like fatty acids and glycerol
- 4) results in high recovery of glycerol

**8- Glycerol productivity .....**

- 1) is measured as conversion of glyceride in the oil phase
- 2) is the rate of glycerol transferred from oil phase to aqueous phase
- 3) increases as the reactor volume increases
- 4) is measured as the glycerol production in the aqueous phase per unit reactor volume

**9- Choose the correct phrase:**

- 1) In countercurrent operation, oil will be introduced to the column downward while the water is sprayed into it.
- 2) For maximizing the glycerol production, it is enough to maximize the glyceride conversion in the oil phase.
- 3) Countercurrent operation is the best arrangement for glycerol production.
- 4) Spray column reactor with conventional design results in highest glycerol productivity.

**C) Read the following passage and then complete the sentences: ۱**

1) One important source of emissions from gasoline-powered automobile engines that causes smog is nitrogen oxides NO and NO<sub>2</sub>. They are formed whether combustion is complete or not as follows. At the high temperatures that occur in an internal combustion engine during burning process oxygen and nitrogen combine to form nitric oxide (NO).

**10- Burning process creates .....**

- 1) complete reactions
- 2) excess energy for internal combustion engines
- 3) elevated temperature forming NO
- 4) descending temperature conditions

**11- Formation of NO and NO<sub>2</sub> will proceed whether reaction is .....**

- 1) complete
- 2) complete or incomplete
- 3) incomplete
- 4) with high conversion

2) A diesel engine differs from the gasoline engine in that it has no spark plug and fuel is injected into cylinder at the end of compression stroke. Its compression ratios can be higher than those of an Otto-cycle engine because cylinder contains only air during the compression stroke.

**12- Sparking is necessary for .....**

- 1) gasoline engine
- 2) diesel engine
- 3) both diesel and gasoline engines
- 4) engines with high compression ratio

**13- Otto-cycle engine has .....**

- 1) higher compression stroke than diesel engine
- 2) lower compression ratio than gasoline engine
- 3) lower compression ratio than diesel engine
- 4) fuel for injection during the compression stroke

3) The pitot-static tube provides a simple, relatively inexpensive way to measure fluid speed. Its use depends on the ability to measure the static and stagnation pressures. Care is needed to obtain these values accurately. An accurate measurement of static pressure requires that none of the fluid's kinetic energy be converted into a pressure rise at the point of measurement.

**14- Pitot-static tube does not give an accurate measurement of fluid velocity if .....**

- 1) fluid velocity increases linearly
- 2) static and stagnation pressure does not rise uniformly
- 3) a rise in pressure does not influence kinetic energy of fluid
- 4) kinetic energy of fluid causes an increase in pressure

4) Milk is a low viscosity fluid whose flow characteristics are much like those of water, but during processing it is vital to avoid microbiological contamination. Thus, the equipment must be designed for either easy dismantling and cleaning or cleaning in place. Stainless steel is the main material of construction in the food industry, and in order to ensure that contaminants are removed, the surfaces must be smooth, free from pits and crevices and without corners. A mirror polish has often been specified, but the surface finish is less important than the roughness, which must be less than a few micrometers.

**15- "Pit" means .....**

- |         |         |            |             |
|---------|---------|------------|-------------|
| 1) dirt | 2) dent | 3) microbe | 4) impurity |
|---------|---------|------------|-------------|

**16- "Contamination" means .....**

- |              |            |             |           |
|--------------|------------|-------------|-----------|
| 1) infection | 2) scandal | 3) activity | 4) growth |
|--------------|------------|-------------|-----------|

**17- "Vital" means .....**

- |              |                         |
|--------------|-------------------------|
| 1) necessary | 2) important            |
| 3) critical  | 4) absolutely necessary |

**18- "Dismantling" means .....**

- |                 |                     |
|-----------------|---------------------|
| 1) construction | 2) operation        |
| 3) maintenance  | 4) taking to pieces |

**D) Read the passage below and select the best answers to the questions.**

1) Design is a creative activity and as such can be one of the most rewarding and satisfying activities undertaken by a chemical engineer. It is the synthesis, putting together, of ideas to achieve a desired purpose.

**19- What is the most rewarding activity for a chemical engineer?**

- 1) to achieve a desired purpose by calculation.
- 2) to have creative activity.
- 3) designing, to achieve a desired purpose.
- 4) to put together available data.

2) The chemical engineer start with the set of all possible solutions bounded by the external constraints, and by a process of progressive evaluation and selection, narrows down the range of candidates to find the best design for the purpose.

**20- What is the most important duty of a chemical engineer as a designer?**

- |   |                                    |
|---|------------------------------------|
| 1) to increase possible constraints.    | 2) to find out possible solutions. |
| 3) to decrease the range of candidates. | 4) to evaluate and select.         |

**4) MSc Entrance Examinations (1379)**

- 1- Due to the efforts of conservationists and environmentalists, few people are unaware of the problems of endangered species.  
1) ignorant                      2) adjacent                      3) indifferent to                      4) obstinate about
- 2- The thermodynamic properties of liquids and solids are more difficult to predict than those of gases. The reason is that no comprehensive theories of the liquid and solid states are available, which in turn reflects the fact that the liquid and solid states are more complex than the gas state.  
Thermodynamic properties of gases .....  
1) are easier than solids and liquids to predict  
2) are more difficult than liquids and solids to predict  
3) reflect the fact that liquids and solids are more complex  
4) are difficult to predict because there are no comprehensive theories for them
- 3- It is difficult to discern the sample that is on the slide unless the microscope is adjusted.  
1) debate                      2) arrange                      3) discard                      4) determine
- 4- Agitation is related to .....  
1) stars                      2) mixing                      3) animals                      4) freezing
- 5- Dehumidification is .....  
1) losing air                      2) gaining air  
3) losing water                      4) gaining water
- 6- In the past, energy sources were thought to be boundless.  
1) solar                      2) natural                      3) inexpensive                      4) without limit
- 7- Once the executives of a company have become interested in the idea of building a new plant, their first step is usually to call for a feasibility study.  
A feasibility study is:  
1) diagram of a chemical process                      2) a step in a chemical process  
3) determining if a project can be successful                      4) a study to optimise a chemical process
- 8- If permissible, leaching should be carried out at higher temperatures as this will result, among other things, in higher ..... of the solute in the solvent.  
1) solution                      2) solubility                      3) dissolution                      4) dissolvability
- 9- In order to improve the overall efficiency of a leaching ....., it may be necessary to increase the surface area of the solid exposed to the solvent.  
1) method                      2) process                      3) approach                      4) technique
- 10- Cryogenics is to study .....  
1) high pressures                      2) irrigation systems                      3) low temperatures                      4) genetic engineering
- 11- A gas scrubber cleans air very effectively, but it also leaves the engineer with the problem of disposing a lot of dirty water.  
A gas scrubber is an equipment which .....  
1) swirls a gas to separate solids from it  
2) uses centrifugal force to separate materials  
3) remove undesirable gases from air through surface adsorption  
4) remove particles from air by spraying droplets of water through it



19- Which of the following words best describe the tone of this passage?

- |                |                  |
|----------------|------------------|
| 1) humorous    | 2) imaginative   |
| 3) explanatory | 4) argumentative |

20- The word "tracking" (underlined) is closest in meaning to which of the following?

- |                  |              |                |             |
|------------------|--------------|----------------|-------------|
| 1) searching for | 2) repairing | 3) glancing at | 4) fighting |
|------------------|--------------|----------------|-------------|

### 5) MSc Entrance Examinations (1380)

**I. Read the following texts and answer the related questions by choosing the best choice.**

Changing economic circumstances as well as changing technology create a challenge for the chemical engineer designing or improving process plant. Within this changing picture, the need for accurate mass and energy balances remains paramount since they determine the size and design of the associated unit operations.

1- By the help of material and energy balances one can .....

- |                              |  |
|------------------------------|--|
| 1) size the unit operations  | 2) design the unit operations          |
| 3) order the unit operations | 4) size and design the unit operations |

2- Why do you have to improve process plant?

Because of change in .....

- |                             |                                |
|-----------------------------|--------------------------------|
| 1) technology               | 2) economic easures            |
| 3) energy and mass balances | 4) both economy and technology |

3- Paramount means .....

- |            |            |            |               |
|------------|------------|------------|---------------|
| 1) logical | 2) unknown | 3) supreme | 4) mysterious |
|------------|------------|------------|---------------|

4- Circumstance means .....

- |         |              |               |              |
|---------|--------------|---------------|--------------|
| 1) rule | 2) condition | 3) acceptance | 4) agreement |
|---------|--------------|---------------|--------------|

### II.

Separators operate basically upon the principle of pressure reduction to achieve separation of gas and liquid from an inlet stream. Further refinement of the gas and liquid streams is induced by allowing the liquid to "stand" for a period of time so that any dissolved gas in the liquid can escape by the formation of small gas bubbles that rise to the liquid surface and removing the entrained liquid mist from the gas by gravity settling, impingement, centrifugal action, and other means. Turbulent flow allows gas bubbles to escape more rapidly than laminar flow and many separators therefore have sections where turbulence is induced for this purpose. On the other hand, for the removal of liquid droplets from the gas by gravity settling, turbulence is quite detrimental to removal efficiency. Thus, the design of a separator comprises different modules assembled to achieve different functions in a single vessel. Equilibrium is attained in the piping and equipment just upstream of the separator, the separator itself serving only as a "wide" spot in the line to refine the vapor and liquid streams resulting from this basic separation.

5- Induce means .....

- |           |             |              |               |
|-----------|-------------|--------------|---------------|
| 1) to end | 2) to cause | 3) to remove | 4) to inhibit |
|-----------|-------------|--------------|---------------|

6- Entrained liquid mist is removed from the gas by .....

- 1) gravity settling, impingement and centrifugal action
- 2) combination of gravity settling, impingement and centrifugal action
- 3) methods other than gravity settling, impingement and centrifugal action
- 4) combination of gravity settling, impingement, centrifugal action and other means

**7- Liquid is allowed to stand for a period of time so that .....** .

- 1) dissolved gas is removed
- 2) gas is dissolved in the liquid
- 3) entrained liquid mist is removed
- 4) small gas bubbles form at the surface of the liquid

**III. Sources of Microorganisms**

The microbial flora of a food consists of the microorganisms associated with the raw material, those acquired during handling and processing, and those surviving any preservation treatment and storage.

Since these microorganisms do not arise by spontaneous generation, they must contaminate the food at some stage of production, harvesting, handling, processing, storage, distribution, or preparation for consumption. Most foods are subjected to many potential sources of microorganisms.

Why should we be concerned with sources of contamination? Primarily so that we can control contamination and keep the microbial load on or in the food as low as possible. By doing this, we obtain a longer shelf life for the food; we hope that this reduces the chance of microbial foodborne illness when the food is ingested. By keeping the contamination low, we can more easily control or eliminate the microorganisms with food-preservation techniques.

The potential sources of contamination are soil, water, air, plants, feed or fertilizer, animals, human beings, sewage, processing equipment, ingredients, product to product, and packaging materials.

Microorganisms can be exchanged between these sources. For example, animals contaminate the soil with faecal material. Then rain washes the microorganisms into the creeks and rivers. This water may be used for irrigation and contaminate plants used for food.

**8- Microorganisms must contaminate the food at some stage of production, harvesting and handling because .....** .

- 1) food must be prepared for consumption
- 2) microorganisms arise by spontaneous generation
- 3) microorganisms do not arise by spontaneous generation
- 4) most foods are subjected to many potential sources of microorganisms

**9- We are concerned with sources of contamination in order to .....** .

- 1) store the food
- 2) control contamination
- 3) prepare it for consumption
- 4) preserve and store the food

**10- We can control or eliminate the microorganisms by .....** .

- 1) using food preservation techniques
- 2) keeping the contamination low
- 3) reducing the change of microbial foodborne illness
- 4) keeping the microbial load on the food as low as possible

**IV.**

In designing gas production, processing transport, and handling systems a complete knowledge of gas properties is crucial. For this reason, much research has been done in the measurement and prediction of hydrocarbon fluid properties. The area of property prediction continues to attract significant attention from researchers who seek to optimize design and control of gas and oil systems. The current trend is to develop

mathematical equations for implementation on computers, rather than the traditional engineering charts and tables, because with computers it is far more efficient to solve equations than to interpolate in a huge domain of possible parameter values, whereas the opposite is probably true for humans.

**11- Implement means .....** .

- 1) to predict
- 2) to determine
- 3) to establish
- 4) to carry into effect

**12- Much research has been done in the measurement and prediction of hydrocarbon fluid properties because .....** .

- 1) researchers seek to optimize design and control of gas and oil systems
- 2) the area of property predictions continues to attract significant attention
- 3) gas production, processing, transport and handling systems need to be designed
- 4) a complete knowledge of gas properties is crucial in designing gas production, processing, transport and handling systems

**13- For humans, it is probably more efficient .....** .

- 1) to solve equations
- 2) to work with computers
- 3) to work with mathematical equations
- 4) to interpolate a huge domain of possible parameter values

**V.**

In this paper, rheological properties of ceramic slips have been investigated. The increasing of slip density within the acceptable range of viscosity increases the yield of equipments such as ball mills and spray dryers. Chemical and mineralogical properties of raw materials, volume fraction, milling of particles, soluble ions in the water system and deflocculants are affecting the rheological properties of ceramic slips. In this investigation, in addition to the above mentioned parameters, formula of the body of floor tile has been changed plus sodium silicate and sodium three polyphosphate (T.P.P.) have been used as deflocculants in slips. Thus slip density have been increased from 1.56 to 1.62 gr/cm<sup>3</sup>.

**14- The rheological properties of ceramic slips .....** .

- 1) are indicating the mathematical strength of the slips
- 2) depends on the physical properties of the slurries
- 3) only shows the analytical properties of the material
- 4) are describing the mineralogical aspects of fluids

**15- The equipments yield used in ceramic processing before firing can be increased by .....** .

- 1) increasing slip density
- 2) using larger solid particles in the slip
- 3) change in mechanical strength of the equipments
- 4) increasing the temperature and speed of the equipments



**VI. Fill in the blanks with suitable choices.**

**16- It is not possible to proceed very far in the study of convection and fluid flow without defining viscosity, a property which has an important bearing upon both.**

This statement implies that .....

- 1) convection and fluid flow have bearing upon viscosity
- 2) viscosity is an important property when studying convection and fluid flow
- 3) without convection and fluid flow it is not possible to proceed with viscosity
- 4) convection and fluid flow are both important properties when studying viscosity

**17-Desorption or ..... involves the removal of a volatile component from a liquid stream by contact with an inert gas such as steam or nitrogen.**

- 1) strip
- 2) stripped
- 3) stripping
- 4) stripper

**18-There are a bewildering number of semiempirical correlations that can be applied to the operating conditions of this experimental study.**

**bewildering means .....**

- 1) few
- 2) huge
- 3) puzzling
- 4) different

**19- Cryostat is related to .....**

- 1) low velocity
- 2) high velocity
- 3) low temperatures
- 4) high temperatures

**20- Curvature is related to the .....**

- 1) graphs
- 2) stars
- 3) oceans
- 4) metals

**6) MSc Entrance Examinations (1381)**

**Part A: Choose the best answer.**

**1- Metallurgists believe that wet steam is apt to erode the blades of a turbine.**

**The word "apt" in this context is closest in meaning to .....**

- 1) evolved
- 2) inclined
- 3) diffused
- 4) augmented

**2- On entering turbine, the steam impinges on the rotating blades.**

**The word "impinge" in this context is closest in meaning to .....**

- 1) immerse
- 2) imprint
- 3) impose
- 4) implicate

**3- A heat exchanger in which hot gases are used to boil water to produce steam and simultaneously to cool the gases is a .....**

- 1) waste heat boiler
- 2) water-tube boiler
- 3) recovery boiler
- 4) recovery exchanger

**Part B: Read the passage carefully and choose the best answer.**

The oxidation of ethanol to acetic acid is an example of the incomplete oxidations carried out by acetic acid bacteria. Certain other incomplete oxidative conversions by acetic acid bacteria are industrially important. Gluconic acid, which is used by the pharmaceutical industry, is made by oxidation of glucose by acetic acid bacteria. Many sugar alcohols are converted to sugars by acetic acid bacteria. One such reaction in commercial use is the production of sorbose from sorbitol. Sorbose is used as a suspending agent for certain pharmaceuticals, and it is an intermediate in the manufacture of L-ascorbic acid (vitamin C).

**4- Which of the following is sugar alcohol?**

- 1) sorbose
- 2) sorbitol
- 3) glucose
- 4) ethanol

**5- Sorbitol is used as a suspending agent for certain pharmaceuticals.****The statement means that .....**

- 1) certain pharmaceuticals are dispersed in sorbitol
- 2) certain pharmaceuticals are dissolved in sorbitol
- 3) sorbitol is dissolved in certain pharmaceuticals
- 4) sorbitol is dispersed in certain pharmaceuticals

**6- Which of the following is the correct meaning of "intermediate" as used in the text?**

- 1) An intermediate stage obtained as a necessary final product between the original material and the substance.
- 2) An original material obtained as a necessary intermediate stage between the final product and the substance.
- 3) A substance obtained as a necessary intermediate stage between the original material and the final product.
- 4) A final product obtained as a necessary intermediate stage between the original material and the substance.

**7- Which of the following oxidation is NOT an example of incomplete oxidation?**

- |                             |                           |
|-----------------------------|---------------------------|
| 1) sorbitol to sorbose      | 2) ethanol to acetic acid |
| 3) glucose to gluconic acid | 4) sugar to sugar alcohol |

**7) MSc Entrance Examinations (1383)****Part A: Read the following passage and fill the blanks with the most appropriate alternatives given.**

There has always existed on earth a natural radiation background to which all living organisms are exposed. The intensity of the natural sources of radiation and the doses to human beings have been carefully evaluated, because this exposure constitutes the largest component of the collective dose received by the world population. Doses from man-made sources are often compared to the reference level formed by exposure to the natural background sources.

The natural radiation sources include external sources of extra-terrestrial origin (i.e., cosmic radiation), radiation of terrestrial origin (i.e., radionuclides in the earth's crust, in building materials and in air) and internal sources of radiation (i.e., natural radionuclides inhaled or ingested). Some of these exposures are relatively constant and uniform to all individuals throughout the world, for example the dose from ingestion in foods of <sup>40</sup>K, an element that is immethodically controlled in the body, and from cosmogonic radionuclides that are relatively homogeneously distributed over the surface of the earth. Other exposures vary widely depending on location, for example greater cosmic ray intensity at higher altitudes and elevated concentrations of uranium and thorium in soils in localized areas. Exposures can also vary, due to human activities and practices. In particular, the building materials of houses and the design and ventilation systems strongly influence the indoor levels of radon and thorium and their decay products, which can contribute significantly to internal doses through inhalation.

**1- ..... are exposed to natural radiation.**

- 1) All people
- 2) All animals
- 3) All creatures
- 4) Those who work with radioactive materials

**2- External sources of natural radiation (n. r.) are .....**

- 1) only a fraction of total n. r.
- 2) of terrestrial origin
- 3) the main source of total n. r.
- 4) the important source of total n. r.

**3- Ingestion means .....**

- |                            |                                       |
|----------------------------|---------------------------------------|
| 1) analysis                | 2) disintegration                     |
| 3) decomposing of the body | 4) taking into the body for digestion |

**4- Inhalation means .....**

- |                |                 |               |                 |
|----------------|-----------------|---------------|-----------------|
| 1) uptake from | 2) breathing in | 3) acceptance | 4) digestion of |
|----------------|-----------------|---------------|-----------------|

**5- Building materials are categorized as ..... source of n. r.**

- |             |             |              |                |
|-------------|-------------|--------------|----------------|
| 1) external | 2) internal | 3) important | 4) terrestrial |
|-------------|-------------|--------------|----------------|

**6- Radionuclides of cosmic origin can be .....**

- 1) found in special area
- 2) controlled in the body
- 3) found almost everywhere
- 4) concentrated at higher altitude

**7- Ventilation systems .....**

- 1) should be matched with building materials
- 2) may influence the indoor level of exposure
- 3) contribute significantly to internal doses
- 4) may increase the radon and thorium concentrations

**8- n. r. .... compared with man-made sources.**

- |                   |                              |
|-------------------|------------------------------|
| 1) is negligible  | 2) is significant            |
| 3) can be ignored | 4) has become less important |

**Part B: Fill in the blanks with the most suitable choice given.**

**9- It is well proven that at ....., the net rate of mass transfer is equal to zero.**

- |                  |                      |
|------------------|----------------------|
| 1) equilibrium   | 2) the interface     |
| 3) low pressures | 4) high temperatures |

**10- It is a universal physical law that the direction of ..... energy flow is invariably from the hot body to the cold body.**

- |             |               |
|-------------|---------------|
| 1) thermal  | 2) chemical   |
| 3) physical | 4) mechanical |

**11- Unit operations, e.g., extraction, absorption, distillation, are usually carried out under ..... conditions.**

- |          |             |            |                 |
|----------|-------------|------------|-----------------|
| 1) ideal | 2) variable | 3) extreme | 4) steady state |
|----------|-------------|------------|-----------------|

**12- A hot steel bar can be cooled by .....**

- |             |              |              |              |
|-------------|--------------|--------------|--------------|
| 1) treating | 2) tempering | 3) quenching | 4) hammering |
|-------------|--------------|--------------|--------------|

**13- In chemical engineering, a flowsheet is a/an ..... way of expressing information.**

- |        |            |               |                 |
|--------|------------|---------------|-----------------|
| 1) odd | 2) tedious | 3) convenient | 4) unacceptable |
|--------|------------|---------------|-----------------|

**8) MSc Entrance Examinations (1384)**

*Read Passage I and complete the sentences.*

**Passage I:**

Microbially enhanced oil recovery (MEOR) has several unique advantages that make it an economically attractive method to enhance oil recovery. MEOR processes do not consume large amounts of energy as do thermal recovery processes and MEOR processes do not depend on the price of crude oil as do many chemical recovery processes. Because microbial growth occurs at exponential rates, it should be possible to produce large amounts of useful products quickly from inexpensive and renewable resources. Economic analysis of two recent MEOR field trial show that in addition oil is produced for as little as three dollars per barrel.

**1- MEOR processes can be expanded .....**

- 1) for all reservoirs
- 2) if the price of oil increases slowly
- 3) without considering the oil prices
- 4) in accordance with thermal recovery process

**2- Thermal recovery processes are .....**

- 1) no longer attractive
- 2) expected to develop more
- 3) superior to microbial systems
- 4) applied for enhanced oil recovery

**3- Microorganisms .....**

- 1) are the main tool in MEOR
- 2) can be sold as the main product
- 3) are abundant compared with chemicals
- 4) produce considerable amount of energy

*Read the Passage II and answer the questions.*

**Passage II:**

Chemical engineering design of new chemical plants and the expansion or revision of existing ones require the use of engineering principles and theories combined with a practical realisation of the limits imposed by industrial conditions. Development of a new plant or process from concept evaluation to profitable reality is often an enormously complex problem.

**4- For the expansion of a chemical plant, we rely more on .....**

- |               |               |                |              |
|---------------|---------------|----------------|--------------|
| 1) facilities | 2) experience | 3) investments | 4) equipment |
|---------------|---------------|----------------|--------------|

**5- "Enormously complex problem" is a problem that is .....**

- |                   |                     |
|-------------------|---------------------|
| 1) not complex    | 2) very complex     |
| 3) hugely complex | 4) slightly complex |

**6- In the development of a new chemical plant, profitable reality .....**

- |                                    |                                      |
|------------------------------------|--------------------------------------|
| 1) precedes concept evaluation     | 2) precedes complex problems         |
| 3) is preceded by complex problems | 4) is preceded by concept evaluation |

**Read Passage III and answer the questions or complete the sentences.**

**Passage III:**

When the mixture is ignited, the products of combustion expand down the cylinder, which is fitted with a reciprocating piston. The downward movement of the piston is converted into a rotational movement of the crankshaft by means of a connecting rod. As the crankshaft rotates, the piston is driven upwards again, and the exhaust gases are expelled through the exhaust valve in the cylinder head. When the piston nears the top of this stroke, the inlet valve is opened and the exhaust valve closed. The piston then descends on the induction stroke, and draws a fresh charge into the cylinder. As the piston rises again on the compression stroke, the charge is compressed and ignited, and the cycle begins again. This is the four-stroke cycle which is in common use. An *alternative* cycle is the two-stroke cycle, which combines the exhaust and compression strokes into one.

**7- What is the function of the connecting rod?**

- 1) For downward movement of the piston.
- 2) For rotational movement of the crankshaft.
- 3) To descend the piston on the induction stroke.
- 4) To convert the movement of the piston into a rotational movement.

**8- A two-stroke cycle combines ..... strokes into one.**

- |                                  |                                      |
|----------------------------------|--------------------------------------|
| 1) two                           | 2) exhaust and combustion strokes    |
| 3) exhaust and induction strokes | 4) compression and induction strokes |

**9- In which stroke both the inlet and exhaust valve are not open simultaneously?**

- |            |              |                |         |
|------------|--------------|----------------|---------|
| 1) Exhaust | 2) Induction | 3) Compression | 4) None |
|------------|--------------|----------------|---------|

**Read Passage IV and complete the sentences.**

**Passage IV:**

**Answering Mexico's gas demand**

**International contractor partnership overcomes construction obstacles to build Mier-Monterrey line  
(A Staff Report)**

Natural gas consumption in Mexico has increased dramatically in the past few years. Demand is being driven by new combined-cycle power generation plants, environmental regulations, and the privatization of domestic and industrial gas networks. Growing demand, in turn, has led to increased gas imports from the United States, from 400 MMcfd in 1999 to 800 Mmcfd in 2002.

For years, Mexico was self-sufficient in natural gas. It could easily meet its needs with domestic production, and had surplus supply available for export. To take advantage of this situation, in the late 1970s and early 1980s the government constructed a 48-in., bi-directional pipeline that could export gas to the United States. For various reasons, including lack of investment in new fields, the line has not been used to export gas. Indeed, in recent years, Mexico has been facing a gas shortage.

To remedy the supply imbalance, the Mexican government has been pursuing several solutions. One involves amending its energy law so that private national and international capital can spur domestic exploration and production activities. Another solution is the promotion of the infrastructure needed to import natural gas.

An example of the latter is kinder-Morgan's recently completed Mier-Monterrey natural gas pipeline, which links the Kinder Morgan system to the Pemex network in Monterrey, Mexico. The project involved installation of a 100-mi, 30-in natural gas line from Bob West, Texas, through Ciudad Mier, to Monterrey. It was completed in five and a half months, one month ahead of schedule.

**10- To develop new fields .....**

- |   |   |
|---|---|
| 1) the gas import needs to be cut           | 2) energy law needs to be changed           |
| 3) a 48-in pipeline needs to be constructed | 4) considerable amount of capital is needed |

**11- Consumption of natural gas in Mexico has increased because of .....**

- |                                |                                 |
|--------------------------------|---------------------------------|
| 1) import regulations          | 2) limited gas network          |
| 3) high demand for electricity | 4) required capital investments |

**12- Mexico ..... natural gas.**

- |                          |                                |
|--------------------------|--------------------------------|
| 1) imports               | 2) exports                     |
| 3) is self sufficient in | 4) neither imports nor exports |

**13- The constructed 48-in gas pipeline was intended for .....**

- |           |           |                    |                 |
|-----------|-----------|--------------------|-----------------|
| 1) import | 2) export | 3) industrial uses | 4) domestic use |
|-----------|-----------|--------------------|-----------------|

**14- Construction obstacles means .....**

- |                          |                            |
|--------------------------|----------------------------|
| 1) bureaucratic problems | 2) construction hindrance  |
| 3) construction expenses | 4) management disagreement |

*Read Passage V and complete the sentences.*

**Passage V:**

Ammonia is one of the most important chemicals being manufactured in large tonnage today. Unlike sulphuric acid, its production is not linked to the Industrial Revolution, but to the population explosion which followed. At the beginning of the twentieth century, there was a need to increase food production, and a necessary solution in the densely populated industrial world was to increase the yield per acre by use of nitrogen-containing fertilizers. Although nitrogen is generally unreactive, Fritz Haber showed that thermodynamically the reaction of nitrogen with hydrogen was feasible. In 1911, he discovered that an iron catalyst would facilitate production, and process development started. During the First World War, the manufacture of ammonia in Germany accelerated rapidly because it was a convenient home-based substance which could be converted to nitric acid, which was crucial to the production of explosives.

**15- Population increased after .....**

- |                                      |                                     |
|--------------------------------------|-------------------------------------|
| 1) First World War                   | 2) Industrial Revolution            |
| 3) large increase in food production | 4) development of ammonia synthesis |

**16- Production of sulphuric acid expanded as a result of .....**

- |                                   |                                      |
|-----------------------------------|--------------------------------------|
| 1) Industrial Revolution          | 2) population explosion              |
| 3) increase in ammonia production | 4) large increase in food production |

**17- Yield per acre means .....**

- 1) tonnage produced per unit area
- 2) production rate per square meter
- 3) the efficiency per unit of production
- 4) the amount of ammonia produced per ton of nitrogen

**18- The development of Fritz Haber process is mainly related to .....**

- 1) World War I
- 2) the industrial Revolution
- 3) the population growth
- 4) the production of explosives

**Complete the following sentences.**

**19- Cryostat is related to .....**

- |                     |                      |
|---------------------|----------------------|
| 1) low velocity     | 2) high velocity     |
| 3) low temperatures | 4) high temperatures |

**20- Pyrometer is a device for measuring .....**

- |             |              |             |                |
|-------------|--------------|-------------|----------------|
| 1) velocity | 2) viscosity | 3) pressure | 4) temperature |
|-------------|--------------|-------------|----------------|

**9) MSc Entrance Examinations (1385)**

**Read the following passages and complete the sentences.**

**Passage I:**

Fluid mechanics, as the name indicates, is that branch of applied mechanics which is concerned with the static and dynamics of liquids and gases. The analysis of the behaviour of fluids is based upon the fundamental laws of applied mechanics which relate to the conservation of mass-energy and the force-momentum equation, together with other concepts and equations with which the student who has already studied solid-body mechanics will be familiar. There are, however, two major aspects of fluid mechanics which differ from solid-body mechanics. The first is the nature and properties of the fluid itself, which are very different from those of a solid. The second is that, instead of dealing with individual bodies or elements of known mass, fluid mechanics is frequently concerned with the behaviour of a continuous stream of fluid, without beginning or end.

**1. Academically speaking, the student who takes the course of fluid mechanics, should have already passed solid mechanics. In other words, solid-body mechanics is ..... fluid mechanics.**

- |              |                    |                 |             |
|--------------|--------------------|-----------------|-------------|
| 1) needed to | 2) prerequisite to | 3) requisite to | 4) prior to |
|--------------|--------------------|-----------------|-------------|

**2. Unlike solid-body mechanics, ..... is dealing with the behaviour of a continuous stream of fluid, without beginning or end.**

- |            |             |                    |                      |
|------------|-------------|--------------------|----------------------|
| 1) statics | 2) dynamics | 3) fluid mechanics | 4) applied mechanics |
|------------|-------------|--------------------|----------------------|

**3. Fluid mechanics is regarded as a branch of applied mechanics because.....**

- 1) it is dealing with liquid and gases
- 2) fluid laws are similar to solid laws
- 3) the behaviour of fluid is based upon the fundamental laws of applied mechanics
- 4) fluid mechanics like applied mechanics is concerned with the dynamics of continuous streams

**Passage II:**

Petrochemicals are generally considered to be chemical compounds which are derived from petroleum either by direct manufacturer or by indirect manufacture as by-products from the variety of processes that are used during the refining of petroleum. Gasoline, kerosene, fuel oils, lubrication oils, waxes, asphalts, and the like are excluded from the definition of petrochemicals, since they are not, in the true sense, chemical compounds, but are, in fact, intimate mixtures of hydrocarbons.

The starting materials for the petrochemical industry are obtained from crude petroleum in one of two general ways. They may be present in the virgin petroleum and, as such, are isolated by physical methods such as distillation or solvent extraction. On the other hand, they may be present, if at all, in trace amounts and are synthesized during the refining operations.

**4. Fuel oils, lubricating oils, waxes and asphalts are.....**

- |                             |                              |
|-----------------------------|------------------------------|
| 1) petrochemicals           | 2) mixtures of hydrocarbons  |
| 3) partially petrochemicals | 4) petroleum based chemicals |

**5. The feedstock for petrochemical industry may be obtained either directly from ..... of crude oil, or ..... during refining operations.**

- |                             |                                    |
|-----------------------------|------------------------------------|
| 1) distillation-synthesized | 2) distillation-solvent extraction |
| 3) synthesis-distillation   | 4) solvent extraction-distillation |

**Passage III:**

The 19<sup>th</sup> Century saw enormous advances in polymer chemistry. However, it required the insights of chemical engineers during the 20<sup>th</sup> Century to make mass produced polymers a viable economic reality. When a plastic called Bakelite was introduced in 1908 it sparked the dawn of the "Plastic Age" and quickly found uses in electric insulation, plugs & sockets, clock bases, iron cooking handles, and fashionable jewelry. Today plastic has become so common that we hardly notice it exists. Yet nearly all aspects of modern life are positively and profoundly impacted by plastic.

**6. According to the above passage, choose the correct sentence.**

- 1) Plastic is not a useful product in modern life.
- 2) Polymer chemistry is part of chemical engineering.
- 3) All the artificial jewelries are made from Bakelite.
- 4) Mass production of plastic was the achievement of chemical engineering.

**7. According to the above passage, complete the following sentence "It sparked the dawn of plastic age" means.....**

- |                                    |   |
|------------------------------------|---|
| 1) the plastic age started         | 2) Bakelite is a plastic                |
| 3) plastic can be joined by sparks | 4) when you see a spark the dawn starts |

**Passage IV:**

One of the industrial processes for the production of phenol is a two stage oxidation reaction in which initially toluene is converted to benzoic acid which in turn is oxidized to phenol. Efficient gas-liquid contacting design and economic recovery of organics from the water containing fractions in the second stage are the two main design problems.

The incentive for switching to toluene as an aromatic source comes from the oversupply of toluene available at low-cost from petroleum reforming. The major disadvantages of the method are the two-stage oxidation with the handling of solid intermediate and a fairly elaborate process scheme throughout. The development of a simpler, single step oxidation of toluene would indeed be a major break-through in synthetic phenol production.



**8. Toluene is a good raw material for the production of phenol because.....**

- 1) it is an aromatic source  
2) its production exceeds its demand  
3) it is converted to phenol in two stages  
4) it is produced during petroleum reforming

**9. In the production of phenol, benzoic acid is a/an.....**

- 1) product  
2) by-product  
3) raw material  
4) an intermediate

**Passage V:**

From blankets and clothes to beds and pillows, synthetic fibers keep us warm, comfortable, and provide a good night's rest. Synthetic fibers also help reduce the strain on natural sources of cotton and wool, and can be tailored to specific applications. For example; nylon stockings make legs look young while bullet proof vests keep people out of harm's way.

**10. According to the text, choose the correct sentence.**

- 1) synthetic fibers have a dominant role in everyday life.  
2) synthetic fibers are not as good as natural fibers.  
3) synthetic fibers are made from petroleum derivatives.  
4) synthetic fibers put a lot of pressure on the consumption of cotton and wool.

**Passage VI:**

An immense number of analytical solutions for conduction heat-transfer problems has been accumulated in the literature over the past 100 years. Even so, in many practical situations the geometry or boundary conditions are such that an analytical solution has not been obtained at all, or if the solution has been developed, it involved such a complex series solution that numerical evaluation becomes exceedingly difficult. For such situations the most fruitful approach to the problem is one based on finite-difference techniques. Of course, the rapid development of high-speed computers has enabled the practicing heat-transfer specialist to obtain numerical solutions to many problems heretofore believed to be impossible.

**11. From the text, writer implies that the accumulation of the analytical solutions to the problems of conduction heat-transfer has not offered clear-cut solutions to them over the past 100 years.**

- 1) attained  
2) prescribed  
3) proposed  
4) mentioned

**12. From the text, it can be inferred that with the aid of high-speed computers, heat-transfer specialists have made a remarkable ..... in finding numerical solutions to many problems heretofore believed to be impossible.**

- 1) progress  
2) point  
3) record  
4) approach

**13. The word "heretofore" in the last line of the text is closest in meaning to .....**

- 1) they  
2) latterly  
3) which  
4) formerly

**Passage VII:**

Chemical engineers have long studied complex chemical processes by breaking them up into smaller "unit operations." Such operations might consist of heat exchangers, filters, chemical reactors and the like. Fortunately this concept has also been applied to the human body. The results of such analysis have helped improve clinical care, suggested improvements in diagnostic and therapeutic devices, and led to mechanical wonders such as artificial organs. Medical doctors and chemical engineers continue to work hand in hand to help us live longer fuller lives.

**14. According to the above passage, choose the correct sentence.**

- 1) "Unit-operations" are more complicated than human organs.
- 2) Most of the diagnostic and the therapeutic devices are made by chemical engineers.
- 3) Medical doctors would not do anything without the help of chemical engineers.
- 4) Chemical engineers have helped medical doctors for health improvement of human.

**15. According to the text above, finish the following sentence.**

- 1) is a complete chemical process
- 2) can work with many artificial organs
- 3) can be broken up into small unit operations
- 4) needs more clinical care than complicated chemical plants

**Passage VIII:**

Petroleum refineries are marvels of modern engineering. Within them a maze of pipes, distillation columns, and chemical reactors turn crude oil into valuable products. Large refineries cost billions of dollars, employ several thousand workers, operate around the clock, and occupy the same area as several hundred football stadiums. The U.S. has about 300 refineries that can process anywhere between 40 and 400,000 barrels of oil a day. These refineries turn out the gasoline and chemical feedstocks that keep the country running.

**16. A maze of pipes refers to .....**

- |   |                                   |
|---|-----------------------------------|
| 1) pipes with lots of valves and fittings | 2) numerous pipes gone everywhere |
| 3) a number of large pipes                | 4) pipes of different sizes       |

**17. Operation around the clock means.....**

- |                                 |                                  |
|---------------------------------|----------------------------------|
| 1) work very precisely          | 2) operate on a time basis       |
| 3) all units are time dependent | 4) operate on a continuous basis |

**Passage IX:**

The domination of oil is coming to an end. Emissions of CO<sub>2</sub> must be reduced. These two widely-publicised premises press for new sources of energy, and soon, too. The steadily increasing price of crude oil adds weight. Could hydrogen be the elixir for the world's energy supply?

Why not? Hydrogen is the most abundant element on earth (in the universe, in fact), and its energy release does not contribute CO<sub>2</sub> to the atmosphere. Hydrogen looks ideal. No more energy cartels; no more global warming warnings attributed to humans' energy uses. Seems perfect. Let's look at key facets of such an energy system to be sure.

First, availability. Yes, hydrogen is all over the place—in almost everything organic, in the ground, and in water, the substance which covers about 70% of the earth's surface. But is hydrogen easily captured by itself? There's a rub. Hydrogen clings tightly to its neighbours. Much energy has to be expended for it to release its bond, then, usually, some more energy must be given up to separate and purify it; hydrogen has to be pure for most effective, efficient energy uses.

**18. We need sources of energy in order to.....**

- |                               |   |
|-------------------------------|---|
| 1) decrease oil prices        | 2) decrease CO <sub>2</sub> discharges  |
| 3) publicise the two premises | 4) make oil a dominant source of energy |

**19. What is disadvantage of hydrogen as an energy source?**

- |                                |  |
|--------------------------------|--|
| 1) It has to be pure.          | 2) It is all over the place.                 |
| 3) It is not energy efficient. | 4) It is elixir of the world's energy supply |

**20. Hydrogen can be a good alternative energy source to oil because .....**

- |                                     |  |
|-------------------------------------|--|
| 1) it is an ideal gas               | 2) it is a scarce element                            |
| 3) it does not cause global warming | 4) it has low CO <sub>2</sub> emission to atmosphere |

**10) MSC Entrance Examination (1386)**

*Directions: Read the following passages and choose the best choice (1), (2), (3), or (4). Then mark it on your answer sheet.*

In leaching, soluble material is dissolved from its mixture with an inert solid by means of a liquid solvent. Typical countercurrent leaching plant consists of a series of units, in each of which the solid from the previous unit is mixed with the liquid from the succeeding unit and the mixture allowed to settle. The solid is then transferred to the next succeeding unit, and the liquid to the previous unit. As the liquid flows from unit to unit, it becomes enriched in solute, and as the solid flows from unit to unit in the reverse direction, it becomes impoverished in solute. The solid discharged from one end of the system is well extracted, and the solution leaving at the other end is strong in solute. The thoroughness of the extraction depends on the amount of solvent and the number of units. In principle, the unextracted solute can be reduced to any desired amount if enough solvent and a sufficient number of units are used.

**1. Which of the following words best describes the passage of the liquid and the solid from one unit to another?**

- |               |                    |
|---------------|--------------------|
| 1) alternate  | 2) counter current |
| 3) co-currnet | 4) succeeding      |

**2. What is the best meaning for impoverished as used in this text?**

- |               |              |
|---------------|--------------|
| 1) demoted    | 2) denatured |
| 3) devastated | 4) depleted  |

**3. What is the best meaning for discharged as used in this text?**

- |              |               |
|--------------|---------------|
| 1) disbanded | 2) dismissed  |
| 3) removed   | 4) introduced |

A diffusion driven desalination process was recently described where a very effective direct contact condenser with a packed bed is used to condense water vapor out of an air/ vapor mixture. A laboratory scale direct contact condenser with packed bed has been fabricated with co-current and counter current flow stages. Temperature and humidity data have been collected at the inlet and exit of the packed bed for different water to air mass flow ratios that vary between 0 and 2.5. The condenser effectiveness is strongly dependent on the water to air mass flow ratio and not sensitive to the air inlet temperature/ humidity. Because the temperature range is small at any cross section for the current application, a simplified two-fluid model using one-dimensional mass and energy conservation equations has been developed for co-current and countercurrent flow packed bed direct contact condensation heat and mass transfer. A one-dimensional model based on conservation principles, predicts the variation of temperature, humidity, and condensation rate through the condenser stages. In general, the analytical model proves to be quite satisfactory for predicting the thermal performance of both flow configurations.

**4. A direct contact condenser can be fabricated with ..... flow stages.**

- |               |                  |
|---------------|------------------|
| 1) vertical   | 2) perpendicular |
| 3) horizontal | 4) cocurrent     |

**5 . The condenser efficiency is sensitive to .....**

- |                |                                 |
|----------------|---------------------------------|
| 1) temperature | 2) humidity                     |
| 3) latent heat | 4) water to air mass flow ratio |

**6 . The two fluid model for heat and mass transfer in direct contact condensation has been used .....**

- 1) because of the low temperature variation.
- 2) because of the constant temperature
- 3) because of the low pressure variation
- 4) to develop one dimensional mass and energy conservation equation

**7 . In which case is the use of the analytical model satisfactory?**

- |  |                                       |
|--|---------------------------------------|
| 1) with caution for counter current flow | 2) cocurrent and countercurrent flows |
| 3) only cocurrent flow                   | 4) for vertical flow                  |

**Important determinants of solvent selection**

Early predictions suggested that solvents would eventually be eliminated from industrial applications because of health and environmental concerns. After a short period of a small decline in solvent use in 1990s, the solvent demand is now growing steadily by 2.3% per year.

At the same time, there have been changes in the types of solvents that are being used today. The general trend is towards elimination and replacement of some the more toxic and environmentally unfriendly species. There has been an increase in the use of high-performance solvents, as well as the application of enquiring controls to prevent accidental releases of solvents. In line with these trends, it is essential for chemical engineers to understand the parameters that are important for solvent selection, enabling them to choose a high- performance solvent for a particular application.

**8 . Solvent consumption is .....**

- |                     |                    |                   |                 |
|---------------------|--------------------|-------------------|-----------------|
| 1) being eliminated | 2) at steady state | 3) growing slowly | 4) growing fast |
|---------------------|--------------------|-------------------|-----------------|

**9 . Species means .....**

- |           |             |                   |             |
|-----------|-------------|-------------------|-------------|
| 1) brands | 2) elements | 3) microorganisms | 4) solvents |
|-----------|-------------|-------------------|-------------|

**10 .In line with these trends means, .....**

- |  |                                |
|--|--------------------------------|
| 1) in accordance with what was said before | 2) in harmony with consumption |
| 3) in comparison with others               | 4) nevertheless                |

**11 .To choose the right solvent .....**

- |  |                                   |
|--|-----------------------------------|
| 1) selection parameters should be understood | 2) prices should be compared      |
| 3) plant engineers should be trained         | 4) its performance should be high |

Research investigation for a chemical industrial company in general covers three main aspects. There is research on the existing processes, which has the objectives of improving the processes and lowering the costs; then there is a field of research arising from modifications and alterations to these processes and lastly there is exploratory research on entirely new processes and products.

**12 .One of the main objectives to carry out research in a chemical industrial company is:**

- |                                   |                                |
|-----------------------------------|--------------------------------|
| 1) decreasing taxes               | 2) increasing production costs |
| 3) changes in an existing process | 4) increasing maintenance      |

**13 .The result of research in a chemical industrial company can be:**

- |                          |                            |
|--------------------------|----------------------------|
| 1) abandoned product     | 2) completely new products |
| 3) conventional products | 4) traditional products    |

In one plant, odorous emissions were observed for several years near a drum dryer line used for volatilizing an organic solvent from a reaction mixture.

Although two and field testing indicated that the chemical compounds causing the odors were produced in upstream unit operations due to the hydrolysis of a chemical additive used in the process. The hydrolysis products were stripped out of the solution by the process solvent and appeared as odorous fumes at the dryer. Conditions for hydrolysis were favorable at upstream locations because of temperature and acidity conditions and the residence time available in the process. Also, the water for the hydrolysis was provided by another water – based chemical additive used in the dryer line that had the odor problem.

Because the cause of the odorous emission was the process chemistry, the plant had to evaluate ways to minimize hydrolysis and the resulting formation of odorous products. Ventilation modifications to mitigate the odor levels would not be a long-term solution to the odor problem.

**14 .The text talks about how the odors can be .....**

- 1) prevented                      2) observed                      3) generated                      4) emitted

**15 .The main source of odor was due to .....**

- 1) acidic conditions                      2) degradation of the organic solvent  
3) hydrolysis of a chemical compound                      4) long residence time conditions

**16 .Odor problem could be successfully overcome by .....**

- 1) adding a new line                      2) preventing hydrolysis  
3) strip out chemical compound                      4) ventilation

**17 .Water for hydrolysis comes from .....**

- 1) another chemical additive                      2) chemical reaction within the process  
3) odorous compound                      4) the other dryer line

The search for alternative sources of energy has led various directions. Many communities are burning garbage and other biological waste products to produce electricity. Converting waste products to gases or oil is also an efficient way to dispose of wastes.

Experimental work is being done to derive synthetic fuels from coal, oil shale, and coal tars. But to date, that process has proven expensive. Other experiments are underway to harness power with giant windmills. Geothermal power, heat from the earth, is also being tested.

Some expert experts utility companies to revive hydroelectric power derived from streams and rivers. Fifty years ago hydroelectric power provided one third of the electricity used in the United States, but today it supplies only 4 percent. The oceans are another potential source of energy. Scientists are studying ways to convert the energy of ocean currents, tides, and waves to electricity. Experiments are also underway to make use of temperature differences in ocean water to produce energy.

**18 .Which is the best title for the passage?**

- 1) The use of Water products for Energy                      2) New Discoveries in Geothermal Power  
3) Efficient Ways Of Disposing of Waste                      4) Alternative Sources of Energy

**19 .Which of the following is NOT mentioned in the passage as an alternative source of energy?**

- 1) Synthetic fuels                      2) Geothermal power                      3) Electricity                      4) Burning of garbage

**20 .What can be inferred from the last paragraph?**

- 1) All alternative production of energy will be derived from water.  
2) Alternative energy will come from a variety of sources.  
3) Hydroelectric power will be the main source of energy.  
4) Synthetic fuels will be the principal source of alternative energy.

### 11) MSC Entrance Examination (1387)

**Directions:** Read the following five passages and choose the best choice (1), (2), (3) or (4). Then mark it on your answer sheet.

#### PASSAGE 1:

Discarded tires have been a disposal problem in the past and continue to accumulate throughout the world today. Recent figures from the United States Environmental Protection Agency (EPA) show that over 279 million discarded tires are being added to an estimated 2-3 billion tires currently stockpiled around the US. The discarded tires can present both health and environmental hazards. Improperly stored tires are potential breeding grounds for diseases-carrying insects and rodents; tire fires can be difficult and expensive to extinguish and can cause air, soil and water quality problems.

#### 1. In the U.S., there are:

- |                                       |   |
|---------------------------------------|---|
| 1) little concerns about used tires   | 2) about 2-3 billion tires on the roads               |
| 3) billions of accumulated used tires | 4) millions of improper stockpiles of discarded tires |

#### 2. To extinguish means to .....

- |            |           |            |             |
|------------|-----------|------------|-------------|
| 1) put out | 2) expand | 3) destroy | 4) find out |
|------------|-----------|------------|-------------|

#### 3. Due to storage of discarded tires .....

- |  |  |
|--|--|
| 1) environmental hazards may be eliminated | 2) there will be potential for energy saving |
| 3) soil quality problem can be prevented   | 4) water pollution may happen                |

#### PASSAGE 2:

The human-relations aspect of engineering practice is not usually emphasized in undergraduate training because of the great quantity of technical information and techniques the student must learn. That this may be a fallacious course is implied by the fact that failures of young engineers because of personnel problems are at least five times as frequent as failures because of inadequate technical training. All engineers must realize that the industry in which they are working requires team effort of all personnel. Valuable information can be obtained from operators of limited educational background who have observed similar processes. The person who has "lived" with an operation has probably observed actions and effects and has learned methods of detailed control that cannot be approached by formal theory alone. The best engineering job can be done only with proper regard for all available facts regardless of their source. A new process or the technical improvement of an existing one designed without due regard for the operators is usually destined to failure. The start-up of a new plant or the installation of a technical change is likely to be much smoother and the cost of it much less if the operating personnel understand the objectives and are convinced of their soundness.

#### 4. According to the passage -----.

- 1) there is no failure of young engineers due to personal relations
- 2) inadequate technical information can be compensated by personal relations
- 3) failure of young engineers due to personal relations is five times greater than failure due to inadequate technical training
- 4) failure of young engineers due to inadequate technical training is five times greater than failure due to personal relations

**5. According to the passage personal relations aspect of engineering is not emphasized because.....**

- 1) it is not important in engineering practice
- 2) industry work does not require team effort
- 3) human relations aspect of engineering can be taught in industry
- 4) there is a lot of technical information to be taught in undergraduate training

**6. "Soundness" in the last sentence means that the objectives are .....**

- 1) lousy
- 2) logically valid
- 3) irrational
- 4) with sound

**7. According to the passage a lot of technical information can be obtained from .....**

- 1) operating personnel
- 2) human relations
- 3) the startup of a new plant
- 4) observing actions and effects

**PASSAGE 3:**

Batch reactors are one of the reactors that are extensively used in industry. Because of its flexibility and convenience in operation, batch reactors are always used in manufacturing products in small volume but of high added value. However, batch reactors are operated in a closed tank. Improper control may have other sub-reaction or cracking reaction not found in correct production. If out of control, reactors may reach high temperature and pressure beyond the endurance of the reactor, thus resulting in a runaway. Similar runaway phenomenon can be found in continuously stirred tank reactors (CSTRs).

**8. A runaway .....**

- 1) only occurs in CSTR
- 2) only occurs in batch reactors
- 3) is the limit of endurance of a batch reactor
- 4) is a situation which has grown out of control

**9. Batch reactors .....**

- 1) are operated at very high pressure and temperature
- 2) are used for massive production of expensive products
- 3) are used for production of expensive products
- 4) can be used for the production of a very limited range of products

**PASSAGE 4:**

Activated carbon (AC) has been widely used in various fields due to its outstanding adsorption capacity of organic compounds. AC can remove harmful organic compounds from industrial wastewaters. Recently, The demand for AC is growing rapidly in Korea as the emission standards of treated wastewater become more stringent. However, a disadvantage of using AC is its high cost in both operation and disposal of spent ones, which makes the regeneration of the spent activated carbon (SAC) economically feasible. Thermal regeneration has been a broadly applied method among various techniques, but, upon the regeneration, it suffers from production of air pollutants, a high energy input, decrease in hardness of AC, and enlargement of pore size.

As an alternative to the thermal regeneration, chemical' regeneration of SAC using organic solvents might be a choice due to its high regeneration rates as well as recovery of the original integrity of SAC. Chemical regeneration becomes more economical than thermal regeneration as the amount of adsorbate increases

**10. The emission standards of treated wastewater in Korea have become:**

- 1) tougher                      2) relaxed                      3) more complex                      4) more flexible

**11. What can be said for thermal regeneration of activated carbon?**

- 1) It encloses the pore size of activated carbon.                      2) It has been used more than other techniques.  
3) It increases the hardness of activated carbon.                      4) It has economical energy consumption.

**12. Chemical regeneration of activated carbon might be a better choice compared to thermal regeneration because:**

- 1) it is always more economical                      2) it uses an organic solvent  
3) the amount of adsorbate increases                      4) it produces reactivated carbon at a high rate

**PASSAGE 5:**

In recent years, the risks posed by chemical industries to life, property and environment has significantly increased due to many reasons: increased population density near industrial complexes, size of operation, complexity, and use of extreme operating conditions. This has led to the development and use of better hazard identification and analysis techniques like FMEA, QRA, HAZOP, etc. which try to reduce the frequency and consequences of accidents. Such safety analyses at later stages complicate the design and prompt additional costs. Estimates show that in the oil and chemical industries, 15-30% of capital cost is now spent on such safety and pollution prevention measures. This has challenged chemical industries to develop processes that are inherently safer, environmentally friendlier, simpler, and more cost effective.

Just because it has not happened yet, does not mean that one has a safe facility. Many people have said, "We haven't had an accident here in 15 years". They, therefore, assume they have a safe facility. Such a statement is an absolute fallacy. No doubt they said that one day before Bhopal, Chernobyl Pasadena, etc.

**13. In the second paragraph of the passage "an absolute fallacy" means:**

- 1) completely wrong                      2) unbelievable                      3) an exaggeration                      4) perfectly true

**14. In the first sentence in the second paragraph of the passage, "it" refers to:**

- 1) hazard                      2) an accident  
3) hazard analysis and identification                      4) frequency and consequences of accidents

**15. The hazards of chemical industries have increased recently because chemical factories:**

- 1) have become less complex                      2) use moderate temperatures and pressures  
3) have got bigger in size                      4) are situated near to less populated areas



## 12) MSC Entrance Examination (1388)

**Directions:** Read the following five passages and choose the best choice (1), (2), (3) or (4). Then mark it on your answer sheet.

### Passage I:

Often spectacular oxidation of organic matter by atmospheric oxygen occurs by combustion. The burning of trees, grass and petroleum are examples of oxidation through the combustion process. Many organic compounds can exist in the environment in the presence of the %20 of oxygen in the atmosphere without combustion occurring. However, ignition by a spark or flame initiates the occurrence of combustion. The burning or combustion of organic matter such as wood and petroleum, is a major source of energy in human society. This has a major impact on the occurrence of oxygen and carbon dioxide in the Earth's atmosphere. The energy produced by combustion of many organic compounds can be estimated. The production of this energy is critical to the use of organic compounds as fuels.

#### 1. What is the major source of energy in our life?

- 1) Nuclear                      2) Biomass                      3) Inorganic matter                      4) Organic matter

#### 2. "Spectacular" means:

- 1) Gentle                      2) Amazing                      3) Partial                      4) Spontaneous

#### 3. Oxygen depletion is because of .....

- 1) trees activities                      2) ignition by a flame  
3) release of oxygen from organic matter                      4) combinations of organic matters with oxygen

#### 4. Usually, the presence of oxygen will not affect organic compounds unless there is a/an .....

- 1) great accident                      2) increase in temperature  
3) major source of energy                      4) radical change in occurrence

#### 5. The text talks about:

- 1) Fuel from Oxidation                      2) Energy for Human Society  
3) Oxidation through Combustion                      4) Combustion through Oxidation

### Passage II

Leaching differs very little from the washing of filtered solids and leaching equipment strongly resembles the washing section of various filters. In leaching, the amount of soluble material removed is often rather greater than in ordinary filtration washing, and the properties of the solids may change considerably during the leaching operation. Coarse, hard, or granular feed solids may disintegrate into pulp or mush when their content of soluble material is removed.

When the solids form an open, permeable mass throughout the leaching operation, solvent may be percolated through an unagitated bed of solids. With impermeable solids or materials which disintegrate during leaching, the solids are dispersed into the solvent and are later separated from it. Both methods may be either batch or continuous.

#### 6. During filtration washing operation, the properties of the solvent may .....

- 1) remain the same                      2) change                      3) disintegrate                      4) improve

7. Which one of the following is the nearest in meaning to the underlined word **disintegrate** in the text?

- 1) dismantle                      2) give away                      3) take apart                      4) break up

8. From the text, it is understood that during leaching operation of permeable solids, the solvent may be ..... an unagitated bed of solids.

- 1) passed through                      2) poured out                      3) secreted into                      4) stirred in

9. Which one of the following is the nearest in meaning to the underlined word **dispersed** in the text?

- 1) decayed                      2) faded away                      3) destroyed                      4) discarded

10. Which of the following titles is the most appropriate for the passage?

- 1) The Leaching Process                      2) Filtration versus Leaching  
3) Leaching Equipment Performance                      4) Batch and Continuous Leaching Methods

### Passage III

Today's chemical process industry is gearing itself toward safer technology for a better environment. With increasing safety awareness in the industry and society, it has become every process engineer's responsibility to design a plant that provides minimum damage to the environment. The emphasis is often to minimize waste of materials and energy due to plant leaks.

Apart from pollution due to leakage of toxic materials, every drop leaked adds to the production cost. These leaks come from various sources-typically pumps, valves and flange joints. This can be reduced considerably, if not eliminated totally, by various steps. Valve leakage can be reduced by: 1) proper choice of valves with respect to material of construction, size and design conditions; 2) proper installation; 3) periodic and preventive maintenance. In spite of taking all precautions, there is a possibility of fluid leakage from the valve gland. A bellows seal valve remedies this problem.

11. Which of the following suggestions is the most suitable title for this passage?

- 1) How to minimize valve leakage  
2) Safer technology for a better environment  
3) Toxic pollution in the chemical process industries  
4) The importance of fluid leakage in chemical processes

12. Fluid leakage in chemical processes can lead to which of the followings:

- 1) reduction in pollution                      2) refrain from material waste  
3) increase in production costs                      4) decrease in energy consumption

13. Which of the bellows following suggestions can reduce leakage of the valves:

- 1) the use of bellow seal valve                      2) choice of valves  
3) installation of the valve                      4) prevention of valve maintenance

14. In the last sentence "remedies" means:

- 1) relieves                      2) activates                      3) aggravates                      4) intensifies

Part D: Fill in the blank by choosing the best choice (1), (2), (3), or (4). Then mark the correct choice on you answer sheet.

15. There are two ways of ..... a signal: (a) pneumatically, using compressed air or liquid, or (b) electrically, using electrical signals.

- 1) transferring                      2) transporting                      3) transmitting                      4) transcending

## SECTION 3      SELECTED TESTS

**Choose the correct choice.**

When a temperature gradient exists in a body, experience has shown that there is an .... 1 .... transfer from the high-temperature region to the low- temperature region. We say that the energy is transferred by ... 2 ... and that the heat transfer ... 3 ... per unit ... 4 ... is ... 5 ... to the normal temperature gradient.

- |                       |                 |               |              |
|-----------------------|-----------------|---------------|--------------|
| 1. 1) temperature     | 2) mass         | 3) momentum   | 4) energy    |
| 2. 1) radiation       | 2) convection   | 3) conduction | 4) diffusion |
| 3. 1) ratio           | 2) rate         | 3) value      | 4) amount    |
| 4. 1) length          | 2) width        | 3) region     | 4) area      |
| 5. 1) disproportional | 2) proportional | 3) lateral    | 4) vertical  |

**6. Thermodynamics is the study of energy and its .....**

- |                |                   |
|----------------|-------------------|
| 1) consumption | 2) utilization    |
| 3) application | 4) transformation |

**7. .... is the fluid property that causes shear stresses in a moving fluid.**

- |            |                  |              |               |
|------------|------------------|--------------|---------------|
| 1) Density | 2) Specific heat | 3) Viscosity | 4) Elasticity |
|------------|------------------|--------------|---------------|

**8. The three modes of heat transfer are conduction, radiation, and .....**

- |               |                |
|---------------|----------------|
| 1) convection | 2) expansion   |
| 3) separation | 4) contraction |

**9. When a thermodynamic system changes from one state to another, it is said to execute a ....**

- |              |           |            |              |
|--------------|-----------|------------|--------------|
| 1) procedure | 2) method | 3) process | 4) technique |
|--------------|-----------|------------|--------------|

**10. The boiling points of different substances .....**

- |             |               |
|-------------|---------------|
| 1) combines | 2) determines |
| 3) differs  | 4) measures   |

**11. When a state of equilibrium has been reached, diffusion .....**

- |           |            |              |           |
|-----------|------------|--------------|-----------|
| 1) begins | 2) changes | 3) continues | 4) ceases |
|-----------|------------|--------------|-----------|

**12. The word thermodynamics means heat power, or power ..... from heat.**

- |             |              |
|-------------|--------------|
| 1) expanded | 2) built     |
| 3) improved | 4) developed |

**13. The recycling of aluminum conserves ninety-five percent of the energy needed to make a new material. Recycling means .....**

- |              |                 |
|--------------|-----------------|
| 1) cleaning  | 2) reprocessing |
| 3) reselling | 4) crushing     |

**14. Linen could not be manufactured by machines until recently because the inelasticity of the fibres caused them to break readily under tension.**

- |             |           |                 |               |
|-------------|-----------|-----------------|---------------|
| 1) unevenly | 2) easily | 3) unexpectedly | 4) ultimately |
|-------------|-----------|-----------------|---------------|

15. Pollutants introduced into a lake can rapidly accelerate its natural aging process.

- 1) change  
2) speed up  
3) turn around  
4) destroy

16. When heat travels by conduction, ..... moves through a material without carrying any of the material with it.

- 1) what it  
2) which  
3) it  
4) and

17. .... is removal of a component by selectively dissolving it in a liquid.

- 1) Extraction  
2) Filtration  
3) Distillation  
4) Separation

18. If a fluid is passed upward through a bed of solids with a velocity high enough for the particles to separate and become freely supported in the fluid, the bed is said to be .....

- 1) liquefied  
2) fluidized  
3) neutralized  
4) pressurized

Filtration is the ... 19 ... of ... 20 ... from liquids by passing the mixture through a suitable medium such as filter ... 21 ... .

19. 1) mixing  
2) extraction  
3) separation  
4) agitation
20. 1) solids  
2) gases  
3) liquids  
4) chemicals
21. 1) glass  
2) wood  
3) cloth  
4) paper



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# **APPENDIX A**

## ***“Practice Tests”***

## PRACTICE TEST 1

Required Time: 15 minutes

Choose the correct choice.

1. The word thermodynamics means heat power, or power .... from heat.

- |             |              |
|-------------|--------------|
| 1) expanded | 2) built     |
| 3) improved | 4) developed |

2. The three modes of heat transfer are convection, radiation, and ....

- |               |               |
|---------------|---------------|
| 1) conduction | 2) extraction |
| 3) separation | 4) agitation  |

3. When a thermodynamic system changes from one state to another, it is said to execute a ...

- |              |              |
|--------------|--------------|
| 1) procedure | 2) method    |
| 3) process   | 4) technique |

4. The recycling of aluminum conserves ninety-five percent of the energy needed to make a new material. Recycling means ...

- |              |                 |
|--------------|-----------------|
| 1) cleaning  | 2) reprocessing |
| 3) reselling | 4) crushing     |

Read the following passage and choose the correct choice.

Distillation, the process of separating the elements of a solution, is widely used in industry today. The two most common methods of distillation are fractional distillation and flash distillation, used for the conversion of ocean water to fresh water.

In fractional distillation a mixture is separated into its various component parts by boiling. This method makes use of the fact that different elements boil at varying temperatures. For example, alcohol has a considerably lower boiling temperature than water; the boiling temperature of water is 100°C, and the boiling temperature of alcohol is 78°C. Thus, when a mixture of alcohol and water is heated, the alcohol vaporizes more quickly than the water. The distillate is collected and the process is repeated until the desired purity has been achieved.

Flash distillation does not require high temperatures but instead is based on pressure. In this process, a liquid that is to be separated is forced from a compartment kept under high pressure into a compartment kept at a lower pressure. When a liquid moves into the low-pressure chamber, it suddenly vaporizes, and the vapor is then condensed into distillate.

5. The word "fresh" (underlined), in the first paragraph, could most easily be replaced by .....

- |                  |              |
|------------------|--------------|
| 1) original      | 2) modern    |
| 3) inexperienced | 4) nonsaline |

6. According to the passage, what makes fractional distillation occur?

- |         |             |
|---------|-------------|
| 1) Time | 2) Pressure |
| 3) Heat | 4) Water    |

**7. According to the passage, what happens when water and alcohol are heated together?**

- 1) Both the water and the alcohol evaporate at the same rate.
- 2) The alcohol cannot evaporate because of the water.
- 3) The alcohol evaporates at a temperature of 100°C.
- 4) The alcohol evaporates from the mixture first.

**8. According to the passage, in the flash distillation process, what causes the liquid to vaporize?**

- 1) The pressure on the liquid is suddenly changed.
- 2) The liquid changes compartments.
- 3) The addition of seawater to a solution causes a chemical change to occur.
- 4) There is a rapid increase in the pressure on the liquid.

**9. Which of the following processes would probably involve distillation?**

- 1) Adding a new substance to a mixture
- 2) Dividing a pure element into smaller quantities
- 3) Mixing two elements together to form a new solution
- 4) Removing impurities from a solution

**10. The word "vaporizes" (underlined), in the last paragraph, could best be replaced by .....**

- |                     |               |
|---------------------|---------------|
| 1) becomes gaseous  | 2) disappears |
| 3) becomes stressed | 4) solidifies |

**11. The word "thus" in line 7 is closest in meaning to which of the following?**

- |            |             |                |              |
|------------|-------------|----------------|--------------|
| 1) However | 2) Moreover | 3) Furthermore | 4) Therefore |
|------------|-------------|----------------|--------------|

**12. The main purpose of this passage is to**

- 1) explain how salt water can be turned into fresh water
- 2) give an example of fractional distillation
- 3) describe a scientific process
- 4) discuss the boiling temperatures of various liquids



## PRACTICE TEST 2

Required Time: 15 minutes

Choose the correct choice.

1. .... is a technique whereby gas or vapor is passed through solids so that the mixture behaves as a liquid.

- 1) Fermentation                      2) Coagulation                      3) Fluidization                      4) liquefaction

Fermentation is a ... 2 ... pathway whereby organic compounds, especially carbohydrates, are broken down ... 3 ... in the absence of ... 4 ... .

2. 1) electrochemical                      2) biochemical                      3) biomechanical                      4) chemical  
3. 1) systematically                      2) mechanically                      3) chemically                      4) enzymatically  
4. 1) oxygen                      2) hydrogen                      3) nitrogen                      4) phosphorous

... 5 ... is the extraction of a soluble metallic compound from an ore by ... 6 ... in a solvent.

5. 1) Leaching                      2) Drying                      3) Pulping                      4) Bleaching  
6. 1) washing                      2) dissolving                      3) mixing                      4) exposing  
7. When the entropy of a system is constant during a reversible adiabatic process, the process is said to be ....  
1) isobaric                      2) isentropic                      3) adiabatic                      4) isothermal

8. The only method by which heat can travel in a vacuum is by ... .

- 1) conduction                      2) convection                      3) insulation                      4) radiation

9. The production of steel and the mining of coal are predominant industries of Pennsylvania.

- 1) principal                      2) inactive                      3) archaic                      4) overlooked

10. Sustained industrial growth and strong consumer spending must be present in order for an economy to grow.

- 1) tangible                      2) consistent                      3) moderate                      4) measurable

Read the following passage and choose the correct choice.

Convective flow should be familiar to anyone who has noted the boiling of a heated liquid. The most elementary type of convection can be explained by the fact that heat rises. In the simplest cases, convective flow begins when a fluid is heated from below. As the bottom layer of the fluid is heated, it expands and thus becomes less dense than the layers above. The warmer and lighter bottom layer then tends to rise and the cooler layer tends to sink in a continuous cycle. The same mechanism of convective flow is responsible for the great ocean currents and for the global circulation of the atmosphere. In an ocean, the water is warmed by the Sun to a depth of perhaps thirty meters, and evaporation near the water's surface is responsible for the cooling effect.



**11. The main purpose of this passage is to .....**

- 1) explain the basic principle of convection
- 2) describe regular changes in the Earth's atmosphere
- 3) explain the boiling temperatures of liquids
- 4) state the principles of ocean currents

**12. According to the passage, what happens as a fluid is warmed?**

- 1) The bottom layer sinks.
- 2) The circulation stops.
- 3) It becomes very sensitive to light.
- 4) It becomes less dense.

**13. What does the passage say about ocean currents?**

- 1) They circulate locally as well as globally.
- 2) They usually cause a rise in air temperature.
- 3) They interfere with atmospheric circulation.
- 4) They are caused by circular flow.

**14. According to the passage, which of the following is the result of convective flow?**

- 1) The electric currents in the atmosphere
- 2) The power of oceangoing vessels
- 3) The movement of air around the Earth
- 4) The daily rotation of the globe

**15. A simple example of convection could be seen in .....**

- 1) a cake baking
- 2) a pot of soup heating
- 3) sunlight being absorbed by a plant
- 4) water dripping from a faucet



## PRACTICE TEST 3

Required Time: 12 minutes

Fill in the blanks with the most appropriate answers.

1. If a fluid is passed upward through a bed of solids with a velocity high enough for the particles to separate and become freely supported in the fluid, the bed is said to be .....

- |                |                |
|----------------|----------------|
| 1) liquefied   | 2) fluidized   |
| 3) neutralized | 4) pressurized |

Filtration is the ... 2 ... of ... 3 ... from liquids by passing the mixture through a suitable medium such as filter ... 4 ... .

- |              |               |               |              |
|--------------|---------------|---------------|--------------|
| 2. 1) mixing | 2) extraction | 3) separation | 4) agitation |
| 3. 1) solids | 2) gases      | 3) liquids    | 4) chemicals |
| 4. 1) glass  | 2) wood       | 3) cloth      | 4) paper     |

... 5 ... process is a process which occurs without ... 6 ... of heat with surroundings.

- |                      |                |                 |                |
|----------------------|----------------|-----------------|----------------|
| 5. 1) Adiabatic      | 2) Isothermal  | 3) Isobaric     | 4) Isentropic  |
| 6. 1) transformation | 2) interchange | 3) transmission | 4) utilization |

Read the following passage and choose the correct choice.

Many chemical industries require large amounts of low-cost electrical power for their operations. Hydro power, developed in times when capital and interest costs were low, is frequently very inexpensive, but most large sources in the developed countries have been exploited, and small units produce electricity at higher cost. Hydroelectric plants must be situated where a head of water is available from a waterfall or a dam. This water is used to drive a turbine attached directly to a generator. The initial cost of a hydroelectric plant is much greater than that of a steam plant of identical size, but the operating cost is far lower.

7. What is the main topic of this passage?

- 1) Electrical power in developed countries
- 2) Hydroelectric power
- 3) Low-cost electrical power
- 4) Initial and operating costs of a hydroelectric power

8. The word "exploited" (underlined) is closest in meaning to which of the following?

- |                            |              |
|----------------------------|--------------|
| 1) to use or develop fully | 2) to misuse |
| 3) to misapply             | 4) to abuse  |

9. The operating cost of a hydroelectric plant is

- |   |   |
|---|---|
| 1) much higher than that of a steam plant | 2) almost the same as that of a steam plant |
| 3) much lower than that of a steam plant  | 4) fairly lower than that of a steam plant  |

10. The word "identical" (underlined) is closest in meaning to which of the following?

- |             |             |
|-------------|-------------|
| 1) the same | 2) unlike   |
| 3) unified  | 4) not like |

## PRACTICE TEST 4

Required Time: 12 minutes

Read the following passage and choose the correct choice.

Magnesium is another mineral we now obtain by collecting huge volumes of ocean water and treating it with chemicals, although originally it was derived only from brines or from the treatment of such magnesium-containing rocks as dolomite, of which whole mountain ranges are composed. In a cubic mile of seawater there are about four million tons of magnesium. Since the direct extraction method was developed about 1941, production has increased enormously. It was magnesium from the sea that made possible the wartime growth of the aviation industry, for every airplane made in the United States ( and in most other countries as well) contains about half a ton of magnesium metal. And it has innumerable uses in other industries where a lightweight metal is desired, besides its long standing utility as an insulating material, and its use in printing inks, medicines, and toothpastes.

**1. What is the main topic of this passage?**

- 1) Uses of seawater
- 2) Treatment of seawater
- 3) Chemical properties of magnesium
- 4) Derivation and uses of magnesium

**2. According to the passage, magnesium was first obtained from**

- 1) rocks found on land
- 2) great amounts of ocean water
- 3) the sea floor
- 4) major industrial sites

**3. According to the passage, which of the following was a direct consequence of the new method of obtaining magnesium?**

- 1) The development of insulation materials
- 2) Increased airplane production
- 3) Improved medical facilities
- 4) The development of cheap inks for printing

**4. According to the passage, why is magnesium important to industry?**

- 1) It is strong
- 2) It conducts heat well
- 3) It weighs little
- 4) It is inexpensive to produce

**5. It can be inferred from the passage that during the past fifty years the demand for magnesium has .....**

- |                       |                       |
|-----------------------|-----------------------|
| 1) declined greatly   | 2) remained stable    |
| 3) increased slightly | 4) risen dramatically |

Choose the correct choice.

6. .... is the fluid property that causes shear stresses in a moving fluid.

- |              |                  |
|--------------|------------------|
| 1) Density   | 2) Specific heat |
| 3) Viscosity | 4) Elasticity    |

7. Linen could not be manufactured by machines until recently because the inelasticity of the fibres caused them to break readily under tension.

- |                 |               |
|-----------------|---------------|
| 1) unevenly     | 2) easily     |
| 3) unexpectedly | 4) ultimately |

8. Pollutants introduced into a lake can rapidly accelerate its natural aging process.

- |                |             |
|----------------|-------------|
| 1) change      | 2) speed up |
| 3) turn around | 4) destroy  |

9. When heat travels by conduction, ..... moves through a material without carrying any of the material with it.

- |            |          |
|------------|----------|
| 1) what it | 2) which |
| 3) it      | 4) and   |

10. .... is removal of a component by selectively dissolving it in a liquid.

- |                 |               |
|-----------------|---------------|
| 1) Extraction   | 2) Filtration |
| 3) Distillation | 4) Separation |



## PRACTICE TEST 5

Required Time: 15 minutes

Choose the correct choice.

- 1. A quantity which is either an attribute of an entire system or is a function of position which is continuous and does not vary rapidly over microscopic distances, except possibly for abrupt changes at boundaries between phases of the system.**
  - 1) boundary layer
  - 2) kinematic viscosity
  - 3) solid state property
  - 4) thermodynamic property
- 2. A fundamental law, important to the chemical engineer, is the conservation of mass, stating that there ..... during the course of a chemical process.**
  - 1) may be no chemical change
  - 2) can be no transformation of mass to energy
  - 3) may be no molecular exchange
  - 4) can be no net loss or gain of mass
- 3. The rate at which a chemical reaction, or any other system for that matter, approaches equilibrium is, in part, controlled by .....**
  - 1) the pressure and temperature gradients
  - 2) the concentration differentials
  - 3) the potential factor or driving force
  - 4) the operating conditions set by the operator

Read the following passage and choose the correct answer.

Most ionic crystals and their aqueous solutions are transparent in visible light. Moreover, they are soluble in water at room temperature, and thus we can easily monitor the growth of ionic crystals from aqueous solutions by optical microscopy.

Ionic crystals grown in aqueous solution show various habits, a polyhedron bounded by flat surfaces (faceted form), a skeletal form and a dendrite form, depending on the constituent elements, crystal structures and growth conditions. These observations and various habits of ionic crystals have been attractive to many researchers on crystal growth. There are thus many reports on the growth of ionic crystals, which are summarized in Papapetrou's report [1].

However, the growth situation of ionic crystals is never simple. We have hardly any information on diffusion of ions in concentrated solutions, dehydration of ions inserted onto kink sites at growth interfaces and dehydration processes at kink sites.

Both water and aqueous solutions have their own characteristic structures. A dilute aqueous solution of ions can be regarded as a mixture of normal water and hydrated ions which have hydration spheres, which contain more or less differently structured water compared with normal water. The region of more ordered water molecules is termed the structure-making region or positive hydration region. Some ions are believed to have a less ordered hydration sphere than the ordering of molecules in normal water, and the less ordered water layer is called the structure-breaking region or negative hydration region by Frank and Wen [2] and by Samoilov [3], respectively. Concentrated aqueous solutions consist of an assembly of hydrated ions and practically no normal water is present. Thus, a problem might arise as to how ions diffuse through the gaps between hydration spheres.

When an ion deposits on a growing interface, the ion should be dehydrated, at least partly, and then it should enter a kink site. Since the ion acts as a part of the growing surface and the growing surfaces must be fully hydrated, the degree of the partial dehydration of the newly entering ion must depend on the kink site structure where it enters.

- 4. The visual characteristics of ionic crystal solution are said to be ..... .**  
1) solvable                      2) visible                      3) heterogeneous                      4) transparent
- 5. According to the passage, which method of detection can be used for monitoring the growth rate?**  
1) Peftaction index                      2) Spectrophotometry  
3) Gas chromatography                      4) Liquid chromatography
- 6. The text implies that crystal form depends on ..... .**  
1) magnetic field                      2) attraction power  
3) operating pressure                      4) components comprising the solution
- 7. The text states that the growth situation of ionic crystals is ..... .**  
1) complex                      2) impossible  
3) independent of diffusion                      4) independent of concentration
- 8. According to the text, which region is said to be structure-making?**  
1) The assembly region                      2) The less ordered molecules region  
3) The positive hydration region                      4) The negative hydration region
- 9. What is abundant in concentrated aqueous solutions?**  
1) Assembly line                      2) Hydrated ions                      3) Polarity gaps                      4) Abnormal water
- 10. What mechanism is involved in crystal growth?**  
1) Diffusion                      2) Convection                      3) Ion inhibition                      4) Gap formation



## PRACTICE TEST 6

Required Time: 15 minutes

Choose the correct answer.

1. Costs directly related to production costs are .....

- |                   |                        |
|-------------------|------------------------|
| 1) variable costs | 2) manufacturing costs |
| 3) fixed charges  | 4) overhead charges    |

2. Should the heat transfer coefficient of the fluid flowing inside a tube be lower than that flowing on the outside, then the inner surfaces of the tube may be provided with fins.....

- |                                  |                                 |
|----------------------------------|---------------------------------|
| 1) to support the tubes          | 2) to facilitate heat transfer  |
| 3) to reduce rate of energy flow | 4) to restrict the path of flow |

3. It is apparent that higher heat-transfer coefficients result when a liquid is maintained in a state of turbulence.

The most relevant meaning for the above statement is that.....

- 1) heat-transfer coefficients are independent of the state of turbulence
- 2) It is apparent that higher turbulence of a liquid causes better heat transfer
- 3) maintaining the turbulent state of a liquid increases heat transfer coefficients
- 4) It is evident that higher heat transfer causes an increase in the rate of coefficient

The profession of engineering takes the knowledge of mathematics and natural sciences gained through study, experience, and practice and applies this knowledge with judgement to develop ways to utilize the materials and forces of nature for the benefit of all humans.

An engineer is a person who possesses this knowledge of mathematics and natural sciences, and through the principles of analysis and design, applies this knowledge to the solution of problems and the development of devices, processes, structures, and systems for the benefit of all humans.

The end result of an engineering effort, generally referred to as design, is a device, structure, system, or process which satisfies a need. A successful design is achieved when a logical procedure is followed to meet a specific need. The procedure, called the design process, is similar to the scientific method with respect to a step-by-step routine, but it differs in goals and end results. The design process encompasses the following activities, all of which must be completed.

- |                             |                          |
|-----------------------------|--------------------------|
| 1) Identification of a need | 6) Alternative solutions |
| 2) Problem definition       | 7) Analysis              |
| 3) Search                   | 8) Decision              |
| 4) Constraints              | 9) Specification         |
| 5) Criteria                 | 10) Communication        |

In the majority of cases, designs are not accomplished by an engineer simply completing the 10 steps shown in the order given. As the designer proceeds through each step, new information may be discovered and new objectives may be specified for the design. If so, the designer must backtrack and repeat steps. For example, if none of the alternatives appear to be economically feasible when the final solution is to be selected, the designer must redefine the problem or possibly relax some of the criteria to admit less expensive alternatives. Thus, because decisions must frequently be made at each step as a result of new developments or unexpected outcomes, the design process becomes iterative.

**4. What does "possess" mean in the 2nd paragraph?**

- 1) Have                                      2) Play                                      3) Postpone                                      4) Practice

**5. What does "encompass" mean in the 3rd paragraph?**

- 1) Remind                                      2) Protect                                      3) Explain                                      4) Cover

**6. The ..... of an engineering effort of design is usually a device, or a structure which satisfies a need.**

- 1) Application                                      2) Object                                      3) Process                                      4) Routine

**7. Under what circumstances the designer should possibly modify and reduce some aspects of the problem.**

- 1) When it is difficult to justify within the budget limits.  
2) When it is difficult to define the problem.  
3) When it is difficult to analyze the problem.  
4) When it is difficult to communicate with other designers.

Reactors are used in many industries. There are catalytic crackers for oil refining; blast furnaces for iron making; activated sludge ponds for sewage treatment; polymerization tanks for plastics, paints, and fibers; pharmaceutical vats for producing drugs, and fermentation. To find out what a reactor is able to do, three things must be known: the kinetics, the contacting pattern, and the performance equation.

Kinetics is a study of how fast things happen in the reactor. If a reaction is fast, equilibrium calculations will predict the amount of each component. If the reaction is not fast, then the rate of chemical reaction, the rate of heat transfer, or rate of mass transfer will determine the amounts of the components present.

The contacting pattern refers to how the materials flow through the contactor, when they mix, and the clumpiness or segregation. Finally the most important quantitative relationship is the performance equation. The performance equation relates the input to the output for various kinetics and contacting patterns. A generalized form of a performance equation is:  $\text{output} = f(\text{input, kinetics, contacting pattern})$ . The performance equation predicts the effects of changing various parameters, and enables the best design to be selected.

**8. To show how the material flows through the contactor, one should consider the .....**

- 1) catalytic cracker                                      2) contacting pattern  
3) kinetics                                      4) performance equation

**9. Using the performance equation, one can .....**

- 1) find out how fast the reaction is  
2) find out the phase equilibrium conditions  
3) predict the results that may be required for other calculations  
4) predict the effects of changing various parameters and selecting the best design

**10. At equilibrium, it is possible to predict the amount of each component when .....**

- 1) the reaction is fast                                      2) the reaction is slow  
3) there is no reaction                                      4) the reaction has no effect

**11. To evaluate the capability of a reactor, things that must be known are the .....**

- 1) kinetics and the contacting pattern  
2) contacting pattern, the performance equation, and state of being  
3) contacting pattern, the kinetics, and the input conditions  
4) kinetics, the contacting pattern, and the performance equation



## PRACTICE TEST 7

Required Time: 15 minutes

Fill in the blanks with the most appropriate words.

- In ....., a soluble constituent of the gas stream is transferred into the liquid absorbent stream.**
  - 1) gas absorption equipment
  - 2) large distillation columns
  - 3) industrial desorption units
  - 4) certain stripping processes
- Examination of new processes to assess feasibility or performance assessment of existing processes is called .....**
  - 1) process control
  - 2) process design
  - 3) process analysis
  - 4) process integration
- When dealing with industrial dryers, the method of ..... the thermal energy to the wet solid should be closely considered.**
  - 1) transporting
  - 2) transferring
  - 3) dispatching
  - 4) conveying
- Those properties of a system which are independent of the history of the system, that is the path followed by a system in passing from one state to another, but, on the other hand, are dependent only on the end states, are called .....**
  - 1) path functions
  - 2) state functions or point functions
  - 3) intensive or specific properties
  - 4) energy, enthalpy, and entropy
- Unlike liquids, gases are easily compressed and hence, the effect of ..... and changes of internal energy must be considered.**
  - 1) expansivity
  - 2) compressibility
  - 3) variability
  - 4) stability
- For economic and technical reasons, most chemical processing operations are designed to run .....**
  - 1) under transient or unsteady conditions
  - 2) in a continuous manner
  - 3) as a batch operation
  - 4) on inexpensive feed material

From physical experience, we know that a flow of energy or matter can be set up in a conducting system whenever there is a spatial gradient of a state variable, for example, temperature, pressure or voltage. All fluxes will vanish under condition of spatial homogeneity where the spatial gradients of all state variables are zero. Irreversible thermodynamics provides a more specific statement. Recall that an intensive thermodynamic property is independent of mass or size of the system the converse holding for an extensive property.

- Having read the text, one may recall that an intensive thermodynamic property is .....**
  - 1) dependent on size alone
  - 2) dependent on the mass alone
  - 3) independent of mass or size of the system
  - 4) not independent of mass or size of the system

**Read the following passage and choose the correct choice.**

Renewable energies are fashionable again -- but what is the true motivation for their popularity? The first provocation for change is usually economics. On paper renewable energies can be made to appear a bargain, provided the required subsidies are concealed in fuzzy accounting, with the source of subsidies -- taxpayers -- not being mentioned.

Use of primary fuels, including natural gas and the derivatives from crude oil, may not often approach ideal efficiencies on an absolute basis, but when compared with renewable fuels on a 'cradle-to-grave' basis, primaries win hands down -- particularly economically. The petroleum industry has been around for quite a while, and is mature. It can find the shortest (cheapest) route to a solution, it has remarkable flexibility to a changing product slate, and is continuously striving for improved efficiency. Like the petroleum industry, the natural gas industry is as economically efficient as is feasible. The world's industrial, transport, and domestic energy markets depend intensively on these particular energy sources. The primary energies have to be technically cost effective.

To displace the primary energies from their markets, or even to capture a fraction for a measurable period, requires sound economics. Renewable energies have not been able to exhibit this quality.

**8. The renewable energies ..... gases.**

- 1) easily achieve better quality energy than
- 2) are exhibiting more energy than natural
- 3) are not able to exhibit quality energies compared to natural
- 4) cheaper and easier in transportation than natural

**9. According to the text, natural gas and derivatives from crude oil ..... .**

- 1) are more expensive than the renewable energies
- 2) produce cheaper energies than the renewable ones
- 3) are producing more air pollution than the renewable materials
- 4) are very difficult to be changed to thermal energy than the renewable ones

**10. From the passage, one concludes that the efficiency of producing energy from renewable energies**

- ..... .
- 1) more economical than other sources
  - 2) less cost effective than the crude oil derivatives
  - 3) much more than other sorts of energy sources
  - 4) more than the other sources because it is easily transported

## PRACTICE TEST 8

Required Time: 15 minutes

Fill in the blanks with the most appropriate words.

1. **Accurate.....of temperature, in the form of electrical signals, may be conducted using thermocouples, thermistors, etc.**

- 1) observations
- 2) measurements
- 3) estimations
- 4) calculations

The transfer of heat in fluids may be brought about by conduction, convection, diffusion, and radiation. The transfer of heat by convection does not give rise to any new transport property. Heat transfer can also take place because of the interdiffusion of various species.

2. **According to the text, heat transfer is about .....**

- 1) solids
- 2) liquids and gases
- 3) liquids
- 4) all the states of matter

3. **The text states that the .....**

- 1) interdiffusion of various species gives rise to a new transport property
- 2) transfer of heat in fluids does not give rise to any new transport property
- 3) interdiffusion of various species takes place by conduction, convection and diffusion alone
- 4) transfer of heat in fluids may be brought about by conduction, convection, diffusion and radiation

The overall rate is controlled by the rate of the slowest step. This is then called the rate determining step or rate limiting step. If the rate limiting step is either step one or three, which involve the introduction or removal of reactants, then the reaction is called diffusion controlled with the rate governed by the mass transport relations previously set out.

4. **The passage implies that the .....**

- 1) slowest step controls the rate
- 2) slowest step may control the rate
- 3) slowest step controls the overall rate
- 4) none of the above

5. **From the text, one understands that .....**

- 1) diffusion controlled is the rate governed by mass transport
- 2) the mass transport relations were previously set out
- 3) it is the slowest step that is important not the rate determining step
- 4) reactions may involve the introduction or removal of reactants

6. **The paragraph states that the .....**

- 1) rate determining step is the rate of one step
- 2) rate determining step is the rate limiting step
- 3) rate determining step is not the rate limiting step
- 4) none of the above

Frictionless adiabatic and frictionless isothermal processes are internally and externally..... . The increase of entropy principle provides one of the criteria of ..... of any system. In a piston, when the insulation is put back on the cylinder head and the gas is compressed ..... and adiabatically, its temperature and pressure will increase.

7.

- 1) reversible, irreversibility, reversibly
- 2) reveysible, irreversible, irreversibility
- 3) reversible, reversibility, irreversibility
- 4) reverse, reversible, irreversibility

**Read the following passage and choose the correct choice.**

Because so few real flows can be solved exactly by analytical methods alone, the development of fluid mechanics has depended heavily on experimental results. Solutions of real problems usually involve a combination of analysis and experimental information. First, the real physical flow situation is approximated with a mathematical model that is simple enough to yield a solution. Then experimental measurements are made to check the analytical results. Based on the measurements, refinements in the analysis are made. The experimental results are an essential link in this iterative process. Empirical designs, developed without analysis or careful review of available experimental data, are often high in cost and poor or inadequate in performance.

**8. According to the text, ..... .**

- 1) experimental results are available for all fluid flows.
- 2) many fluid flows can be solved by analytical methods only.
- 3) analytical methods are available for most real fluid flows.
- 4) only a small number of real fluid flows can be solved by mathematical techniques alone.

**9. According to the author, ..... .**

- 1) designs made based merely on empirical concepts are not recommended.
- 2) experimental results are as essential as empirical concepts in a design.
- 3) empirical designs are as useful as designs based on experimental results.
- 4) empirical concept designs are always invalid and must be avoided due to poor performance.

**10. The author believes that ..... .**

- 1) experiments are used to verify the analytical results.
- 2) mathematical models justify experimental measurements.
- 3) the experimental results are necessary to obtain the analytical results.
- 4) the analytical results and mathematical models must be obtained to verify the experimental results.



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## **APPENDIX B**

### ***“Suffixes & Prefixes”***

## Word formation - Suffixes

### AFFIXES

PREFIXES + (STEM) + SUFFIXES

### SUFFIXES

NOUNS	VERBS	ADJECTIVE	ADVERBS
-ance	-ize	-able	-ly
-ence	-ate	-ible	
-or	-fy	-less	
-er	-en	-ic	
-ist	-ify	-ical	
-ness		-ish	
		-ive	

### Noun-forming suffixes

SUFFIX	MEANING	EXAMPLES
-ance	state	performance
-ence	quality of	independence
-er, -or	a person who	programmer, operator
	a thing which	compiler, accumulator
-ation	the act of	execution
-tion		
-ista	person who	analyst, typist
-yst		
-ness	condition of	cleanliness
-ion	action/state	conversion
-ing	activity	multiplexing
-ment	state, action	measurement
-ity	state, quality	electricity
-ian	pertaining to	electrician
-ism	condition/state	magnetism
-dom	domain/condition	freedom
-ship	condition/state	relationship, partnership, friendship
-ary		binary

### Verb-forming suffixes

SUFFIX	MEANING	EXAMPLES
-ize	to make	computerize
-ate		automate, activate, calculate
-fy		simplify
-en		harden, widen

### Adverb-forming suffix

SUFFIX	MEANING	EXAMPLES
-ly	in the manner of	electronically, logically, comparably, helpfully

### Adjective-forming suffixes

SUFFIX	MEANING	EXAMPLES
-al	have the quality of	computational, logical
-ar		circular
-ic		magnetic
-ical		electrical
-able	capable of being	comparable
-ible		divisible
-ous	like, full of	dangerous
-ious		religious
-ful	characterized by	helpful
-less	without	careless
-ish	like	yellowish
-ed	having	computed, punched
-ive	quality of	interactive
-ing	to make or do	programming, coding, processing, multiplexing

## Word formation - prefixes

### PREFIXES

NEGATIVE AND POSITIVE	SIZE	LOCATION	TIME AND ORDER	NUMBER
un-	semi-	inter-	pre-	mono-
non-	mini-	super-	ante-	bi-
in-	micro-	trans-	fore-	hex-
dis-		ex-	post-	oct-
re-		extra-		multi-
		mid-		

### Negative and positive prefixes

PREFIX	MEANING	EXAMPLES
<u>Negative</u>		
un-	not,	unmagnetized, unpunched
in-	not good enough	incomplete
im-		impossible
il-		illegal
ir-		irregular, irrelevant
non-	not connected with	non-programmable, non-impact
mis-	bad, wrong	mispronounce
dis-	opposite feeling opposite action	disagree disconnect
anti-	against	antisocial
de-	reduce, reverse	demagnetize, decode
under-	too little	underestimate
<u>Positive</u>		
re-	do again	reorganize
over-	too much	overheat, overuse



### Prefixes of size

PREFIX	MEANING	EXAMPLES
semi-	half, partly	semiconductor
equi-	equal	equidistant
maxi-	big	maxicomputer
micro-	small	microcomputer
mini-	little	minicomputer
macro-	large	macroeconomics
mega-		megabyte

### Prefixes of location

PREFIX	MEANING	EXAMPLES
inter-	between, among	interface, interactive
super-	over	supersonic
trans-	across	transmit, transfer
ex-	out	exclude, extrinsic
extra-	beyond	extraordinary
sub-	under	subschema
infra	below	infra-red
peri-	around	peripheral

### Prefixes of time and order

PREFIX	MEANING	EXAMPLES
ante-	before	antecedent
pre-		prefix
prime-	first	primary, primitive
post-	after	postdated
retro-	backward	retroactive

### Prefixes of numbers

PREFIX	MEANING	EXAMPLES
semi-	half	semicircle
mono-	one	monochromatic
bi-	two	binary
tri-	three	triangle
quad-	four	quadruple
penta	five	pentagon
hex-	six	hexadecimal
septem-	seven	September
oct	eight	octal
dec-	ten	decimal
multi	many	multiprogramming, multiplexor

### Other prefixes

PREFIX	MEANING	EXAMPLES
pro-	for	program
auto	self	automatic
co-	together	coordinate
neo-	new	neoclassical
pan-	all	Pan-American



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# APPENDIX C

*“Answer Key”*

## SECTION 2 (M.Sc. EXAM's QUESTIONS)

**1376**

1- (3)	2- (1)	3- (2)	4- (4)	5- (2)
6- (2)	7- (4)	8- (3)	9- (4)	10- (1)

**1377**

1- (1)	2- (2)	3- (4)	4- (1)	5- (1)
6- (2)	7- (2)	8- (2)	9- (3)	10- (2)
11- (1)	12- (1)	13- (4)	14- (3)	15- (4)
16- (4)	17- (3)	18- (2)	19- (1)	20- (2)
21- (4)	22- (2)	23- (1)	24- (4)	25- (3)
26- (2)	27- (3)	28- (2)	29- (4)	30- (3)

**1378**

1- (2)	2- (4)	3- (4)	4- (3)	5- (2)
6- (3)	7- (2)	8- (4)	9- (3)	10- (3)
11- (2)	12- (1)	13- (3)	14- (4)	15- (2)
16- (1)	17- (4)	18- (4)	19- (3)	20- (3)

**1379**

1- (1)	2- (1)	3- (4)	4- (2)	5- (3)
6- (4)	7- (3)	8- (2)	9- (2)	10- (3)
11- (4)	12- (1)	13- (3)	14- (4)	15- (1)
16- (4)	17- (4)	18- (2)	19- (3)	20- (1)

**1380**

1- (4)	2- (4)	3- (3)	4- (2)	5- (2)
6- (4)	7- (4)	8- (3)	9- (2)	10- (1)
11- (4)	12- (4)	13- (4)	14- (2)	15- (1)
16- (2)	17- (3)	18- (3)	19- (3)	20- (1)

**1381**

1- (2)	2- (3)	3- (3)	4- (2)	5- (1)
6- (3)	7- (4)			

**1383**

1- (3)	2- (1)	3- (4)	4- (2)	5- (4)
6- (3)	7- (3)	8- (2)	9- (1)	
10- (1)	11- (4)	12- (3)	13- (3)	

**1384**

1- (3)	2- (4)	3- (1)	4- (2)	5- (3)
6- (4)	7- (4)	8- (1)	9- (4)	10- (2)
11- (3)	12- (1)	13- (2)	14- (2)	15- (2)
16- (1)	17- (1)	18- (3)	19- (3)	20- (4)

**1385**

1- (2)	2- (3)	3- (1)	4- (2)	5- (1)
6- (4)	7- (1)	8- (2)	9- (4)	10- (1)
11- (3)	12- (1)	13- (4)	14- (4)	15- (3)
16- (2)	17- (4)	18- (2)	19- (1)	20- (3)

**1386**

1- (2)	2- (4)	3- (3)	4- (4)	5- (4)
6- (1)	7- (2)	8- (3)	9- (4)	10- (1)
11- (1)	12- (3)	13- (2)	14- (1)	15- (3)
16- (2)	17- (1)	18- (4)	19- (3)	20- (2)

**1387**

1- (3)	2- (1)	3- (4)	4- (3)	5- (4)
6- (2)	7- (1)	8- (4)	9- (3)	10- (1)
11- (2)	12- (4)	13- (1)	14- (2)	15- (3)

**1388**

1- (4)	2- (2)	3- (4)	4- (2)	5- (3)
6- (1)	7- (4)	8- (1)	9- (2)	10- (1)
11- (4)	12- (3)	13- (1)	14- (1)	15- (3)

**SECTION 3 (SELECTED TESTS)**

1- (4)	2- (3)	3- (2)	4- (4)	5- (2)
6- (4)	7- (3)	8- (1)	9- (3)	10- (3)
11- (4)	12- (4)	13- (2)	14- (2)	15- (2)
16- (3)	17- (1)	18- (2)	19- (3)	20- (1)
21- (4)				

**APPENDIX A (PRACTICE TESTS)****PRACTICE TEST 1**

1- (4)	2- (1)	3- (3)	4- (2)	5- (4)
6- (3)	7- (4)	8- (1)	9- (4)	10- (1)

**PRACTICE TEST 2**

1- (3)	2- (2)	3- (4)	4- (1)	5- (1)
6- (2)	7- (2)	8- (4)	9- (1)	10- (2)
11- (1)	12- (4)	13- (4)	14- (3)	15- (2)

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