Chapter 6

MCAT Verbal Reasoning Exercises

Passage 21

Nitrogen is the most abundant element in the atmosphere, making up 78 percent of the volume of dry air. Combined with other elements, nitrogen occurs in a great number of compounds, both inorganic and organic. The chief inorganic compound is the salt, sodium nitrate. Nitrogen is the most important element in proteins, and proteins are the basic constituents of protoplasm. Hence, nitrogen is as vital to life as oxygen is.

A complex relationship exists between plants and animals and nitrogen. This relationship is known as the nitrogen cycle. Briefly, the cycle operates in the following manner. Certain bacteria, known as nitrogen-fixing bacteria, take gaseous nitrogen directly from the atmosphere and convert the nitrogen into part of their own protoplasm. Colonies of these bacteria live on the roots of certain plants called legumes. Examples of legumes are alfalfa, soy beans, and clover. Legumes, in their growth, make use of some of the nitrogen-containing substances in the protoplasm of the bacteria on their roots. These substances are used in the formation of plant proteins.

Plants die and are decomposed by certain kinds of bacteria and molds, and the former plant proteins become nitrogen-containing compounds in the soil. These compounds, mostly nitrates, can be used by any plants to build proteins.

Herbivorous animals eat plants and some of the plants’ proteins (with their nitrogen) become animal protein. The animals excrete nitrogen-containing compounds in their waste matter which eventually becomes part of the soil. Animals die and decomposers (certain bacteria and fungi) break down animal proteins, making them part of the soil along with decomposed plant proteins. In this manner, animal protein becomes a source of nitrogen for plants.

Some of the nitrates in the soil are acted upon directly by so-called denitrifying bacteria, which change the nitrates to nitrous oxide, which escapes into the atmosphere where it eventually splits into nitrogen and oxygen. Thus, gaseous nitrogen is returned to the atmosphere, and the nitrogen cycle is complete.

A relatively small amount of nitrogen in the air is converted by lightning into oxides of nitrogen. These combine with water vapor, forming dilute nitric acid, which is carried by rain into the soil. Here nitrates are formed and are used by plants.

1. Before the twentieth century, farmers would plant a field with food crops for one or two years, then, in a third year, plant the field with clover or alfalfa and plough this crop into the soil. They did this in order to

A. increase the amount of nitrogen in the soil. B. give the soil a rest from bearing food crops. C. have the denitrifying bacteria put nitrogen into

the soil.

D. None of the above.

2. If nitrogen-fixing bacteria suddenly were to disappear from earth, the nitrogen cycle could continue because of the action of

A. plants.

B. lightning. C. legumes.

D. denitrifying bacteria.

3. From the nitrogen cycle, it is possible to make a good guess that the first living things on land were A. animals.

B. plants.

C. amphibians. D. crawling fish.

4. Since there were no legumes before the first plants lived on land (plants lived in the seas and other bodies of water before invading the land), the nitrogen compounds needed by land plants probably were put into the earth’s early soil by

A. lightning. B. sunlight.

C. water plants. D. Both A and B.

Passage 22

Among the most puzzling microbes are the flagellates, which move about by making use of one or more long, whip-like extensions of the body called flagella (singular, “flagellum”). Flagella are somewhat like cilia: both are flexible, movable, hair-like projections from the surface of the organism. When few in number and long in proportion to the size of the organism, these structures are called flagella: when numerous and short, they are called cilia. As a rule, the movements of flagella are independent of each other, whereas the movements of cilia are coordinated. Recent electron-microscope studies have revealed that flagella and cilia are remarkably similar in internal structure, no matter where they occur in the protist, plant, or animal kingdoms.

Some flagellates contain chlorophyll, synthesizing their own food when light is present. When light is not present, they may digest food particles in the surrounding water and absorb the products. Other species lack chlorophyll

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but capture smaller microorganisms, such as bacteria, and digest them internally. Such a mixture of “plant” and “animal” characteristics has made the classification of flagellates extremely difficult - especially when only two kingdoms are recognized.

Flagellates are abundant in soil, in fresh water, and in the ocean. Among the most common are the species of the genus Euglena, great numbers of which often tint a pond bright green in late summer. All species of Euglena have a flexible outer covering and spirally arranged contractile fibers that permit a shortening or lengthening of the body. In moving from place to place, a Euglena extends its whip-like flagellum into the surrounding water; then, by quickly curling the whip, the organism draws itself in that direction, contracting and elongating its body and revolving on its long axis.

Many flagellates live in very close community relationship with other organisms - symbiosis. These relationships may be parasitic or mutualistic. For example, some live in the intestines of certain cockroaches and termites. There they digest cellulose, a substance abundant in the wood eaten by the insects. Without the flagellates, the termite or roach would starve to death, just as we would on a cellulose diet; for neither we, nor the insects, can digest this material. Thus the insects obtain food from the digestive activity of the flagellates, and the flagellates, in turn, get a moist place to live and a convenient supply of food - the wood chewed up by the insects.

In fresh water and in the ocean, there are flagellates that have cellulose built into their own bodies. The cellulose is in walls of sculptured plates that are fitted together like armor. These are the dinoflagellates. Most dinoflagellates swim in the upper levels of the ocean, where they can carry on photosynthesis. But many obtain food from decaying matter, and still others capture and digest bacteria. One of these more animal-like dinoflagellates is the permanently naked Noctiluca, which emits a flash of light when stimulated. Often, at night, so many Noctiluca are agitated by the swirling of a human swimmer or the wake of a boat that the water becomes filled with their little sparkling points of light.

1. The author indicates that flagellates

1. are somewhat like cilia
2. exist primarily in soil
3. use chlorophyll almost to the exclusion of all else

The correct combination is:

A. I only

B. I and III

C. I and II

D. None of the above

2. According to the passage, the digestion of cellulose A. cannot be achieved by microbes, humans,or

insects.

B. by termites allows the flagellates to provide food.

C. is a good example of symbiosis.

D. by certain microbes is essential to the life processes of certain insects.

3. The most common of the flagellates are characterized by their

A. inhabiting upper levels of oceans. B. ability to digest cellulose.

C. spirally arranged contractile fibers. D. ability to emit light.

4. In order to synthesize their own food, flagellates A. need only exist in an environment where light

is present.

B. must be able to digest food particles when light is not present.

C. depend almost entirely on ecology. D. must contain chlorophyll.

5. The classification of flagellates as either plants or animals is difficult because

A. many flagellates live in close community

relationship with other organisms.

B. their hair-like projections are similar to other

organisms.

C. some flagellates contain chlorophyll while

others do not.

D. they are puzzling.

6. According to the passage, the Noctiluca

A. exist by swimming in the upper levels of the

ocean so as to be able to carry on

photosynthesis.

B. exist by obtaining food from decayed matter.

C. emit a flash of light at periodic intervals.

D. are really not in the flagellate category.

7. The whip-like extensions of the body of flagellates A. are called cilia when few in number and short

in projection to the size of the organism.

B. are called flagella when the cilia is dissipated. C. would probably be flagella if their movements

were independent of each other.

D. are capable of regrowth if severed.

8. The flagellates containing their own natural supply of cellulose

A. are known as dinoflagellates.

B. are the night-swimming Noctiluca. C. are sometimes called Euglena.

D. do not, as a rule, require photosynthesis to exist.

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9. It can be inferred that some dinoflagellates A. inhabit lower levels of the ocean.

B. do not require cellulose wall plates for survival.

C. depend on insects which eat wood for survival. D. are more adaptable to soil than others.

1. With which of the following would the author probably agree?
   1. Little is known about flagellates by scientists.
2. Flagellates can exist almost anywhere on our planet.
3. Because flagellates have characteristics found in both the plant and animal kingdoms, they can only be described with great difficulty.

The correct combination is:

A. II only

B. I only

C. II and III

D. I and II

Passage 23

Perhaps the most important carryover of Roman law into our law is the statutory insistence, both then and now, that the adopted child be completely assimilated into the family of the adopter. The adoptee lost what was his originally by birth and passed completely out of his natural family.

On the death of the Roman empire began the slumber of adoption by judicial process, a characteristic of adoption in Western culture. During the feudal period, no unwanted children existed as such. The feudal lord had responsibility for all of the persons in his charge. Thus, the children may have been ill-treated or neglected, but they were never outcasts.

Adoption, as we know it, reappeared in Europe under the Code Napoleon of the early nineteenth century. Napoleon’s Civil Code of 1804, which was based on Roman law, recognized adoption, but only persons over twenty-one could be adopted and only those over fifty could adopt. The Code Napoleon and the adoption laws of all European countries, which are based thereon, in whole or in part, were primarily concerned, not with the interests of the adoptee, but with inheritance rights. Indeed, it was not until 1925 that the Code Napoleon was changed to allow minors to be adopted. The great number of orphans and illegitimate children resulting from World War I caused this change.

Adoption first entered the United States through those states which based their laws upon the European civil codes. Based upon Napoleon’s Civil Code, the Louisiana

Civil Code of 1808, Article 35, allowed adoption by any person forty years or older, and required the adoptive child to be at least fifteen years younger than the adopting parents. Later, adoption was abolished by the Louisiana Civil Code of 1825, Article 214. As French law influenced Louisiana statutes, so too did Spanish law influence early Texas legislation. In 1832, while subject to Mexican rule, Texas was under Spanish law, and emphasis on the adoptee as heir was carried over. However, Spanish law differed from other European civil law in that a person having living legitimate children could not adopt a stranger to be a coheir with his natural children. To circumvent this prohibition, the adoptive parent had to make an inter-vivos gift.

In Texas, the person adopted succeeded as heir to the adopter, but the adoption did not make the adoptee a member of the adoptive family as such. The adoptee neither received the full benefits nor was obligated with the duties which usually flow from adoption. The entire adoption was purely a technical matter. The adoption law required that the adoption be formalized by the joint appearance of the natural father and the adoptive father before a judge and by the execution at that time of an instrument (“deed”) which testified to the act. This instrument was then recorded in much the same way that a deed is recorded today. Adoption by deed also occurred in other states, such as Iowa and Pennsylvania, but the statutes which permitted this have been repealed over the years. Now every state mandates that an adoption be formalized by a judicial procedure.

1. Adoption by deed can now occur in A. Iowa and Pennsylvania.

B. Texas and Louisiana.

C. Louisiana and Pennsylvania. D. None of the above.

2. There was no adoption in the feudal period because

A. there were no unwanted children.

B. all orphans were considered as property of the state.

C. the feudal lord was responsible for everyone in his domain.

D. children were left to fend for themselves because of the “lex romanicae.”

3. The most important facet of Roman adoption law that has been carried into our law is that

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| A. | only persons over twenty-one could be |  |
|  | adopted. |  |
| B. | the adopted person was completely assimilated |  |
|  | into his new family. |  |
| C. | adoption could be by deed. |  |
| D. | adoption could be formalized by a joint |  |
|  | appearance by the natural and adoptive father |  |
|  | before a judge. |  |
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4. An inter-vivos gift is

A. leaving property in one’s will. B. a gift made by a living donor.

C. a gift to one’s illegitimate children. D. a gift by deed.

5. The adoption laws of European countries were changed after World War I due to the

A. great number of orphans and illegitimate children.

B. disillusionment with the Napoleonic code. C. desire to change the structure of inheritance

laws.

D. influence of new leadership.

6. Under Napoleon’s Civil Code of 1804, the following was true: Only persons

A. under 15 could be adopted.

B. over 15 [ear than 21 could be adopted. C. over 21 could be adopted.

D. over 21 could adopt.

7. Adoption first entered the United States through states A. which based their adoption laws on Roman

law.

B. which based their adoption laws on feudal practice.

C. which based their adoption laws on European laws.

D. which based their adoption laws on natural law.

8. The author approves of which of the following? A. Adoption by deed

B. Feudal adoption practices

C. Texas and Louisiana adoption law

D. The concept that the person adopted be fully assimilated into the family

9. It is implied in the passage that the adoption procedure in Texas was primarily to

A. provide a home for orphans. B. legalize illegitimate children.

C. provide work for lawyers and judges.

D. enable a person to make another his heir by adopting him.

1. According to the passage, Spanish adoption law differed from other European civil law in that

A. adoption could be performed by deed. B. only persons over fifty could adopt.

C. adoption was not possible under Spanish adoption law.

D. a person having living legitimate children could not adopt a stranger.

Passage 24

The rise of the executive branch to pre-eminence and the blurring of the traditional division of functions are not due solely to the increase of governmental activities. Besides the organization of the career civil service, a second great innovation of the nineteenth century was the new kind of party system with its mass following. Political parties had no place in the calculations of those who espoused the doctrine of the separation of powers, an omission which, though regrettable, is not altogether surprising for a period when parties were despised as factions. But their impact on the separation of powers was bound to be felt after the extension of the franchise had encouraged the electorate to mobilize under the banner of parties and thus compete for control of the state.

Thus it was that in mid-nineteenth century America the parties made their onslaught upon the institutions of government. They regarded jobs in public offices as the spoils of political warfare, to be looted after an electoral victory. The patronage thus obtained was used to grease the party machine. But simultaneously it filled the civil service with partisan employees of uncertain tenure and dubious qualifications. Almost the same treatment was accorded to the judiciary. Control of the courts was necessary to the party because of the key role they played in law enforcement plus their power of judicial review. Where judges were elected to the bench, as in many state and local governments, the parties determined the selection of candidates and ensured the support of the voters. Otherwise, if judicial office were filled by appointment, the party could influence the chief executive who made the nomination and the senate that confirmed. The capture of the legislature, and of elective posts in the executive branch, was achieved through the electoral system, where the parties maintained a firm grip on nominating procedures and methods of balloting. Often without holding any public office himself, a boss was able by his unchallenged mastery of the party machine to achieve a concentration of power that violated the fundamental concepts of American democracy.

The popular reaction, however, to the scandals, which in this instance, as always, accompanied excessive power, ushered in a trend of reforms, designed to purify the processes of government and restore to the people their birthright of political authority. Slowly, but surely and inexorably, the evil of bossism, entrenched in so many sectors of American public life, has been attacked and, if not completely eradicated, at least reduced to smaller and safer proportions. Administrators and judges must be kept independent of party pressure in one case through security of tenure and appointment by merit, and in the other by nonpartisan election or selection.

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While dikes and dams were thus erected to hold back the floodwaters of party power, alternative channels had to be provided in which the new pressures could usefully and legitimately flow. Since parties inevitably brought politics in their train, any place in the governmental system that fitted one was appropriate for the other. Plainly then, the correct fields for parties to penetrate and occupy were the legislature and the elective offices of the executive branch. These areas were rightfully theirs. Nobody would want to see the parties ejected from the institutions that represent and translate the preferences of the voting public on broad issues of economic and social policy. But that being so, if it were permissible for the parties to capture the presidency and governorships and to organize majority and minority caucuses in Congress and the state legislatures, the structural separation of the executive and legislative branches was certain to be modified by the party tie. Though discipline within the party may not always be strong, though there may be opposition to the leadership of the chief executive, nevertheless a common interest of a sort - even if it is no more than the desire to keep their side in power - unites all those who bear the same label.

1. Among the contributing factors in the blurring of distinctions between the three branches of the American government, is

A. the impact of the reform of party control of the judiciary.

B. the influence of parties on patronage.

C. political bosses who held no office of their own.

D. the increase of governmental activities.

2. It can be inferred that the writers of the Constitution A. were in favor of a party system.

B. were unalterably opposed to the two-party system.

C. gave little or no thought to a party system at all.

D. envisioned a two-party system but were unsure of its ramifications.

3. The author implies that the main uniting intra-party force is

A. the electorate.

B. a common desire for power. C. the leaders of the party.

D. the need for unanimity.

4. According to the passage, the main danger of party politics is the

A. influence the party may have on presidential decision.

B. likelihood of graft.

C. chance that a dictator may usurp power in the United States.

D. influence the party may have on courts and the civil service.

5. In the nineteenth century, parties regarded political positions as

A. the rewards of the political arena to be looted after election.

B. places to put unwanted party workers. C. steps to higher office.

D. an excellent means of ensuring continued loyalty from members.

Passage 25

Strontium-90, like other radioactive isotopes of elements, has probably always existed in the biosphere in small amounts. But recent activities of man, particularly the testing of atomic weapons, have increased the quantity of strontium-90. Chemically, strontium is very much like calcium and is used by organisms in a similar way. But if calcium in an animal is replaced by strontium-90, the strontium-90 releases radiation that harms or kills living tissues. Strontium, like calcium, can be passed from green plants to cows, and from cows’ milk to man. But not all the strontium-90 that might be in a cow’s food goes into her milk; much of it stays in her own skeleton or passes out as wastes. In fact, the metabolism of a cow discriminates against strontium in synthesizing muscle and milk. The contaminated plants a cow eats contain twice as much strontium as the cow’s muscles and seven times as much as her milk. If strontium-90 pollutes the atmosphere, it is obviously safer to drink milk than to eat green vegetables.

Perhaps more dangerous at present than radioactive substances are pesticides. Because of the basic similarity in metabolism of all living things, it is difficult to find a substance that is poisonous to one organism and not to another, particularly another closely related one. For example, a substance poisonous to wasps (which might be considered pests) is very likely to be poisonous also to honeybees (which seldom are considered pests).

In the struggle to produce enough food for the growing human population, poisons against many kinds of fungi, nematodes, mites, insects, and other organisms are necessary. But the ever-increasing use of these poisons endangers the biosphere. Some (DDT, for example) are very resistant to chemical change. Therefore, even small amounts of DDT, when used repeatedly, build up to large amounts in soil and water. Further, some poisons are concentrated in the bodies of organisms; DDT accumulates especially in fats. In Clear Lake, California, DDT was applied at the rate of 14, 20, and 20 parts per billion of lake water in 1949, 1954, and 1957,

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respectively. In 1957, all lake organisms that were tested contained DDT. Fatty tissues of the aquatic birds called grebes that had died from poisoning were found to contain concentrations of DDT 80,000 times greater than that in the lake water. Fat in some fishes showed a concentration of DDT 140,000 times greater than that in the lake water.

1. Although strontium-90 and calcium are chemically similar, the difference that makes strontium-90 a poison is that strontium-90

A. replaces calcium in the tissues of living organisms.

B. is a pesticide.

C. collects in the fatty tissues of organisms.

D. is radioactive, releasing radiation that harms or kills living tissues.

2. The first stage in the process by which strontium-90 gets into milk is that

A. a cow synthesizes strontium-90 in her muscles.

B. a green plant synthesizes strontium-90 in its tissues.

C. a green plant takes up strontium-90 from its environment.

D. Both A and B.

3. Animals can habitually eat green plants or drink water containing DDT without suffering immediate harm and yet eventually die from DDT poisoning because A. DDT becomes fatal only at certain times of

the year.

B. DDT collects in the animals’ fatty tissues. C. it takes time for a lethal dose of DDT to collect

in the fatty tissues.

D. Both B and C are correct.

4. When a cow eats plants contaminated by strontium-90, her metabolism

A. passes one-seventh of the strontium-90 into her milk.

B. holds back all the strontium-90 from her milk. C. prevents six-sevenths of the strontium-90 from

going into her milk.

D. Both A and C are correct.

5. A beekeeper who had an orchard that was invaded by a swarm of wasps would have to be careful in choosing a pesticide for use against the wasps because A. the pesticide would probably hurt the apple

trees.

B. a pesticide would accumulate in the fatty tissuesof the bees.

C. a pesticide that killed wasps would probably also kill bees.

D. None of the above.

Passage 26

A rabbit and a raspberry bush: One is an animal; the other, a plant. One moves around; the other is rooted in a particular place. All of us can tell an animal from a plant, a rabbit from a raspberry bush!

This looks clear enough. But if we try to work out clear and inclusive definitions, we get into trouble. Everyone who has looked into the matter agrees that corals and sponges are animals. Yet they are as fixed in position as any plant. Then there are things called slime molds, which are sometimes classed as plants but do a great deal of creeping about. And in the microscopic world there are many creatures that move about actively, as most animals do, but use the energy of sunlight for building up foods, as do most plants. Presently we find ourselves in a state where we no longer know the difference between all plants and all animals.

Let us try another way of looking at the matter. The rabbit is hiding under the raspberry bush. This is important, for most animals must have some place to hide, some kind of shelter. Even more important, the rabbit must have food. Rabbits usually do not eat raspberry bushes, though they would not scorn the young shoots in time of need. But rabbits and raspberry bushes do not live alone. Around the raspberry patch are many other kinds of green plants that rabbits like.

We can call such green plants the producers of the living world, since they build up foods by using the energy of sunlight, and the rest of the living world depends on this production. Rabbits, which cannot make food in this way, are consumers—that is, “eaters.” Because they feed directly on the green plants, they are called first-order consumers. Foxes, cats, wolves, and hawks eat rabbits. Besides these larger animals, there are fleas in a rabbit’s fur, worms in its intestine, and mosquitoes seeking out its pink ears. These are second-order consumers. But wolves may also have fleas, which are then third-order consumers. Even higher-order consumers may be found, each order a step farther from the food producers. Thus, the producers are the basis of a complicated network of consumers.

1. All carnivores habitually are meat-eating animals; therefore, they are

A. first-order consumers. B. second-order consumers. C. third-order consumers.

D. not all classifiable in a single consumer order.

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2. Many bacteria are producers. Single-celled animals, such as amoebas, eat these bacteria. Therefore, amoebas are

A. producers.

B. first-order consumers. C. second-order consumers. D. None of the above.

3. All plants can be distinguished from all animals because

A. all plants have green leaves.

B. plants are fixed in one location.

C. plants alone use the energy of sunlight to make foods.

D. None of the above.

4. Human beings are A. producers.

B. higher-order consumers. C. first-order consumers. D. Either B or C.

5. When a human being eats caviar (fish eggs), he is a A. third-order consumer.

B. second-order consumer. C. first-order consumer. D. Impossible to tell.

Passage 27

We could spend a lifetime observing in a helter-skelter manner without learning very much about our world. But mere observation is not science. The observations of the scientist are usually guided by the statement of a problem. Of course, we seldom become aware of problems unless we have observed at least a little. So the relation between problem and observation is something like the relation between the chicken and the egg: which comes first?

One of the most frequent results of observation is to raise specific questions in the mind of the scientist. We do not know how this occurs, nor do we know why certain questions stir the curiosity of some persons and not others. But with curiosity aroused, the scientist applies his imagination to the task of designing a specific statement that can be tested. Such a statement is a hypothesis. It is the starting point for an experiment. An experiment attempts to determine the truth or falsity of a hypothesis. Again the scientist needs imagination to dream up an experiment that fits the problem. In more formal language, a scientist needs imagination to design an experiment that will produce data from which a decision concerning the hypothesis can be made. Even in an experiment, observation remains a basic activity of the scientist, because these data (those obtained from the experiment) are observations.

Often observations must be made indirectly by means of instruments. Some of the instruments used by scientists are quite simple and have been used for a long time. Others are quite complex and have been developed only recently. In biological science, one of the most frequently used aids is the microscope. Even beginning students in biology must learn to use the microscope effectively.

Finally, the modern scientist needs to state his observations in numerical form. To do this, he must measure. Only thus are exact descriptions and meaningful comparisons possible. Indeed, modern science is often dated from the time of Galileo, who first realized the importance of measurement and the mathematical handling of numerical data for clear understanding of our world and universe.

1. The ancient Greeks developed ideas in art, philosophy, mathematics, and politics that still have an important influence, but the Greeks made only a very modest contribution to science. One reason for this was that

A. the Greeks were democratic.

B. the Greeks had to fight many battles. C. the Greeks had many gods.

D. the Greeks did not generate and test hypotheses.

2. Robinson Crusoe kept an accurate record of the weather on his island. This record

A. was really a simple scientific experiment. B. was not a scientific experiment because it was

not guided by any hypothesis.

C. was the rudiments of modern meteorology. D. Both B and C.

3. Once a scientist has designed an experiment, he A. stops observing and concentrates on

performing the experiment.

B. may forget about his hypothesis.

C. must continue to observe during every step of the experiment.

D. needs to design instruments to carry out the experiment.

4. At the end of the seventeenth century, chemistry was much more advanced than biology. One reason for this difference was that

A. biology is harder than chemistry.

B. it is easy to make observations in chemistry. C. the microscope was not invented until the

1670’s.

D. chemistry was more popular than biology.

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5. A knowledge of mathematics is necessary to a scientist because it

A. disciplines the scientific mind.

B. enables the scientist to keep his records in order.

C. enables the scientist to put his data and conclusions in numerical form.

D. enables the scientist to make meaningful, quantifiable conclusions.

Passage 28

The ancient Greeks advanced several theories about the nature of light. One of them is of particular interest. According to the theory, light is something that streams out of the eyes much like water out of a hose, the idea being that we see a thing by directing this stream of light to hit it. Thereby we learn what it looks like, much as we learn what a thing feels like by feeling it with our hands. A blind man’s eyes emit no light; for this reason he cannot see. Until the intellectual awakening in Europe known as the Renaissance, this theory was never seriously challenged. Sir Isaac Newton (1642-1727) was one of the first to advance a consistent theory of light based upon observation and experiment.

In formulating a theory of light, Newton considered two hypotheses: one, that light is matter; the other, that it is wave energy. Knowing the ability of sound and water waves to bend around a corner, which light seemingly does not do because we cannot see around a corner, Newton rejected the theory of waves in favor of the theory of matter. According to Newton, light consists of small particles (corpuscles) of matter emitted in all directions in straight lines, or rays, by a luminous body such as the sun, a burning candle, or a red-hot coal. If these rays consisting of corpuscles strike our eyes, we see the source of them.

About the same time that Newton proposed the corpuscular theory, Christian Huygens (1629-1695), a Dutch astronomer and physicist, advanced the wave theory of light. The farther a wave front is from the source, the more nearly a

short section of it approaches a straight line, and the more nearly two wave fronts become parallel. Such waves are known as parallel waves.

Light waves coming directly from a source, or from a body which reflects them, cause the sensation of sight, just as Newton claimed for the corpuscles.

Let us suppose that Newton and Huygens had met for the purpose of each scientist arguing for his theory. Newton would not accept the wave theory. He argued

that “Sound, which is a wave motion, will travel through a crooked hollow pipe, bend around a hill or other obstruction and be heard. If light is a wave, it too should do the same, but experiment proves that it doesn’t.”

In reply, Huygens said, “That is not a convincing argument. Take short water waves on a river striking the side of a ship; the waves originating on one side will not be seen on the other. However, if the waves are large and the obstacle is small, the waves will bend around the obstacle and be seen on the other side.” Huygens even went so far with this line of reasoning as to predict that a very small obstruction would cast no shadow in light. Modern science accepts the theories of both Newton and Huygens, since light acts in some situations as if it were made up of corpuscles called photons and in other situations as if it were made up of waves.

1. According to the ancient Greeks’ theory of light, A. no seeing person should ever be in the dark. B. no seeing person would ever need a torch or

a lamp.

C. light is much like water. D. All of the above.

2. The theories of light of both Newton and Huygens A. had in common the belief in light as being

composed of corpuscles.

B. were based on the fact that light bends around corners.

C. postulated that light travels from the source to the eye.

D. were much like the ancient Greeks’ theories of light.

3. Huygens believed that a very small obstruction would cast no shadow because

A. it would be too small to be seen.

B. light rays would bend around the obstruction. C. it would absorb light rays.

D. None of the above.

4. According to the Greeks’ theory of light cited above, an opaque object between a viewer and a fire

A. should not appear as a dark shape against the fire.

B. could not be seen.

C. would appear in its normal color. D. Both A and C.

5. The theories of the ancient Greeks, Newton, and Huygens had in common that they

A. have all been proved false. B. all explained light correctly.

C. considered light to be a kind of motion. D. None of the above.

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Passage 29

Most earthquakes are the result of movement along an existing fracture in the deep rock beds. The walls of a fault are usually very closely pressed together. Rock beds that are under stress undergo many years of slowly increasing pressures before they move along a fracture. Finally the stress exceeds the strength of the rock. Then a sudden movement occurs along the fault, causing the earthquake vibrations. According to the elastic rebound theory of earthquakes, pressure is exerted on two adjacent rock areas from opposite directions for long periods of time. The pressure may be upward, downward, or sideways. As it increases, the rocks bend slowly. Eventually the strain becomes so great that the rocks split apart, either vertically or horizontally, along the fault line.

The San Andreas fault, along which the California earthquake occurred in 1906, can be traced over a distance of 270 miles. The chief movement along the fault was horizontal. The southwest side shifted toward the north in relation to the opposite side. In some places the horizontal displacement was 21 feet.

There are thousands of known faults all over the earth. Few of them, however, seem to be the sources of earthquakes. Most earthquakes, therefore, must probably have their source in faults below the earth’s surface. The trembling of the solid rock immediately after faulting sets up the earthquake shocks. These may be strong enough to affect an entire continent or may be so slight that sensitive instruments are needed to record their presence.

Earthquakes that are the result of crustal movements, such as faulting, are classed as tectonic earthquakes. These larger quakes usually originate in the outer 20 to 100 miles of the lithosphere. Earthquakes are also often associated with volcanic activity. Volcanic earthquakes are due either to explosive volcanic activity or to the flow of magma below the crust. Sometimes tectonic earthquakes may trigger volcanic eruption. Earthquakes caused by volcanic activity are always relatively feeble compared with the more violent, tectonic. They may, however, be the cause of greater local damage.

Landslides occurring over a wide area may result in earthquakes of lesser intensity than those associated with faulting or volcanism. Landslips, as such landslides are called, usually occur in regions of rugged relief. They sometimes also take place on the sea floor near the margins of the submerged continental shelves.

Earthquakes of tectonic, volcanic, or landslip origin may also occur under the ocean. Their most noticeable effect is the production of seismic sea waves, or tsunamis.

1. The most violent earthquakes are caused by A. movements along faults.

B. landslips. C. volcanoes.

D. All of the above.

2. In tough rock, as compared to brittle rock, the time between earthquakes will probably be

A. shorter. B. longer.

C. about the same.

D. None of the above.

3. One force that builds mountains is the folding of the earth’s crust. Earthquakes are most likely to be found in

A. newly formed mountains.. B. old, worn-down mountains. C. middle-aged mountains

D. plains.

4. The earth’s crust is between 7 and 20 miles thick. The largest earthquakes take place

A. only in the crust.

B. only below the crust.

C. both in the crust and below it. D. above the crust.

5. A tectonic earthquake may be the cause of a A. volcanic earthquake.

B. landslip earthquake. C. tsunami.

D. All of the above

Passage 30

Sir George Darwin, son of the great naturalist, Charles Darwin, formulated a theory to explain the fact that our moon always turns the same side to the earth, so that we can see only one half of our satellite’s surface. Darwin wondered whether the fact that the moon’s period of rotation equals the time of its revolution around the earth is due to chance or the working of natural law.

Darwin answered the question with the following argument. The gravitational pull of the moon causes tides on earth. Since most of the earth’s surface is covered by water, tidal crests can form on two opposite points of the earth. A line connecting the crests is directed toward the moon. The earth’s rotation beneath the tidal crests causes two great waves to travel around the earth. These waves cause the earth’s high tides. The tidal waves are fed continually by water from areas of low tide. This causes a current to run contrary to the line of the earth’s rotation, thereby creating appreciable friction because water naturally resists any displacement of its particles. This tidal friction acts as a brake on the earth’s rotation,

gradually slowing it down. This continual, nearly imperceptible braking process will last until the tidal waves cease their movement and the tides and their resultant friction come to an end. This will happen when the earth’s rotation has become so slow that one earth day equals the moon’s period of revolution around the earth—in other words, when the earth keeps the same side turned to the moon so that the moon no longer revolves around the earth.

The fact that we always see the same side of the moon probably originated in the foregoing process. In the very distant past, Darwin surmised, the moon’s surface was covered by molten lava. At that time, the moon’s rotation was probably much faster than it is now. It gradually slowed down as the earth’s gravitational attraction caused ever-increasing tidal movement and consequent friction in the molten lava. This braking effect has long ceased, but the braking effect of the moon on the earth (through the earth’s tides) will not cease for many millions of years. Darwin gave three reasons for this series of events. First, because the moon is much smaller than the earth, the resistance of the moon’s inertia to the braking influence of the earth was weak. Second, the earth exerted a much greater tidal influence on the moon than the moon on the earth. Third, the moon’s tidal movement took place in lava, matter which was viscous rather than completely liquid, as the earth’s waters are, and whose inner friction was greater than the earth’s freely moving oceans.

1. The braking effect exerted by the moon on the

earth

A.

B.

C.

D.

2. If the earth had no oceans it would A. be spinning faster.

B. be spinning slower.

C. exert a greater braking effect on the moon. D. be stationary.

3. If the moon were to speed up the time of rotation on its axis and still keep one side always facing the earth, the time necessary for the moon to revolve around the earth would be

A. longer. B. shorter.

C. unchanged. D. irregular.

4. At one time in its history, the earth was molten. At that time, the earth’s rate of rotation was slowed by the moon’s gravitational influence

A. which caused lava tides and their consequent friction.

B. on both lava tides and on the earth’s oceans. C. only on the earth’s oceans.

D. Both A and B.

5. Gases are fluid. From this we conclude that the earth’s atmosphere, which is a mixture of gases, A. moves around the earth in tides due to the

moon’s gravitational influence.

B. provides a braking force on the earth’s rotation.

C. is too shallow, in comparison with the earth’s waters, to provide a braking force on the earth’s rotation.

D. Both A and B.

still causes molten tides on the moon. works through the effect of the ocean tides which the moon causes.

will continue for millions of years. Both A and C.