Montogue

# AP Biology

## 80 Practice Problems

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**Problem Distribution**

| **Primary Problems (1 – 50)** | |
|---|---|
| **Topic** | **Problems** |
| ***Cell Structure and Function*** | 1 – 7 |
| ***Cell Energetics, Proteins, and Cell Cycle*** | 8 – 15 |
| ***Gene Expression and Regulation*** | 16 – 28 |
| ***Heredity*** | 29 – 34 |
| ***Natural Selection and Ecology*** | 35 – 50 |
| **Secondary Problems (51 – 80)** | |
| ***Plant Form and Function*** | 51 – 62 |
| ***Animal Form and Function*** | 62 – 68 |
| ***Human Physiology*** | 69 – 80 |

**Primary Problems**

**1.** In addition to being found free in the cytoplasm, ribosomes are found on the outer surface of the:
**(A)** Nucleus.
**(B)** Smooth endoplasmic reticulum.
**(C)** Mitochondrion.
**(D)** Chloroplast.

**2.** Which of the following is a characteristic that differentiates the domains Archaea and Bacteria?
**(A)** Only members of Archaea have a nuclear envelope.
**(B)** Only members of Archaea have a circular chromosome.
**(C)** Only members of Bacteria have peptidoglycans in their cell walls.
**(D)** Only members of Bacteria have plasma membranes with lipids.

**3.** Gram-negative bacteria are distinguished from Gram-positive bacteria by:
**(A)** An anaerobic culturing process.
**(B)** The types of environment that they normally inhabit.
**(C)** A differential staining technique.
**(D)** The resistance to bacteriophage viruses: Gram-positive bacteria are resistant to most bacteriophages, whereas Gram-negative microbes are not.

**4.** Which of the following is a difference between cyanobacteria and green unicellular algae?
**(A)** Cyanobacteria have no nuclei.
**(B)** Cyanobacteria lack cell walls.
**(C)** Green algae produce cell membranes.
**(D)** Green algae contain lipids.

**5.** Which of the following is a reason that geneticists use mitochondrial DNA (mtDNA) to study the relatedness of animal populations?
**(A)** All mitochondrial proteins are coded for by mitochondrial genes.
**(B)** mtDNA is passed from mother to child and is free from the recombination that occurs between pairs of chromosomes.
**(C)** A large percentage of the mitochondrial genome codes for proteins, and thus the majority of retained mutations are neutral.
**(D)** mtDNA mutates at a slower rate than nuclear DNA.

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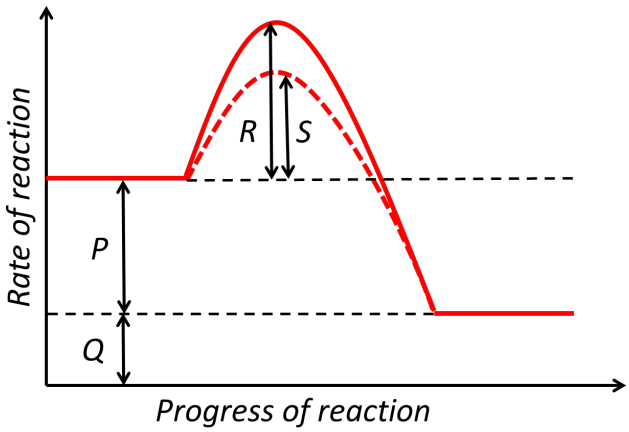
**6.** Which of the following is **not** evidence that chloroplasts were originally free-living prokaryotes that subsequently evolved a symbiotic relationship with a eukaryotic host?
**(A)** Presence of circular DNA in chloroplasts and in free-living prokaryotes.
**(B)** Susceptibility of chloroplasts to inhibitors of prokaryotic protein synthesis.
**(C)** Similarities of rRNA sequences between chloroplasts and free-living prokaryotes.
**(D)** Ability of chloroplasts to synthesize all their own proteins.

**7.** All of the following are associated with microtubules, **except**:
**(A)** Centrioles.
**(B)** Muscle contraction.
**(C)** Separation of chromosomes into chromatids.
**(D)** Motion of flagella.

**8.** Which of the following is an enzyme that digests disaccharides to monosaccharides?
**(A)** Lactase.
**(B)** Kinase.
**(C)** Zymogen.
**(D)** Phosphatase.

**9.** The graph below demonstrates two chemical reactions. One is catalyzed by an enzyme, one is not. Which of the following gives the energy of activation of the enzyme-catalyzed reaction?




**(A)** $P + S$
**(B)** $P + Q$
**(C)** $R$
**(D)** $S$

**10.** When a compound is used to inhibit ATP production in the cells of an organism, what happens to that organism?
**(A)** It continues regular metabolic processes without change by switching to a higher-energy phosphate compound.
**(B)** It continues regular metabolic processes using GTP.
**(C)** It is unaffected by the cessation of ATP production.
**(D)** It slows all metabolic activity and eventually dies.

**11.** If a plant undergoing the light-dependent reactions of photosynthesis began to release $^{18}O_2$ instead of "normal" molecular oxygen, one could reasonably conclude that the plant had been supplied with:
**(A)** $H_2O$ containing radioactive oxygen.
**(B)** $CO_2$ containing radioactive oxygen.
**(C)** $C_6H_{12}O_6$ containing radioactive oxygen.
**(D)** $NO_2$ containing radioactive oxygen.

**12.** Some characteristics of the metabolism of plants able to carry out CAM-pathway photosynthesis are directly related to their prevalence in desert environments. Which of the following is one such characteristic?
**(A)** CAM-pathway plants are capable of metabolically splitting oxygen from $CO_2$ molecules instead of water, which contributes to their preservation in water-scarce environments.
**(B)** CAM-pathway plants are capable of carrying out parts of their photosynthetic processes, including the Calvin cycle, not only in chloroplasts but also in leucoplasts.
**(C)** CAM-pathway plants often keep their stomata closed during daytime, reducing hydric stress when exposure to heat is most severe.
**(D)** CAM-pathway plants develop cuticles, layers of waxy material that shield the plant from hydric stress; most $C_3$- and $C_4$-metabolism plants are unable to secrete cuticles.

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**13.** When electrons flow along the electron transport chains of mitochondria, which of the following changes occurs?
**(A)** $NAD^+$ is oxidized.
**(B)** The electrons gain free energy.
**(C)** The pH of the matrix increases.
**(D)** ATP synthase pumps protons by active transport.

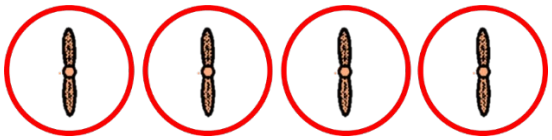
**14.** Which of the following mature cell types remains in the $G_1$ phase of the cell cycle?

**I.** Kidney epithelial cells.
**II.** Skeletal muscle cells.
**III.** Nerve cells.

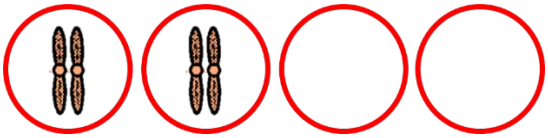
**(A)** I only.
**(B)** I and II only.
**(C)** III only.
**(D)** II and III only.

**15.** (*Based on Berkeley Review, MCAT Biology*) During nuclear division, chromosomes or chromatids move to the opposite poles of the cell. This is called *disjunction*. If disjunction were to fail, two chromosomes or two chromatids would go to one pole and none would go to the other pole. This is called *nondisjunction*. *Primary nondisjunction* occurs at the first meiotic division, while *secondary nondisjunction* occurs at the second meiotic division. Which of the following diagrams represents secondary nondisjunction is spermatogenesis?

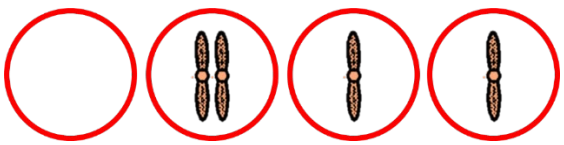
**(A)**



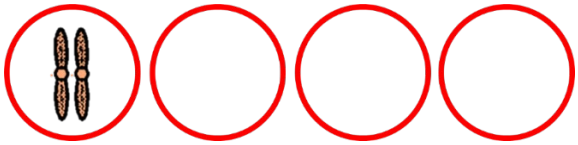
**(B)**



**(C)**



**(D)**



**16.** On July 21st, 2000, scientists announced that the sequencing of the human genome had been completed. This milestone implies that scientists had successfully:
**(A)** Determined the correct number of chromosomes of the human species.
**(B)** Determined the nucleotide sequence of the human chromosomes.
**(C)** Identified all types of protein coded by human genes.
**(D)** Determined the amino acid sequence of all human proteins.

**17.** A missense mutation is one that:
**(A)** Creates a stop codon in the mRNA.
**(B)** Changes the codon of one amino acid to that of another.
**(C)** Changes the reading frame of the mRNA.
**(D)** Creates a break in the DNA strand.

**18.** Which of the following do **not** play a role in replication?
**(A)** Stop codons.
**(B)** DNA polymerases.
**(C)** RNA primers.
**(D)** Helicases.

**19.** Which of the following is true about a double-stranded DNA genome that is determined by chemical means to be 23 percent adenosine?
**(A)** The genome is 11.5% guanosine.
**(B)** The genome is 23% guanosine.
**(C)** The genome is 27% guanosine.
**(D)** The genome is 54% guanosine.

**20.** All of the following are necessary for a DNA virus to complete a lytic cycle, **except**:
**(A)** Chromosomes of the host cell.
**(B)** Replication enzymes of the host cell.
**(C)** Ribosomes of the host cell.
**(D)** Amino acids of the host cell.

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**21.** Bacteriophages are viruses constituted of a DNA molecule surrounded by a protein capsule. There exist several types of bacteriophage, which differ in the structure of their DNA and capsule proteins. Scientists have successfully constructed active viral particles with DNA from a species and capsule of another. In one such experiment, scientists created a virus using DNA from bacteriophage $T_2$ and a capsule from bacteriophage $T_4$. The offspring of this artificial virus will have:
**(A)** DNA and capsule of a $T_2$ virus.
**(B)** DNA of a $T_2$ virus and capsule of a $T_4$.
**(C)** DNA of a $T_4$ virus and capsule of a $T_2$.
**(D)** DNA and capsule of a $T_4$ virus.

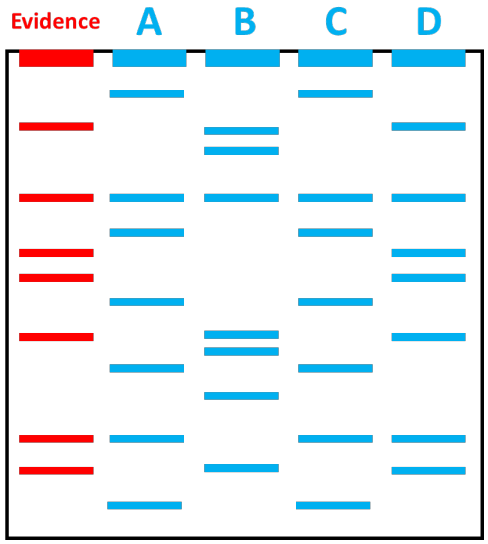
**22.** Retroviruses violate the Central Dogma because:
**(A)** They do not contain hereditary material, but use the DNA of host cells instead.
**(B)** They store their genetic material as RNA, which is reverse-transcribed to DNA.
**(C)** Retroviruses do not require transcription to make proteins.
**(D)** Retroviruses do not use the same codon sequences that living organisms do.

**23.** Molecular cloning is used in medicine to create identical copies of a DNA sequence. Which of the following is **not** an application or form of cloning?
**(A)** Repopulation of endangered species.
**(B)** Generating new tissues and organs for transplants.
**(C)** Creating genetically modified crops.
**(D)** *In vitro* fertilization.

**24.** Restriction enzymes are used to cut DNA at specific sites, yielding molecule fragments that can be employed in a variety of genetic engineering applications. Regarding restriction enzymes, which of the following is **false**?
**(A)** Restriction enzymes recognize specific sequences of nitrogenous bases.
**(B)** Not all restriction enzymes yield DNA fragments of the same size.
**(C)** Restriction enzymes remove phosphates and pentoses, leaving only the nitrogenous bases.
**(D)** Restriction enzymes can be used to isolate a single gene in a chromosome.

**25.** In paternity tests, the DNA, when extracted from the blood, is obtained from:
**(A)** Red blood cells.
**(B)** Leukocytes.
**(C)** Red blood cells, leukocytes, and plasma.
**(D)** Leukocytes and globulins, but not from red blood cells.

**Questions 26, 27 and 28 refer to the following figure.**




**26.** The figure above shows the electrophoretic DNA evidence obtained from a crime scene, in red, and the DNA signatures of four suspects, A to D, in blue. The DNA placed in electrophoresis gel separates as a result of what characteristic?
**(A)** pH.
**(B)** Size.
**(C)** Charge.
**(D)** Ratio of A/T bases to G/C bases in the DNA strand.

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**27.** Which of the four individuals was likely in the crime scene?
**(A)** Individual A.
**(B)** Individual B.
**(C)** Individual C.
**(D)** Individual D.

**28.** Which two individuals, while not guilty, could possibly be identical twins?
**(A)** Individuals A and B.
**(B)** Individuals B and C.
**(C)** Individuals A and C.
**(D)** Individuals B and D.

**29.** In a diploid organism, there are three different alleles for a particular gene. Of these three alleles, one is recessive and the other two exhibit codominance. How many phenotypes are possible with this set of alleles?
**(A)** 2
**(B)** 3
**(C)** 4
**(D)** 5

**30.** How many different types of gametes would be produced by an organism of genotype *AABbccDdEe* if all of the genes were to assort independently?
**(A)** 4
**(B)** 8
**(C)** 16
**(D)** 32

**31.** In pea plants. suppose the gene for yellow color ($Y$) is dominant over the gene for green color ($y$). Which of the following genotype pairs represents a crossing that could produce green plants, even though the parent plants are both yellow?
**(A)** $YY \times YY$
**(B)** $YY \times yy$
**(C)** $Yy \times Yy$
**(D)** $Yy \times yy$

**32.** The gene for color blindness is $X$-linked. If normal parents have a color-blind son, what is the probability that the son inherited the gene for color blindness from his mother?
**(A)** 25%
**(B)** 50%
**(C)** 75%
**(D)** 100%

**33.** In a species of ferret, the allele for black fur ($B$) is dominant to the allele for brown fur ($b$), and the allele for round ears ($E$) is dominant to the allele for triangular ears ($e$). When a ferret of unknown genotype was crossed against a brown-triangular ear individual, the phenotype distribution shown below was observed. What is the genotype of the unknown parent?

| |
|---|
| 25% Black-round ears |
| 25% Brown-round ears |
| 25% Black-Δ ears |
| 25% Brown-Δ ears |

**(A)** $BBEE$
**(B)** $BBEe$
**(C)** $BbEe$
**(D)** $Bbee$

**34.** The color of wheat seeds is determined by two pairs of alleles with additive effect. The following table shows the colors determined by a given number of dominant genes. With reference to the table, determine the proportion of normal red offspring expected in a crossing between a $AaBb$ individual and a $Aabb$ individual.

| *Number of dominant alleles* | *Seed color* |
|---|---|
| 4 | Dark red |
| 3 | Medium red |
| 2 | Normal red |
| 1 | Clear red |
| Zero | White |

**(A)** 1/8
**(B)** 3/16
**(C)** 3/8
**(D)** 5/8

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**35.** Which of the following conditions are required to keep a population in Hardy-Weinberg equilibrium?
**(A)** Genetic drift.
**(B)** Gene flow.
**(C)** Random mating.
**(D)** Mutation.

**36.** Blood type in the rhesus system is a single-locus, two-allele trait in which the dominant and recessive alleles determine Rh-positive and Rh-negative blood, respectively. A population under Hardy-Weinberg equilibrium has 10,000 individuals, of which 900 have Rh negative blood. The number of homozygote Rh positive individuals in this population is, most nearly:
**(A)** 900
**(B)** 4550
**(C)** 4900
**(D)** 5550

**37.** The primordial soup proposed by Oparin, Haldane, and subsequent investigators consisted of organic precursor molecules formed by interactions between all the following gases, **except**:
**(A)** Nitrogen.
**(B)** Helium.
**(C)** Oxygen and hydrogen.
**(D)** Carbon dioxide.

**38.** Which of the following is **false** based on Darwin's theory of evolution?
**(A)** Natural selection is the driving force of evolution.
**(B)** Favorable genetic variations become more and more common in individuals throughout their lives.
**(C)** Natural selection drives organisms to live in groups and ultimately become distinct species.
**(D)** Fitness is measured in terms of reproductive success.

**39.** The modern or synthetic theory of evolution incorporates two main concepts from Darwin's original work. These two concepts are:
**(A)** Natural selection and mutation.
**(B)** Mutation and genetic recombination.
**(C)** Mutation and adaptation.
**(D)** Adaptation and natural selection.

**40.** Three different populations of insects, $X$, $Y$, and $Z$, inhabiting the same region and belonging to the same species, were geographically isolated. After several years, with the disappearance of the geographic barrier, it was verified that crossings of individuals from population $X$ with individuals of population $Y$ produced sterile hybrids. Crossings of individuals of population $X$ with those of population $Z$ produced fertile descendants. Crossings of individuals of population $Y$ with those of population $Z$ produced no offspring. These results enable us to conclude that:
**(A)** $X$, $Y$ and $Z$ still belong to the same species.
**(B)** $X$ and $Z$ became different species, and $Y$ still belongs to the original species.
**(C)** $X$ and $Z$ still belong to the original species, and $Y$ became a different species.
**(D)** $X$ and $Y$ continue to belong to the same species, and $Z$ became a different species.

**41.** The principle of competitive exclusion states that:
**(A)** Two species of the same genera cannot coexist in the same habitat.
**(B)** Two species that have exactly the same niche cannot coexist in a community.
**(C)** Competition between two species always causes extinction or emigration of one species.
**(D)** Two species will stop reproducing until one leaves the habitat.

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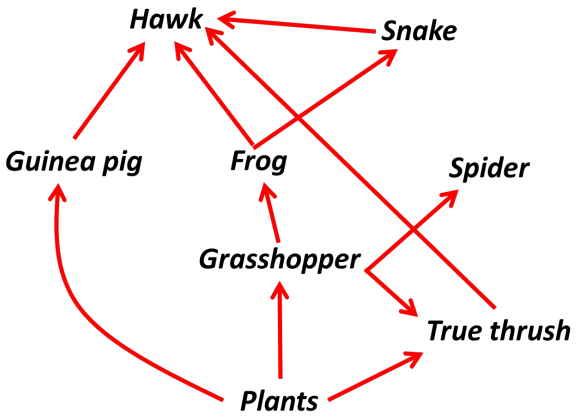
**42.** *(Modified from Campbell Biology, 2016)* If you applied a fungicide to a cornfield, what would you expect to happen to the rate of decomposition and net ecosystem production?
**(A)** Both decomposition rate and NEP would decrease.
**(B)** Decomposition rate would increase and NEP would decrease.
**(C)** Decomposition rate would decrease and NEP would increase.
**(D)** Both decomposition rate and NEP would decrease.

**43.** In a pyramid of energy, the **least** amount of stored chemical energy is found in which of the following trophic levels?
**(A)** Primary producers.
**(B)** Primary consumers.
**(C)** Tertiary consumers.
**(D)** Decomposers.

**44.** Consider the following food web. Which organism can occupy the greatest number of trophic levels?




**(A)** Plants.
**(B)** Spider.
**(C)** Frog.
**(D)** Hawk.

**45.** Mistletoes and Latin American bromelias are small plants that support themselves over larger trees. One important difference is that mistletoes extract water and minerals from the host plant, whereas bromelias simply use larger trees for mechanical support, all the while achieving harmless benefits such as greater exposure to sunlight. If $A$ denotes the ecological relationship between mistletoes and the host plant, and $B$ denotes the ecological relationship between bromelias and the host plant, which of the following correctly defines $A$ and $B$?
**(A)** $A$. Epiphytism; $B$. Competition;
**(B)** $A$. Holoparasitism; $B$. Hemiparasitism;
**(C)** $A$. Parasitism; $B$. Epiphytism;
**(D)** $A$. Predation; $B$. Epiphytism;

**46.** Which of the following biomes is associated with the greatest biodiversity?
**(A)** Tropical rain forest.
**(B)** Tundra.
**(C)** Deciduous forest.
**(D)** Desert.

**47.** The climate with the shortest growing season would be located in a:
**(A)** Tropical rain forest.
**(B)** Savanna.
**(C)** Deciduous forest.
**(D)** Taiga.

**48.** Consider the logistic growth equation, where $N$ is population size, $t$ is time, $r$ is growth rate, and $K$ is carrying capacity. Regarding the LGE, which of the following is true?

$$\frac{dN}{dt} = rN\frac{(K-N)}{K}$$

**(A)** A population grows exponentially when $K$ is small.
**(B)** Population growth is zero when $N$ equals $K$.
**(C)** The number of individuals added per unit time is greatest when $N$ is close to zero.
**(D)** The per capita population growth rate increases as $N$ approaches $K$.

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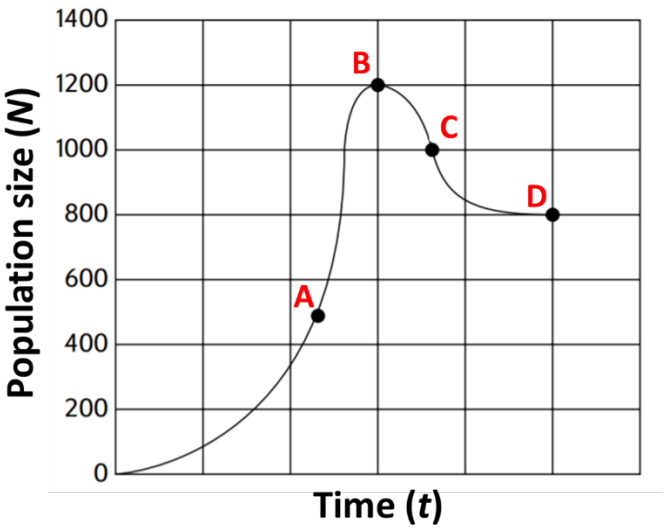
**Questions 49 and 50 refer to the following figure.**




**49.** The graph above represents the variation of the number of individuals in a population, $N$, over the course of time, $t$. At what point in the graph is the intrinsic rate of growth equal to zero?
**(A)** Point A.
**(B)** Point B.
**(C)** Point C.
**(D)** Point D.

**50.** What is the carrying capacity of the environment for this population?
**(A)** 500
**(B)** 800
**(C)** 1000
**(D)** 1200

## Secondary Problems

**51.** During a biology class, a teacher stated that bryophytes can be considered the "amphibians of the plant kingdom." This observation is valid because, like many amphibians, bryophytes:
**(A)** Have a system of water conduction based on cell-to-cell osmosis.
**(B)** Reproduce by alternation of generations.
**(C)** Live in moist environments and require water for fertilization.
**(D)** Undergo a metamorphosis process in which the oxygen-absorption mechanisms are altered.

**52.** There are two phases or generations in the life cycle of a fern. Which of the following correctly defines the two phases?
**(A)** Both are multicellular, with a haploid sporophyte and a diploid gametophyte.
**(B)** Both are multicellular, with a diploid sporophyte and a haploid gametophyte.
**(C)** The fern alternates between a multicellular diploid sporophyte and a unicellular haploid gametophyte.
**(D)** The fern alternates between a unicellular haploid sporophyte and a multicellular diploid gametophyte.

**53.** In the evolution of plants, the pollen grain arose in plants that belong to the same taxonomic unit as contemporary pine trees. Thus, in evolutionary terms the pollen grain appeared:
**(A)** Before fruits and after flowers.
**(B)** Before flowers and after fruits.
**(C)** Before seeds and before fruits.
**(D)** Before flowers and before fruits.

**54.** Cell types of phloem tissue include:
**(A)** Tracheids and companion cells.
**(B)** Tracheids and vessel elements.
**(C)** Sieve tube members and companion cells.
**(D)** Fibers and sclereids.

**55.** An angiosperm's endosperm cell has:
**(A)** Only paternal genetic material.
**(B)** Only maternal genetic material.
**(C)** More paternal genetic material than maternal genetic material.
**(D)** More maternal genetic material than paternal genetic material.

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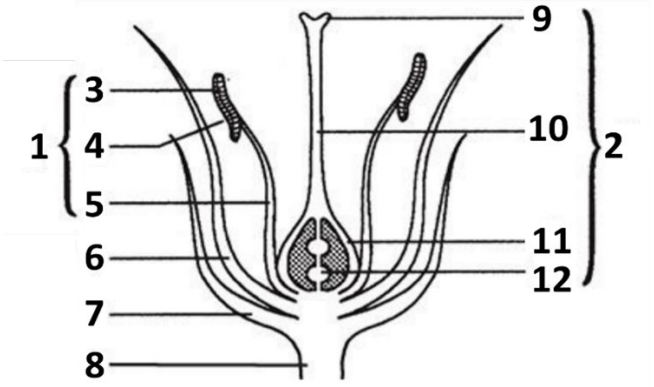
**Questions 56, 57 and 58 refer to the following figure.**



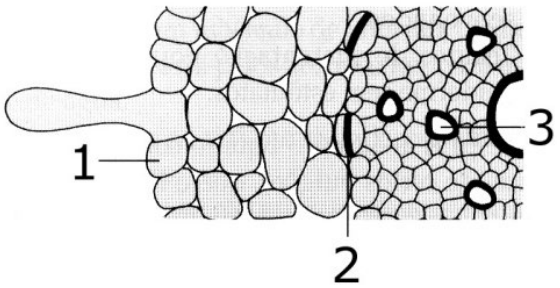

**56.** Shown above is the illustration of a complete flower. Which structure contains the female gametophyte?
**(A)** 1
**(B)** 4
**(C)** 11
**(D)** 12

**57.** Which is the part of the flower that catches pollen?
**(A)** 3
**(B)** 5
**(C)** 6
**(D)** 9

**58.** In which part of the flower do pollen grains develop?
**(A)** 4
**(B)** 5
**(C)** 6
**(D)** 8

**59.** In gardening, the habit of pruning shoot tips promotes the lateral growth of branches, flowers and fruit. This process is related to the phenomenon of:
**(A)** Dormancy, controlled by abscisic acid.
**(B)** Abscission, controlled by gibberellins.
**(C)** Apical dominance, controlled by auxins.
**(D)** Apical dominance, controlled by ethylene.

**60.** Shown below is the transversal cross-section of the primary structure of a root. The structures indicated by 1, 2 and 3 are, respectively:




**(A)** Epidermis, endodermis, xylem.
**(B)** Exodermis, endodermis, phloem.
**(C)** Cortex, pericycle, xylem.
**(D)** Epidermis, pericycle, phloem.

**61.** A herb species $P$ is a long-day plant with a critical photoperiod of 12 hours, while a herb species $Q$ is a short-day plant with a critical photoperiod of 16 hours. What will happen if the two plants are exposed to a light source for 13 hours without interruption?
**(A)** Both herbs will flower.
**(B)** Herb species $P$ will flower, whereas $Q$ will not.
**(C)** Herb species $Q$ will flower, whereas $P$ will not.
**(D)** Neither herb species will flower.

**62.** Associate the animal groups (left column) with the corresponding means of respiration (right column).

| *Animal group* | *Means of respiration* |
|---|---|
| **I.** Porifera | **P.** Branchial |
| **II.** Crustaceans | **Q.** Tracheal |
| **III.** Insects | **R.** Cutaneous |
| **IV.** Reptiles | **S.** Pulmonary |

**(A)** I.R; II.P; III.Q; IV.S;
**(B)** I.R; II.Q; III.P; IV.S;
**(C)** I.P; II.Q; III.P; IV.R;
**(D)** I.R; II.S; III.Q; IV.P;

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**63.** Nephridia, flame cells and Malpighian tubules are excretory structures respectively associated with:
**(A)** Annelids, mollusks, and insects.
**(B)** Annelids, Platyhelminthes, and insects.
**(C)** Insects, Platyhelminthes, and annelids.
**(D)** Platyhelminthes, mollusks, and annelids.

**64.** Which of the following combinations of phylum and description is **incorrect**?
**(A)** Echinodermata → Includes starfish. Bilateral symmetry as a larva, coelomate.
**(B)** Nematoda → Includes roundworms. Pseudocoelomate.
**(C)** Platyhelminthes → Includes flatworms. Endowed with a gastrovascular cavity, acoelomate.
**(D)** Porifera → Includes sponges. Endowed with a gastrovascular cavity, coelomate.

**65.** If the blastopore of a gastrula originates the anus of the future animal, this animal may be:
**(A)** A grasshopper.
**(B)** An earthworm.
**(C)** A sea urchin.
**(D)** A coral.

**66.** In bony fish, the organ responsible for maintenance of hydrostatic equilibrium is:
**(A)** The liver.
**(B)** The stomach.
**(C)** The swim bladder.
**(D)** The skeleton.

**67.** An animal with a cylindrical and slender body, endowed with a coelomic cavity, has pharyngeal clefts during its embryonic development. This animal may be:
**(A)** A snake.
**(B)** A roundworm.
**(C)** A polychaete.
**(D)** A tapeworm.

**68.** The following characteristics are displayed by the eggs of certain groups of chordates:
**I.** Presence of amnion and allantois.
**II.** Calcareous eggshells.
**III.** Egg with abundant yolk.

These characteristics are typical of which chordate groups?
**(A)** Reptiles and fish.
**(B)** Reptiles and amphibians.
**(C)** Birds and reptiles.
**(D)** Birds and amphibians.

**Questions 69 and 70 refer to the following list of options.**
**I.** Skeletal muscle.
**II.** Cardiac muscle.
**III.** Smooth muscle.

**69.** Which of the above muscle types possess sarcomeres?
**(A)** I and II.
**(B)** I and III.
**(C)** II and III.
**(D)** I, II, and III.

**70.** Which of the above muscle types is involuntary?
**(A)** I only.
**(B)** II only.
**(C)** III only.
**(D)** II and III.

**71.** In the human circulatory system,
**(A)** The superior vena cava conveys oxygen-poor blood collected in the head, arms and upper torso to the left atrium of the heart.
**(B)** The inferior vena cava conveys oxygen-poor blood collected in the lower torso and the lower limbs to the right atrium of the heart.
**(C)** The pulmonary veins convey oxygen-rich blood from the lungs to the right atrium of the heart.
**(D)** The aorta conveys oxygen-rich blood to the body via the systemic circulation and stems from the right ventricle of the heart.

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**72.** Which is the correct sequence of passageways through which air travels during inhalation?
**(A)** Pharynx → Larynx → Trachea → Bronchi → Alveoli
**(B)** Pharynx → Trachea → Bronchioles → Bronchi → Alveoli
**(C)** Pharynx → Trachea → Lungs → Bronchi → Alveoli
**(D)** Larynx → Pharynx → Trachea → Bronchi → Alveoli

**73.** Which of the following choices **incorrectly** pairs a digestive enzyme with its site of secretion?
**(A)** Sucrase → Salivary glands
**(B)** Carboxypeptidase → Pancreas
**(C)** Trypsin → Pancreas
**(D)** Lactase → Intestinal glands

**74.** Which of the following best describes why gastric pH must be precisely controlled?
**(A)** Gastric enzymes are most active at low pH.
**(B)** High gastric pH stimulates the release of pancreatic secretions.
**(C)** Low intracellular pH is necessary for proper parietal cell function.
**(D)** Gastric juices create the optimal environment for nutrient absorption in the large intestine.

**75.** Which of the following are **not** found in the glomerular filtrate of a healthy kidney nephron?

**I.** Sodium
**II.** Glucose
**III.** Protein
**IV.** Red blood cells

**(A)** I, II and III.
**(B)** I, III and IV.
**(C)** II, III and IV.
**(D)** I, II, III and IV.

**76.** An individual with insufficient ADH secretion would most likely exhibit an:
**(A)** Increased urinary volume.
**(B)** Increased urinary osmolarity.
**(C)** Increased water reabsorption in the kidneys.
**(D)** Increased filtration rate in the kidneys.

**77.** After eating a meal, a person's blood sugar levels change. What happens in the body to control the blood sugar level after eating?

| | *Blood sugar level* | *Hormone released* | *Effect of hormone* |
|---|---|---|---|
| **(A)** | High | Insulin | Converts glucose into glycogen |
| **(B)** | High | Insulin | Converts glycogen into glucose |
| **(C)** | High | Glucagon | Converts glycogen into glucose |
| **(D)** | Low | Insulin | Converts glucose into glycogen |

**78.** Which of the following hormones is **not** derived from cholesterol?
**(A)** Aldosterone.
**(B)** Testosterone.
**(C)** Oxytocin.
**(D)** Progesterone.

**79.** Elevated levels of cholesterol in the blood serum can lead to plaque-like deposits on the inner walls of the arteries, a process known as atherosclerosis. This disease reduces the diameter of the blood vessels and leads to adverse clinical conditions, such as a stroke or heart attack. Atherosclerosis results from the:
**(A)** Increased synthesis of bile salts from cholesterol.
**(B)** Increased synthesis of steroid hormones from cholesterol.
**(C)** Removal of excess cholesterol from cellular lipid bilayers.
**(D)** Insolubility of cholesterol in water.

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**80.** All of the following are associated with the myelin sheath, **except**:
**(A)** Faster conduction of nervous impulses.
**(B)** Nodes of Ranvier form gaps along the axon.
**(C)** Increased energy output for nervous impulse conduction.
**(D)** Saltatory conduction of action potentials.

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## Solutions

**1.A.** Most ribosomes that are not free in the cytoplasm are found on the rough endoplasmic reticulum, but some are found on the outer nuclear membrane, which is continuous with the membrane of the endoplasmic reticulum. Mitochondria and chloroplasts also have their own ribosomes, but these are found inside the organelles, not on the outer surface.

**2.C.** Only Bacteria have cell walls with peptidoglycans. Most Archaea have cell walls, but they are usually constituted of substances other than peptidoglycans, cellulose, and chitin. One order of Archaea worth mentioning is Methanobacteriales, whose cell walls are made up of *pseudopeptidoglycan*, a polymer that can be distinguished from "typical" bacterial peptidoglycan due to its lack of $D$-amino acids and $N$-acetylmuramic acid.

**3.C.** The Gram-stain procedure involves staining samples with a purple dye, such as crystal violet, using iodine as a mordant (i.e., an agent that fixes the crystal violet to the bacterial cell wall), and then staining with a pink dye, safranin. The differences in cell wall structure allow for characterization of so-called Gram-positive and Gram-negative bacteria.

**4.A.** Cyanobacteria are prokaryotes and hence have no nuclei.

**5.B.** Mitochondrial DNA is exclusively inherited from the mother and does not undergo extensive crossing over, unlike most of the extramitochondrial genetic material. Accordingly, mtDNA constitutes an ideal target for studies on relatedness of animal populations.

**6.D.** Chloroplasts have circular DNA akin to that of prokaryotes; they are sometimes susceptible to the same inhibitors of protein synthesis that work on prokaryotic cells; and they have rRNA sequences similar to those of free-living eukaryotes. But the protein machinery of chloroplasts is not capable of supplying all the peptides needed for their maintenance; this is one of the reasons why chloroplasts stop short of constituting independent organisms.

**7.B.** Microtubules are found in centrioles, basal bodies, flagella, and cilia. Microtubules form the spindle that functions to separate the chromosomes during mitosis and meiosis. In contrast, the protein fibers of muscle cells include actin, which is a micro*filament*, not a set of microtubules.



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**8.A.** Lactase breaks lactose into glucose and galactose. In (B), kinase is an enzyme that phosphorylates its substrate. A zymogen, option (C), is an enzyme that is secreted in an inactive form; examples of zymogen include digestive enzymes such as pepsinogen, trypsinogen, and chymotrypsinogen, which are cleaved in the digestive tract to yield the active enzymes pepsin, trypsin, and chymotrypsin, respectively. Lastly, in (D) phosphatase is an enzyme that removes phosphate from its substrate.

**9.D.** The energy of activation equals the distance from the energy level of the reactants to the uppermost energy level. In the case at hand, there are two peaks; the solid-line peak is higher and represents the energy level required to promote the reaction *without* an enzyme, while the dotted-line peak is lower and represents the enzyme-catalyzed reaction. The energy of activation we're looking for is represented by segment $S$ of the graph.

**10.D.** ATP is a cell's energy currency, and without it the cell's metabolic processes slow down and the cell eventually dies. A human being has an energy reserve of about four minutes of ATP and other phosphate compounds in every cell. This is one of the reasons why brain damage is likely to occur after someone has been without a heartbeat for about four minutes and is then revived.

**11.A.** The oxygen released during light reaction comes from splitting $H_2O$. It follows that the plant in question was most likely supplied with radioactive water. Statement (B) is false because carbon dioxide is involved in the dark reaction and produces glucose. Statement (C) is likewise false because glucose is the final product and would not be radioactive unless the $CO_2$ supplied were radioactive. Statement (D) is false because nitrogen dioxide plays no direct role in photosynthesis.

**12.C.** Plants based on crassulacean acid metabolism usually keep their stomata closed during the day, reducing evapotranspiration in heat-intensive regimes such as those of deserts. Statement (A) is false because CAM plants rely on $H_2O$ for gaseous oxygen just like any other plant. Statement (B) is false because leucoplasts usually lack chlorophyll and hence play no role in photosynthetic metabolism. Statement (D) is false because cuticles are by no means exclusive traits of CAM plants; even bryophytes coat their leaves with layers of waxy polymer.

**13.C.** As the electron transport chain is carried out, oxygen is reduced to form water and protons are continuously pumped from the mitochondrial matrix to the intermembrane space. The latter process causes the pH of the matrix to increase.



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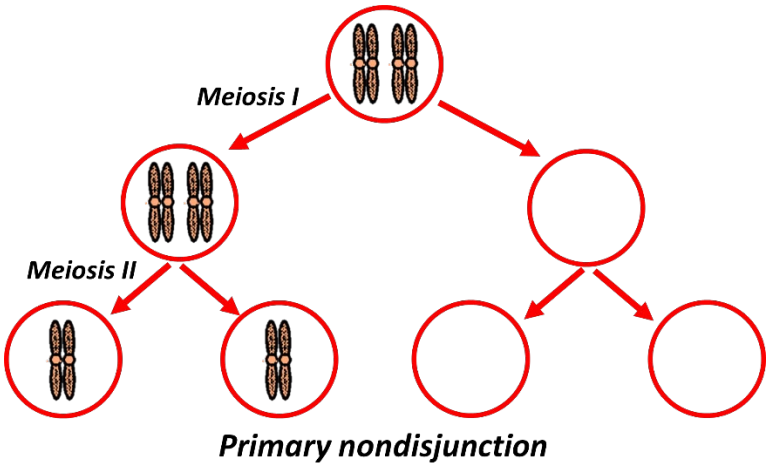
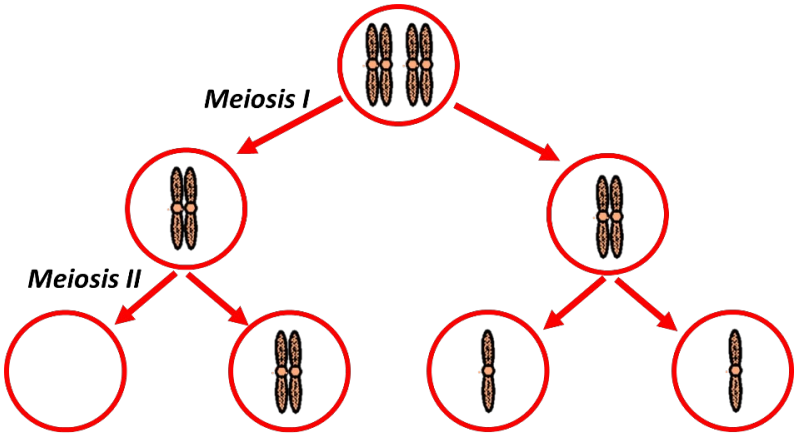
**14.D.** Two mature cell types that do not replicate at all are skeletal muscle cells and nerve cells. The resting state for these cells is the $G_1$ phase of the cell cycle. It is in the $G_1$ phase that transcription and translation for the various cell functions take place. The $G_1$ phase is part of interphase.

**15.C.** As explained by the authors of *The Berkeley Review* material from which this question was adapted, the best way to see the difference between primary and secondary nondisjunction is to consider diagrams of each case. The text explains that primary nondisjunction occurs at the first meiotic division, whereas secondary nondisjunction takes place at the second meiotic division. The two types of disjunction are illustrated below.




***Primary nondisjunction***




***Secondary nondisjunction***

**16.B.** To sequence a species' genome means to determine the nucleotide sequence of all its chromosomes.

**17.B.** A *missense* mutation changes the codon of one amino acid to that of another. A *nonsense* mutation is one that creates a stop codon. A *frameshift* mutation is one that changes the reading frame of the mRNA.

**18.A.** In replication, helicase enzymes unwind the double helix, primase mediates the formation of a complementary RNA primer to initiate the synthesis of DNA, and DNA polymerase III synthesizes the leading strand continuously in the 5' to 3' direction. Stop codons are used to halt protein



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synthesis during translation of mRNA. None of the DNA transcription machinery takes any special notice of bases that will generate a stop codon in mRNA; they are copied in exactly the same way as the rest of the genome.

**19.C.** The sum of the adenosine/tyrosine proportion and the guanosine/cytosine proportion should yield 100%,

$$2\left[\%\left(\mathrm{A/T}\right)\right]+2\left[\%\left(\mathrm{G/C}\right)\right]=100$$
$$\therefore 2\times 23+2\left[\%\left(\mathrm{G/C}\right)\right]=100$$
$$\therefore 2\left[\%\left(\mathrm{G/C}\right)\right]=100-46$$
$$\therefore \left[\%\left(\mathrm{G/C}\right)\right]=\frac{100-46}{2}=\boxed{27\%}$$

**20.A.** In a lytic cycle, a DNA virus does not necessarily need access to the host chromosome. During a lysogenic cycle, however, the viral DNA joins with the host DNA.

**21.A.** The genetic material alone determines the structure of the offspring. Accordingly, a virus carrying DNA from a $\mathrm{T}_2$ bacteriophage will yield an offspring with genetic material, capsule, and all else inherent to a $\mathrm{T}_2$ bacteriophage, even though the parent virus had the capsule of a $\mathrm{T}_4$.

**22.B.** According to the Central Dogma, RNA is normally synthesized by transcription of DNA. Retroviruses violate this principle by using a host cell's machinery to carry out the reverse process, retro-transcribing viral RNA into DNA.

**23.D.** Statement (A) is true: populations of endangered species could be cloned to prevent extinction. Statement (B) is true: new organs can be grown from either stem cells or in another organism. Statement (C) is true: use of molecular cloning has been integrated in the development of disease-resistant crops. Statement (D) is false, in that *in vitro* fertilization involves fertilization of an egg by a sperm in a laboratory environment; molecular cloning is unrelated to this process.

**24.C.** Statements (A), (B) and (D) are true. Statement (C) is false: restriction enzymes actually retain phosphates and pentoses.

**25.B.** The DNA used in paternity tests, when sampled from blood material, is generally extracted from leukocytes. Leukocytes are a good choice of DNA source because they are ubiquitous, large, and nucleated (whereas mammalian RBCs are not).



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**26.B.** Gel electrophoresis separates DNA on the basis of size. Smaller samples travel a greater distance down the gel compared to larger samples.

**27.D.** Individual D has a DNA fingerprint identical to that of the material recovered from the crime scene. Accordingly, individual D was likely involved in the crime.

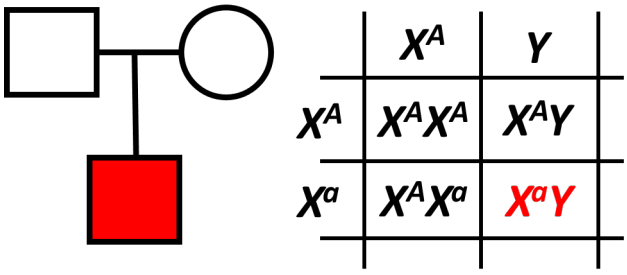
**28.C.** Individuals A and C have the same DNA fingerprint, and hence could be identical twins.

**29.C.** Let $a$ denote the recessive allele and $A$ and $B$ denote the codominant alleles. It is easy to see that an individual can exhibit four phenotypes, one for genotypes $AA$ and $Aa$, another for genotypes $BB$ and $Ba$, a third one for genotype $AB$, and a fourth for genotype $aa$.

**30.B.** The number of types of gametes is given by $2^n$, where $n$ is the number of genes for which the individual is heterozygous. The individual in question is heterozygous for genes $B/b$, $D/d$, and $E/e$, therefore it should be capable of producing $2^3 = 8$ types of gamete.

**31.C.** In option (C), both parents carry the dominant allele $Y$ and hence should be yellow in color; still, each parent also carries the recessive allele $y$, which means that they could produce green offspring.

**32.D.** The $X$ chromosome of male offspring is inherited from the mother. Thus, for the son to be color blind the allele associated with this trait was necessarily inherited from the mother, as illustrated in the following Punnett square, where $X^a$ denotes an $X$ chromosome that carries the color-blindness gene. The mother is phenotypically normal because the $X$-linked color blindness allele is recessive and she is heterozygous for this trait.




**33.C.** The individual with the known phenotype (brown-triangular ear) can only have genotype $bbee$. For a crossing involving one such ferret to yield an offspring with even distribution of all four possible phenotypes, the other individual has to be heterozygous for both genes. This is shown in the following Punnett square, where the gamete $be$ produced by the ferret



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of known genotype is shown in blue and the four types of gamete produced by the double-heterozygous ferret are shown in red.

| | $BE$ | $Be$ | $bE$ | $be$ |
|---|---|---|---|---|
| $be$ | $BbEe$ | $Bbee$ | $bbEe$ | $bbee$ |

**34.C.** The parent with $AaBb$ genotype is heterozygous for both genes and should be able to produce $2^2 = 4$ types of gamete, while the parent with $Aabb$ genotype is heterozygous for one gene only and should yield $2^1 = 2$ types of gamete. In the following Punnett square, the gametes of the $AaBb$ parent are highlighted in blue, while those of the $Aabb$ are written in red.

| | $AB$ | $Ab$ | $aB$ | $ab$ |
|---|---|---|---|---|
| $Ab$ | $AABb$ | $AAbb$ | $AaBb$ | $Aabb$ |
| $ab$ | $AaBb$ | $Aabb$ | $aaBb$ | $aabb$ |

As indicated by the genotypes in green, 3/8 of the offspring will carry two dominant alleles for either gene, which corresponds to normal red seeds.

**35.C.** Random mating is one of the main requirements for Hardy-Weinberg equilibrium to hold. Other requirements include:
1. The population is very large.
2. No mutations affect the gene pool.
3. There is no net migration of individuals into or out of the population.
4. The genes in the population are all equally successful at reproduction.

Options (A), (B) and (D) are all phenomena that may modify the composition of the gene pool and cause the population to violate Hardy-Weinberg equilibrium.

**36.C.** Suppose $R$ and $r$ denote the dominant and recessive alleles in the rhesus blood group system, respectively. Further, let $p$ and $q$ denote the frequency of the dominant and recessive alleles in the population at hand. If 900 individuals have Rh negative blood, or a $rr$ genotype, the frequency $q$ of the recessive allele is

$$q^2 = \frac{900}{10,000} \rightarrow q = \sqrt{0.09}$$

$$\therefore q = 0.3$$



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Since $p + q = 1$, the frequency of the dominant allele is $p = 0.7$. The frequency of homozygote Rh positive individuals, which have a $RR$ genotype, is $p^2 = 0.7^2 = 0.49$. The number of homozygote Rh positive individuals is then $10{,}000 \times 0.49 = 4900$.

**37.B.** In the early days of Earth's existence, abiotic synthesis of organic molecules was the result of interactions between methane, carbon dioxide, nitrogen gas, hydrogen gas, trace amounts of oxygen, and other precursor gases. Helium, a noble gas, most likely did not participate in the formation of precursor molecules.

**38.B.** In broad terms, Darwin postulated that natural selection is the driving force of evolution, as mentioned in (A), and that the fitness of an individual is measured in terms of reproductive success, as stated in (D). Through natural selection, organisms become separated in groups, depending on how adapted they are to a particular environment, and these groups eventually separate to the point of becoming distinct species; this is in accord to option (C). Statement (B) is false because the theory of natural selection applies to a population of organisms, not to a particular individual. Favorable genetic variations become more and more common from generation to generation, not during the lifetime of an individual.

**39.D.** Modern evolutionary theory incorporates Darwin's notion that natural selection leads to the prevalence of the fittest individuals, and that adaptation to selective pressure over the course of generations is an integral part of this process. Mutation and genetic recombination are molecular biology concepts that were not available in Darwin's time.

**40.C.** If insect populations $X$ and $Z$ can still mate and produce fertile descendants, they still belong to the same species. Since crossings between $Y$ and $X$ or $Z$ yield sterile offspring or no offspring at all, $Y$ has been reproductively isolated from these populations and now constitutes a different species.

**41.B.** According to the PCE, two species with the exact same niche cannot coexist in a community. Even a student with no knowledge of the PCE should choose option (B), given how outlandish statements (A), (C) and (D) are.

**42.C.** Since many species of fungi are detritivores, eliminating them with a fungicide would reduce the decomposition rate. Lowering the population of fungi, which are heterotrophs, would also lower total ecosystem respiration and cause the net ecosystem production to rise somewhat.

**43.C.** Each level in a pyramid of energy loses some energy from the level before it as a result of the loss of heat and energy costs of maintenance of



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the organism at each level. Therefore, the least amount of stored chemical energy will be found in the highest trophic level of a given food chain – in the present case, that of tertiary consumers.

**44.D.** The amount of red arrows that point to the hawk gives it away. The hawk can function as a secondary consumer by serving as the predator of a true thrush or a guinea pig; it can also function as a tertiary consumer by consuming a frog; and it can act as a quaternary consumer by consuming a snake.

**45.C.** A mistletoe's extraction of xylem from another plant is a textbook case of *parasitism*, a +/– ecological relationship. Such a relationship does not qualify as predation because one of the organisms (the parasite) requires the other to remain alive for the relation to remain viable. In turn, innocuous installation of a small plant such as a bromelia on a larger plant is an example of *epiphytism*, a +/0 ecological relationship. Epiphytism can be regarded as a special type of commensalism.

**46.A.** Tropical forests have the highest biodiversity and primary productivity of any of the terrestrial biomes. For example, the Amazon basin concentrates the largest number of freshwater fish species in the world, with more than 3,000 species.

**47.D.** A growing season decreases as latitude increases. It follows that a taiga, which has the northernmost latitude of the choices available, should be associated with the shortest growing season.

**48.B.** In a logistic model, a population stops growing when the carrying capacity, $K$, reaches the number of individuals, $N$. Statement (A) is false because the carrying capacity alone does not determine whether a given population is growing exponentially. Statement (C) is false because the number of individuals added per unit time, $dN/dt$, can be shown to be greatest when the number of individuals is at half the carrying capacity. Lastly, in statement (D) the per capita population growth rate actually *decreases* as $N$ approaches $K$.

**49.B.** Growth rate is zero when the population-time graph reaches an extremum, and its tangent line becomes horizontal. In the given graph, this occurs at point B.

**50.B.** The carrying capacity is the maximum population size that can be sustained by the environment. In the present case, the population seems to stabilize at point D, when the number of individuals is at 800.



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**51.C.** Most bryophytes inhabit humid environments and require water for the male gamete, a flagellate antherozoid, to swim toward the archegonium. Unlike spermatophytes, bryophytes have no pollen tube to serve as a direct link between male and female reproductive structures.

**52.B.** In a fern's lifecycle, a multicellular, diploid sporophyte is the prevailing generation. The sporophyte produces spores by meiosis; the spores germinate and yield multicellular, haploid gametophytes known as antheridia (male) and archegonia (female). The gametophytes produce gametes via mitosis; fertilization of an egg yields a diploid zygote, which develops into a new diploid sporophyte. The cycle is then complete.

**53.B.** If pollen grains arose in gymnosperms, they must necessarily have appeared before flowers and fruits; these are reproductive structures associated with angiosperms, which appear after gymnosperms in the evolutionary record.

**54.C.** Phloem is constituted of sieve tube members, through which organic solutes are translocated, and companion cells, which support the metabolism of the sieve tube members. Companion-cell support is necessary because sieve tube members lack nuclei.

**55.D.** An endosperm cell is triploid in nature and forms when a sperm cell released by a pollen grain fuses with two polar bodies. Since the polar bodies belong to the female part of the plant, one can state that an endosperm cell has more maternal genetic material than paternal genetic material.

**56.D.** The female gametophyte is indicated by No. 12. The ovules are contained in the ovary, an enlarged base of the pistil. Each ovule contains a haploid egg nucleus, which is the female gametophyte *per se*.

**57.D.** The stigma, indicated in the illustration by No. 9, is the sticky top part of the female reproductive system that intercepts pollen.

**58.A.** The structures associated with the male region of the flower are indicated by No. 1. Specifically, development of pollen grains takes place in structure 4, the pollen sacs, cavities in the anther that produce and store male gametes.

**59.C.** The phenomenon in question is apical dominance. By default, auxins produced by meristematic tissue in shoot tips inhibit growth of lateral buds. When the apical bud is removed, the lowered auxin concentration enables the lateral buds to grow and produce new shoots, competing directly with central-stem growth.



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**60.A.** Structure 1 is the epidermis, an outer layer of cells that protects the surrounding medium from the root cortex. Structure 2 is the endodermis, which separates the cortex from the stele. Structure 3 is a xylem vessel.

**61.A.** The key in this type of problem is to use the period of darkness, not the period of exposure to light, as the reference. Since herb species $P$ is a long-day plant, it will flower if the night period *exceeds* a critical period – in this case, 12 hours. In turn, herb species $Q$ is a short-day plant and will flower if the night period is *less than* a critical period – in this case, 16 hours. It follows that exposing the plants to light for 13 hours will cause both species to initiate flowering.

**62.A.** Sponges have no specialized structures for gas exchange; they simply trade gases by diffusion between their body surface and water. Crustaceans respire through branchia. Insects exchange gases through a network of trachea distributed over their bodies. Reptiles breathe through lungs.

**63.B.** Nephridia are typical of annelids; flame cells occur in flatworms; Malpighian tubules are the excretory systems of hexapods.

**64.D.** Statement (D) is doubly false: sponges have no gastrovascular cavity; these are characteristic of cnidarians and flatworms. Further, porifera are acoelomates, much like lower invertebrate phyla such as flatworms and cnidarians.

**65.C.** Like the chordates, echinoderms such as starfish and sea urchins are deuterostomes, that is, animals in whose embryonic development the blastopore originates the anus.

**66.C.** Doesn't get any easier than this, does it? The swim bladder is a sac-like structure installed in the dorsal region of Osteichthyes that regulates buoyancy by absorbing or releasing gas.

**67.A.** All four options are cylindrical animals, but only the snake, the only chordate on the list, may have exhibited pharyngeal clefts during its embryonic development.

**68.C.** Egg characteristic (I) is the key to answer this problem, in that extraembryonic membranes such as the amnion and the allantois arose in the development of reptiles, birds, and egg-laying mammals; amphibians and fish are not amniotes. Further, the eggs laid by amphibians and fish lack shells, and this is one of the reasons why they have limited viability in terrestrial environments.

**69.A.** Sarcomeres allow for rapid, forceful contractions, and are thus found in skeletal and cardiac muscle, but not in smooth muscle.



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**70.D.** Although skeletal muscle responds to voluntary motor impulses, cardiac and smooth muscle (found in the heart and in places like the lining of the stomach) are involuntary forms of muscle tissue, contracting without conscious control.

**71.B.** Statement (B) is true. Statement (A) is false because blood collected in the vena cava unload in the right, not left, atrium. Statement (C) is false because pulmonary veins unload in the left, not right, atrium. Statement (D) is false because the aorta stems from the left, not right, ventricle.

**72.A.** Air enters the respiratory tract through the external nares (nostrils) and travels through the nasal cavities. It then passes through the pharynx and into the larynx. (Ingested food also passes through the pharynx on its way to the esophagus; to ensure that food does not accidentally enter the larynx, the epiglottis covers the larynx during swallowing.) Air then moves through the trachea and into the bronchi. The bronchi branch into smaller and smaller bronchi, the terminal branches of which are termed bronchioles. The bronchioles are surrounded by clusters of alveoli.

**73.A.** Sucrase is released in the small intestine, not in the oral cavity. As its name suggests, sucrase catalyzes the breakdown of sucrose, a disaccharide, into fructose and glucose.

**74.A.** Gastric enzymes, such as pepsin, have optimum activity in an environment with a pH between 2 and 3. Statement (B) is false because it is low pH, not high, that stimulates the release of pancreatic secretions. Statement (C) is likewise false. Statement (D) is not valid because the acidity of the chyme entering the neutralized by the bicarbonate ion in the duodenum; by the time it reaches the large intestine, the chyme is no longer acidic.

**75.C.** Ideally, all sugars, protein, and red blood cells will have been reabsorbed before filtration in a nephron is completed and the filtrate enters the collecting duct. Sodium, on the other hand, is an osmotic regulator and its occurrence in particularly high or low amounts in the kidney filtrate is rarely indicative of an anomaly.

**76.A.** ADH is secreted by the posterior pituitary gland in response to high plasma osmolarity. ADH acts on the kidneys to increase their water reabsorption, thereby decreasing the plasma's solute concentration by diluting it with water. Increasing water reabsorption in the kidneys decreases the volume of urine excreted and increases urine osmolarity. A person with insufficient ADH production would therefore be expected to suffer from the opposite effects – decreased water reabsorption in the kidneys, which leads to an increase in urinary volume, a decrease in urine osmolarity, and an increase in plasma osmolarity.



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**77.A.** Insulin is released when the blood sugar level is high; it causes excess glucose to be converted to glycogen, which is stored in the liver. When blood sugar levels are low, glucagon is released and glycogen is converted to glucose.

**78.C.** Steroid hormones are derived from cholesterol. This characteristic makes them lipophilic and allows them to diffuse freely across cell membranes. Steroid hormones include glucocorticoids (cortisol and cortisone), mineralcorticoids (aldosterone), and cortical sex hormones (androgens such as estrogen, progesterone, and testosterone). Oxytocin is a peptide hormone unrelated to cholesterol.

**79.D.** Cholesterol is quite insoluble in water, and its accumulation in the walls of arteries leads to the formation of plaques. Statement (A) is false because, if there were an increase in the synthesis of bile salts from cholesterol, less cholesterol would be in the serum and more would be excreted in the feces. By the same token, statement (B) is not valid because synthesis of steroid hormones would actually entail a reduction in the levels of cholesterol in the blood serum. Finally, statement (C) errs because there is no mechanism to remove excess cholesterol from lipid bilayers.

**80.D.** Myelin is a white, lipid-containing material surrounding the axons of many neurons in the central and peripheral nervous systems. Myelin is produced by glial cells (specifically, oligodendrocytes in the central nervous system and Schwann cells in the peripheral nervous system) and is arranged on the axon discontinuously. The gaps between the segments of myelin are called nodes of Ranvier. Myelin increases the conduction velocity by insulating segments of the axon so that the membrane is permeable to ions only at the nodes of Ranvier. Because of these nodes, the action potential jumps from node to node, a process known as saltatory conduction. Myelin sheaths do not increase the energy output of nervous impulse conduction; rather, they speed conduction.



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# Answer Summary

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | A | 21 | A | 41 | B | 61 | A |
| 2 | C | 22 | B | 42 | C | 62 | A |
| 3 | C | 23 | D | 43 | C | 63 | B |
| 4 | A | 24 | C | 44 | D | 64 | D |
| 5 | B | 25 | B | 45 | C | 65 | C |
| 6 | D | 26 | B | 46 | A | 66 | C |
| 7 | B | 27 | D | 47 | D | 67 | A |
| 8 | A | 28 | C | 48 | B | 68 | C |
| 9 | D | 29 | C | 49 | B | 69 | A |
| 10 | D | 30 | B | 50 | B | 70 | D |
| 11 | A | 31 | C | 51 | C | 71 | B |
| 12 | C | 32 | D | 52 | B | 72 | A |
| 13 | C | 33 | C | 53 | D | 73 | A |
| 14 | D | 34 | C | 54 | C | 74 | A |
| 15 | C | 35 | C | 55 | D | 75 | C |
| 16 | B | 36 | C | 56 | D | 76 | A |
| 17 | B | 37 | B | 57 | D | 77 | A |
| 18 | A | 38 | B | 58 | A | 78 | C |
| 19 | C | 39 | D | 59 | C | 79 | D |
| 20 | A | 40 | C | 60 | A | 80 | D |

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