Bio League Competition 2024 Phase Two

Contents

Biochemistry & Cell Biology:

1- If a replicating cell encounters significant DNA damage during the S phase, what is the most likely result?

A. It will arrest in the S phase checkpoint and undergo repair.
B. It will immediately trigger apoptosis and die.
C. It will utilize bypass polymerases to complete the S phase.
D. It will utilize telomerase to extend past the damage.
E. It will undergo a reductive division.

2- Simple diffusion and facilitated diffusion have in common that they:

A. possess rectangular hyperbolic kinetics
B. are done in a favorable gradient
C. may reach saturation
D. are specific
E. all of the above

3- Which of the following statements is/are TRUE regarding glycogen buildup and breakdown? (Select all that apply)

A. possess rectangular hyperbolic kinetics
B. are done in a favorable gradient
C. may reach saturation
D. are specific
E. all of the above

4- What is the best reason why oxygen is able to bind to the heme group in myoglobin, despite the heme being deep in the protein?

A. Rapid flexing of the amino acid side chains produces temporary cavities for the oxygen to enter.
B. The side chains pass the oxygen to each other until it reaches the heme group.
C. The myoglobin protein contains special alpha helix domains that let the oxygen tunnel through.
D. The myoglobin protein moves the heme group towards its surface through rearrangement of its tertiary structure.
E. High partial pressure of oxygen displaces carbon dioxide attached to the heme group.

5- Steroid hormones act at the cellular level:

A. inhibiting pre existing enzymes
B. through a second messenger
C. by regulating gene expression
D. through G proteins
E. modifying the concentration of intracellular ionic calcium

6- **Ethanol ingestion is incapable of supplying carbons for gluconeogenesis. This is due to which of the following?**

A. Ethanol is converted to acetone, and the carbons are lost during exhalation
B. Ethanol is lost directly in the urine
C. Ethanol cannot enter the liver, where gluconeogenesis predominantly occurs
D. Ethanol's carbons are lost as carbon dioxide before a gluconeogenic precursor can be generated
E. Ethanol is converted to lysine, which is strictly a ketogenic amino acid

7- **Which of the following MOST ACCURATELY accounts for the diverse array of intracellular responses triggered by cyclic AMP in mammalian cells?**

A. It is synthesized in substantial amounts within the cell.
B. It translocates to the DNA, where it interacts with various histones.
C. It activates an extensive range of specific protein kinases.
D. It inhibits the activation of alternative hormonal signaling pathways

8- **If you fluorescent-labeled the exterior of the trans-membrane proteins of one mammalian cell with a yellow label and another cell with a red label, and then fused them, which of the following would MOST likely occur over approximately 1 hour at 37ºC?**

A. The labels would remain unevenly distributed on the exterior of the fused cells.
B. The labels would rapidly disappear from view.
C. One color would be observed inside the cell while the other remains on the exterior.
D. The labels would diffuse evenly across the exterior surface of the fused cells

9- **Cyclic photophosphorylation functions mainly for which of the following purposes?**

A. Generating NADPH
B. Generating PGAL
C. Recycling electrons resulting from the absorption of light in Photosystem I
D. Regenerating RuBP

Genetics & Evolution:

1- Which of the following alternative breeding strategies allows an individual to pass on its genetic material indirectly?

A. Young male birds participate in a lek alongside an older, unrelated male, who monopolizes all copulations.
B. Young female birds clandestinely deposit an egg in another female's nest for incubation.
C. Non-breeding helpers are genetically unrelated to the offspring of a breeding pair.
D. Non-breeding helpers are full siblings to the offspring of a breeding pair.

2- In the famous experiment by Hershey and Chase that showed DNA was the genetic material, what did they use to transmit the DNA into E. coli:

A. other E. coli
B. electric shocks
C. a blender
D. Bacteriophage

3- If the human SRY gene is inactivated in the first week of gestation, which of the following will occur:

A. the embryo will die
B. the embryo will remain female
C. the embryo will continue as a male
D. the embryo will remain in a quiescent state

4- Nucleotide excision repair of pyrimidine dimers uses which of the following enzyme(s)

A. photolyases
B. nucleases, DNA polymerases and DNA ligases
C. exonucleases and DNA ligases
D. restriction endonucleases and DNA polymerases
E. restriction endonucleases and DNA ligase

5- Natural selection is effective in the evolutionary processes because it:

A. causes evolution.
B. changes allele frequencies.
C. changes genotype frequencies.
D. leads to fixation or loss of particular alleles.
E. increases the mean fitness of a population.

6- **Loss of heterozygosity can be caused by all of the following EXCEPT:**

A. genetic drift.
B. positive frequency-dependent selection.
C. heterozygote advantage.
D. inbreeding.
E. heterozygote disadvantage.

7- **The Central Dogma of molecular biology states that one gene leads to one transcript and results in one protein product. Which of the following processes would refute this dogma?**

A. Ordered splicing.
B. RNA editing.
C. Telomerase activity.
D. Translation starts site recognition.
E. Polyadenylation of new transcripts.

8- **Which of the following is NOT TRUE regarding translation in prokaryotes?**

A. tRNA synthetases couple amino acids to charged tRNAs.
B. The peptidyl transferase reaction requires a charged tRNA bound at the P site.
C. Polypeptide synthesis proceeds from the amino end to the carboxyl end; while mRNAs are translated in a 5′-to-3′ direction.
D. The positioning of the very first tRNA entering the P site is facilitated by the binding of mRNA to 16s RNA in the small subunit of the ribosome.

9- **Which of the following mechanisms of microevolution is influenced specifically by population size?**

A: Gene flow.
B: Genetic drift.
C: Mutation.
D: Natural selection.
E: Sexual selection.

Anatomy & Physiology:

1- **Which of the following steroid hormones is the precursor to all of the others listed in the answer choices?**

A. Estrone
B. Testosterone
C. Progesterone
D. Androstenedione

2- **Multiple Choice In which of the following glands do hematopoietic stem cells develop into T cells?**

A. Pineal
B. Thymus
C. Pituitary
D. Adrenal

3- **In a countercurrent exchange system, arteries and veins are located near one another, allowing the transfer of arterial heat energy to the cooler venous blood. Conservation of heat energy through this system decreases the need for additional energy to warm the chilled venous blood. Which of the following best illustrates the greatest need for heat conservation using a countercurrent blood flow?**

A. Stomachs of beluga whales
B. Ears of Asian elephants
C. Flippers of Atlantic dolphins
D. Breast muscles of Canadian geese

4- **A decrease in cortisol secretion would lead to a(an)**

A. decrease in epinephrine synthesis.
B. decrease in ACTH synthesis.
C. increase in blood glucose concentration.
D. increase in blood pressure.
E. increase in the body mass index.

5- **The inspiratory phase of mammal respiration is characterized by:**

A. expansion of the rib cage and contraction of the diaphragm.
B. expansion of the rib cage and relaxation of the diaphragm.
C. collapse of the rib cage and contraction of the diaphragm.
D. collapse of the rib cage and relaxation of the diaphragm.
E. contraction and relaxation of the diaphragm.

6- **Inflammation and injury of the pancreas can cause elevated levels of serum amylase. Injury or disease of which of the following organs might you expect to produce a similar laboratory finding?**

A. Liver
B. Colon
C. Thyroid
D. Salivary gland
E. Adrenal gland

7- **Which of the following conditions will cause an increase in blood pressure, an acceleration of the heartbeat, an increase in blood flow to peripheral muscles, and dilation of the pupils?**

A. Stimulation of the somatic nervous system.
B. Stimulation of the thyroid gland.
C. Stimulation of the parasympathetic nervous system.
D. Stimulation of the sympathetic nervous system.
E. Stimulation of the somatic nervous system and the thyroid gland.

8- **The final step in the synthesis of the biologically active form of vitamin D in humans occurs in the**

A. Kidney.
B. Liver.
C. Parathyroid.
D. Skin.
E. Thyroid.

9- **Which of the following changes, by itself, would tend to make lymph form more slowly?**

A. An increase in capillary blood pressure.
B. An increase in the osmotic concentration of the interstitial fluid.
C. An increase in the osmotic concentration of the blood plasma.
D. Two of the above could both make lymph form more slowly.
E. All of the above could make lymph form more slowly.

Ecology & Ethology:

1- Hundreds of fossils from an extinct quail species have been discovered on a small Pacific island. The fossil femur is notably longer than that of modern mainland quails, while the fossil ulna is shorter. What might explain these morphological differences between the extinct quail and contemporary specimens?

A. The extinct quail had adapted to jumping higher due to a greater concentration of predators on islands.
B. The extinct quail was likely undergoing an evolutionary transition towards flightlessness.
C. The extinct quail fossils represent juvenile individuals.
D. The extinct quail was a hybrid between the mainland species and another, as yet unidentified, island species.

2- Spotted Owls and Barred Owls are examples of ecotypes that can interbreed to produce Sparred Owls – a hybrid species. Which of the following is NOT true about the sparred owls?

A. They are protected under the Endangered Species Act since they are offspring of spotted owls
B. They may interbreed with spotted owls, reducing future numbers of pure spotted owls
C. They may interbreed among themselves, creating a new subspecies
D. They could trigger the extinction of the Spotted Owl

3- The Spotted Owl is considered an endangered species in the western United States, largely due to competition from the introduced Barred Owl. These two species are genetically similar and are believed to have speciated from a common ancestor after separation of the two populations on opposite coasts of the United States. This is an example of:

A. Allopatric speciation
B. Sympathetic speciation
C. Sympatric speciation
D. Genetic drift

4- Which of the following is NOT required by nitrogen-fixing organisms for growth?

A. carbon dioxide
B. nitrate
C. nitrogen
D. oxygen
E. all are required

5- For populations that exhibit _____ population growth, maximum harvesting yield is achieved when _____.

A. exponential, population growth rate is highest
B. logistic, the population reaches its carrying capacity
C. logistic, population growth rate is highest
D. logistic, population growth rate is not changing with population size
E. exponential, the population reaches its carrying capacity

6- Natural ecosystems provide an array of basic processes that affect humans." Which of the following statements does NOT support this quotation?

A. Bacteria help recycle materials.
B. Algal populations of a lake help to oxygenate the water.
C. Trees add to the amount of atmospheric oxygen.
D. Lichens and mosses living on rocks help to break the rocks down, forming soil.
E. Treated sewage is less damaging to the environment than untreated sewage.

7- Which of the following statements is correct about diversity in ecological environments?

A. Prokaryotic nitrogen fixation is a mode for nitrogen entrance into ecosystems.
B. Solar energy is the force that causes water to move in a global cycle.
C. The carbon cycle mirrors the shared processes of cellular respiration and photosynthesis.
D. The proportion of a particular nutrient form and its cycling in that form is consistent within ecosystems.
E. Vegetation regulates nutrient cycling.

8- Which of the following is FALSE regarding the cycling of water and nutrients in the ecosystems?

A. Prokaryotic nitrogen fixation is a mode for nitrogen entrance into ecosystems.
B. Solar energy is the force that causes water to move in a global cycle.
C. The carbon cycle mirrors the shared processes of cellular respiration and photosynthesis.
D. The proportion of a particular nutrient form and its cycling in that form is consistent within ecosystems.
E. Vegetation regulates nutrient cycling.

9- According to the equilibrium hypotheses of island biogeography, there is a balance between the rate at which species immigrate to the island and the rate at which species:

A. Emigrate from the island.
B. Become locally extinct.
C. Fill other ecological niches.
D. Undergo character displacement.
E. Become extinct on the mainland.