



# KSO 2018 x DALTON

## Written Exam

### 1hr 30 mins

## Biology

#### **INSTRUCTIONS:**

1. Please write your name (name on your name tags), grade, and school on both this exam booklet and the scantron (bubble) sheet provided.
2. NO CALCULATOR is allowed.
3. Fill in the bubble clearly and erase the bubble COMPLETELY if you would like to make a change.
4. If you are using a pen for bubbling, make sure to cross out any answers you don't want to be marked for.
5. Write clearly for FRQ, any handwriting that cannot be deciphered will not be scored.
6. Look at your own paper ONLY.
7. If you complete your exam early, please leave all pieces of paper in a neat pile on your desk and make your way to the new cafe for snacks. (You will not be allowed to leave in the last 10 minutes should you finish early)

NAME:

GRADE:

SCHOOL:

1. Garden beans and many other eudicots have a hooked hypocotyl during germination. Which of the following is true concerning hypocotyls and/or the hypocotyl hook?
  - a. It is the first structure to emerge from a eudicot seed.
  - b. It pushes the cotyledons up through the soil.
  - c. It straightens when exposed to sufficient water.
  - d. It is stunted in an etiolated seedling.
  - e. It emerges after the successful establishment of the radicle.
2. Two eukaryotic proteins have one domain in common but are otherwise very different. Which of the following processes is most likely to have contributed to this similarity?
  - a. Gene duplication
  - b. RNA splicing
  - c. Exon shuffling
  - d. Histone modification
  - e. Random point mutations
3. According to the concept of punctuated equilibrium, the "sudden" appearance of a new species in the fossil record means that
  - a. The species is now extinct.
  - b. Speciation occurred instantaneously.
  - c. Speciation occurred in one generation.
  - d. Speciation occurred rapidly in geologic time.
  - e. The species will consequently have a relatively short existence, compared with other species.
4. Natural selection should favor the highest proportion of juxtamedullary nephrons in which of the following species?
  - a. A river otter
  - b. A mouse species living in a tropical rainforest
  - c. A mouse species living in a temperate broadleaf forest
  - d. A mouse species living in a desert
  - e. A beaver
5. Bacteria perform each of the following ecological roles. Which role typically does not involve a symbiosis?
  - a. Skin commensalist
  - b. Decomposer
  - c. Aggregates with methane-consuming archaea
  - d. Gut mutualist
  - e. Pathogen
6. Increased atmospheric CO<sub>2</sub> concentrations might have what effect on seawater?
  - a. Seawater will become more acidic, and bicarbonate concentrations will decrease.
  - b. Seawater will become more alkaline, and carbonate concentrations will decrease.
  - c. There will be no change in the pH of seawater, because carbonate will turn to bicarbonate.
  - d. Seawater will become more acidic, and carbonate concentrations will decrease.
  - e. Seawater will become more acidic, and carbonate concentrations will increase

7. For several decades now, amphibian species worldwide have been in decline. A significant proportion of the decline seems to be due to the spread of the chytrid fungus, *Batrachochytrium dendrobatidis* (Bd). Chytrid sporangia reside within the epidermal cells of infected animals, animals that consequently show areas of sloughed skin. They can also be lethargic, which is expressed through failure to hide and failure to flee. The infection cycle typically takes four to five days, at the end of which zoospores are released from sporangia into the environment. In some amphibian species, mortality rates approach 100%; other species seem able to survive the infection. If infection primarily involves the outermost layers of adult amphibian skin, and if the chytrids use the skin as their sole source of nutrition, then which term best applies to the chytrids?
- Anaerobic chemoautotroph
  - Aerobic chemoautotroph
  - Anaerobic chemoheterotroph
  - Aerobic chemoheterotroph
  - Chemoautotroph and chemoheterotroph
8. Organisms with a reproductive pattern that produces shelled amniotic eggs generally
- End up having a higher embryo mortality rate than do organisms with unprotected embryos.
  - Invest most of their reproductive energy in the embryonic and early postnatal development of their offspring.
  - Invest more energy in parenting than do placental animals.
  - Produce more gametes than do those animals with external fertilization and development.
  - Lower their embryo mortality rate to less than one in a thousand.
9. If thermoregulation is considered to be a secondary function of the large ears of jackrabbits, then the primary function of the ears is
- To optimize nutrient intake through the thin, permeable surfaces on the ears.
  - To alter the rate of gas exchange, based on the adjustable radius of the ears' blood vessels.
  - To detect predators by using the large size and flexible positioning of the external ears to channel sound waves into the ear canal.
  - To protect offspring from bright sunlight by the positioning of the ears to cast the maximum shadows.
  - To protect against pathogens by having a thick, waxy surface on the ears
10. You are studying three populations of birds. Population A has ten birds, of which one is brown (a recessive trait) and nine are red. Population B has 100 birds, of which ten are brown. Population C has 30 birds, and three of them are brown. In which population would it be least likely that an accident would significantly alter the frequency of the brown allele?
- Population A
  - Population B
  - Population C
  - They are all the same.

- e. It is impossible to tell from the information given.
11. Which of the following differentiates between independent assortment and segregation?
- a. The law of independent assortment requires describing two or more genes relative to one another.
  - b. The law of segregation requires describing two or more genes relative to one another.
  - c. The law of segregation requires having two or more generations to describe.
  - d. The law of independent assortment is accounted for by observations of prophase I.
  - e. The law of segregation is accounted for by anaphase of mitosis
12. Reinforced, threadlike pseudopods that can perform phagocytosis are generally characteristic of which group?
- a. Radiolarians and forams
  - b. Gymnamoebas
  - c. Entamoebas
  - d. Amoeboid stage of cellular slime molds
  - e. Oomycetes
13. Pepsin is a digestive enzyme that
- a. Is manufactured by the pancreas.
  - b. Helps stabilize fat-water emulsions.
  - c. Splits maltose into monosaccharides.
  - d. Begins the hydrolysis of proteins in the stomach.
  - e. Is denatured and rendered inactive in solutions with low pH.
14. What must be true of any organ that is described as vestigial?
- a. It must be analogous to some feature in an ancestor.
  - b. It must be homologous to some feature in an ancestor.
  - c. It must be both homologous and analogous to some feature in an ancestor.
  - d. It need be neither homologous nor analogous to some feature in an ancestor.
  - e. None of the above.
15. The presence of altruistic behavior is most likely due to kin selection, a theory maintaining that
- a. Aggression between sexes promotes the survival of the fittest individuals.
  - b. Genes enhance survival of copies of themselves by directing organisms to assist others who share those genes.
  - c. Companionship is advantageous to animals because in the future they can help each other.
  - d. Critical thinking abilities are normal traits for animals and they have arisen, like other traits, through natural selection.
  - e. Natural selection has generally favored the evolution of exaggerated aggressive and submissive behaviors to resolve conflict without grave harm to participants.
16. Which of the following is a true statement regarding mineral nutrients in soils and their implication for primary productivity?
- a. Globally, phosphorus availability is most limiting to primary productivity.

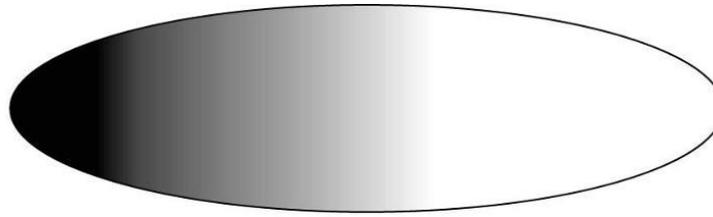
- b. Adding a non-limiting nutrient will stimulate primary productivity.
  - c. Adding more of a limiting nutrient will increase primary productivity, indefinitely.
  - d. Phosphorous is sometimes unavailable to producers due to leaching.
  - e. Alkaline soils are more productive than acidic soils.
17. Which of the following is the most important assumption for the capture-recapture method to estimate the size of wildlife populations?
- a. All females in the population have the same litter size.
  - b. More individuals emigrate from, as opposed to immigrate into, a population.
  - c. Over 50% of the marked individuals need to be trapped during the recapture phase.
  - d. There is a 50:50 ratio of males to females in the population before and after trapping and recapture.
  - e. Marked individuals have the same probability of being recaptured as unmarked individuals during the recapture phase.
18. The hemocyanin of arthropods and molluscs differ from the hemoglobin of mammals in that
- a. The oxygen dissociation curve for hemocyanin is linear.
  - b. Hemocyanin carries appreciably more carbon dioxide.
  - c. Hemocyanin has protein coupled to copper rather than iron.
  - d. The protein of hemocyanin is not bound to metal.
  - e. Hemocyanin includes cyanic acid.
19. In a tide pool, a student encounters an organism with a hard outer covering that contains much calcium carbonate, an open circulatory system, and gills. The organism could potentially be a crab, a shrimp, a barnacle, or a bivalve. The presence of which of the following structures would allow for the most certain identification of the organism?
- a. A mantle
  - b. A heart
  - c. A body cavity
  - d. A filter-feeding apparatus
  - e. Eyes
20. The value for  $\Psi$  in root tissue was found to be  $-0.15$  MPa. If you take the root tissue and place it in a  $0.1$  M solution of sucrose ( $\Psi = -0.23$  MPa), the net water flow would
- a. Be from the tissue into the sucrose solution.
  - b. Be from the sucrose solution into the tissue.
  - c. Be in both directions and the concentrations would remain equal.
  - d. Occur only as ATP was hydrolyzed in the tissue.
  - e. Be impossible to determine from the values given here.
21. Which of the following investigations would shed the most light on the distribution of organisms in temperate regions that are faced with climate change?
- a. Remove, to the mineral soil, all of the organisms from an experimental plot and monitor the colonization of the area over time in terms of both species diversity and abundance.

- b. Look back at the changes that occurred since the Ice Age and how species redistributed as glaciers melted, then make predictions on future distribution in species based on past trends.
  - c. Compare and contrast the flora and fauna of warm/cold/dry/wet climates to shed light on how they evolved to be suited to their present-day environment.
  - d. Quantify the impact of man's activities on present-day populations of threatened and endangered species to assess the rate of extirpation and extinction.
  - e. There is no scientific investigation that can help make predictions on the future distribution of organisms.
22. Sequencing an entire genome, such as that of *C. elegans*, a nematode, is most important because
- a. It allows researchers to use the sequence to build a "better" nematode, which is resistant to disease.
  - b. It allows research on a group of organisms we do not usually care much about.
  - c. The nematode is a good animal model for trying out cures for viral illness.
  - d. A sequence that is found to have a particular function in the nematode is likely to have a closely related function in vertebrates.
  - e. A sequence that is found to have no introns in the nematode genome is likely to have acquired the introns from higher organisms.
23. The biological clock controlling circadian rhythms must ultimately
- a. Depend on environmental cues.
  - b. Affect gene transcription.
  - c. Stabilize on a 24-hour cycle.
  - d. Speed up or slow down with increasing or decreasing temperature.
  - e. Do all of the above.
24. Five dialysis bags, constructed from a semipermeable membrane that is impermeable to sucrose, were filled with various concentrations of sucrose and then placed in separate beakers containing an initial concentration of 0.6 M sucrose solution. At 10-minute intervals, the bags were massed (weighed) and the percent change in mass of each bag was graphed.



- c. ACTH stimulates the adrenal cortex, and neurons of the sympathetic nervous system stimulate the adrenal medulla.
  - d. The posterior pituitary gland secretes more growth hormones.
  - e. The calcium levels in the blood are increased due to actions of two antagonistic hormones, epinephrine and norepinephrine.
27. Tay-Sachs disease is a human genetic abnormality that results in cells accumulating and becoming clogged with very large and complex lipids. Which cellular organelle must be involved in this condition?
- a. The endoplasmic reticulum
  - b. The Golgi apparatus
  - c. The lysosome
  - d. Mitochondria
  - e. Membrane-bound ribosomes
28. At a specific area of a chromosome, the sequence of nucleotides below is present where the chain opens to form a replication fork.
- 3' C C T A G G C T G C A A T C C 5'
- An RNA primer is formed starting at the underlined T of the template. Which of the following represents the primer sequence?
- a. 5' G C C T A G G 3'
  - b. 3' G C C T A G G 5'
  - c. 5' A C G T T A G G 3'
  - d. 5' A C G U U A G G 3'
  - e. 5' G C C U A G G 3'
29. Which of the following series best reflects what we know about how the flu virus moves between species?
- a. An avian flu virus undergoes several mutations and rearrangements such that it is able to be transmitted to other birds and then to humans.
  - b. The flu virus in a pig is mutated and replicated in alternate arrangements so that humans who eat the pig products can be infected.
  - c. A flu virus from a human epidemic or pandemic infects birds; the birds replicate the virus differently and then pass it back to humans.
  - d. An influenza virus gains new sequences of DNA from another virus, such as a herpesvirus; this enables it to be transmitted to a human host.
  - e. An animal such as a pig is infected with more than one virus, genetic recombination occurs, the new virus mutates and is passed to a new species such as a bird, the virus mutates and can be transmitted to humans.
30. You are hiking in a forest and happen upon a plant featuring a central stem-like structure from which sprout many, tiny, leaf-like structures. Which of the following would be the most certain means of distinguishing whether it was a true moss or a club moss?
- a. Its color
  - b. Its height
  - c. If seeds are present
  - d. If conducting tissues are present

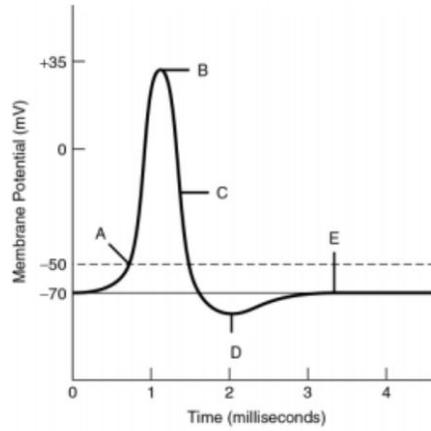
- e. The appearance of its spore-producing structures
31. The researcher measures the concentration of the polypeptides from different regions in the early embryo and finds the following pattern (darker shading = greater concentration).



Regions 1 2 3 4 5

- Which of the following would be his most logical assumption?
- a. The substance has moved quickly from region 5 to region 1.
  - b. Some other material in the embryo is causing accumulation in region 1 due to differential binding.
  - c. The cytosol is in constant movement, dispersing the polypeptides.
  - d. The substance is produced in region 1 and diffuses toward region 5.
  - e. The substance must have entered the embryo from the environment near region 1.
32. All cell cycle checkpoints are similar in which way?
- a. They respond to the same cyclins.
  - b. They utilize the same Cdks.
  - c. They give the go-ahead signal to progress to the next checkpoint.
  - d. They each have only one cyclin/Cdk complex.
  - e. They activate or inactivate other proteins.
33. Both animals and fungi are heterotrophic. What distinguishes animal heterotrophy from fungal heterotrophy is that only animals derive their nutrition by
- a. Preying on animals.
  - b. Ingesting it.
  - c. Consuming living, rather than dead, prey.
  - d. Using enzymes to digest their food.
  - e. There is no way to distinguish them.

34. The neuronal membrane is at its resting potential at label

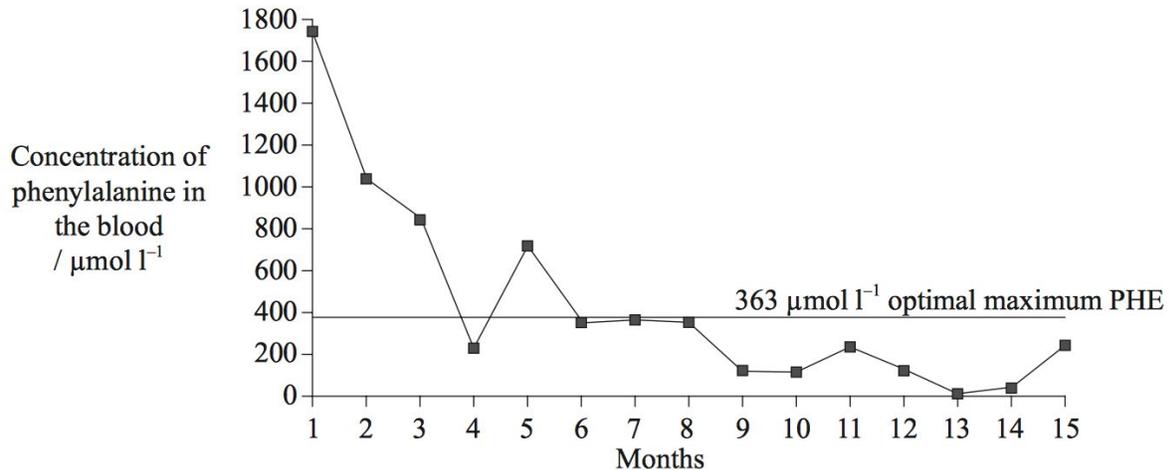


- a. A
  - b. B
  - c. C
  - d. D
  - e. E
35. Which group is noted for the independence of gametophyte and sporophyte generations from each other?
- a. Ferns
  - b. Mosses, hornworts, and liverworts
  - c. Charophytes
  - d. Angiosperms
  - e. Gymnosperms



- c. Outline how biologists can ensure that research into energy release involving animals is ethically acceptable

2. Phenylketonuria (PKU) is a recessive genetic disease in which the affected individual lacks functional phenylalanine hydroxylase. As a consequence, affected individuals cannot convert dietary phenylalanine (an amino acid) to the amino acid tyrosine and phenylalanine (PHE) builds up in the blood. The graph shows the levels of phenylalanine in the blood of a newborn baby with PKU until the age of 15 months. The baby was fed a modified diet to control blood phenylalanine. The target maximum blood PHE is  $363 \mu\text{mol l}^{-1}$ .



[Source: [www.pahdb.mcgill.ca/?Topic=Information&Section=Clinical&Page=1](http://www.pahdb.mcgill.ca/?Topic=Information&Section=Clinical&Page=1)]

- Determine the number of months that the baby's blood phenylalanine level was above the optimal maximum PHE.
- Suggest how the baby's diet might have been modified.
- If a parent is a carrier for PKU, it is likely that their DNA possess genetic markers. List two methods that can be used to detect the presence of these markers.

3. Discuss the sources and actions of each of the following pairs of hormones in humans and describe the feedback mechanisms that control their release.

a. Insulin ... glucagon

b. Parathyroid hormone ... calcitonin

c. Thyrotropin (TSH) ... thyroxine (T<sub>4</sub>)