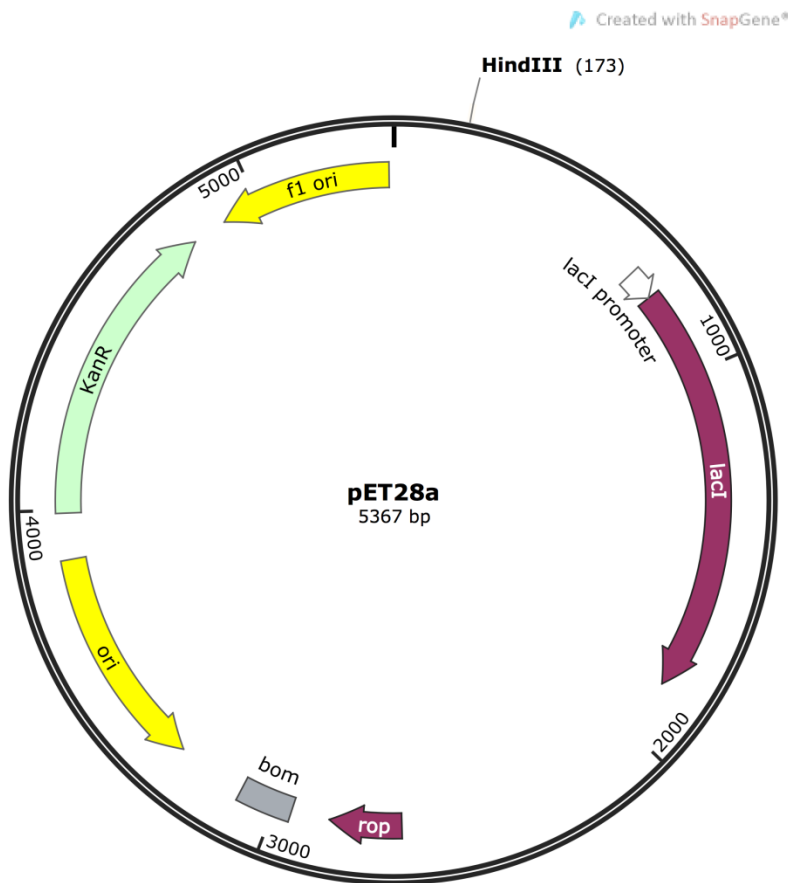


USABO Open Exam  
February 2 to 12, 2016

1. Thales is prided as the first Greek philosopher and postulated that water is the unifying principle of the universe. Which of the following is a property of water?
- A. Water is least dense at 0°C.
  - B. Linear hydrogen bonds involving water are stronger than covalent bonds.
  - C. Water has a lower heat capacity than methanol
  - D. Hydroxide is the conjugate base of water.
  - E. Water boils at a higher temperature than blood plasma
2. Which of the following statements is FALSE regarding the secretion of hormones by the anterior pituitary? SELECT ALL THAT APPLY

Hormone	Target	Effect
A. Beta-endorphin	Adrenal gland	Secretion of glucocorticoid
B. Corticotropin	Adrenal gland	Secretion of androgens
C. Prolactin	Mammary glands	Promotes lactation
D. Growth Hormone	Liver	Promotes growth
E. Leptin	Corticotrophic cells	ACTH secretion

3.

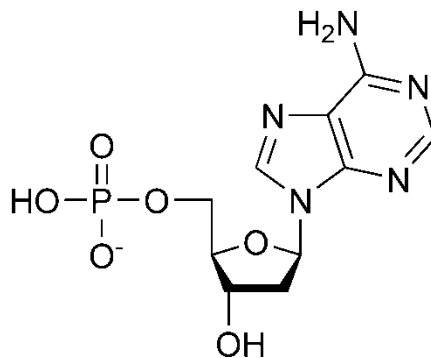


You inserted the coding sequence for your favorite protein into the HindIII site. You find that *E. coli* carrying this plasmid express the protein in the presence of IPTG, a lactose analog. What DNA elements would you expect to find in proximity to the HindIII site? Select the choice which gives the appropriate elements in the correct order.

1. Binding sites for the LacI repressor
2. Enhancer sequences
3. Poly-A sequence
4. Ribosomal binding site
5. Stop codon(s)
6. Strong constitutive promoter

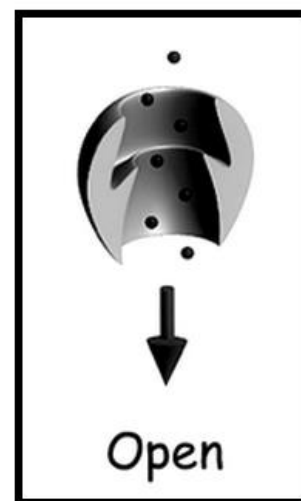
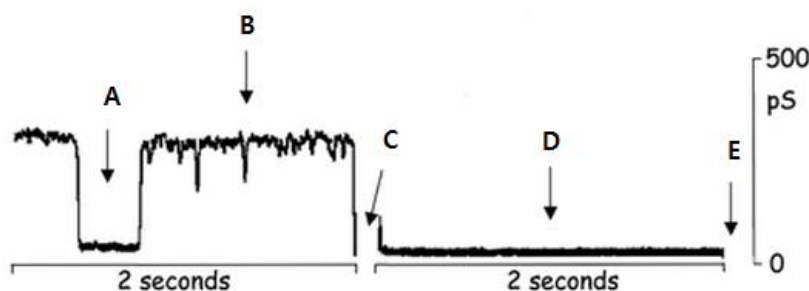
- A. 1, 2, 4, [HindIII site], 5, 3
- B. 2, 1, 4, [HindIII site], 3, 5
- C. 6, 1, 3, [HindIII site], 4, 5
- D. 1, 6, 4, [HindIII site], 3, 5
- E. 6, 1, 4, [HindIII site], 5, 3

4. As DNA replication is occurring, the molecule below is inserted into the nascent DNA strand as it lengthens. Which statement below is TRUE of the progress of replication immediately afterwards?



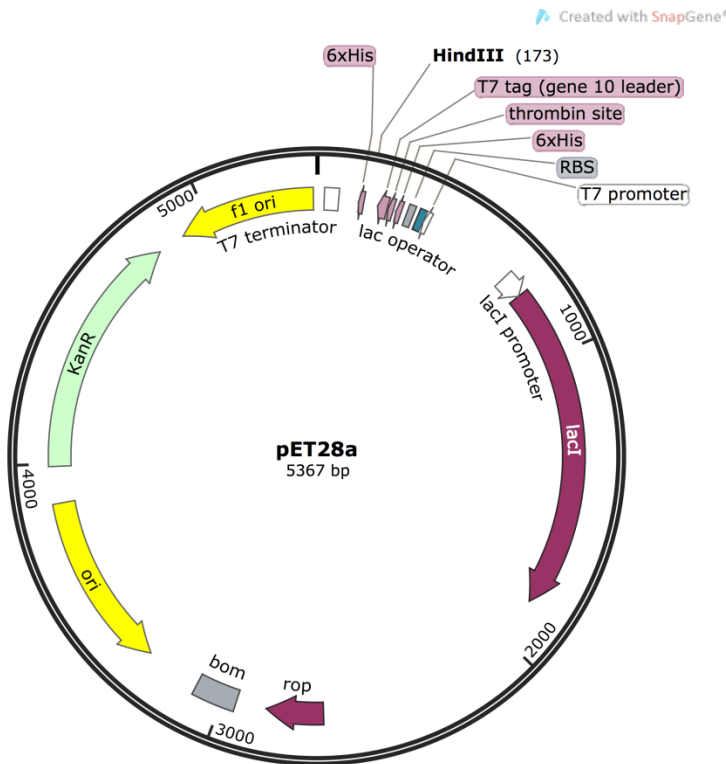
Source: Wikipedia.

- A. DNA replication would halt because there is an extra 5'-phosphate group for DNA polymerase to add the next nucleotide.
  - B. DNA replication would halt because there is no 3'OH for DNA polymerase to add the next nucleotide.
  - C. DNA replication would halt because there is no 5'OH for DNA polymerase to add the next nucleotide.
  - D. DNA replication would continue, but the new strand would have to be built from 3' to 5'.
  - E. DNA replication would proceed normally.
5. A figure shown below is a transport model for inorganic ions and macromolecules in nuclear pore derived from patch-clamp experiments.



In the absence of macromolecular transport, the electrical conductance (in pS) of the NPC is variable, shifting between open and closed states. In the presence of macromolecule transport, the central channel of the NPC is filled with electrically isolating material that plugs the tunnel. This results in a low passive permeability. In the closed state (closed NPC without transport cargo inside) and in the plugged state (open NPC with electrically isolating transport cargo inside), the patch resistance is high (in GΩ). From the patch-clamp recording graph, which of the following would correspond to the “open” state?

6. Consider the following plasmid, pET28a, a popular expression vector that is used for protein expression in bacteria.



You freshly purified plasmid from overnight bacterial culture using extraction kit, also known as miniprep. You confirmed the quality of plasmids by checking DNA and protein ratio (A260/280) and running them on a DNA agarose gel. They looked pure as they should be. You would now like to digest this vector for gene manipulation (molecular cloning) to generate vectors suitable for molecular cloning. If you cut the above plasmid with restriction enzyme called HindIII, the form of DNA will be changed from

- Linear to supercoiled.
- Nicked to linear.
- Nicked to supercoiled.
- Supercoiled to linear.
- Supercoiled to nicked.

7. Compound C is a single organic biomolecule with an important role in plant metabolism. Solutions of C in four separate test tubes yield the following results when combined with the reagents listed:

Ninhydrin - Blue

Biuret reagent - Blue

Tollens' reagent - Clear

Lugol's solution - Brown

Addition of a hydrolytic enzyme to a fresh tube of compound C results in a solution that, when combined with Tollen's reagent, forms a silvery precipitate. Which of the following is a possible identity for Compound C?

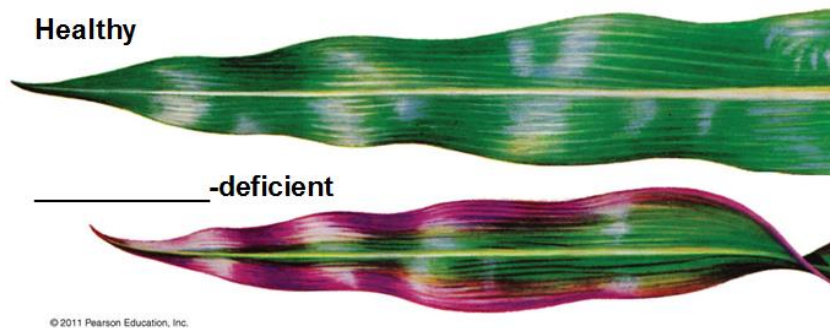
- A. Amino acid; serine.
  - B. Monosaccharide; glucose.
  - C. Peptide; glutathione.
  - D. Disaccharide; sucrose.
  - E. Polysaccharide; amylose.
8. You have designed a 15 base-pair long degenerate primer (sequence: CATCATCATMAAGCM). The Ms represent base pairs which can either be A or C. You will be using these primers for binding within a genome of  $2 \times 10^9$  base pairs. What is the expected number of binding sites for your primers?
- A. 7.
  - B. 70.
  - C. 700.
  - D. 7000.
  - E. 70000.
9. Suppose you have solutions of the following amino acids buffered at a pH of 7.0. In which of the solutions would the major species have no net charge? SELECT ALL THAT APPLY
- A. Histidine (6.0)
  - B. Glutamic Acid (4.2)
  - C. Cysteine (8.3)
  - D. Isoleucine (>14)
  - E. Lysine (10.0)

10. The progression of cancer is often driven by genetic and epigenetic alterations. Which of the following is not likely to contribute to tumorigenesis?
- A. Loss of function mutation in the p53 gene.
  - B. Upregulation of pro-apoptotic proteins.
  - C. Duplication of the telomerase gene.
  - D. Increased secretion of growth factors.
  - E. Moderately high level of oxidative stress.
11. Botanist Grace is attempting to determine the identity of a plant. She masterfully sections the leaves, and through a light microscope observes that the vessels have a thick layer of concentric mesophyll tissue around them. Which of the following plants could this most likely be?
- A. Chard.
  - B. Crabgrass.
  - C. Kale.
  - D. Rutabaga.
  - E. Squash.
12. The Death Star experiences a power outage. Darth Guha, being the hipster he is, really doesn't want his kale to die. He uses his red lightsaber as an emergency light source for his beloved kale. Anticipating this scenario, Darth Guha engineered his kale to overexpress beta-carotene. What is the engineered kale's photosynthetic rate, compared to wild-type kale, under the red lightsaber?
- A. The engineered kale has a significantly higher photosynthetic rate compared to wild-type kale because beta-carotene absorbs red light better than chlorophyll.
  - B. The engineered kale has a significantly lower photosynthetic rate compared to wild-type kale because beta-carotene interferes with the absorption of red light.
  - C. The engineered kale has a significantly lower photosynthetic rate compared to wild-type kale because beta-carotene does not significantly absorb red light.
  - D. The engineered kale has approximately the same photosynthetic rate compared to wild-type kale because beta-carotene does not significantly absorb red light.
  - E. The engineered kale has approximately the same photosynthetic rate compared to wild-type kale because beta-carotene is not an accessory pigment to chlorophyll a or chlorophyll b.
13. Which of the following statements about plant growth and development is NOT correct?
- A. Most plant hormones are transmitted from one individual to another through the air.
  - B. A nail hammered into the trunk of a tree will remain at the same height throughout the tree's lifetime.
  - C. When the tip of a shoot is plucked off, the plant will become bushier.
  - D. Plants bend towards light because cells on the dark side of the stem elongate in response to auxins.
  - E. The biomass of a plant is derived primarily from carbon dioxide in the air.

14. During the reproductive process in angiosperms, all of the following transitions occur **EXCEPT** that the:

- A. Microspores become pollen grains.
- B. Ovulary becomes a fruit.
- C. Integuments become the seed coat.
- D. Flower petals fall off.
- E. The tube and sperm nuclei fuse.

15. Symptoms of mineral deficiency depend on the nutrient's function and mobility within the plant. In a figure shown below, deficiency in this nutrient results in changing color of leaves into purple. What mineral is missing in the figure shown below?



- A. Calcium.
- B. Iron.
- C. Nitrogen
- D. Oxygen.
- E. Potassium.

16. Anthocyanins produce the red color in leaves. Trees produce them to protect the photosynthetic machinery in the fall as they start to shut-down for the winter. Schaberg et al. (2003) measured amount of leaf color in sugar maples from June-October 1999. Based on their data, which of the following statements is FALSE?

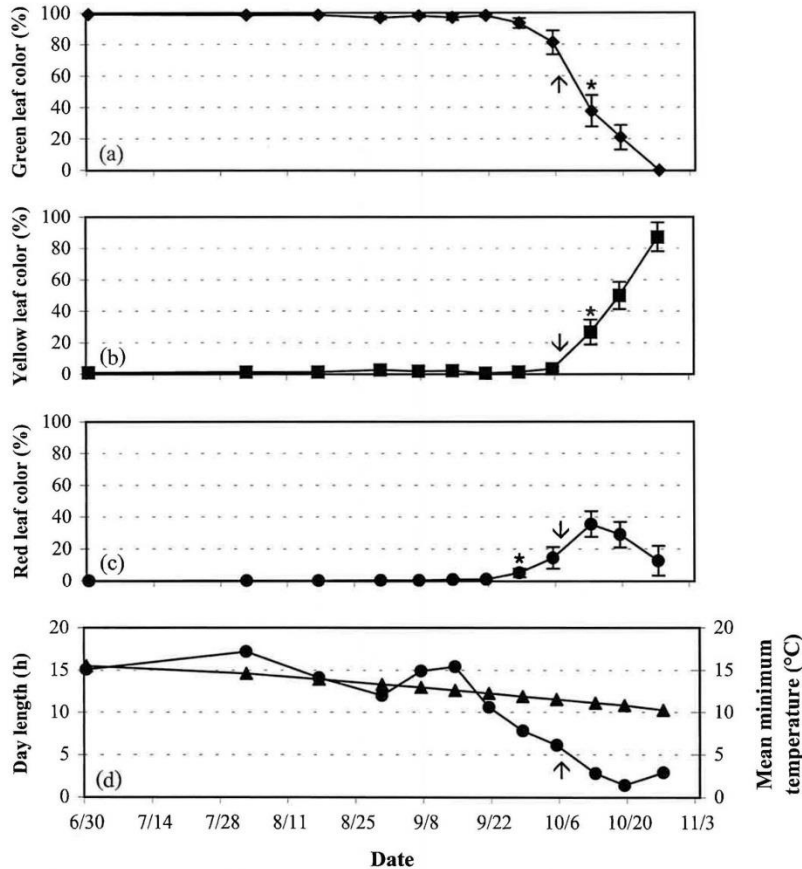


Figure 1. Stand means ( $\pm 1$  SE) for green (a), yellow (b) and red (c) leaf color on all dates sampled from June through October 1999. Asterisks indicate the first sampling date on which there was a significant change in color as determined by a Dunnett's test. In each panel, the occurrence of the first frost is indicated by an arrow. Day length (▲) and mean minimum temperature between sample dates (●) are also shown (d).

- A. Yellow color increased as green color decreased.
- B. Significant color changes for all three colors was not detected until after the first frost.
- C. Red color achieved a maximum earlier than yellow color.
- D. When green leaf color was at a minimum, leaf color was more yellow than red.
- E. All of the above are correct.

(Based on Figure 1 from *Tree Physiology* 23, 325–333, 2003 Heron Publishing—Victoria, Canada Factors influencing red expression in autumn foliage of sugar mapletrees P. G. SCHABERG, A. K. VAN DEN BERG, P. F. MURAKAMI, J. B. SHANE and J. R. DONNELLY)



**17. Which of the following statements about apical meristems is FALSE?**

- A. Apical meristems are found in roots, shoots and axillary buds.
- B. Apical meristems are protected by tissues made from differentiated cells produced by the meristem.
- C. The pattern of nodes is laid down by the shoot apical meristem like the pattern of branch roots is laid down by the root apical meristem.
- D. The root apical meristem contains a region called the quiescent center.
- E. All apical meristems produce primary growth.

**18. In what ways can terrestrial plants increase their access and uptake of water?**

- A. Increase the production of root hairs
- B. Increase concentrations of osmotically-active solutes in the root cortical cells
- C. Increase the production of siphonophores
- D. B and C.
- E. A and B.

**19. In Adolf Huxley's *Brave New World*, John remembers Linda's quotes like "A, B, C, Vitamin D. The fat's in the liver, the cod's in the sea." This ditty was intended to coerce people into taking vitamins. Which disease below could be helped with the same vitamin found in cod and the liver?**

- A. Beriberi.
- B. Pellagra.
- C. Rickets.
- D. Scurvy.
- E. Kwashiorkor-edema.

**20. Which of the following statements regarding vitamins and minerals is incorrect?**

- A. Essential minerals must be consumed in the diet.
- B. Vitamins are organic substances.
- C. Vitamins are important sources of energy for the body.
- D. Iron, Fluorine, Calcium, and Sodium are all minerals.
- E. Trace minerals represent <10% of our body weight.

Questions 21 & 22. SELECT ALL THAT APPLY.

A.



B.



C.



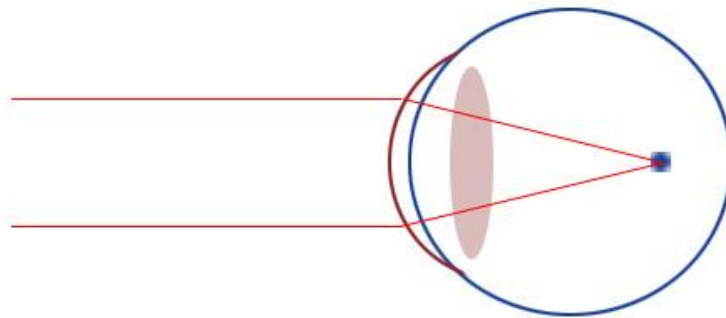
D.



21. Which organisms in the figures above utilize holoblastic cleavage?

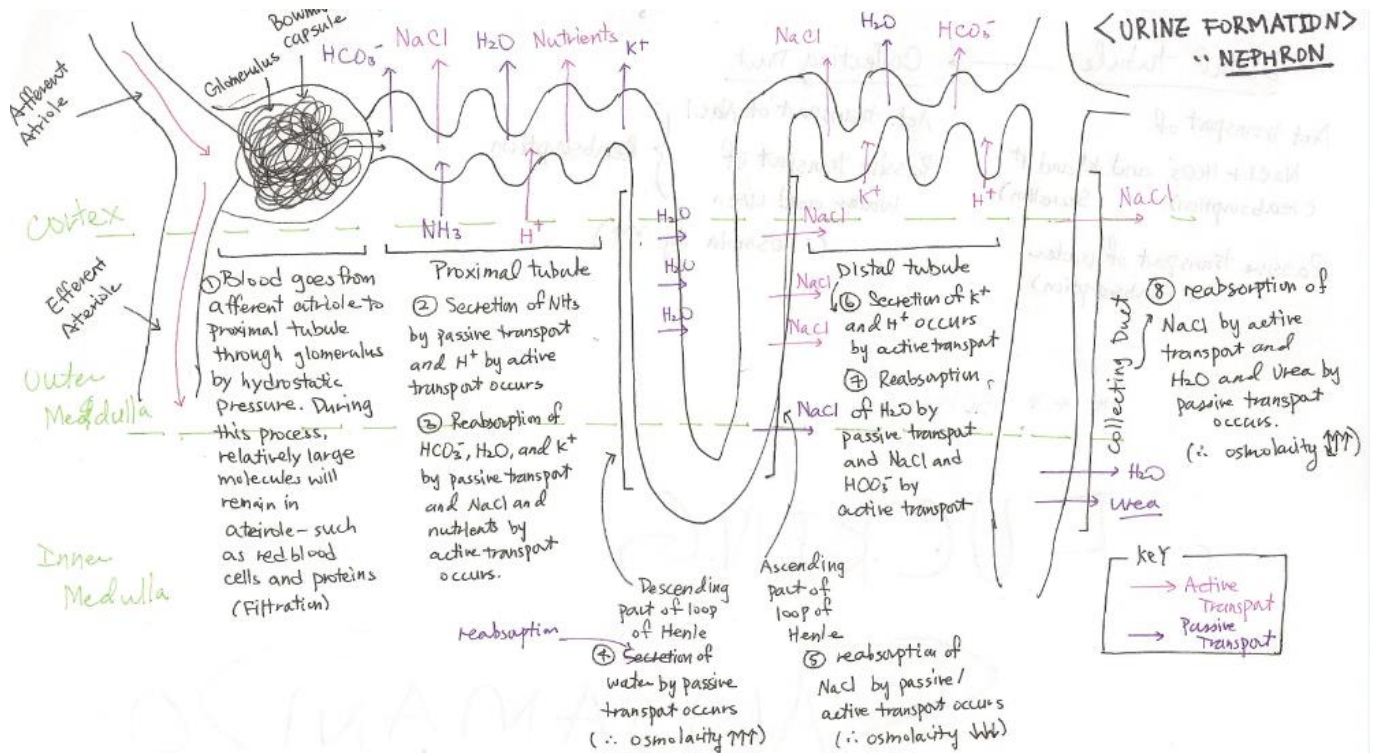
22. Which of the organism above in the figure above utilizes positive pressure breathing?

23. Examine the diagram below of a human eye condition. Which of the following statements is TRUE? SELECT ALL THAT APPLY.



- A. Vision may be restored with convex lens and refractive surgery.
- B. Vision may be restored with concave lens and refractive surgery.
- C. This condition often occurs in elderly people.
- D. This phenomenon can be fixed by LASIK (laser-assisted in situ keratomileusis) surgery.

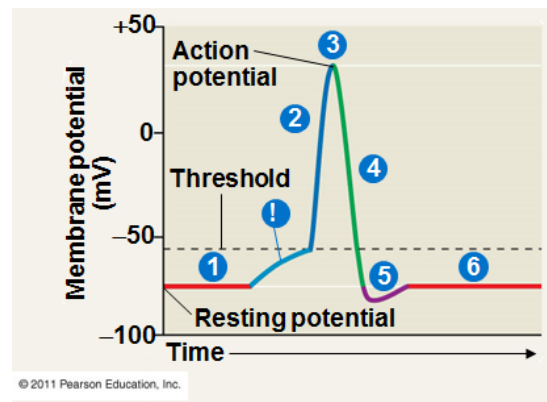
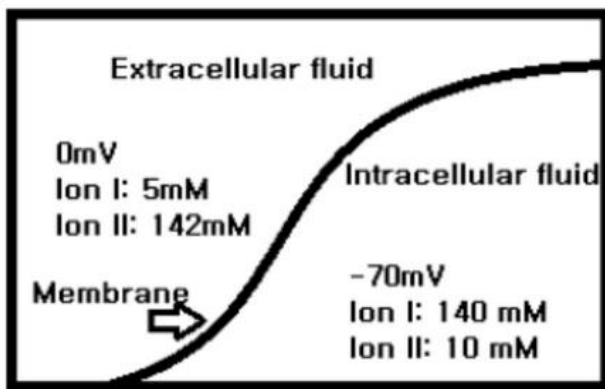
24. In your high school biology course, you were assigned to draw a diagram of the formation of urine in human. A figure shown below is homework you did for your high school biology course. Now, you would like to double check before you submit this to your teacher, Dr. Lee. Is there anything wrong with this figure? If so, why?



- No, there is nothing wrong with this figure.
- Yes, afferent and efferent arterioles are reversed.
- Yes, ascending part of loop of Henle should be thicker than descending part.
- Yes,  $\text{NaCl}$  should be absorbed first and then water should be re-absorbed in loop of Henle.
- Yes, the order of the layer in kidney should be inner medulla, outer medulla, and cortex. The sequences for those are reversed.

25. Which of the following amniotic membranes can be involved in the respiratory exchange of gases in a snake embryo? SELECT ALL THAT APPLY.

- Amnion.
- Chorion.
- Respiratory lamina propria.
- Allantois.
- Yolk sac.



26. Figure 1 on the left panel describes the change in membrane potential when there is a stimulus introduced, indicated by the arrow (or !, 0 second). Figure 2 describes the membrane potential of one of the stages from Figure 1. We don't know which stage it is, however. In Figure 2, Ion I and II are also unknown –but they are either sodium ions or potassium ions. Which of the following is TRUE regarding Stages from 1 to 6?

- A. In Stage 1, the action potential is formed as a result of the stimulus that is slightly below threshold.
- B. In both Stages 2 and 3, the Ion II influxes into the inside of the cell.
- C. In Stage 4, the gates for Ion I are inactivated while those for Ion II are open.
- D. In Stage 5, as more Ion II rushes into the inside of the cell, the membrane potential decreases below -70 mV.
- E. In Stage 6, as more Ion II rushes into the inside of the cell, the resting potential will be formed.

27. Manuel has just finished an intense 10-kilometer running race. His body has

- A. An increased level of carbonic acid and increased pH of body fluids.
- B. An increased level of carbonic acid and decreased pH of body fluids.
- C. A decreased level of carbonic acid, and increased pH of body fluids.
- D. A decreased level of carbonic acid and decreased pH of body fluids.
- E. No change in level of carbonic acid or pH.

28. Before birth in the mammalian fetal heart, the ductus arteriosus joins the pulmonary artery and the aorta and the foramen ovale joins the two atria. Why do these modifications disappear hours after birth?

- A. The fetal heart is not yet strong enough to sustain a normal circulation.
- B. Development of the beating heart is one of the last steps in the maturation of the fetus.
- C. The pulmonary circulation is bypassed because the fetus is not breathing in the womb.
- D. Maternal hormones suppress the competing infant circulation via the placenta.
- E. They act as safety valves to relieve the pressure of the viscous amniotic fluid on the fetal heart.

29. While taking the Open Exam, you begin to experience the effects of sympathetic stimulation by your autonomous nervous system, initiating the fight or flight response. Which of the following choices are examples of sympathetic responses?

- I. Dilation of pupils.
- II. Relaxation of bladder.
- III. Inhibition of digestive functions.
- IV. Increase in heart rate.

- A. I, II, III, and IV.
- B. I and III only.
- C. I, III, and IV only.
- D. II, III, and IV only.
- E. I and IV only.

30. Your grandfather has chronic high blood pressure, also called hypertension. Which of the following would be a good target for treatment for his condition?

- A. Stimulation to increase his heart rate.
- B. Stimulation of the parasympathetic nervous system to release acetylcholine.
- C. Stimulation of the sympathetic nervous system to release norepinephrine.
- D. Administration of compounds that constrict his blood vessels.
- E. Stimulation of the parasympathetic nervous system to release adrenaline.

31. In one forest, butterfly Species A is harmless but has evolved to closely resemble bad tasting Species B. This is an example of \_\_\_\_\_ mimicry, and its protective power is strengthened if the ratio of the populations of Species A to B \_\_\_\_\_.

- A. Batesian, decreases.
- B. Batesian, increases.
- C. Mullerian, increases.
- D. Mullerian, decreases.
- E. Aposematic, increases.

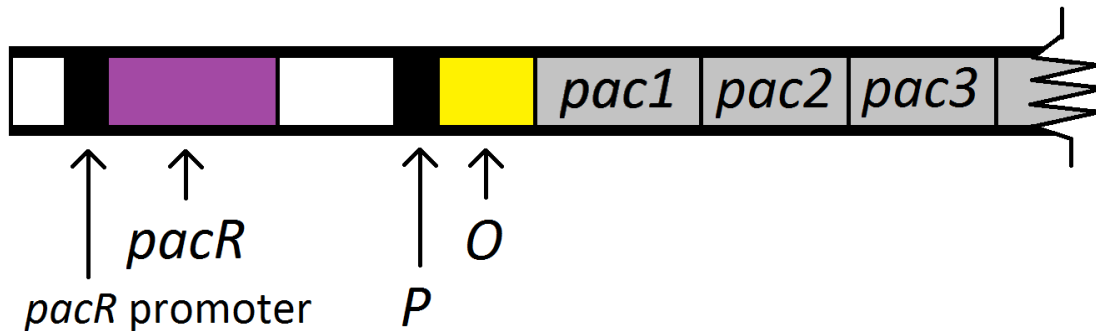
32. Person A and Person B, who are cousins, are both childless. Their fathers were brothers, while their mothers are unrelated. Person B is engaged and intends to have nine children. Person A is married expects to have only one child. One day, Person B falls into a river, from which he cannot swim out alone and would die otherwise. Person A has a 40% chance of saving Person B if he enters the river. However, entering the river also means certain death for Person A, regardless of whether or not he saves Person B.

Calculate the coefficient of relatedness between Person A and Person B and decide whether, based on Hamilton's rule, Person A should try to save Person B.

- A. 0.25; Person A should try to save B.
- B. 0.125; Person A should NOT try to save B.
- C. 0.25; Person A should try to save B.
- D. 0.0625; Person A should NOT try to save B.
- E. 0.125; Person A should try to save B.

33. During the breeding and egg-laying season, female red-cockaded woodpeckers store bone fragments instead of seeds in the barks of trees where they nest. From time to time, they retrieve these bones, peck at them, and ingest bone flakes. The most likely effect of this feeding practice is to:
- A. Add calcium supplements to the birds' diet for eggshell development.
  - B. Hasten the rate of egg production.
  - C. Increase the number of eggs produced.
  - D. Strengthen the bones of the developing embryos.
  - E. Shorten the period of gestation.
34. Arrange the following genera from earliest to latest on the evolutionary time scale:
- I. Amborella.
  - II. Pteridium.
  - III. Sphagnum.
  - IV. Gnetum.
  - V. Pisum.
- A. I, II, III, IV, V.
  - B. I, III, II, IV, V.
  - C. II, III, IV, V, I.
  - D. III, II, IV, I, V.
  - E. III, II, IV, V, I.
35. At the end of a perfect week, Barney is suddenly confronted by the horrible news that he is the father of a baby girl. After Barney disappears to Bermuda, the mother orders a paternity test to confirm that Barney truly is the father. If Barney's blood type is AB and Rh<sup>-</sup>, which of the following blood types could his daughter NOT have?
- A. A and Rh<sup>+</sup>.
  - B. B and Rh<sup>-</sup>.
  - C. AB and Rh<sup>-</sup>.
  - D. AB and Rh<sup>+</sup>.
  - E. O and Rh<sup>-</sup>.

36. Consider the existence of a hypothetical operon, *pac*, which controls the expression of several enzymes involved in the metabolism of alcohol. The structure of the operon is as shown below:



The gene for the operon regulatory protein is represented as *pacR*, which is normally made in inactive form. The *pac* operon includes a promoter *P* and an operator sequence *O*, as well as genes coding the metabolic proteins. Binding of alcohol to *pacR* activates *pacR*, allowing it to bind to the *O* sequence, where it acts as a crucial transcription factor.

To study the *pac* operon, you generate diploids with various mutations in the *pac* operon and plate them on medium containing alcohol as the only carbon source. (A plus sign denotes the wild-type form of the component while a minus sign denotes mutation in that component.) Of the following mutants listed, select the choice that best corresponds to those mutants that will successfully survive in your experiment. **SELECT ALL THAT APPLY.**

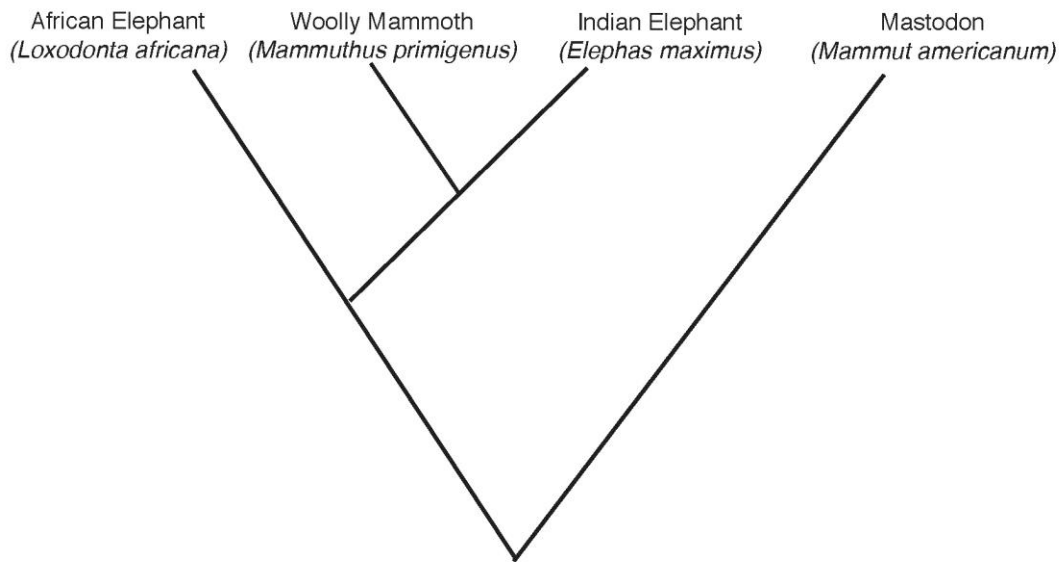
- A. *pacR*-*P*+*O*+/*pacR*+*P*-*O*-.
  - B. *pacR*-*P*+*O*-/*pacR*+*P*-*O*+.
  - C. *pacR*+*P*-*O*+/*pacR*-*P*+*O*+.
  - D. *pacR*+*P*+*O*+/*pacR*-*P*-*O*+.
  - E. *pacR*+*P*+*O*-/*pacR*+*P*-*O*+.
37. You sequence a group of 50 female fruit flies, all from the same population, and calculate nucleotide diversity across the genome for your sample sequences. You find that the X chromosome has lower nucleotide diversity than the autosomes. Which of the following theories could explain this finding? Assume equal numbers of males and females in the population as a whole.
- I. Balancing selection is acting to decrease diversity on the X chromosome
  - II. Effective population sizes are lower on the X than the autosomes because males only have one X chromosome but they have two of every autosome.
  - III. Effective population sizes are higher on the X than the autosomes because males only have one X chromosome but they have two of every autosome.
  - IV. Purifying selection is acting to decrease diversity on the X chromosome.
- A. I and II.
  - B. I and III.
  - C. II and IV.
  - D. I and IV.
  - E. I, II, and IV.

38. You sequence the alcohol dehydrogenase locus in *Drosophila* (*Adh*) in 50 strains of fruit flies. You find that the *Adh* gene has two times as many mutations that differentiate the strains at this locus compared to five other genes in the genome that you are using as a control. Which factors might explain the pattern that you see?

- I. There are really two copies of *Adh* in these genomes, making it look like *Adh* has accumulated mutations twice as quickly.
  - II. *Adh* is affected by balancing selection, which acts to increase nucleotide diversity in the gene.
  - III. The 'control' genes have experienced strong directional selection, reducing the number of mutations that can segregate in the population.
  - IV. *Adh* is less constrained by selection than the control genes, allowing it to accumulate more mutations.
- 
- A. II only.
  - B. I and III only.
  - C. III only.
  - D. I, III, and IV.
  - E. I, II, III, and IV.



39. You have started working on the woolly mammoth genome sequence. When comparing mammoths to modern elephants and mastodons, you identify the following phylogenetic tree. Which of the following is true?



- I. Mastodons are more closely related to African elephants than to Indian elephants.
- II. Mastodons are more closely related to Indian elephants than to African elephants.
- III. Mammoths are more closely related to Indian elephants than to African elephants.
- IV. Mammoths are more closely related to African elephants than to Indian elephants.

- A. I only.
- B. III only.
- C. I AND III only.
- D. II AND III only.
- E. I AND IV only.

40. You are working on samples of *Phytophthora infestans* (potato blight) that you have sequenced from natural populations. You then obtain more samples from a museum in Ireland that date to the 1840s and 1850s, when the potato blight swept through Europe (the Irish Potato Famine). You build a phylogenetic tree and find that the samples cluster in the following way. Which of the following conclusions best describes the data?

- A. The Irish potato blight from the museum samples likely originated in Mexico.
- B. The Irish potato blight from the museum samples likely originated in Argentina.
- C. The Irish potato blight from the museum samples likely originated in the United States
- D. All modern *Phytophthora infestans* comes from a strain that was ancestral to the Irish potato blight found in the museum samples and you cannot determine its geographic origin from this data.
- E. All modern *Phytophthora infestans* is descended from a subset of the strain that caused the Irish potato famine, and you cannot determine its geographic origin from this data.

41. Elk populations A and B have 1000 and 100 individuals, respectively, with all individuals in a given population existing in Hardy-Weinberg equilibrium with one another. One day, you observe that in each population, a single individual has gained a new mutation that gives it spotted fur. The spotted fur allele is not found to affect survival or reproductive fitness. Let  $p_A$  be the probability that the spotted fur allele eventually goes extinct in population A, and let  $p_B$  be the probability that the spotted fur allele eventually goes extinct in population B. Which of the following statements correctly describes the relationship between  $p_A$  and  $p_B$ ?

- A.  $p_A > p_B$ .
- B.  $p_A < p_B$ .
- C.  $0 < p_A = p_B < 1$ .
- D.  $p_A = p_B = 0$ .
- E.  $p_A = p_B = 1$ .

42. When true-breeding, brown female flies with wild-type wings are mated to true-breeding, black male flies with vestigial wings, the F1 offspring have the following phenotypes, with the numbers of male and females approximately equal in each phenotypic class:

781 brown flies with wild-type wings  
769 black flies with vestigial wings  
23 brown flies with vestigial wings  
27 black flies with wild-type wings

You had expected there to be equal numbers of offspring in each phenotypic class. Which of the following best explains the deviation?

- A. Small sample sizes frequently cause large differences between expected and observed offspring ratios.
- B. One or both of the genes is sex-linked.
- C. The alleles responsible for body color and wing size are linked.
- D. Spontaneous mutation caused some individuals carrying the allele for vestigial wings to revert to wild-type wings, and vice versa.
- E. Meiotic drive causes certain chromosomes to preferentially be passed on to the next generation.

43. In most species, males and females are born in an approximately 1:1 ratio. From an evolutionary perspective, what is the most likely reason that explains this?

- A. In a population with a 1:1 ratio, a parent that produces nonequal numbers of males and females is less likely to pass on their genes relative to the rest of the population.
- B. A 1:1 ratio is the most likely because it has the most entropy.
- C. There is no major selection pressure that acts on sex ratio.
- D. Since each offspring must have 1 male and 1 female parent, this would maximize the number of total possible offspring.
- E. Since each offspring must have 1 male and 1 female parent, this would maximize the amount of genetic diversity in the population.

**44. Ranger Geraldo is conducting a population of Rhydon in the Kanto Regional Safari Zone. Rhydon are large mammals which move in herds. Which of the following sampling methods would be most effective?**

- A. Aerial Counting.
- B. Catch 'em all.
- C. Mark & Recapture.
- D. Quadrant Sampling.
- E. Transect Sampling

**Questions 45 to 47, refer to the following experiment on voles:**

**Two varieties of the same species of voles (meadow mice), albino and red-backed, were used in an experiment. Both varieties were subjected to the predation of a hawk, under controlled laboratory conditions. During the experiment, the floor of the test room was covered on alternate days with white ground cover that matched the albino voles and red-brown cover that matched the red-backed voles. The chart below shows the results of 50 trials.**

Variety	Number of Voles Captured		
	White Cover	Red-Brown Cover	Total
Albino	35	57	92
Red-backed	60	40	100
Total	95	97	192

**45. The purpose of the experiment was to:**

- A. Compare the agility of the several varieties of voles.
- B. Compare the effects of protective coloration.
- C. Decrease the vole population.
- D. Determine the basic intelligence of hawks and voles.
- E. Measure the visual acuity of hawks.

**46. Which result would have been most likely if only red-brown floor covering had been used?**

- A. A greater number of red-backed voles would not have survived.
- B. Ninety-seven red-backed voles would have survived.
- C. Ninety-five albino voles would have survived.
- D. There would have been no change in the results.
- E. The survival rate of the albino voles would have decreased markedly.

**47. The results of this experiment lend credibility to the concept of**

- A. Adaptation allowing the species to survive.
- B. Species perpetuation through overproduction.
- C. Spontaneous generation of lethal mutations.
- D. The female of the species being more deadly than the male.
- E. Use and disuse of organs and tissues.

48. An investigator studying the diatom community present in a certain stream found 150 different species of diatoms in Mile 1, none of which comprised more than 5% of the total diatoms in the stream. In Mile 25, the investigator found only 20 different species, with 2 species representing 80% of the total. Which of the following is the best explanation of these observations?
- A. The stream was larger at mile 25.
  - B. The nature of the stream bottom changed.
  - C. Organic wastes high in nitrates and phosphates entered the stream somewhere between the two sampling stations.
  - D. The stream velocity changed.
  - E. There must have been something wrong with the sampling methods.
49. Which of the following classes would have members undergo radial and indeterminate cleavage during development? **SELECT ALL THAT APPLY.**
- A. Cephalopoda.
  - B. Holothuroidea.
  - C. Mammalia.
  - D. Scyphozoa.
  - E. Trematoda.
50. Chef Grace is cooking up a stir fry. She wants to use a pseudocoelomate larva. Which of the following groups would **NOT** provide suitable larvae for her consumption? **SELECT ALL THAT APPLY.**
- A. Cestoda.
  - B. Aves.
  - C. Rotifera.
  - D. Mollusca.
  - E. Nematoda.