Circle the best single letter choice for each of the following questions before transferring your answers to your computer sheet.

1. By the Devonian, the development of _____ allowed an adaptive radiation of land plants.

A. sporangia
B. fluid transport mechanisms
C. leaves
D. stomata
E. All of A, B, C and D are correct.

---

2. Pitcher plants provide "niches" for mosquito larvae *(Wyeomyia smithii)*. They provide similar niches for

1. ants.
2. midge larvae *(Metriocnemus knabii).*
3. caterpillars of moths *(Eryxia fax* and *Papaipema appasionatai).*
4. rotifers *(Habrotrocha rosa).*

A. 1, 2, and 3
B. 1 and 3
C. 2 and 4
D. 4 only
E. All of A, B, C and D are correct.

---

3. Pitcher plants such as *Sarracenia purpurea,* obtain nitrogen from insect prey and from rotifer excretory products. This also is true of

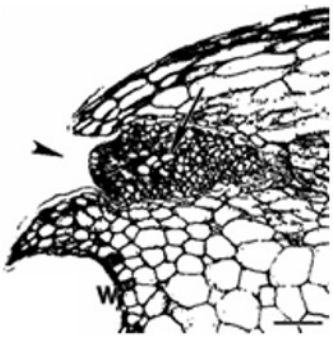
A. other pitcher plants.
B. sundews.
C. venus fly traps.
D. water wheels.
E. None of A, B, C or D is correct.

---

4. These two pictures show different parts of a pitcher plant as seen in lecture.
   - nectary
   - digestive zone

A. Picture 1 is an SEM of a nectary.
B. Picture 2 is a light micrograph of a nectary.
C. Picture 1 is a light micrograph of a nectary.
D. Picture 2 is an SEM of the digestive zone.
E. C and D only are correct.

Picture 1



Picture 2

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5. If you find a fossil with heterodont teeth from Triassic rocks, you would be able to confirm that it is from a mammal if it has

A. carnassial teeth.
B. two occipital condyles.
C. a diaphragm.
D. milk glands.
E. a well developed left aortic arch.

---

6. Monotremes (spiny anteaters, duck-billed platypuses) are a type of mammal that

1. occur in Australia and New Guinea.
2. have a pouch.
3. lay eggs.
4. are extinct.

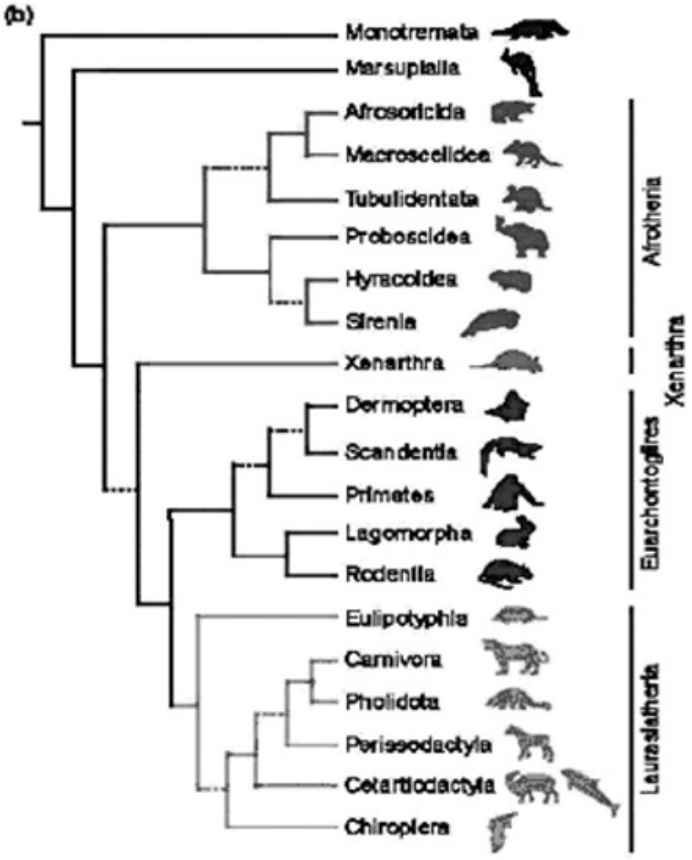
A. 1, 2, and 3
B. 1 and 3
C. 2 and 4
D. 4 only
E. All of 1, 2, 3 and 4 are correct.

---

7. This phylogeny shows the adaptive radiation of mammals. In which of the following groups do **marine mammals** occur?

1. Cetariodactyla (also known as Cetacea)
2. Carnivora
3. Sirenia
4. Rodentia

A. 1, 2 and 3
B. 1 and 3
C. 2 and 4
D. 4 only
E. All of 1, 2, 3 and 4 are correct.



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8. In this phylogeny, the ant- eating and termite-eating niche has evolved in

A. Pholidota.
B. Xenarthra.
C. Tubulidentata
D. Lagomorpha.
E. A, B and C only are correct.

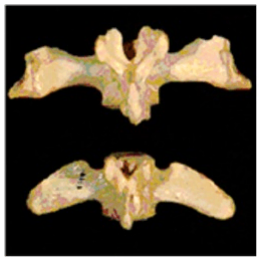
---

9. The "Mesozoic beaver"

A. was a docodont.
B. was a rodent.
C. had heterodont teeth.
D. bore live young.
E. A and C only are correct.

---

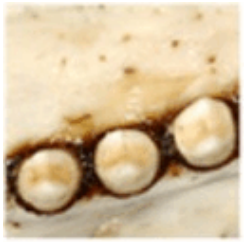
10. This photograph shows two



A. auditory ossicles.
B. caudal vertebrae.
C. parts of a beaver's tail.
D. teeth.
E. B and C only are correct.

---

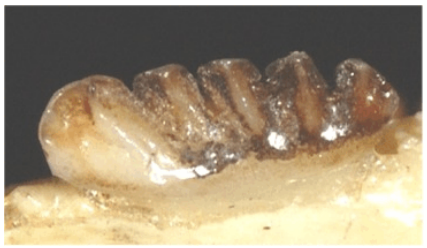
11. The teeth in this photograph **cannot** be described as



A. mammalian.
B. molar.
C. carnassial.
D. homodont .
E. A, B and D only are correct.

---

12. This lower incisor of a flying lemur (Demaptera) mainly functions in



A. cutting.
B. grinding.
C. piercing and holding food.
D. combing.
E. None of A, B, C or D is correct.

---

13. The spines that occur in mammals like hedgehogs, spiny mice, tenrecs and porcupines, are actually modified

A. hairs.
B. bones.
C. teeth.
D. horns.
E. None of A, B, C or D is correct.

---

14. In mammals, the appearance of armour (two examples shown) occurs in

1. armadillos.
2. turtles.
3. scaly anteaters.
4. old world porcupines.

A. 1, 2 and 3
B. 1 and 3
C. 2 and 4
D. 4 only
E. All of 1, 2, 3 and 4 are correct.

---

15. Adaptive radiation occurs when a group of organisms develops a breakthrough adaptation (or suite of adaptations), allowing them to thrive in many different situations. The adaptive radiation of mammals involved changes in use of, and access to, energy. This was directly facilitated by

1. homeothermy.
2. auditory ossicles.
3. heterodont teeth.
4. diphyodont teeth

A. 1, 2 and 3
B. 1 and 3
C. 2 and 4
D. 4 only
E. All of 1, 2, 3 and 4 are correct.

---

16. "Extirpated" refers to

A. species that have ceased to exist.
B. individuals that have died.
C. species that no longer occur in Canada.
D. dinosaurs.
E. A and D only are correct.

---

17. The Galapagos Islands

A. were visited by Charles Darwin.
B. are home to giant tortoises.
C. are home to Darwin's finches.
D. were discovered and occupied by humans in 1535 AD.
E. All of A, B, C and D are correct.

---

18. If an organism became extinct 10,000 years ago, which of the following "dates" would be correct?

A. 8,000 BC
B. 8,000 BCE
C. 10,000 BP
D. 1 AD
E. A, B and C only are correct.

---

19. Carrying capacity, (**K**) limits population growth. In humans, there is evidence that **K** can be determined by the availability of

A. food.
B. jobs.
C. housing.
D. mineral resources.
E. All of A, B, C and D are correct.

---

20. Assume that you are a planner for a city that today has a population of 100,000 women and 100,000 men. If R = 1.5 (3 children per woman) and survivorship is 0.99, how many students can you expect to enter school at age five in the next generation? Assume that generation time = 25 years. Recall that $N_t = N_0 R^g$

A. 148,500
B. 150,500
C. 200,000
D. 297,000
E. 300,000

---

21. If the population of Ontario is now 12.4 million, (N_0 = 12.4 million and r = 0.0034), then what will it be in 100 years? (assuming no significant immigration or emigration).
Remember $N_t = N_0 e^{rt}$ where e = 2.718.

A. 20.4 million
B. 17.4 million
C. 15.4 million
D. 13.4 million
E. 10.9 million

---

22. Proteins were an evolutionary advancement over ribozymes because proteins

A. possess catalytic activity.
B. can fold into three-dimensional shapes.
C. are far more diverse with some having far greater catalytic ability.
D. use a much simpler machinery for synthesis than ribozymes.
E. not only catalyze reactions but can also be a repository for genetic information.

---

23. Which of the following was **not** a finding of the "Miller-Urey experiment"?

A. Purine and pyrimidine bases can be synthesized abiotically.
B. Amino acids can be formed in the absence of life.
C. A source of high energy is required for synthesis.
D. H_2O was required for abiotic synthesis on the primitive earth.
E. Abiotic synthesis required an oxidizing atmosphere.

---

24. Which of the following statements about chirality is **correct**?

A. Homochirality must have developed early during the evolution of life.
B. Chiral molecules are superimposible on their mirror image.
C. Unlike humans, plants synthesize both L and D alanine.
D. All molecules are chiral.
E. 50% of the alanine found in the Murchison Meteorite is in the D form.

---

25. Which of the following statements about water is **not** correct?

A. Water exhibits both a high heat of vaporization and high heat capacity.
B. Water is a polar molecule.
C. Water has a role in minimizing charge interactions between proteins.
D. Based upon its low molecular weight, water should be a solid at room temperature.
E. Water is fundamentally important to life as we know it.

---

26. Which of the following is most easily predicted given the primary structure (the amino acid sequence) of a polypeptide?

A. How the protein folds – its three dimensional shape.
B. The size and shape of the active site of an enzyme.
C. If the protein has membrane spanning domains.
D. The binding sites for cofactors.
E. If the protein will have quaternary structure.

---

27. According to thermodynamics,

A. closed systems will never reach equilibrium.
B. we need to eat food to maintain high entropy.
C. living things are always at equilibrium.
D. substances that are stable have low free energy.
E. an exergonic reaction can never be endothermic.

---

28. Which of the following reactions shows the correct ΔG?

A. $FADH_2 \rightarrow FAD^+$ ($\Delta G > 0$)
B. Pyruvate $\rightarrow$ glucose ($\Delta G > 0$)
C. ATP $\rightarrow$ ADP + Pi ($\Delta G > 0$)
D. Acetyl CoA $\rightarrow CO_2$ ($\Delta G > 0$)
E. $CO_2 \rightarrow CH_2OH$ ($\Delta G < 0$)

---

29. An example of "energy coupling" is

A. oxidative phosphorylation.
B. ATP hydrolysis in an aqueous solution producing heat.
C. melting of ice at room temperature.
D. using the hydrolysis of ATP to synthesize glutamine.
E. A and D only are correct.

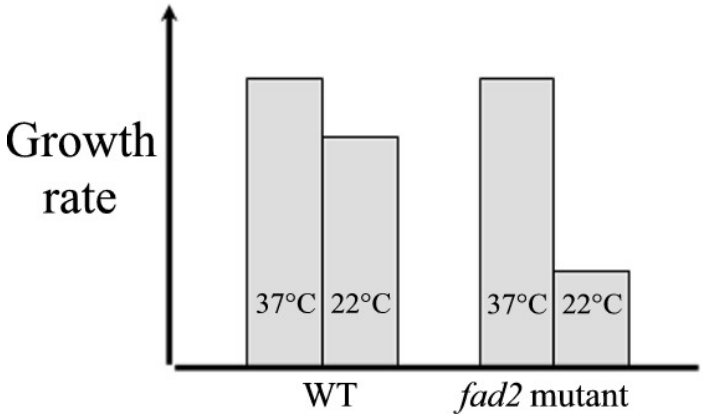
---

30 Which of the following milkshakes has the most calories?

A. Banana and pyruvate
B. Banana and glucose-6 phosphate
C. Banana and acetyl CoA
D. Banana and CO_2
E. Banana and oxaloacetate (Denis' favourite)

---

31. The *fad2* mutant of *E. coli* lacks the enzyme, desaturase D and grows poorly at 22°C as shown by these data. The probable reason for the mutant's poor growth at 22°C is its inability to



A. decrease the amount of fatty acids that contain *cis* double bonds.
B. prevent membrane rupture due to excessive fluidity.
C. increase lipid unsaturation.
D. increase cholesterol levels within the plasma membrane.
E. None of A,B,C or D is correct.

---

32 Individuals who are carriers (Cc) of the allele that causes cystic fibrosis

A. are less susceptible to diarrhea.
B. suffer from cystic fibrosis.
C. lack the ability to pump chloride (Cl^-) into the epithelial lining.
D. are more susceptible to death by Cholera.
E. A and C only are correct.

---

33. Trans fats

A. are a group of fatty acids that contain double bonds.
B. are common in our diet because they are used by the baking industry.
C. are the reason vegetable oil is liquid at room temperature.
D. contain more H atoms than a saturated fatty acid with the same number of carbons.
E. A and B only are correct.

---

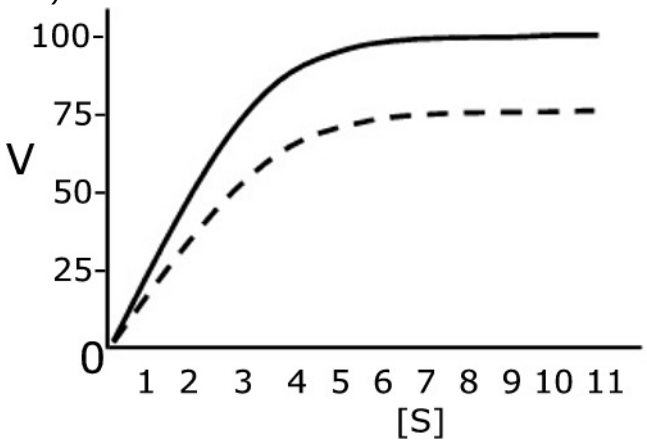
34. Which of the following statements about membrane transport is **correct**?

A. Facilitated diffusion requires ATP hydrolysis.
B. The proton motive force involves a difference in pH across a membrane.
C. H^+ can more easily diffuse across a membrane than H_2.
D. Co-transport does not require the proton motive force.
E. At high substrate concentration carrier-mediated (facilitated) diffusion shows higher transport rates than simple diffusion.

---

35. What is the Km of the un-inhibited enzyme in this graph (solid line)?
(where V = velocity and [S] = substrate concentration)

A. 2
B. 5
C. 25
D. 50
E. 100



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36. From the previous graph, compare the Vmax of the un-inhibited enzyme (solid line) with one in which an inhibitor was added (dashed line). While both reactions contained 1000 molecules of enzyme, how many molecules of non-competitive inhibitor were added to achieve the reduction in Vmax seen in the dashed line?

A. 25
B. 35.6
C. 75
D. 250
E. 500

---

37. A solution of glucose does not readily break-down into CO_2 because

A. glucose has less free energy than CO_2.
B. the oxidation of glucose into CO_2 is endergonic.
C. so few molecules gain the energy required to get to the transition state.
D. glucose cannot be broken-down to form CO_2 in the presence of water.
E. glucose break-down is a thermodynamically non-spontaneous reaction.

---

38. Which of the following statements about enzymes are correct?

1. They lower the ΔG of a reaction.
2. They enable high rates of reaction at low (37°C) temperature.
3. They decrease the number of substrate molecules that occupy the transition state.
4. They are proteins and therefore are encoded by genes.
5. Competitive inhibition can be overcome by high substrate concentrations.
6. Isoleucine can act as an allosteric inhibitor of isoleucine biosynthesis.

A. 1, 5, 6
B. 2, 4, 6
C. 2, 4, 5, 6
D. 2, 3, 4, 5, 6
E. 1, 2, 3

---

39. Transpeptidase

A. can be inactivated by penicillin.
B. is an enzyme secreted by the liver that kills bacteria.
C. is an antibiotic.
D. inhibits the synthesis of the bacterial cell wall.
E. B and D only are correct.

---

40. Glycolysis

A. requires ADP, ATP and NAD^+.
B. is found in bacteria as well as humans.
C. occurs in the cytosol of the cell.
D. Developed over 3 billion years ago - before there was O_2 in the atmosphere.
E. A, B, C and D are correct.

---

41. Substrate-level phosphorylation

A. results in the formation of NADH.
B. requires enzymes.
C. occurs during Glycolysis and the Krebs Cycle.
D. requires ATP as a substrate.
E. B and C only are correct.

---

42. If a mouse is fed FCCP, an ionophore that uncouples respiration, which of the following rates would decrease?

A. O_2 consumption by mitochondrial electron transport.
B. Oxidative phosphorylation.
C. Citrate synthesis by the Krebs cycle.
D. Glucose breakdown by glycolysis.
E. H^+ pumping by the Cytochrome b-c1 complex.

---

43. Electrons move spontaneously down an electron transport chain because

A. electron transport is linked directly to the free energy released by ATP hydrolysis.
B. the carriers at the end of the chain are more easily oxidized than those at the start.
C. each component in the chain has a greater affinity for electrons than the one before it.
D. electrons entering the chain are associated with stable compounds.
E. A and C only are correct.

---

44. In yeast cells that use anaerobic respiration

A. there is no need for glycolysis.
B. the production of ethanol produces CO_2 and regenerates NAD^+.
C. the oxidation of each glucose generates 38 molecules of ATP.
D. all of the carbon in glucose is oxidized to CO_2.
E. inhibiting pyruvate transport into the mitochondrion would decrease ATP production.

---

45. Which of the following statements is NOT correct?

A. Anabolic processes consume ATP
B. Chaperonins aid in protein folding.
C. The phosphorylation of glucose prevents it from diffusing out of the cell.
D. NADH dehydrogenase is composed of about 40 different polypetides.
E. Because they associate with membranes, peripheral membrane proteins are composed of mostly non-polar amino acids.

1E,2C,3A,4E,5B,6B,7A,8E,9E,10E,11C,12D,13A,14B,15B,16C,17E,18E,19E,20A,21B,22C,23E,24A,
25D,26C,27D,28B,29E,30B,31C,32A,33E,34B,35A,36D,37C,38C,39A,40E,41E,42B,43C,44B,45E

This was last year's December test with certain questions removed, inappropriate for this year's material. Please address lecture questions to respective lecturers.

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