
Name (please print)

Student ID #

BI110 – Unifying Life Processes

Department of Biology, Wilfrid Laurier University

Midterm Exam 2

November 9, 2011

Instructor: Dr. M. Smith

Time: 50 minutes | Total marks: 50

INSTRUCTIONS:

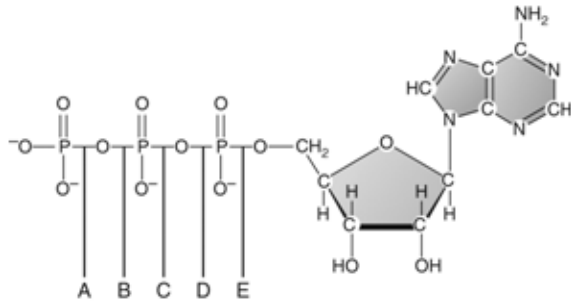
1. DO NOT OPEN THE EXAM PAPER UNTIL YOU ARE INSTRUCTED TO DO SO.

2. Print your name and ID# at the top of this cover page. Note that there are ten (10) pages, printed DOUBLE-SIDED.
3. Use **PENCIL ONLY** to fill-in the ParSCORE (Scantron) sheets using dark marks that fill in the rectangles completely. If you do not have a pencil, one will be provided to you.
4. You **must** fill in the Name field and indicate your 9-digit WLU I.D. number on the ParSCORE card. Note that there is a place for your ID# on both sides of the card (fill in both!). Don't forget to fill in the appropriate rectangles below your ID#. Please leave a space between your last and first names when filling in the name field.
5. There are four different versions of the exam, and you must indicate which one you have by filling in the **Test Form** field on the ParSCORE sheet. **The Test Form is provided on the next page of the exam, but do not open the exam until you are instructed to do so.**
6. Answer all **50** Multiple Choice questions by indicating the **one best choice** on the Scantron card. Only the Scantron card will be marked, *but it is a good idea to also indicate your answer on the exam itself*. Each question is worth one mark. There is no additional penalty for incorrect answers.
7. You must hand in both the question sheets and your ParSCORE/scantron card.
8. No additional materials are allowed.

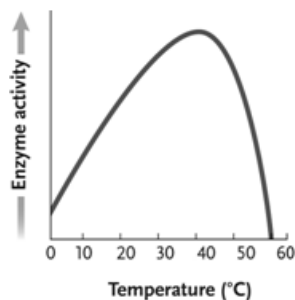
This exam is **TEST FORM A** (*please indicate this on your Scantron card*)

Indicate the best choice for each question on the Scantron card provided (1 mark ea)

1. What were the key elements in the evolution of hoofed mammals into whales?
 - a. genetic variation
 - b. genetic variation, and survival of individuals that used the water to avoid predation
 - c. *genetic variation, survival of individuals that used water to avoid predation, and selection of strains of individuals that switched their diets to fish***
 - d. genetic variation, and selection of strains of individuals that switched their diets to fish
2. A global pattern of environmental diversity results from
 - a. latitudinal variation in incoming solar radiation.
 - b. Earth's orbit around the sun and latitudinal variation in incoming solar radiation.
 - c. Earth's rotation on its axis, and latitudinal variation in incoming solar radiation.
 - d. *latitudinal variation in incoming solar radiation, Earth's rotation on its axis, and its orbit around the sun.***
3. According to the first law of thermodynamics,
 - a. energy can be created and destroyed.
 - b. *energy only changes forms.***
 - c. matter can be created and destroyed.
 - d. matter only changes forms.
4. What will happen to an animal cell placed in a hypotonic solution?
 - a. it will remain the same size
 - b. *it will swell, and perhaps burst***
 - c. it will shrink
5. Reversible reactions in a cell rarely reach equilibrium because
 - a. a cell at equilibrium is dead.
 - b. *the products are generally reactants in other reactions and are thus immediately used.***
 - c. most reactions in a cell are not reversible, allowing the cell to devote additional resources to regulating the few reversible reactions that do occur.
 - d. cells have no way of measuring the relative ratios of reactants and products.
6. Which of the following best describes how enzymes function?
 - a. *increasing the rate of a reaction.***
 - b. adding additional reactants to the system.
 - c. slowing the rate of some reactions and increasing the rate of other reactions.
 - d. changing the ΔG of the reaction.
7. Which reaction is likely to have more products than reactants when the reaction reaches equilibrium?
 - a. $\Delta G = +25 \text{ kcal/mol}$
 - b. $\Delta G = -25 \text{ kcal/mol}$
 - c. $\Delta G = +100 \text{ kcal/mol}$
 - d. *$\Delta G = -100 \text{ kcal/mol}$***

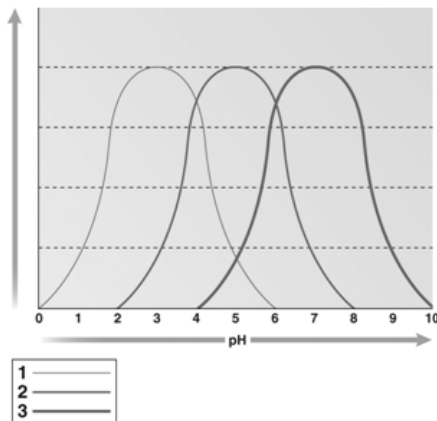


8. In the figure shown above, identify the bond that is cleaved when this molecule is coupled with an endergonic reaction to drive the endergonic reaction to completion. (A molecule of water also required for this reaction is not shown.)
- A
 - B
 - C
 - D
 - E
9. Abiotic factors include
- temperature.
 - wind speed.
 - sunlight.
 - all of the above.**
10. Enzymes work with at least three mechanisms. Which of the following is NOT a mechanism by which enzymes function?
- putting reactants in close proximity to each other
 - orienting the reactants so they are positioned to favour the transition state
 - altering the free energy (ΔG) of the reaction**
 - altering the immediate environment of the reactants to promote reactant interactions



11. In the above figure, why does the curve sharply drop after approximately 45°C instead of mirroring the slope of the line going from 0–40°C?
- The kinetic energy of the reactants is so great that it destabilizes the enzyme and diminishes the enzyme's activity.
 - This is true of all catalysts and is not due to any special features of enzymes.
 - The enzyme begins to denature above a certain temperature, eliminating all catalytic activity of the protein.**
 - The kinetic energy of the reactants is lower than that of the products, forcing a change in enzyme activity.

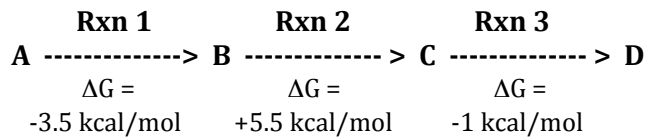
12. You do an experiment in the laboratory and add increasing amounts of substrate to a solution containing an enzyme and a pH buffer. You incubate the container at the optimal temperature for your enzyme. Each time you add more substrate, you measure the rate of the reaction. If you graph the results where the x-axis shows the substrate concentration and the y-axis shows the resulting reaction rate, what will you find over time?
- The rate of the reaction will proceed with a slope of 1 and continue in a linear fashion indefinitely or until you run out of reactants.
 - The rate of the reaction will increase rapidly, taper off, and plateau.**
 - The rate of the reaction will increase slowly, plateau, and then drop sharply back to zero.
 - The resulting graph will be a perfect bell curve.



13. In the graph above, the optimal pH for enzyme 1 is
- 2
 - 3**
 - 4
 - 5
14. If all three enzymes analyzed in the graph above catalyze the same reaction and your conditions require a pH of 7, the best enzyme to use would be
- enzyme 1
 - enzyme 2
 - enzyme 3**
 - either enzyme 2 or 3
15. When an enzyme has an allosteric activator, it means that
- a product of the enzyme, or other downstream product, will bind to the enzyme at the active site and inhibit enzyme activity.
 - a product of the enzyme, or other downstream product, will bind to the enzyme at the active site and stimulate enzyme activity.
 - a product of the enzyme, or other downstream product, will bind to the enzyme at a site other than the active site and inhibit enzyme activity.
 - a product of the enzyme, or other downstream product, will bind to the enzyme at a site other than the active site and stimulate enzyme activity.**

16. When referring to membrane glycolipids and glycoproteins, the term “glyco-“ indicates

- nonpolar carbohydrate groups that are attached to the molecules.
- polar carbohydrate groups that are attached to the molecules.**
- the molecules that are found on both the interior and exterior of the membrane.
- the molecules that are attached to the membrane by ionic bonds.



In the above hypothetical metabolic pathway, molecule A is converted to molecule D via 3 reactions (Rxns 1, 2 and 3). Answer the next three questions based on this hypothetical pathway.

17. Which statement is TRUE about the reactions in the pathway?

- Reaction 1 is exergonic and hence requires energy.
- Reaction 2 is exergonic and hence requires energy.
- Reaction 1 is endergonic and hence requires energy.
- Reaction 2 is endergonic and hence requires energy.**

18. Which statement is TRUE about the metabolic pathway?

- The pathway is anabolic.**
- The pathway is catabolic.
- Reaction 2 is exergonic.
- both a and c.

19. Molecule D is an allosteric inhibitor of the enzyme that catalyzes Rxn 1. This is an example of _____, and when it happens molecule ___ will accumulate.

- feedback inhibition, A**
- feedback inhibition, B
- the lock and key model, A
- the lock and key model, B

20. When ATP is split into ADP and P_i ,

- the energy is released in the form of heat.
- the energy is directly transferred to the target molecule by an unknown mechanism.
- the binding of ADP or P_i to the target molecule allows the energy of ATP hydrolysis to be transferred to the target molecule.**
- the two remaining phosphates acquire the energy that had been present in the linkage of three phosphates.

21. Dr. Weadge spoke to the class about membrane transport systems in bacteria and their biological importance. Why is it important to understand the mechanism by which sugars are transported out of bacterial cells to form the capsule?

- To understand how ATP is used by the cell.
- Capsules are important for the formation of Biofilms.**
- All transport mechanisms are similar, and bacteria offer an easy model system to work with.
- To understand the mechanisms of facilitated diffusion.

22. When a reaction reaches equilibrium,
- there is no longer entropy in the system.
 - the chemical reactions cease.
 - the rate of the forward and reverse reactions are equal.***
 - the concentration of reactants equals the concentration of products.
23. ATP can be used to drive anabolic reactions because ____.
- ATP hydrolysis is an endergonic reaction
 - ATP hydrolysis is an exergonic reaction***
 - ATP hydrolysis is also an anabolic reaction
 - ATP hydrolysis results in the consumption of free energy
24. The ___ component of the cell membrane functions as a selective barrier, while the ___ component has specific functions such as transport, recognizing other cells, and binding to other cells.
- carbohydrate; nucleic acid
 - protein; lipid
 - lipid; protein***
 - lipid; carbohydrate
25. Winter rye is a crop plant that germinates in the fall. The seedlings survive over the winter, and then continue to develop in the spring. How are the membranes of winter rye able to remain fluid when the temperature becomes extremely cold?
- The percentage of unsaturated phospholipids in the membrane is increased.
 - The percentage of saturated phospholipids in the membrane is increased.
 - The percentage of cholesterol molecules in the membrane is increased.
 - The percentage of both unsaturated phospholipids and cholesterol is increased.***
26. Each of the following characteristics are true for both facilitated diffusion and active transport EXCEPT
- a concentration gradient is present.
 - the direction of transport is always with the concentration gradient.***
 - transport proteins can become saturated.
 - transport proteins are specific for the molecules being transported.
27. Which of the following does not ALWAYS alter the activity of the enzyme?
- temperature
 - pH
 - reactant concentrations***
 - inhibitors
28. Which of the following is a reasonable explanation for why unsaturated fatty acids help keep a membrane more fluid at lower temperatures?
- The double bonds form a kink in the fatty acid tail, forcing adjacent lipids to be spaced further apart.***
 - Unsaturated fatty acids have a higher cholesterol content.
 - Unsaturated fatty acids permit more water in the interior of the membrane.
 - The double bonds block interaction among the hydrophilic head groups of the lipids.

29. Which type of lipid is most important in the structure of biological membranes?
- galactolipid
 - triacylglycerol
 - phospholipid**
 - cholesterol
30. Physiological saline is 0.9 percent NaCl; red blood cells placed in such a solution will not gain or lose water; therefore, one could state that the fluid in red blood cells is _____.
- hypertonic
 - hypotonic
 - isotonic**
 - osmotic
31. Membrane sterols such as cholesterol function in animal cell membranes to
- increase the rate of diffusion.
 - store cellular energy.
 - facilitate ion transport.
 - maintain membrane fluidity.**
32. The selective permeability of a membrane refers to
- the movement of a molecule from an area of greater concentration to an area of lesser concentration.
 - the ability of a substance to pass through a membrane.
 - the ability of only certain molecules to pass across a membrane.**
 - the need for carrier proteins to transport some molecules.
33. The concentration gradient that drives diffusion is a form of
- heat.
 - potential energy.**
 - kinetic energy.
 - active transport.
34. Which of these conditions are always true of populations evolving due to natural selection?
- Condition 1: The population must vary in traits that are heritable.**
- Condition 2: Some heritable traits must increase reproductive success**
- Condition 3: Individuals pass on all traits they acquire during their lifetime.**
- Condition 1 only
 - Condition 2 only
 - Conditions 1 and 2**
 - Conditions 2 and 3
 - Conditions 1, 2, and 3
35. The term phospholipid can best be described by which of the following?
- a nonpolar lipid molecule that is made polar by the addition of a phosphate
 - a nonpolar lipid molecule that is made amphipathic by the addition of a phosphate**
 - a polar lipid molecule that fully interacts with water
 - a polar lipid molecule that fully repels water

36. A farmer uses triazine herbicide to control pigweed in his field. For the first few years, the triazine works well and almost all the pigweed dies; but after several years, the farmer sees more and more pigweed. Which of these explanations best describes this observation?
- The herbicide company lost its triazine formula and started selling poor-quality triazine.
 - Natural selection caused the pigweed to mutate, creating a new triazine-resistant species.
 - Triazine-resistant pigweed has less-efficient photosynthesis metabolism.
 - Only triazine-resistant weeds survived and reproduced, so each year more pigweed was triazine-resistant.**
37. Which of the following is the best modern definition of evolution?
- descent without modification
 - change in genetic traits in a population over time**
 - survival of the fittest
 - inheritance of acquired characters
38. After the drought of 1977, researchers hypothesized that on Daphne Major (an island in the Galapagos islands), medium ground finches with large, deep beaks survived better than those with smaller beaks did because they could more easily crack and eat the tough *Tribulus cistoides* fruits (one of the only types of seed that was available during the drought). If this hypothesis is true, what would you expect to observe if a population of these medium ground finches colonized a nearby island where *Tribulus cistoides* was the primary available food in all years?
- Evolution of yet larger, deeper beaks over time**
 - Evolution of smaller, pointier beaks over time
 - Random fluctuations in beak size and shape
 - No change in beak size and shape
39. Facilitated diffusion is specific. This means
- a specific protein will transport certain polar or charged molecules but not others.**
 - that only one specific integral protein per membrane is involved in facilitated diffusion.
 - that the energy molecule ATP is specifically required for transport.
 - only specific hydrophobic molecules can be transported.
40. When phospholipids are put into an aqueous solution, they form lipid bilayers spontaneously. What explains why this reaction is spontaneous?
- The process is endergonic.
 - The process is exergonic.**
 - The process leads to a huge decrease in entropy and no change in potential energy.
 - The process is endothermic.
41. Consider the following reaction at equilibrium: $\text{CO}_2 + \text{H}_2\text{O} \leftrightarrow \text{H}_2\text{CO}_3$. What would be the effect of adding additional H_2CO_3 ?
- It would drive the equilibrium dynamics to the right.
 - It would drive the equilibrium dynamics to the left.**
 - Nothing would happen, because the reactants and products are in equilibrium.
 - The amounts of CO_2 and H_2O would decrease.

42. You have just discovered an organism that lives in extremely cold environments. Which of the following would you predict to be true about the phospholipids in its membranes, compared to phospholipids in the membranes of organisms that live in warmer environments?
- The membrane phospholipids of cold-adapted organisms will have longer hydrocarbon tails.
 - The membrane phospholipids of cold-adapted organisms will have more saturated hydrocarbon tails.
 - The membrane phospholipids of cold-adapted organisms will have more unsaturated hydrocarbon tails.***
43. What will happen to a red blood cell (rbc), which has an internal ion concentration of about 0.9 percent, if it is placed into a beaker of pure water?
- Nothing.
 - The cell would shrink because the water in the beaker is hypotonic relative to the cytoplasm of the rbc.
 - The cell would shrink because the water in the beaker is hypertonic hypotonic relative to the cytoplasm of the rbc.
 - The cell would swell because the water in the beaker is hypotonic relative to the cytoplasm of the rbc.***
44. What must happen for adaptive radiation to occur?
- Chance evolution of a morphological innovation and an opportunity to use it.***
 - Movement of organisms onto terrestrial environments.
 - Oxygenation of the atmosphere by oxygenic photosynthesis.
 - Organisms must live on an island.
45. Carl Woese proposed that all life could be grouped into three domains. What did he base his model on?
- DNA barcodes
 - Morphological characteristics
 - Cytochrome c oxidase gene sequence data
 - Small subunit rRNA gene sequence data***
46. Melting of ice is endothermic, but is also spontaneous because ____.
- of the large increase in entropy***
 - of the large decrease in entropy
 - water is more ordered than ice
 - water has more free energy than ice
47. The lock-and-key model of enzyme-substrate interaction has been largely replaced by
- The induced-fit hypothesis***
 - The padlock hypothesis
 - The intrinsically disordered hypothesis
 - The flexible-interaction model
48. What type of chemical bond is responsible for the formation of lipid bilayers?
- Hydrophobic interactions***
 - Hydrogen bonds
 - Ionic bonds
 - Covalent binds

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49. **Noncompetitive inhibition of an enzyme-catalyzed reaction differs from competitive inhibition in that noncompetitive inhibition ____.**
- a. blocks the active site
 - b. relies on molecules that are structurally similar to substrate molecules
 - c. *changes conformation of the enzyme***
 - d. requires the hydrolysis of ATP
50. **Eukaryotic cells import large molecules through the process of ____ and secrete large molecules by ____.**
- a. *endocytosis; exocytosis***
 - b. diffusion; exocytosis
 - c. exocytosis; endocytosis
 - d. endocytosis; phagocytosis

*Be sure that you indicated **TEST FORM A** on your Scantron/ParSCORE sheet!!!*