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과목코드	55	논술형 답지	과목명	AP 생물학	
문제 쪽수	총 4쪽	별도	학년 반	3학년 1A, 1B 반	

학번 : _____ 이름 : _____

총 문항 수

구분	선다형	논술형	기타
문항 수	20	4	0
배점	60	40	0
점수 합계	100		

[Multiple Choice Questions]

For each statement or question, select the number of the word or expression that, of those given, the BEST completes the statement or answers the question.

(20)×(3) point(s)=(60) points

1. Which of the following best explains why carbon is uniquely capable of supporting the structural and functional diversity required for biological macromolecules?

- ① Carbon readily forms ionic bonds that stabilize large molecular structures in aqueous environments.
- ② Carbon can form up to four covalent bonds, enabling the construction of complex and diverse molecular geometries.
- ③ Carbon has a high electronegativity that allows it to attract electrons and form polar interactions in biomolecules.
- ④ Carbon atoms tend to lose electrons easily, allowing rapid formation of charged biological intermediates.
- ⑤ Carbon primarily forms single bonds only, limiting structural variation but increasing molecular stability.

2. All the following statements about hydrocarbon are correct EXCEPT _____.

- ① Hydrocarbons are molecules composed exclusively of carbon and hydrogen atoms.
- ② Methane (CH₄) represents one of the simplest forms of hydrocarbon structures.
- ③ Hydrocarbons can adopt complex structures such as linear chains, branches, and rings.
- ④ Hydrocarbons typically contain functional groups that increase their solubility in water.
- ⑤ Hydrocarbons are classified as a fundamental category of organic compounds.

3. Which of the following best explains how the structure of phospholipids determines their behavior when placed in an aqueous environment?

- ① Phospholipids contain hydrophilic fatty acid tails and hydrophobic phosphate heads, causing them to disperse uniformly throughout the solution.
- ② Phospholipids have hydrophilic heads made of glycerol and phosphate groups and hydrophobic fatty acid tails, allowing them to assemble into spherical structures that reduce contact with water.
- ③ Phospholipids consist of entirely nonpolar components, leading them to cluster randomly without forming organized structures in aqueous environments.
- ④ Phospholipids are composed of polar and nonpolar regions, but their structure prevents them from forming stable aggregates in water.
- ⑤ Phospholipids include hydrophobic heads and hydrophilic tails, causing them to align in straight chains parallel to surrounding water molecules.

4. Which of the following best describes the flow of genetic information in eukaryotic cells according to the central dogma?

- ① Genetic information flows from DNA to RNA through transcription and from RNA to protein through translation, involving distinct molecular machinery at each step.
- ② Genetic information flows from RNA to DNA through translation and from DNA to protein through transcription, with both processes occurring simultaneously in the cytoplasm.
- ③ Genetic information flows directly from DNA to protein through a single-step process, with RNA functioning only as a temporary structural component.
- ④ Genetic information flows from protein to RNA and then to DNA, allowing cells to modify genetic sequences based on protein activity.
- ⑤ Genetic information flows from DNA to RNA and back to DNA before producing proteins, ensuring that genetic material is duplicated before expression.

5. Which of the following correctly matches a functional group with its corresponding chemical structure?

- ① Methyl group: OPO₃²⁻
- ② Hydroxyl group: COOH
- ③ Amino group: CH₃
- ④ Phosphate group: NH₂
- ⑤ Carbonyl group: C=O

6. Which of the following statements best describes a difference between proteins and nucleic acids?

- ① Proteins contain nitrogen, while nucleic acids do not.
- ② Proteins contain phosphorus, while nucleic acids contain sulfur.
- ③ Proteins contain sulfur, while nucleic acids do not.
- ④ Both proteins and nucleic acids contain sulfur as a key element.
- ⑤ Both proteins and nucleic acids contain nitrogen and sulfur.

7. A group of students are discussing the principles of cell theory. Which student's statement is **inconsistent** with the accepted theory?

- ① Tom: All living organisms are composed of one or more cells that carry out essential life functions.
- ② Daisy: Cells represent the smallest units capable of maintaining independent biological activity.
- ③ Nick: New cells arise only from pre-existing cells through the process of cell division.
- ④ Toni: Some cells can spontaneously arise from nonliving matter under certain environmental conditions.
- ⑤ Myrtle: Cells contain the necessary components to sustain life and regulate internal processes.

8. Which of the following best explains why most cells are small?

- ① Small cells have a lower surface-to-volume ratio, allowing them to reduce the rate of material exchange across the membrane.
- ② Small cells have a higher surface-to-volume ratio, increasing efficiency of material exchange across the membrane.
- ③ Small cells lack selectively permeable membranes, so they rely entirely on rapid diffusion across their surface.
- ④ Large cells have a higher surface-to-volume ratio, enabling faster diffusion and eliminating the need for selective permeability.
- ⑤ Large cells have selectively permeable membranes, so they can block every substances from outside.

9. Flurescent antibody staining is useful in microscopy because it:

- ① binds specifically to target antigens within the cell, enabling the visualization of particualr cellular components.
- ② increases the overall brightness of the specimen, allowing all cellular structures to be observed more clearly.
- ③ enhances the resolution of the microscope by increasing the wavelength of emitted light from all structures.
- ④ allows all molecules within the cell to fluoresce equally, improving contrast between different regions.
- ⑤ permanently alters cellular sturctures so that they can be more easily distinguished under magnification.

10. Which of the following best describes the primary function of ribosomes?

- ① They synthesize lipids and detoxify harmful substances within the cell.
- ② They modify and package proteins for secretion or intracellular transport.
- ③ They store genetic information and regulate transcription inside the nucleus.
- ④ They generate ATP through oxidative phosphorylation in the inner membrane.
- ⑤ They translate mRNA sequences into polypeptide chains during protein synthesis.

11. Which of the following sturctures is **NOT** considered part of the endomembrane system?

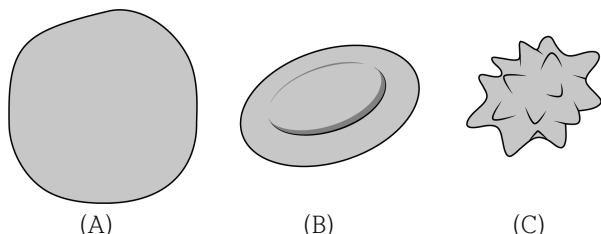
- ① Smooth endoplasmic reticulum
- ② Lysosome
- ③ Mitochondrion
- ④ Golgi apparatus
- ⑤ Plasma membrane

12. Gaucher disease is an inherited disorder in which cells of the body are unable to break down a particular type of lipid, resulting in a buildup of the lipid in some tissues and organs. Based on the information provided, Gaucher disease results most directly from a defect in the function of which of the following organelles?

- ① Smooth endoplasmic reticulum
- ② Lysosome
- ③ Mitochondrion
- ④ Golgi apparatus
- ⑤ Plasma membrane

13. Which pair of organelles is present in animal cells but not in plant cells?

- ① plasmodesma and peroxisome
- ② plasmodesma and centrosome
- ③ lysosome and vacuoles
- ④ lysosome and peroxisome
- ⑤ lysosome and centrosome



14. The diagram shows red blood cells labeled (A), (B), and (C). If plant cells were placed in the same solutions, which of the following correctly predicts their condition?

- | (A) | (B) | (C) |
|-------------|-----------|-----------|
| ① shriveled | turgid | flaccid |
| ② shriveled | flaccid | turgid |
| ③ flaccid | shriveled | turgid |
| ④ turgid | shriveled | flaccid |
| ⑤ turgid | flaccid | shriveled |

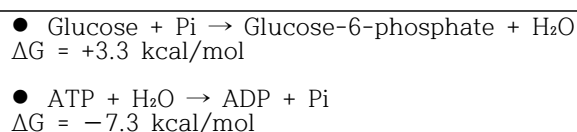
15. Which of the following correctly distinguishes among simple diffusion, facilitated diffusion, and active transport?

- ① Simple diffusion requires ATP, facilitated diffusion uses vesicles, and active transport moves substances against their concentration gradient.
- ② Simple diffusion moves nonpolar molecules through membrane proteins, facilitated diffusion moves polar molecules directly, and active transport requires no energy input.
- ③ Simple diffusion uses carrier proteins, facilitated diffusion uses ATP, and active transport moves substances only within the cytoplasm.
- ④ Simple diffusion moves small nonpolar molecules directly through the membrane, facilitated diffusion uses transport proteins for polar or charged substances, and active transport requires ATP to move substances against their concentration gradient.
- ⑤ Simple diffusion moves substances down their concentration gradient, facilitated diffusion requires ATP, and active transport moves substances randomly across membranes.

16. Which part of the following conversation about ATP structure is incorrect?

- ① Nick: "ATP is composed of adenine, a ribose sugar, and three phosphate groups, right?"
- ② Toni: "Right, and since adenine and adenosine are the same thing, ATP is basically adenosine with phosphates attached. Oh, look! A bird is in your hands."
- ③ Tom: "What do you mean, birds? There are no birds. I might smack your nose off right now. Wait, isn't adenosine actually adenine combined with a ribose sugar?"
- ④ Daisy: "Yeah, so ATP can be thought of as adenosine with three phosphate groups attached."
- ⑤ Myrtle: "Daisy, Daisy, Daisy! That makes sense, since removing the last phosphate releases energy for cellular processes."

17. A student is analyzing the following reactions.



How many ATP molecules are required to drive the overall reaction so that the net ΔG is negative?

- ① 1
- ② 2
- ③ 3
- ④ 4
- ⑤ 0

18. Some membrane proteins help maintain the concentrations of ions inside a cell by transporting the ions across the cell's plasma membrane. Other membrane proteins form pores in the plasma membrane through which the ions can diffuse. A model showing the influence of membrane proteins on the movement of sodium (Na^+) and potassium (K^+) ions across a plasma membrane is presented in Figure 1.

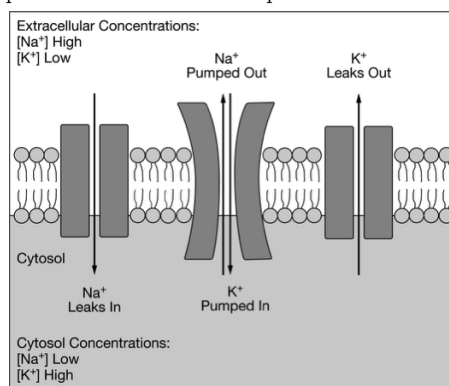


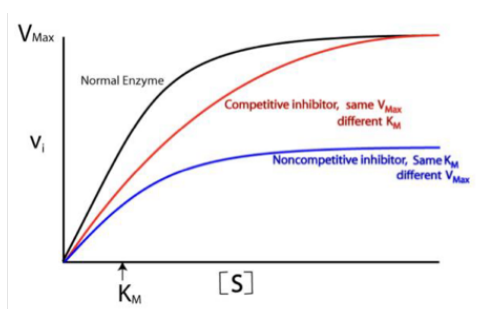
Figure 1. Section of a cell's plasma membrane, showing ion concentrations and membrane proteins

Based on the model presented in Figure 1, which of the following changes will most likely result from a depletion of available ATP stores inside the cell?

- ① The Na^+ concentration outside the cell will increase.
- ② The Na^+ concentration inside the cell will increase.
- ③ The K^+ concentration inside the cell will increase.
- ④ The K^+ concentration outside the cell will decrease.
- ⑤ There will be no change.

19. Which of the following statements about enzymes is **incorrect**?

- ① Enzymes act as biological catalysts by lowering the activation energy required for a reaction to proceed.
- ② Enzymes are not consumed during reactions and can be reused multiple times under appropriate conditions.
- ③ Many enzymes are proteins whose structure can be altered by changes in temperature or pH, leading to denaturation and loss of function.
- ④ Enzymes function by increasing the overall free energy (ΔG) of a reaction to make it more favorable.
- ⑤ According to the induced fit model, the enzyme's active site changes shape slightly to better accommodate the substrate during binding.



20. The graph shows enzyme activity under normal conditions, with a competitive inhibitor, and with a noncompetitive inhibitor. A student recalls that when $[S] = K_M$, the reaction rate is the half of V_{MAX} . Which of the following statements is correct?

- ① A competitive inhibitor decreases V_{MAX} because it binds to the active site, whereas a noncompetitive inhibitor increases K_M because it competes with the substrate indirectly.
- ② A competitive inhibitor increases K_M because it reduces the number of functional enzyme molecules, whereas a noncompetitive inhibitor decreases V_{MAX} because it blocks the active site.
- ③ A competitive inhibitor does not change V_{MAX} because excess substrate can outcompete the inhibitor, whereas a noncompetitive inhibitor decreases V_{MAX} because inhibitor binding reduces the maximum catalytic capacity of the enzyme population.
- ④ A competitive inhibitor decreases K_M because substrate binding becomes less specific, whereas a noncompetitive inhibitor does not change V_{MAX} because it does not affect substrate binding directly.
- ⑤ A competitive inhibitor increases K_M because it binds to an allosteric site, whereas a noncompetitive inhibitor decreases V_{MAX} because it can be overcome by increasing substrate concentration.

[Free Response Questions]

Read the question carefully and completely. Answer must be written out in paragraph form. Bulletin lists, or diagrams alone are not acceptable.

1. Draw the structure of ATP. Clearly label adenosine and the three phosphate groups (α , β , and γ). (10 points)

A biologist performed two series of experiments on lactase, the enzyme that hydrolyzes lactose to glucose and galactose. First, she made up 10% lactose solutions containing different concentrations of enzyme and measured the rate at which galactose was produced (grams of galactose per minute). Results of these experiments are shown in Table A below. In the second series of experiments (Table B), she prepared 2% enzyme solutions containing different concentrations of lactose and again measured the rate of galactose production.

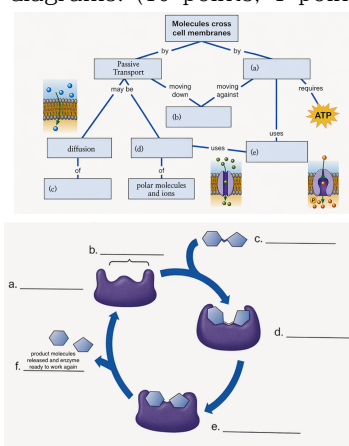
Table A. Reaction Rate and Enzyme Concentration

Lactose concentration	10%	10%	10%	10%	10%
Enzyme concentration	0%	1%	2%	4%	8%
Reaction rate	0	25	50	100	200

Table B. Reaction Rate and Substrate Concentration

Lactose concentration	0%	5%	10%	20%	30%
Enzyme concentration	2%	2%	2%	2%	2%
Reaction rate	0	25	50	65	65

2. Graph and explain the relationship between the reaction rate and the enzyme concentration. (10 points)
3. Graph and explain the relationship between the reaction rate and the substrate concentration. How and why did the results of the two experiments differ? (10 points)
4. Fill in each blank with the most appropriate term based on the diagrams. (10 points, 1 points each)



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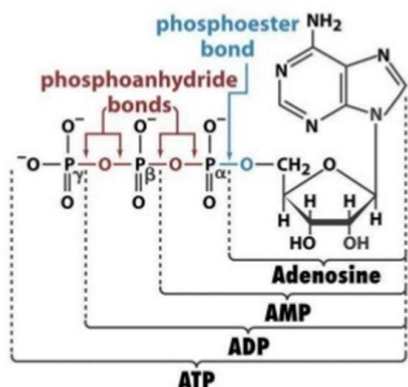


<Answers>

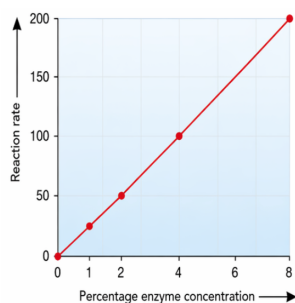
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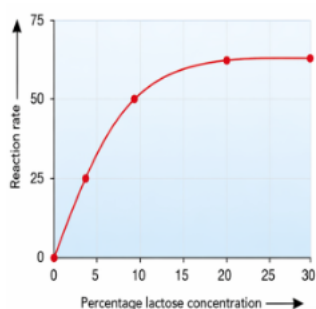
1.



2. The more enzyme present, the faster the rate of reaction, because it is more likely that enzyme and substrate molecules will meet.



3. The more substrate present, the faster the reaction, for the same reason, but only up to a point. An enzyme molecule can work only so fast; once it is saturated (working at top speed), more substrate does not increase the rate.



4. a. active transport; b. concentration gradient; c. small nonpolar molecules; d. facilitated diffusion; e. transport proteins

a. enzyme; b. active site of enzyme; c. substrate; d. substrate in active site; induced fit strains substrate bonds; e. substrate converted to products;