Biology 12: Enzymes Review

Review Questions:

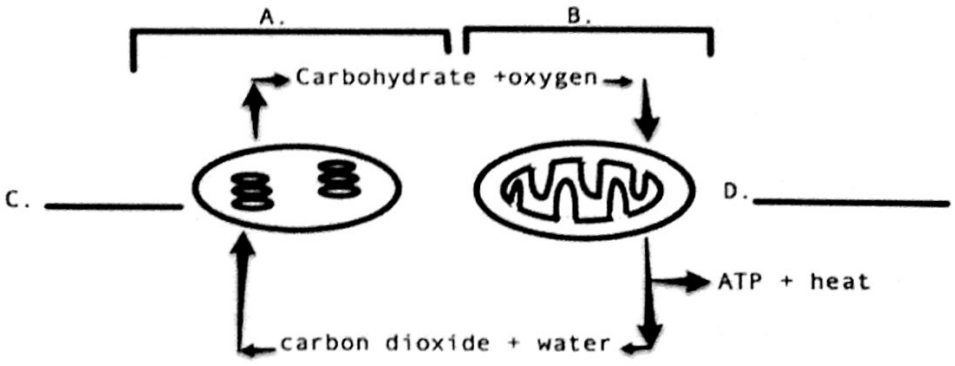
1. Define metabolism. What are the advantages of having metabolic pathways in a cell?
2. What are enzymes? Why are enzymes important?
3. Are enzymes specific?
4. How are enzymes named?
5. Why are enzymes absolutely necessary to the continued existence of a cell?
6. HOW do enzymes increase the rate of a reaction?
7. Describe what happens when an enzyme reacts with a substrate.
8. Where does the substrate fit onto the enzyme?
9. What happens to the enzyme after the reaction?
10. Describe the difference between the lock and key theory and the induced-fit model.
11. What is the difference between enzymatic reactions that bring about synthesis and those that bring about degradation?
12. Why will an increase in the substrate concentration cause an increase in the enzyme's activity only up to a certain point?
13. What happens to an enzyme as the temperature continues to increase? If the pH continues to increase?
14. Define competitive inhibition. What is the difference between irreversible and reversible inhibition?
15. Define noncompetitive inhibition. What is the normal way by which metabolic pathways are regulated?
16. What are coenzymes? List 3 vitamins that are used in coenzymes.

Completion and Short Answer Questions

1. ***Energy*** is defined as the capacity to bring about change or do work.

2. When cells require energy for synthetic reactions, they "spend" ***ATP (energy)*** .

3. In the diagram below, list the two cellular processes that allow for energy transformations on lines a and b. On lines c and d, list the organelles responsible for each cellular process.
A. photosynthesis B. cellular respiration c. chloroplast d. mitochondria



4. Every ATP molecule is composed of the base (a) ***adenine,*** the sugar, (b)***ribose*** , and three (c)***phosphate*** groups.

5. The equation ADP + P -----→ ATP is energy ***requiring*** (requiring/releasing).

6. $A \xrightarrow{E_1} B \xrightarrow{E_2} C \xrightarrow{E_3} D$

In this metabolic pathway, the letter B stands for the (a) ***product*** as a result of the action of Enzyme 1. However, as a result of the action of Enzyme 2, B represents a (b) ***substrate*** . Each and every reaction a cell requires a specific (c) ***enzyme***.

7. The generalized equation for enzymatic action is :
E + S → ES → E + P

8. This equation show that the enzyme and the substrate form a temporary ***Enzyme-substrate*** complex.

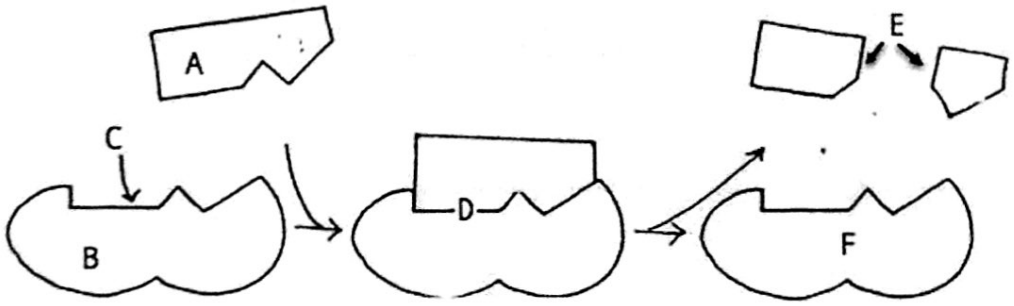
9. In the list below, give the name of the enzyme for each specific substrate.

Substrate	Enzyme
Lipid	***lipase***
Urea	***urease***
Maltose	***maltase***
Ribonucleic acid	***nuclease***

10. Less heat is needed to bring about a chemical reaction within a cell because enzymes will ***decrease*** the energy of activation of a reaction.

11. The ***active*** site is the place where the substrate fits onto the enzyme for orientation so that the reaction takes place.

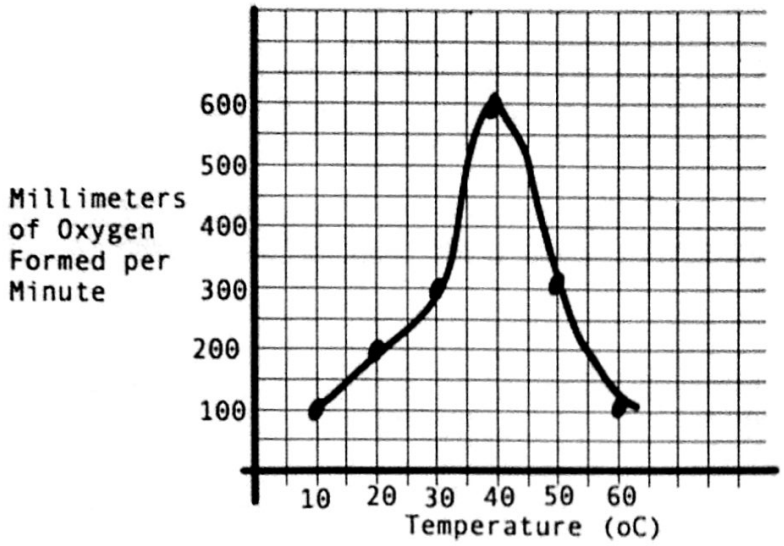
12. Use the following terms to label this diagram:
a. substrate, B. enzyme, c. active site, D. enzyme-substrate complex e. product,



13. When substrate binds to the enzyme, the enzyme undergoes a slight change in shape to achieve maximum fit. This concept is termed the ***induced fit*** model.

14. Suppose two amino acids join together to form a dipeptide. This type of reaction is considered a ***dehydration (or condensation) synthesis*** reaction.

15. Catalase is an enzyme that breaks down hydrogen peroxide into water and oxygen. Plot the results of the data below in the accompanying graph.



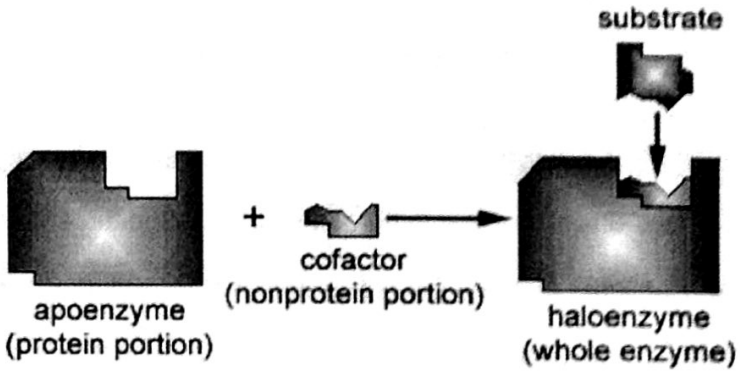
16. On the basis of the above graph, at which temperature did the catalase exhibit the greatest activity? ***40°C***

17. Why did the activity of catalase decrease as the temperature continued to increase above 40°C? ***most likely denatured the enyzme***

18. Explain why hydrogen peroxide can be broken down by the enzyme catalase but another substrate, such as maltose, cannot be broken down catalase. ***Enzymes are substrate-specific – only the correct substrate will "fit" into the active site and therefore allow the reaction to occur.***

What is the cofactor show in the diagram to the right often made from?

Cofactors are often made from VITAMINS



19.

Substrate Concentration (mg/mL)	Amount of Product Formed (mg/mL)
0	0
10	100
20	200
30	400
40	400
50	400

Study the table given above.

a. Which substrate concentration will initially yield the maximum amount of product formed? ***30mg/mL***

b. Explain why the amount of product formed does not increase as the substrate concentration goes beyond 30 mg/mL ***All the active sites will be occupied by the substrate – if you wanted to increase the rate after that, you would have to increase the heat (make them work faster), or increase the [enzyme].***

20. On the basis of the two tables presented below, which table shows irreversible inhibition? ***Table B- when you increase the substrate concentration, it does nothing to the rate – because the enzymes are "turned off!"***

Table A

Substrate Concentration (mg/mL)	Inhibitor Concentration (mg/mL)	Amount of Product Formed (mg/mL)
20	0	200
20	10	100
20	20	50
20	40	0
100	40	400

Table B

Substrate Concentration (mg/mL)	Inhibitor Concentration (mg/mL)	Amount of Product Formed (mg/mL)
20	0	200
20	10	0
20	20	0
20	40	0
100	40	0

21. In ***allosteric (non-competitive)*** inhibition, an inhibitor binds to an enzyme at a site other than the active site.

22. Organic molecules that bind to enzymes and serve as carriers for electrons are called ***coenzymes (** cofactors are inorganic, non-protien, "enzyme helpers")***.

23. Two environmental factors that can change the shape of an enzyme are ***temperature*** and ***pH*** .

24. Enzymes may have a non-protein helper called a(n) ***cofactor***or an organic molecule called a(n) ***coenzyme***

Matching Questions: Use the following answers to match with the words below.

a. inhibitor b. ATP c. extreme temperature d. enzyme

denatured ***C. extreme temperature***

substance that can compete with a substrate a. ***inhibitor***

energy currency of the cell b. ***ATP***

substance that can speed up one particular reaction d. ***enzyme***

True or False. If you believe the statement to be false, then rewrite the statement as a true one.

T 1. Enzymes, being molecules that speed up chemical reactions, are required in photosynthesis and respiration.

T 2. The shape of an inhibitor molecule is very similar to the shape of the enzyme's substrate.
Assuming that is COMPETITIVE inhibition

T 3. High temperature and extreme pH can cause an enzyme to denature.

F 4. All enzymes function at the same pH.
All enzymes have a specific, optimal pH at which they best function

F 5. The first law of thermodynamics states that one usable form of energy cannot be completely converted into another usable form.
This is the second law of thermodynamics

Fill in the Blanks:

B. Energy and Enzymes:

1. A metabolic **pathway** begins with a particular reactant, terminates with an end product, and has many minute steps in between. A **reactant** is a substance that participates in a reaction. A **product** is a substance that is formed by the reaction. The reactants in an enzymatic reaction are called the **substrate** for that enzyme.
2. An **enzyme** is a protein molecule that functions as an organic catalyst to speed up a chemical reaction.
3. The energy that must be added to cause molecules to react with on another is called the **activation energy**. Enzymes **decrease** the amount of energy for activation to occur.
4. When an enzyme forms a complex with its substrate, the small part of the enzyme that complexes with the substrate is called the **active site** In the **lock-and-key** model, the active site undergoes a slight change in shape in order to accommodated the substrate. Only a small amount of enzyme is actually needed in a cell because enzymes are not **used up**.
5. Enzymes are very **specific** in their action and are named for their **substrates**.
6. As the temperature rises, why in there an increase in enzyme activity? ***Molecules move faster, and therefore they will bump into each other faster, and the reaction will proceed faster.***
7. When an enzyme's shape changes due to high temperature or extreme pH, the enzyme is said to be **denatured**.
8. In **feed-back** inhibition, a product produced in high amounts by an enzymatic reaction can inhibit the enzyme's activity. The end product of an enzymatic pathway binds at an allosteric site on the **initial** enzyme of the pathway.
9. In **competitive** inhibition, another molecule is so close in shape to the enzyme" substrate that it can compete with the true substrate for the enzyme's active site. In **allosteric** inhibition, a molecule binds to an enzyme, but not at the active site. This other site is called the **regulator** site and causes a shift in the three-dimensional structure.
10. **Coenzymes** are organic molecules that bind to enzymes and serve as **carriers** for chemical groups or electrons.
11. Vitamins are small organic molecules that are required in trace amounts in our diet for the synthesis of coenzymes.
12. When the substrate binds to the enzyme, the enzyme undergoes a slight alteration in shape to achieve optimum fit. This concept is termed the ***induced***-fit model.

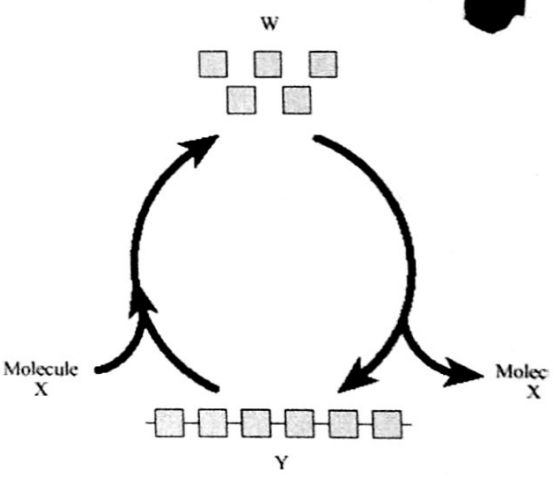
13. For each of the following characteristics of enzymes, put T for true or F for false.
t Each reaction in a cell uses a specific enzyme
t (a better word would be REGULATES) Slows down chemical reactions
t Named for their substrates

f Enzymes and products form a complex
t Substrate binds to enzyme at active site
f Increase in temperature causes decreased activity (unless well beyond optimal)
t Each enzyme has an optimal temperature
f All enzymes have the same optimal pH

14. The thyroid gland releases a hormone called **thryroxin** which acts on cells, causing them to **increase their metabolism**
15. If iodine is lacking in the diet, the thyroid gland enlarges, producing a **goiter**
16. As a result, when there are low levels of thyroxin in the blood, called ***Hypothroidism*** no negative feedback occurs, and the anteriaor pituitary continues to produce ***thyroid-stimulating hormone(TSH),*** which stimulates the thyroid to hypertrophy.
17. Thyroxin increases the ***metabolic*** rate in which glucose is broken down.
18. Describe the process that controls the release of thyroxin from the thyroid gland. (including the hypothalmus) ?What is this process called? ***Negative feed-back inhibition***

1.hypothalamus - receives nervous message - needs to increase metabolism
2. pituitary gland receives chemical message from hypo. (Releasing hormones)
3. Pituitary releases TSH
4. Thyroid receives TSH (chemical message)
5. Thyroid released Thyroxin
6. Thyroxin concentrations build up in blood
7. High [thyroxin] is detected - nervous message is sent to hypothalamus
8. Hypothalamus receives message, and stops sending Releasing hormones to pituitary.

19. Examine the diagram to the right.
a. What is the name of the type of reaction that changes substance " W substance "Y"? ***Dehydration Synthesis or Condensation Synthesis***
b. What is the opposite reaction, from Y to W, called? ***Hydrolysis***
c. What is Molecule X? ***water***
d. Suggest a molecule that is properly represented by "W" and "Y".
If W are amino acids, then Y is a polypeptide(short piece of protein
If W are monosaccharides, Y is a polysaccharide
If W is nucleotides, Y is nucleic acid
If W is fatty acids and glycerol, Y is lipids



20. What is the name of the biological molecule shown below? What is it used for in our body?
that is ATP – it is used for as the ENERGY currency in our body. We use the energy stored in the phosphate bonds to fuel our chemical reactions.