Student Name: _____

TSSM
Creating VCE Success

BIOLOGY 2020

Unit 3
Key Topic Test 4 – Structure and regulation of biochemical pathways

Recommended writing time*: 45 minutes
Total number of marks available: 45 marks

QUESTION BOOK

* The recommended writing time is a guide to the time students should take to complete this test. Teachers may wish to alter this time and can do so at their own discretion.

Conditions and restrictions

- Students are permitted to bring into the room for this test: pens, pencils, highlighters, erasers, sharpeners and rulers.
- Students are NOT permitted to bring into the room for this test: blank sheets of paper and/or white out liquid/tape.
- No calculator is allowed in this test

Materials supplied

- Question and answer book of 11 pages.

Instructions

- Print your name in the space provided on the top of the front page.
- All written responses must be in English.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic communication devices into the room for this test.

SECTION A – Multiple-choice questions

Instructions for Section A

Select the response that is **correct** for the question. A correct answer scores 1; an incorrect answer scores 0. Marks are not deducted for incorrect answers. If more than 1 answer is completed for any question, no mark will be given.

Question 1

An enzyme is known as a biological catalyst. Biological catalysts

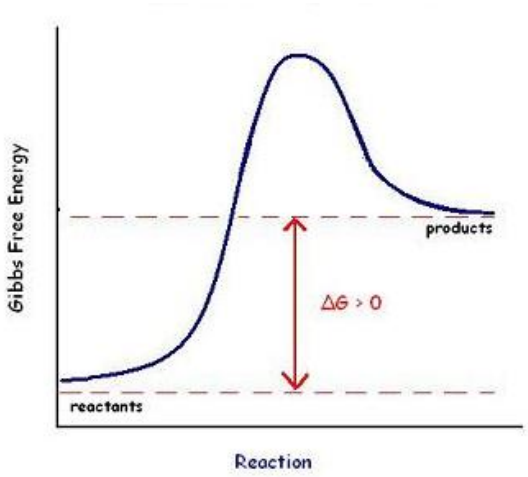
A. decrease activation energy resulting in slower reactions
B. increase activation energy causing faster reactions
C. produce energy when involved in anabolic reactions
D. can be used more than once

Question 2

Enzymes are often part of biological pathways. This mean that the enzymes

A. enhance the reactions in the pathway so that the product is more pure
B. use the products from one reaction as the substrate of another
C. are permanently altered so that they only work in that pathway
D. are inhibited by the product of a reaction

Question 3



Refer to the graph above. In this reaction

A. the products have a lower activation energy than the substrates
B. the products have higher activation energy than the substrates
C. the enzyme catalysed reaction has built energy holding bonds
D. the enzyme has catalysed a catabolic reaction

Question 4

Enzymes are often added to laundry detergents to remove biological stains like blood, grass or grease. A warning on the pack suggested that warm but not hot water should be used. This is because

A. it's cheaper to use warm water than hot water when washing

B. enzyme reactions work too quickly in hot water to be effective

C. if the water is too hot the enzymes may denature

D. hot water may cause the enzyme to work to efficiently and denature the clothes

Question 5

A student conducted an experiment where the laundry detergent was used at different temperatures ranging from 5^oC to 40^oC. When the results were compared the student found

A. the enzymes did not work at 5^oC

B. all the clothes were cleaned by the same amount regardless of temperature

C. the enzymes work fastest at 40^oC

D. enzymes work regardless of temperature

Question 6

Enzymes have an active site where the enzyme interacts with substrate. Enzyme active sites use either a lock and key or induced fit model to interact. A lock and key model has

A. an active site which only fits one specific substrate without changing shape

B. the substrate plays a role in determining the final shape of the active site

C. the substrate will change shape to help the active site fit

D. the enzyme is flexible and breaks bonds between amino acids to fit the substrate

Question 7

Relenza is a synthesized molecule that blocks the enzyme neuraminidases active site stopping an influenza virus from breaking off from a cell. This can occur because

A. the Relenza molecule is a complementary shape to the neuraminidase active site

B. the Relenza active site is an induced fit model meaning it can accept the neuraminidase shape

C. the Relenza molecule is an inhibitor that is the same shape as the neuraminidase enzyme

D. the flu virus can't break off from the cell until the Relenza has attached

Question 8

Sarin is a nerve gas that is an irreversible inhibitor that preferentially attaches to the serine amino acid in the active site of an enzyme called acetylcholine. This is involved in maintaining nerve impulses. Sarin is an irreversible inhibitor that

A. causes a change in the enzyme that can be modified if the sarin is removed

B. alters the shape of the enzyme outside the active site

C. causes the acetylcholine active site to be unable to fit its substrate

D. causes the active site to change shape blocking the release of the product

Question 9

Sulfa drugs are a group of drugs that acts as competitive inhibitors for enzymes involved in bacteria growth. An example of a sulfa drug is sulphanilamide. It binds to the active site of DHPS which halts the production of folic acid, essential for bacterial growth and division. As sulfa drugs are competitive inhibitors

A. sulfa drugs become more effective if folic levels are increased

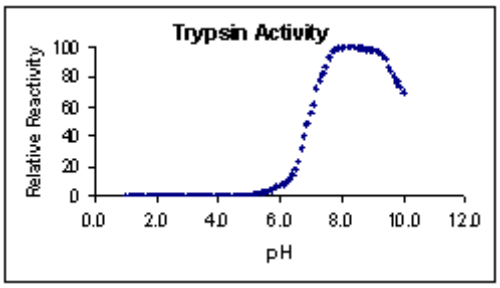
B. sulfa drugs become more effective as DHPS levels increases

C. sulfa drugs compete with folic acid for the active site of DHPS

D. sulfa drugs are a complementary to and move in and out of DHPS active site

Question 10

A student was exploring the link between enzyme activity and pH. Trypsin was used to digest milk and after the experiment was run the following graph was produced



Considering these results which of the following statements is most correct

A. trypsin dies if the pH goes below 6

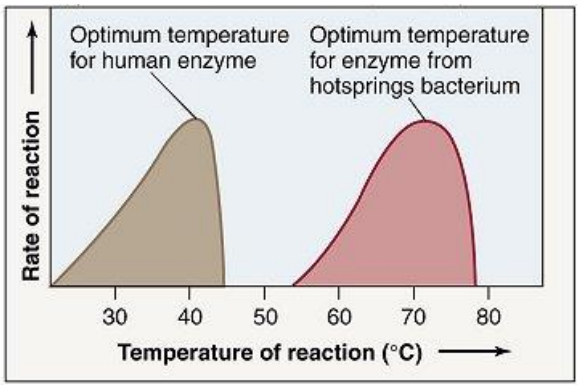
B. trypsin's optimal pH is 10

C. trypsin is denatured at 12

D. trypsin is less active above and below a pH of 8

Question 11

A scientist was comparing the effect of temperature on an enzyme from different organisms that was being used in an experiment.



When considering the results shown in the graph above which of the following inferences is most correct

A. the bacterial enzyme could work in human cells

B. the human and bacteria optimal temperatures are the same

C. both enzymes would denature at 50^{o}C

D. both enzymes would denature at above 80^{o}C

Question 12

Pepsin is a protease enzyme found in the stomach that breaks down protein in substances like egg white, that becomes clear as the egg white is digested. As the concentration of egg white increases the rate of reaction increases until a saturation point where the rate levels off. The limiting factor in this case is

A. the limited amount of amino acids in the egg white

B. the surface area of the pepsin enzyme

C. the number of available pepsin active sites

D. the temperature of the egg white

Question 13

ADP, NAD+ and NADP+ are known as unloaded forms of coenzymes that take part in reactions in organisms. In this context unloaded means

A. able to carry hydrogen

B. able to carry energy, protons or electrons between reactions

C. moving between 2 reactions

D. the movement of electrons and hydrogen ions between the light dependent and light independent stages

Question 14

The loaded forms of ADP, NAD+ and NADP+ are

A. ATP, FADH and NADPH

B. Hydrogen ions and electrons

C. ATP, NADPH and NADH

D. ATP + Pi, NADH and NADPH

Question 15

An example of the cycling of coenzymes is

A. NADP+ picking up hydrogen from the light independent stage and carrying it to the light dependent stage as NADPH

B. ADP + Pi dropping off electrons to become ATP during the light independent stage of photosynthesis

C. NAD+ picking up hydrogen ions during the Krebs cycle to become NADH for use in glycolysis

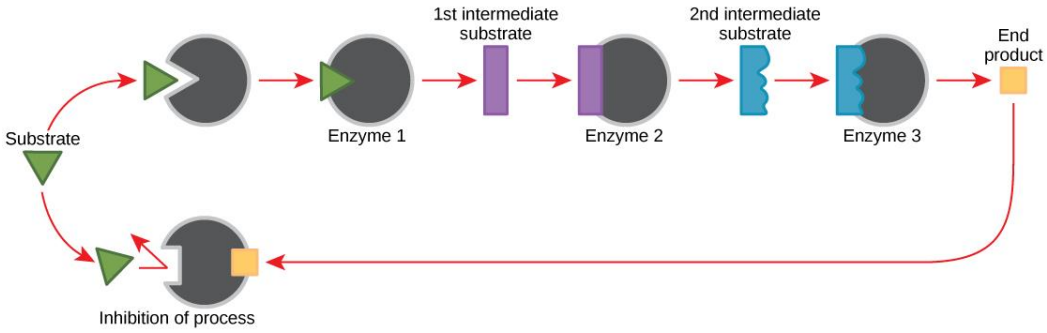
D. ATP being made in the light dependent stage being used to build glucose in the light independent stage

SECTION B - Short-answer questions

Instructions for Section B

Answer **all** questions in the space provided. Write using a blue or black pen.

Question 1



Sourced from: https://opentextbc.ca/biology/chapter/4-1-energy-and-metabolism/

Organisms use a range of enzymes to catalyse biological pathways like the simplified example above.

a. Each of the enzymes shown has a specific 3-dimensional shape including a specific active site. There are 2 theories about how substrates attach to an active site. Provide the name of each and explain the difference between them

_____

_____

_____

4 marks

b. Enzymes catalyse biological pathways. What does catalyse mean and how is this effect produced?

_____

_____

2 marks

c. Referring to the above diagram, if enzyme 2 were denatured would the final product be able to be produced? Explain

_____

_____

_____

3 marks

The active site an enzyme fits a specific substrate due to its complementary shape. However, enzymes can be inhibited through the action of molecules which have an affinity with the active site.

d. In the diagram above the inhibitor interacts with an allosteric site. This is a site other than the active site, yet it still has the same effect of inhibiting the substrate. Explain why the substrate cannot attach to the active site.

_____

_____

2 marks

e. Inhibitors can be either reversible or irreversible. Compare the 2 types of inhibitor referring to substrates in your answer.

_____

_____

2 marks

f. Draw an example of competitive inhibition

3 marks

Total 16 marks

Question 2

Enzymes have an optimal range within which they act at the fastest rate. Outside of this range enzymes may denature causing the biological pathway they are catalysing to slow down or stop

a. Define the term denature.

_____

_____

1 mark

b. Long distance runners may experience a condition known as acidosis which occurs particularly if the athlete is dehydrated. Acidosis occurs when carbon dioxide produced as a by-product of cellular respiration is not cleared by the body fast enough and the blood pH drops below 7.4. What could be the effect of the blood pH dropping below the optimal level of 7.4?

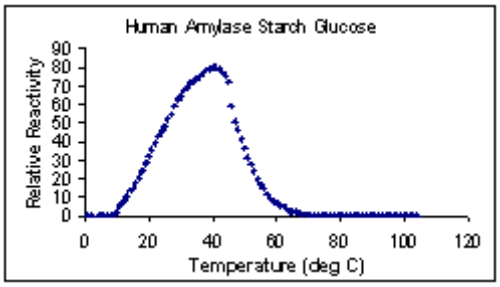
_____

_____

_____

2 marks

c. Two students were discussing an experiment they conducted using the enzyme amylase at different temperatures. The results from the experiment are shown below. One student suggested that the enzyme denatured above and below the optimal temperature. Were they correct? Explain why or why not.



_____

_____

_____

3 marks

Total 6 marks

Question 3

Loaded and unloaded coenzymes act as carrier molecules in various biochemical pathways in organisms. The loading and unloading of the carrier molecules are known as cycling of the coenzymes.

a. Coenzymes are essential to the running of biochemical pathways. Complete the table below for the 3 types of coenzyme

Loaded coenzyme	Unloaded coenzyme	What is carried
ATP		
	NAD+	
		Hydrogen/protons

6 marks

b. Explain why these molecules are known as coenzymes and why cycling of coenzymes occurs.

_____

_____

2 marks

Total 8 marks

END OF KEY TOPIC TEST