Topic 8 Metabolism, respiration and photosynthesis test - mark scheme

Multiple choice questions

1. Enzyme inhibition can occur by an inhibitor doing which of the following?

I binding to the active site

II binding to the allosteric site

III causing a change in the conformation of the enzyme

A I only

B 1 and II only

C I and III only

D I, II and III

1. Which of the following describes a process that occurs In both respiration and photosynthesis?

1. NADP is reduced
2. A high concentration of protons is generated
3. Electrons oxidise electron carriers
4. Reactions occur in the cell cytoplasm

1. Which of the following describes features of a metabolic pathway?

I It can be regulated to suit the needs of the cell

II It can be cyclic in nature

III It can be inhibited by an end-product

IV It can be anabolic or catabolic in nature

A I only

B 1 and II only

C I, III and IV only

D all of the above

1. The following equation represents the link reaction of respiration. CoAS-H represents acetyl coenzyme A and CH_3 COCOOH represents pyruvate:

Which of the following processes occur?

I NAD is reduced

II CoAS-H is reduced

III Pyruvate is decarboxylated

IV Protons are formed

A I only

B 11 and III only

C I, III and IV only

D All of the above

1. Which new development in scientific technique assisted Calvin in working out the steps of the Calvin cycle?
2.

1. Chromatography
2. Electron tomography
3. Autoradiography
4. Artificial enzyme inhibitors

1. The first step in glycolysis is the phosphorylation of glucose.
2. What does this cause to happen?

1. The oxidation of glucose
2. The production of pyruvate
3. The gain of ATP energy
4. Instability in the glucose molecule

1. The production of most of the ATP in aerobic respiration is associated with which of the following processes?

1. Reduction of NAD
2. Chemiosmosis
3. Active transport

4. Decarboxylation

1. Oxygen in aerobic respiration is needed in order to

1. Oxidise NADH
2. Decarboxylise pyruvate
3. Provide energy for active transport
4. Accept protons and electrons

1. Which of the following statements best explains the reason why enzymes increase reaction rates?

1. Substrate binds according to the induced fit model
2. The enzyme lowers the activation energy
3. The enzymes has a transition state
4. The Allosteric site lowers the activation energy

1. Which of the following is the source of electrons for chlorophyll in photosystem II of photosynthesis?

1. NADPH
2. Water
3. Light
4. ATP

Structured answer questions

1. Glycolysis produces pyruvate and 2 molecules of NADH + H^+. Describe how, in aerobic conditions, these molecules lead to a higher ATP yield than in anaerobic conditions. (2 marks)

NADH + H^+ / reduced NAD can enter the mitochondrion

NADH + H^+ /reduced NAD can be used to form ATP (because oxygen is present) / enters the Krebs cycle / aerobic respiration can use ;

In anaerobic conditions (as well as aerobic) only the link reaction happens

1. Dehydrogenase enzymes have a hydrogen acceptor as a coenzyme. Outline an example of a dehydrogenation reaction during aerobic respiration. (2 marks)

Hydrogen removed from substrate'

Accepted by hydrogen acceptor/reduces hydrogen acceptor/NAD+ becomes NADH + H+

Occurs during glycolysis / the link reaction, / in the Krebs cycle

1. State the main difference between images produced by electron microscopy and those produced by electron tomography? (1 mark)

Electron tomography gives a 3-dimensional picture but electron micrographs are 2D

1. In the space below, draw a diagram of the structure of a mitochondrion. Annotate the diagram to describe three ways in which the structure of a mitochondrion is related to its function. (6 marks)

Structure correctly drawn and labelled 1 mark to maximum of 3 marks

Each correct annotation 3 marks

- Outer membrane
- Inner membrane / cristae

1. Explain why two-way paper chromatography was an important technique in the experiments undertaken by Calvin to identify the components of the Calvin Cycle. (2 marks)

Two way chromatography separates components in two directions

Gives a clearer separation/components a greater distance apart

Enables more accurate analysis/identification

1. Amino acids can be respired to make ATP. The amino acid is deaminated (the NH_2 group is removed) in the liver and the remaining organic acid residue is incorporated into the respiratory pathway. This occurs in a stage of the pathway between pyruvate and a point in the Krebs cycle. The following table gives the yield of ATP from 3 kinds of amino acids and the number of hydrogen and carbon atoms in their structure:

Amino acid	Number of carbon atoms in the organic acid residue	Number of hydrogen atoms in the organic acid residue	ATP yield per molecule
•	1.	1.	1.
•	1.	1.	1.

•	1.	1.	1.

Suggest an explanation for the variation in ATP yield from these molecules. (3 marks)

Number of carbon atoms determines where the residue enters the respiratory chain

Greater number of carbon atoms will give entry higher in the chain

More stages available to produce energy

Greater number of carbon atoms will have a greater number of hydrogen atoms

1. In the table below, give two differences between competitive and non-competitive inhibitors. (2 marks)

Competitive inhibitor	Non-competitive inhibitor
Binds to active site Similar structure to substrate/look-alike molecule Active site blocked by inhibitor Activity of inhibitor depends upon/changes with substrate concentration	Binds to allosteric site Dissimilar to substrate molecule Active site shape changed by distortion of enzyme Activity of enzyme is lower at all inhibitor concentrations

1. Using a specific example, describe one way in which enzyme inhibitors can be used in the treatment of disease. (2 marks)

Malarial parasite, identification of enzyme inhibitors

Antibiotics, some act as enzyme inhibitors in bacteria

Protease inhibitors in HIV therapy

Chemotherapy in cancer treatment

1. List three ways in which the structure of the thylakoid is related to its function. (3marks)

Large surface area for light absorbtion/photosystems

Site for chemiosmosis

Contain electron carriers

Create the proton gradient

1. Sucrase is an enzyme which hydrolysing enzyme which hydrolyses the disaccharide sucrose. In an experiment, 10 cm^3 of 1% sucrase was added to 10 cm^3 of 1% sucrose in a 50 cm^3 beaker. Every minute, the concentration of glucose was measured using a glucose meter. The meter gives direct readings of glucose concentrations in $mmol/dm^3$. The raw data is given in the table below:
2.

Time in seconds (+/- 1s)	0	60	120	180	240	300	360	420	480
Glucose concentration $mmol/dm^3$ (± 0.01)	0.01	0.15	0.29	0.41	0.50	0.55	0.59	0.62	0.62

a) Explain why glucose is formed in the reaction mixture. (2 marks)

Disaccharide is hydrolysed / sucrose is broken down into its monosaccharide components

Products are glucose + fructose / Sucrose is made from Glucose and fructose

b) List two variables that should be controlled in this experiment. (2 marks)

Temperature

pH

the amount of stiring

c) Discuss if data collected indicate that the rate of the reaction is constant in the first 3 minutes? (2 marks)

No - Data shows that the rate slightly decreases / reference to numbers from the table.

Yes – the decrease is very small – this could be experimental error

No – the trend over the whole experiment shows the rate is decreasing, so it probably decreases from the beginning.

d) Calculate the rate of reaction in the first 180 seconds. (2 marks)

0.14 (0.136)mmol/dm^3/minute (units needed)

0.0023 mmol/dm^3/sormmoldm$^{-3}s^{-1}$

2.3 x 10^{-3} mmoldm$^{-3}s^{-1}$

e) Describe the trend in the rate of reaction from 320 seconds to the 480 seconds.

. (2 marks)

The rate of reaction gradually decreases

The Rate of reaction drops to zero

f) Why was it not necessary to collect data after the 480 seconds? (1 mark)

Reaction is complete/there will be no further increase in glucose concentration / there is no sucrose left.

1. Predict, with a reason, the fructose concentration in the reaction mixture at the 6th minute. (2 marks)

0.59 mmol/dm^3 or mmoldm^{-3}

One fructose molecule will be formed for each glucose molecule produced

1. L-Arabinose inhibits sucrase activity in a non-competitive manner. On the axis below sketch the graph of the original reaction **and** a predictive graph of the reaction with 1cm^3 of 1% inhibitor. Explain the reason for the differences between the two graphs. (4 marks)

- Correct graph for initial reaction
- Inhibited reaction consistently lower rate (2 marks max for the graph)
- Non-competitive inhibitors bind to allosteric site
- Level of inhibition is constant (2 marks for the explanation)