Respiration

Model Answers 3

Level	A Level
Subject	Biology
Exam Board	OCR
Module	Communication, homeostasis and energy
Topic	Respiration
Booklet	Model Answers 3

Time allowed: **41 minutes**

Score: **/30**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E
>69%	56%	50%	42%	34%	26%

Question 1

Organisms require energy in order to carry out essential metabolism. Organisms are able to release energy by carrying out both aerobic and anaerobic respiration.

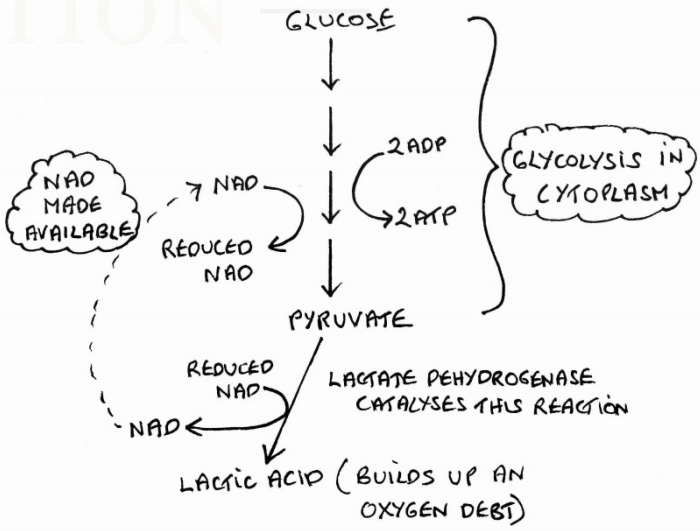
(a) Complete the table to compare **anaerobic** respiration in mammals and yeast. **[3]**

	mammal	yeast
name of hydrogen acceptor after glycolysis	pyruvate	ethanal
is CO_2 produced?	no	yes
name of final product	lactate	ethanol

The end product of glycolysis is pyruvate, in mammals this is reduced to lactic acid, a reaction which is catalysed by the enzyme lactate dehydrogenase. In yeast and plants pyruvate is first of all decarboxylated to ethanal which is then reduced to ethanol using the reduced NAD from glycolysis. The importance of this reaction in plants and animals is that the reduction of ethanal and pyruvate sets free the NAD so it can return to glycolysis and continue to accept the hydrogen atoms. Without the NAD, glycolysis could not continue, and ATP synthesis would stop. Anaerobic respiration is a short-term measure of producing ATP in the absence of oxygen, even though only two molecules of ATP are produced per molecule of glucose

(b) Suggest **one** benefit of anaerobic respiration to an organism. **[1]**

- ATP can still be produced
- NAD is recycled and can be used again
- This allows glycolysis to continue



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Question 2

Fig. 3.1 represents some of the reactions that take place in a leaf cell of a flowering plant.

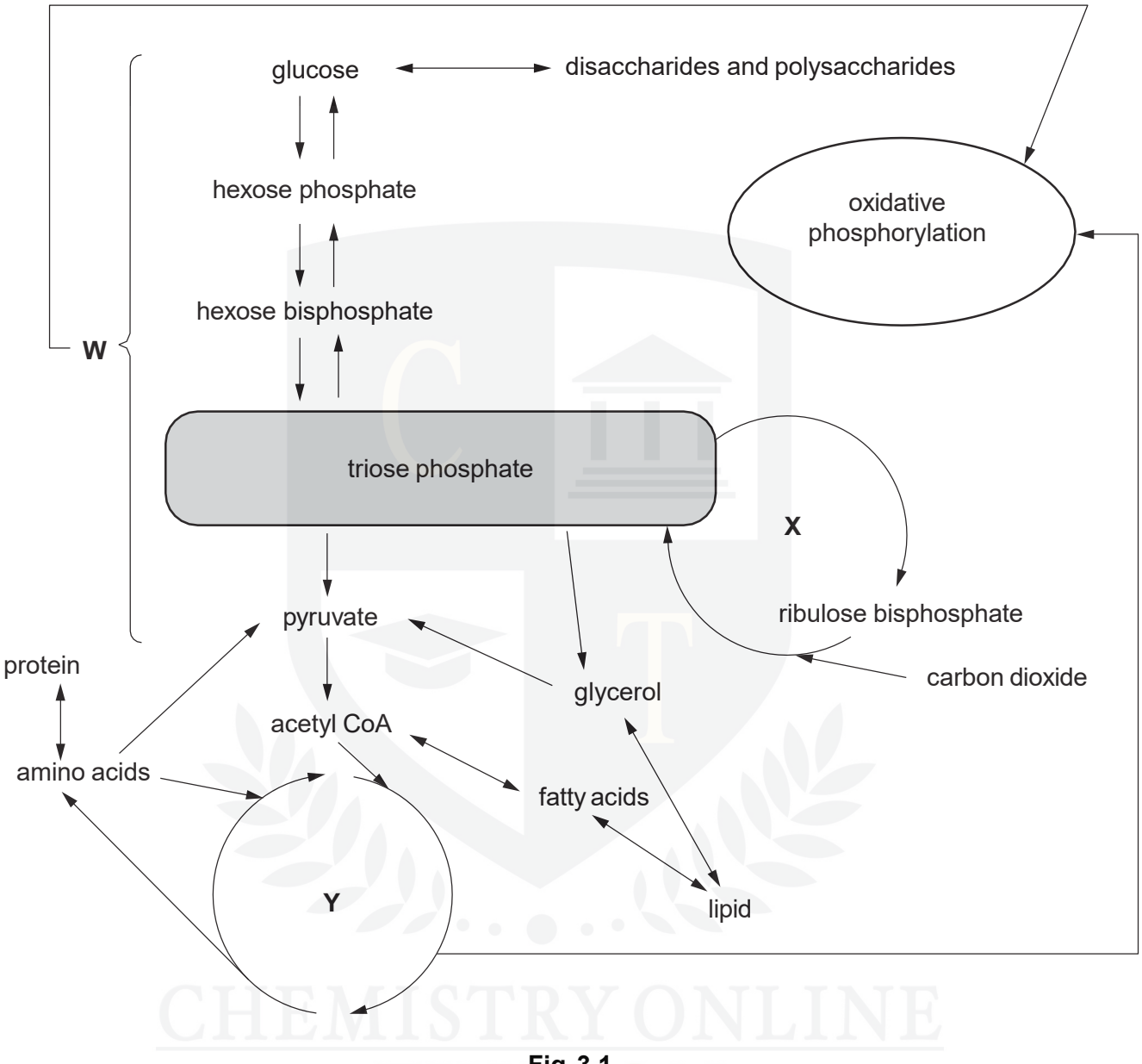

Fig. 3.1

(a) (i) Name the reaction pathways indicated by the letters **W**, **X** and **Y**. **[3]**

W Glycolysis

X Calvin cycle

Y Krebs cycle

(ii) Triose phosphate is a compound that is central to the metabolism of this cell.

Explain how **the three** reaction pathways (**W**, **X** and **Y**) are able to work independently of each other in the same leaf cell.

[3]

- The reactions of Calvin cycle and Krebs all take place in different parts of the cell
- Glycolysis takes place in the cytoplasm
- Calvin cycle takes place in the stroma of the chloroplast
- Krebs cycle takes place in the matrix of the mitochondria

This is also known as compartmentalisation. Pathways and cycles are confined to organelles so their substrates and enzymes are therefore more likely to collide, any pathways have their enzymes and substrates in the correct position.

(iii) Identify which of **these three** reaction pathways (**W**, **X** and **Y**) are associated with: **[2]**

photosynthesis X

aerobic respiration W and Y

(iv) Fig. 3.1 shows that compounds from two of the three pathways are used in oxidative phosphorylation.

State the products of oxidative phosphorylation. **[2]**

The products of oxidative phosphorylation are:

- ATP
- Water
- NAD

(b) Explain the role of coenzymes in this leaf cell, with respect to the metabolic reactions outlined in Fig. 3.1.

[3]

- NAD can accept hydrogen or be reduced
- Reduced NAD supplies electrons to the electron transport chain / oxidative phosphorylation
- Reduced NAD supplies hydrogen ions for chemiosmosis
- Reduced NADP supplies hydrogen for Calvin Cycle (GP to TP)

Firstly, coenzymes are not enzymes. They are not globular proteins and they do not catalyse reactions. Instead they carry hydrogen atoms which they deliver to reactions where reduction is taking place or accept hydrogen atoms where oxidation is occurring. They fit into a position near the active site where the substrate is either being reduced or oxidised

[Total: 13]

Question 3

(a) Fig. 2.1 represents the first stage of respiration.

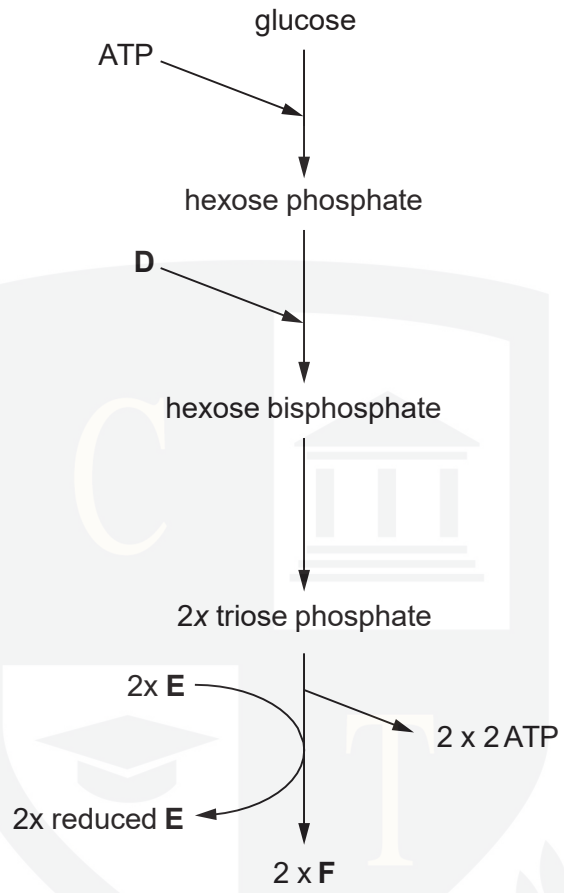

Fig. 2.1

(i) Name the stage represented by Fig. 2.1. **[1]**

Glycolysis

(ii) State precisely where this stage takes place in the cell. **[1]**

Cytoplasm

(iii) Identify the compounds **D**, **E** and **F**. **[3]**

D ATP

E NAD

F Pyruvate

(b) Compound **F** does not proceed to the link reaction in **anaerobic** conditions.

Describe the fate of compound **F** during anaerobic respiration in an animal cell **and** explain the importance of this reaction.

[5]

- Compound F, which is pyruvate is converted to lactate during anaerobic respiration
- Pyruvate accepts hydrogen atoms
- The hydrogen comes from reduced NAD
- This reaction is catalysed by the enzyme lactate dehydrogenase
- This takes place because there is no oxygen to act as the final electron acceptor
- The link reaction and Krebs cycle cannot take place
- NAD can be recycled to be reused and allow glycolysis to continue
- Glycolysis only produces a small amount of energy as two molecules of ATP

If oxygen is not available then ATP must still be made, even if oxidative phosphorylation cannot take place. The cell must therefore rely solely upon glycolysis which makes a net gain of 2ATP by substrate level phosphorylation. One of the last steps of glycolysis involves dehydrogenation (G3P to 1,6 biphosphoglycerate) and the reduction of NAD to reduced NAD, clearly if there is no recycling of NAD then this step cannot continue so glycolysis, and with it, ATP production will stop. To regenerate NAD, the cell 'offloads' the 2 hydrogen atoms onto pyruvate in animals and ethanol in plants. Lactic acid is the end product in animals, ethanol and carbon dioxide in plants.

(c) Fig. 2.2 is a drawing of a common seal, *Phoca vitulina*, an aquatic mammal.

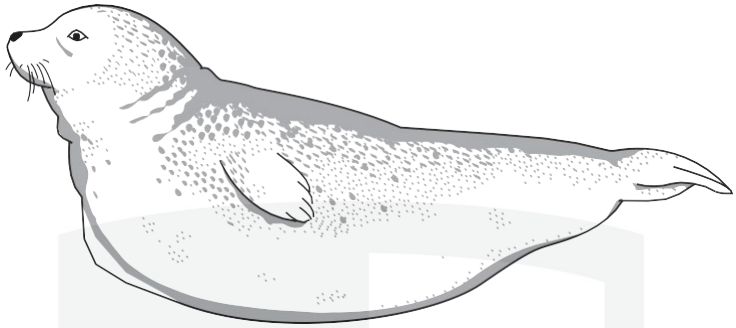

Fig. 2.2

The seal comes to the surface of the water to obtain air and it can then stay underwater for over 20 minutes.

Fig. 2.3 shows a seal at the surface of the water and Fig. 2.4 shows the same animal then submerging again.

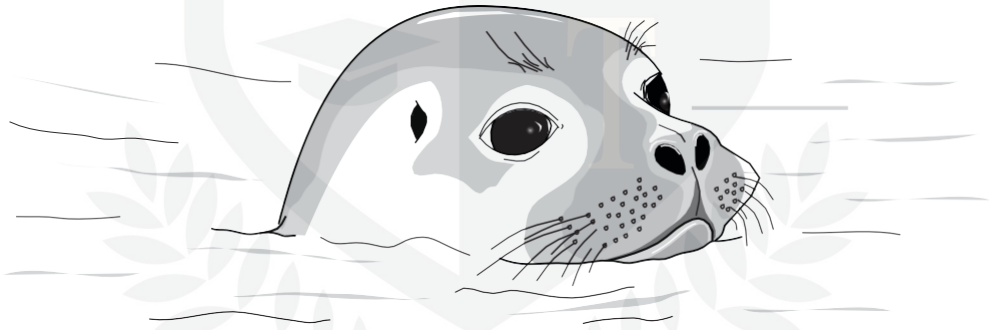

Fig. 2.3

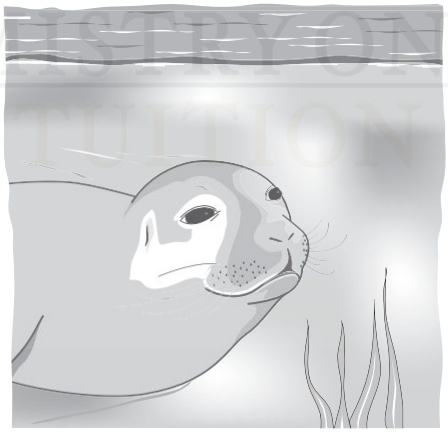

Fig. 2.4

Suggest how the seal is adapted to respire for such a long time underwater. **[3]**

- The seal has large nostrils to take in air
- When underwater the nostrils come close to stop air from escaping
- The seal has large lungs
- The seal has a lower metabolic rate
- Cereals conspired anaerobically for long time
- They can tolerate high levels of lactic acid
- Seals can tolerate low pH
- Seals have lots of haemoglobin and red blood cells to carry oxygen

Some of the information for your answer can be inferred from the diagrams. It is also a "suggest" so any reasonable answer should gain credit. If you focus your answer on anaerobic respiration and its wider implications then you are including some good, relevant biology in your answer. Don't forget to also include any biochemistry wherever possible, even though this does not seem obvious from the question

[Total: 13]