12.2 Respiration

Question Paper

Course	CIE A Level Biology
Section	12. Energy & Respiration
Topic	12.2 Respiration
Difficulty	Medium

Time allowed: 80

Score: /59

Percentage: /100

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Question 1a

Fig.1 below shows the respirometer apparatus used by a teacher for measuring the rate of oxygen consumption of seeds during aerobic respiration.

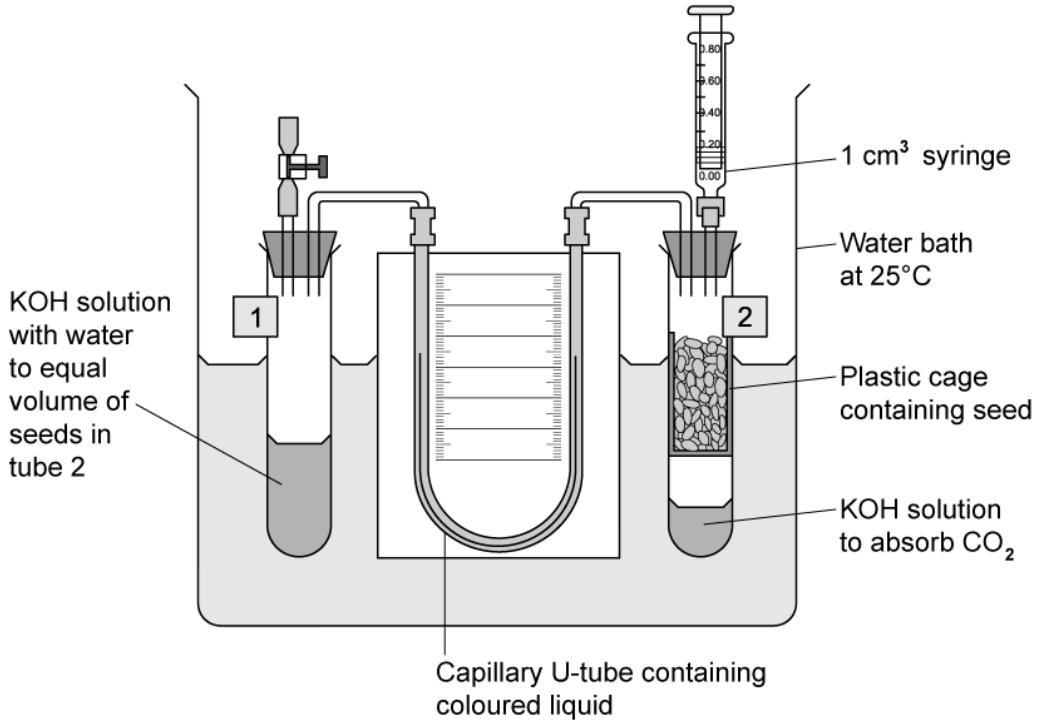

Fig. 1

For the first 12 minutes, the tap attached to tube 1 was left open and the syringe from tube 2 was removed.

Suggest **two** reasons why this was done.

[2 marks]

Question 1b

A temperature of 25°C was used during the experiment. One of the students suggested using a temperature of 35°C.

Explain why the teacher did not do this.

[2 marks]

Question 1c

After 12 minutes, the tap connected to tube 1 was closed and the syringe was attached to tube 2. Every 60 seconds, the syringe plunger was moved to make the levels in the U-tube identical. The reading on the volume scale of the syringe was then recorded. The results are shown in Table 1 below.

Table 1

Time (minutes)	Reading on volume scale of syringe (cm^3)
0	0.85
1	0.82
2	0.79
3	0.76
4	0.74
5	0.72
6	0.69
7	0.67
8	0.64
9	0.61
10	0.58
11	0.56
12	0.53

Predict which tube the coloured liquid in the U-tube moves towards during the experiment. Justify your answer.

[4 marks]

Question 1d

The mass of the seeds was 1.8 g.

Using the information provided in Table 1, calculate the rate of oxygen consumption in $cm^3\ g^{-1}\ hour^{-1}$ by the seeds. Show your working and give your answer to two decimal places.

[2 marks]

Question 1e

Describe the mechanism by which ATP is formed in the mitochondria.

[6 marks]

Question 2a

Mitochondrial diseases in humans cause their mitochondria to malfunction. Individuals that suffer from mitochondrial disease are only able to endure intense exercise for a short period of time.

Explain the reason for this.

[2 marks]

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Question 2b

Fig. 1 below shows a mitochondrion.

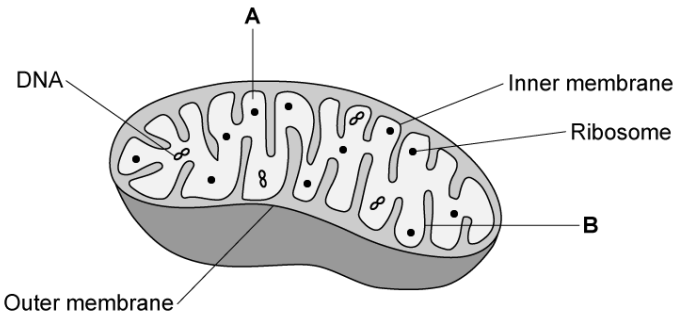

Fig. 1

Identify the structures labelled **A** and **B** in the diagram.

[1 mark]

Question 2c

Some forms of mitochondrial dysfunction result in mitochondria that lack fully formed cristae as shown in Fig. 2 below.

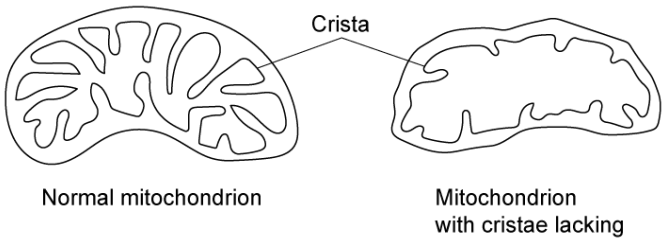

Fig. 2

Suggest, with a reason, the effect of this on the production of ATP.

[3 marks]

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Question 2d

Fig. 3 below shows glycolysis.

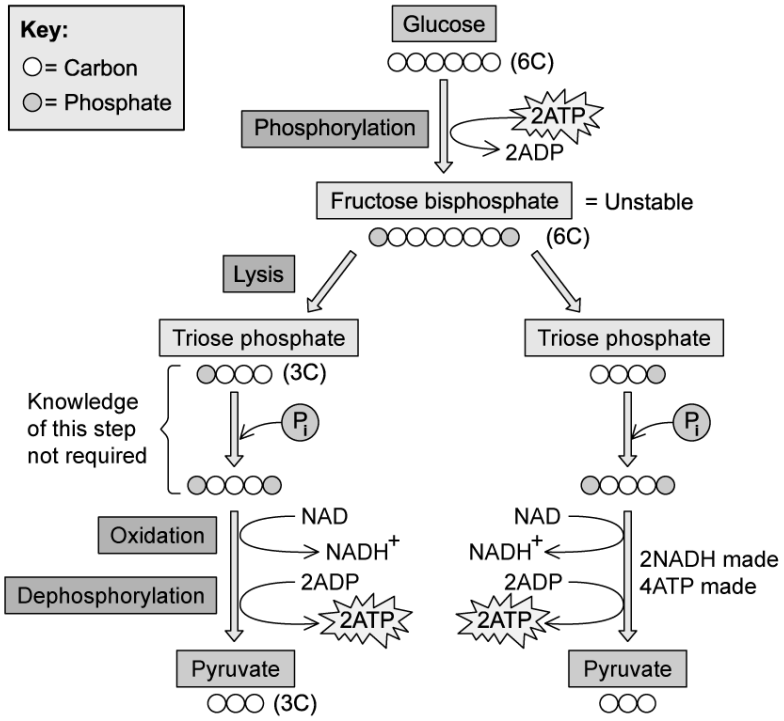

Fig. 3

State the net production of ATP and reduced NAD during glycolysis.

[1 mark]

Question 3a

The Krebs cycle, which takes place in the mitochondrial matrix, releases hydrogen ions.
These hydrogen ions provide a source of energy for the synthesis of ATP, using coenzymes.

Describe the role of the coenzymes in the synthesis of ATP.

[3 marks]

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Question 3b

Explain why the link reaction is described as an oxidative decarboxylation reaction.

[2 marks]

Question 3c

Fig.1 below shows the Krebs cycle.

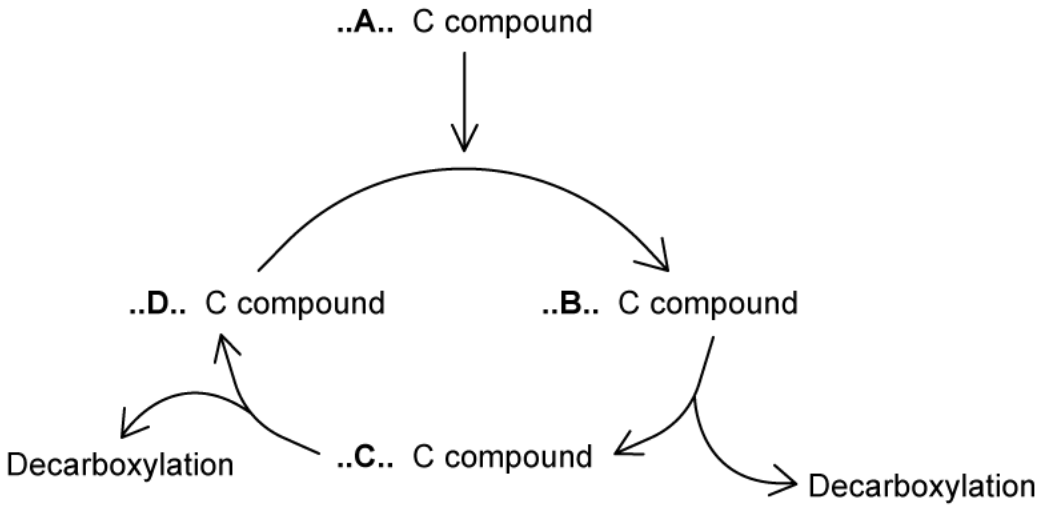

Fig. 1

Identify the number of carbon atoms (e.g. 1C) in the compounds at each stage of the Krebs cycle (**A** to **D**).

[2 marks]

Question 3d

Reduced NAD and FAD are produced throughout the stages of respiration.

Table 1

Stage of respiration	Number of reduced NAD molecules	Number of reduced FAD molecules
Glycolysis		
Link reaction		
Krebs cycle		
Oxidative Phosphorylation		

Complete Table 1 above to show how many molecules of reduced NAD and FAD are produced at each stage per molecule of glucose.

[2 marks]

Question 4a

During a sporting event, an athlete carries out aerobic respiration.

Structures and compounds involved in aerobic respiration are listed, **1** to **10**.

1 coenzyme A

2 cytoplasm

3 pyruvate

4 NAD

5 outer mitochondrial membrane

6 carrier protein

7 inner mitochondrial membrane

8 intermembrane space of mitochondrion

9 ADP

10 acetyl group

Complete Table 1 by matching each description with one number chosen from **1** to **10**, to show the correct structure or compound.

You may use each number once, more than once or not at all.

Table 1

description	number
location of ATP synthase	
transports hydrogen atoms	
nucleotide with a purine base	
location of substrate-linked phosphorylation	
enters the Krebs cycle	
produced by oxidation of triose phosphate	

[6 marks]

Question 4b

Sometimes the muscle cells of an athlete need to carry out respiration in anaerobic conditions.

Explain why the respiration of glucose in anaerobic conditions produces less ATP than in aerobic conditions.

[5 marks]

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Question 5a

Fig. 1 outlines some of the steps of glycolysis.

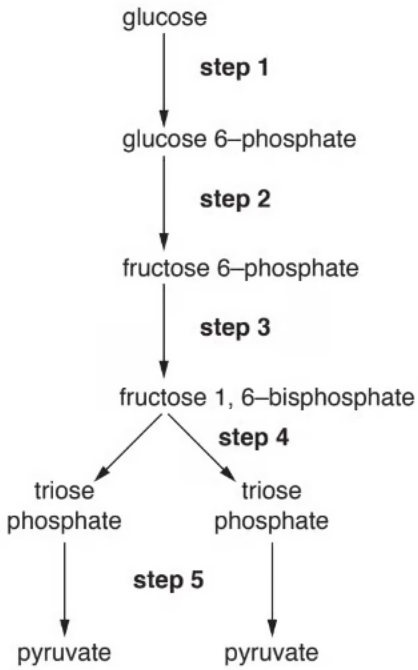

Fig. 1

(i)
State the precise location of glycolysis in the cell.

[1]

(ii)

With reference to Fig.1:

- State the steps where phosphorylation occurs
- State the step where oxidation occurs
- Name the type of reaction by which ATP is made during **step 5**.

[3]

[4 marks]

Question 5b

Some cancer cells have different metabolic requirements from normal cells. These cancer cells obtain most of their ATP from glycolysis, even if oxygen is available.

State how the glucose and oxygen requirements of these cancer cells differ from normal cells.

[2 marks]

Question 6a

The link reaction and Krebs cycle take place in the mitochondrion.

The main stages of the link reaction and Krebs cycle are listed in Table 1.

They are **not** listed in the correct order.

Table 1

stage	description of stage
A	acetyl group combines with coenzyme A to form acetyl CoA
B	citrate is formed
C	hydrogen atoms are accepted by NAD and FAD
D	oxaloacetate is regenerated
E	pyruvate enters the mitochondrial matrix
F	acetyl group is formed
G	acetyl CoA enters Krebs cycle
H	ATP is made by substrate-linked phosphorylation
I	pyruvate is decarboxylated and dehydrogenated
J	acetyl CoA combines with oxaloacetate
K	citrate is decarboxylated and dehydrogenated

Complete Table 2 to show the correct order of the stages.

Three of the stages have been done for you.

Table 2

correct order	letter of stage
1	**E**
2	
3	
4	
5	
6	**J**
7	
8	
9	
10	
11	**D**

[4 marks]

Question 6b

Outline the role of NAD in respiration in aerobic conditions.

[4 marks]

Question 6c

Carbon dioxide is removed from compounds in the link reaction and Krebs cycle by decarboxylation.

(i)

State the total number of molecules of carbon dioxide removed in the link reaction and Krebs cycle for each molecule of glucose respired.

[1]

(ii)

In a mammal, carbon dioxide diffuses from cells into the blood to be transported to the lungs.

Suggest why carbon dioxide is transported in the blood mainly as hydrogen carbonate ions and not as carbonic acid.

[1]

[2 marks]

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