

1. An experiment was set up to investigate the effect of different respiratory substrates on the rate of respiration in yeast. Methylene blue can be used to measure the rate of respiration as it changes from dark blue to colourless when it accepts hydrogen ions. Four test tubes were set up, each containing yeast, methylene blue and one of the respiratory substrates.

The table below shows the results of this investigation.

<i>Test tube number</i>	<i>Respiratory substrate</i>	<i>Appearance of the methylene blue after 20 minutes</i>
1	starch	dark blue
2	sucrose	light blue
3	lactose	dark blue
4	glucose	colourless

Which of the following conclusions is correct?

The rate of respiration is

- A** higher with starch than with glucose
- B** lower with sucrose than with lactose
- C** higher with glucose than with lactose
- D** lower with glucose than with sucrose.

2. Stages of aerobic respiration are shown below.

- 1 Glycolysis
- 2 Citric acid cycle
- 3 Electron transfer chain

Which stage(s) involve(s) both phosphorylation of intermediates and generation of ATP?

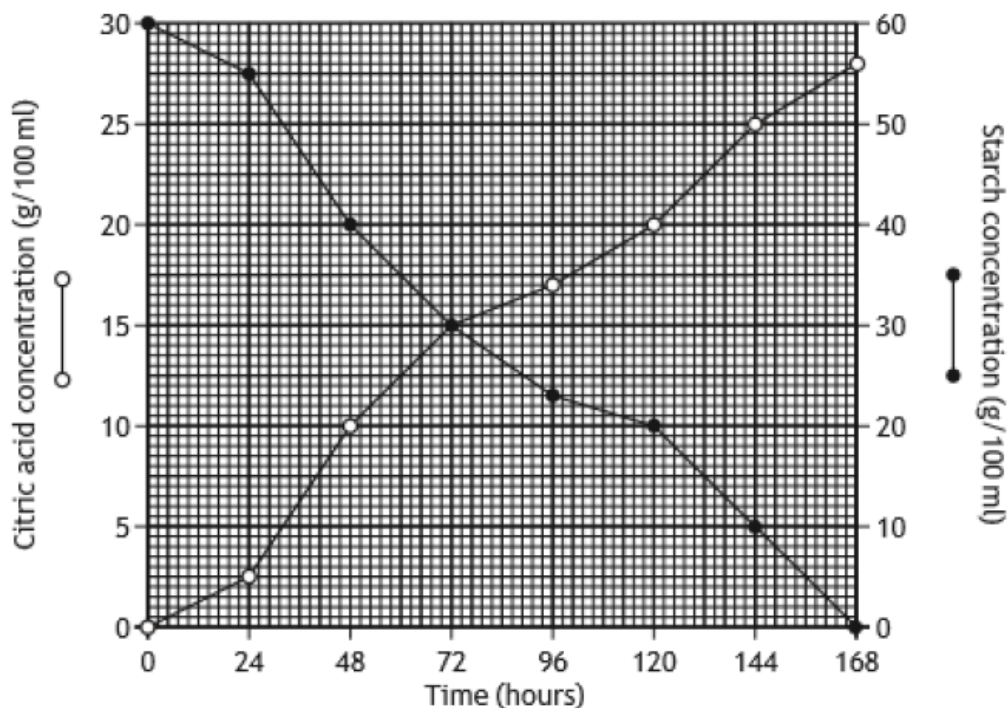
- A** 1 only
- B** 3 only
- C** 1 and 2 only
- D** 1 and 3 only

3. Which row in the table below identifies a stage of aerobic respiration, its site and an event which occurs during that stage?

	Stage	Site	Event
A	electron transfer chain	inner mitochondrial membrane	carbon dioxide is released
B	electron transfer chain	matrix of mitochondrion	hydrogen ions combine with oxygen
C	citric acid cycle	inner mitochondrial membrane	hydrogen ions combine with oxygen
D	citric acid cycle	matrix of mitochondrion	carbon dioxide is released

4. The fungus *Aspergillus niger* is grown in large fermenters to produce citric acid using starch as a substrate.

The graph shows the changes in the citric acid and starch concentrations in a fermenter over 168 hours.



The citric acid concentration equals the starch concentration at

- A** 0 hours
- B** 48 hours
- C** 72 hours
- D** 120 hours

5. The following substances are products of fermentation.

- 1 ATP
- 2 Lactate
- 3 Carbon dioxide

Which of these are products of fermentation in human muscle cells?

- A 2 only
- B 1 and 2 only
- C 2 and 3 only
- D 1, 2 and 3

6. The yeast *Kluyveromyces marxianus* uses lactose as a respiratory substrate. An investigation was carried out into the effect of lactose concentration on ethanol production by this yeast species. Five flasks were set up each containing 5 cm³ of yeast suspension and 100 cm³ of 4, 8, 12, 16 or 20% lactose solution. The flasks were sealed to maintain anaerobic conditions.

Samples were removed from each flask at 12 and 36 hours and the concentration of ethanol was determined. Results are shown in the table below.

<i>Lactose concentration (%)</i>	<i>Ethanol concentration (g per 100 cm³)</i>	
	<i>12 hours</i>	<i>36 hours</i>
4	1.20	1.65
8	1.55	2.80
12	2.00	4.25
16	2.80	3.25
20	2.80	6.50

6 continued

(a) (i) Identify the independent variable. 1

(ii) Identify one variable not already mentioned that should be kept constant so that a valid conclusion can be drawn. 1

(b) Describe the relationship between the lactose concentration and ethanol concentration at 12 hours growth. 1

(c) Calculate the percentage increase in ethanol concentration between 12 and 36 hours growth in the 4% lactose flask.

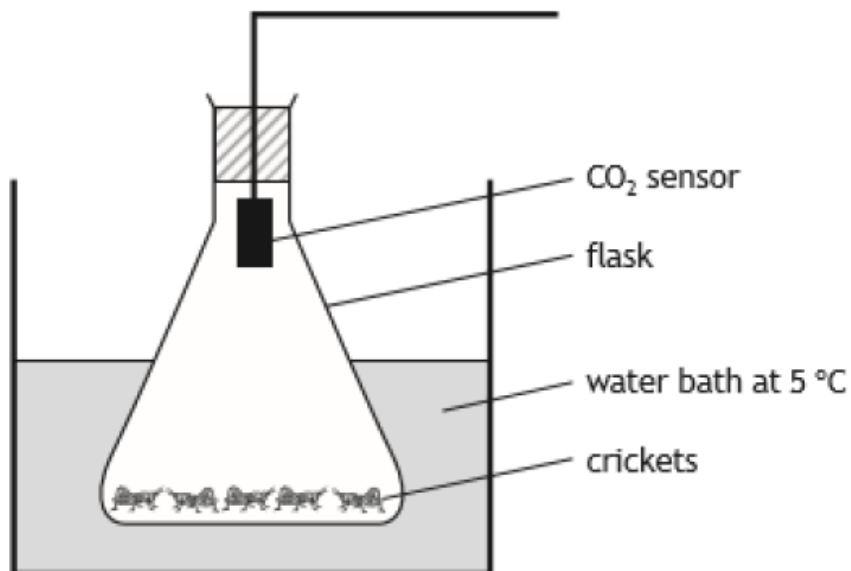
Space for calculation

_____ 1
%

(d) Air leaked into the 16% lactose flask between 12 and 36 hours growth. Explain why this resulted than a lower than expected ethanol concentration. 1

7. An investigation was carried out to compare the rate of metabolism in a species of cricket, *Gryllus assimilis*, at different temperatures.

Five crickets were placed in a sealed flask which was fitted with a carbon dioxide (CO₂) sensor as shown in the diagram below.



The flask was placed in a water bath at 5 °C and left for 10 minutes.

The CO₂ produced per minute was then measured. This procedure was repeated at 10, 15, 20 and 30 °C.

The results are shown in the table below.

<i>Temperature (°C)</i>	<i>Rate of CO₂ production (units per minute)</i>
5	300
10	500
15	800
20	1200
30	1600

(a) (i) Give a reason why the flask was left for 10 minutes at each temperature before each reading was taken.

7 continued

(ii) A control flask should be included in this investigation.

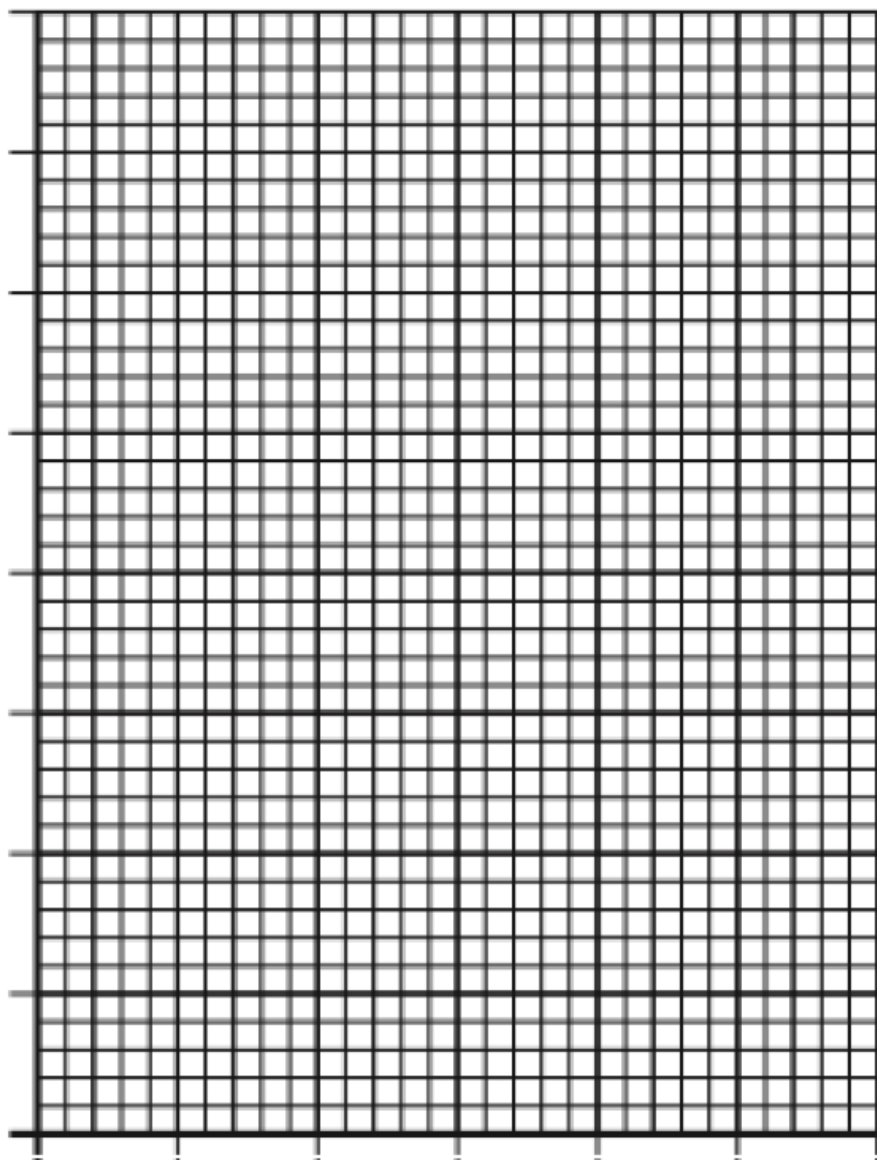
Describe the control and explain its purpose in the investigation.

Description

Explanation

2

(b) Plot a line graph to show the results of the investigation.



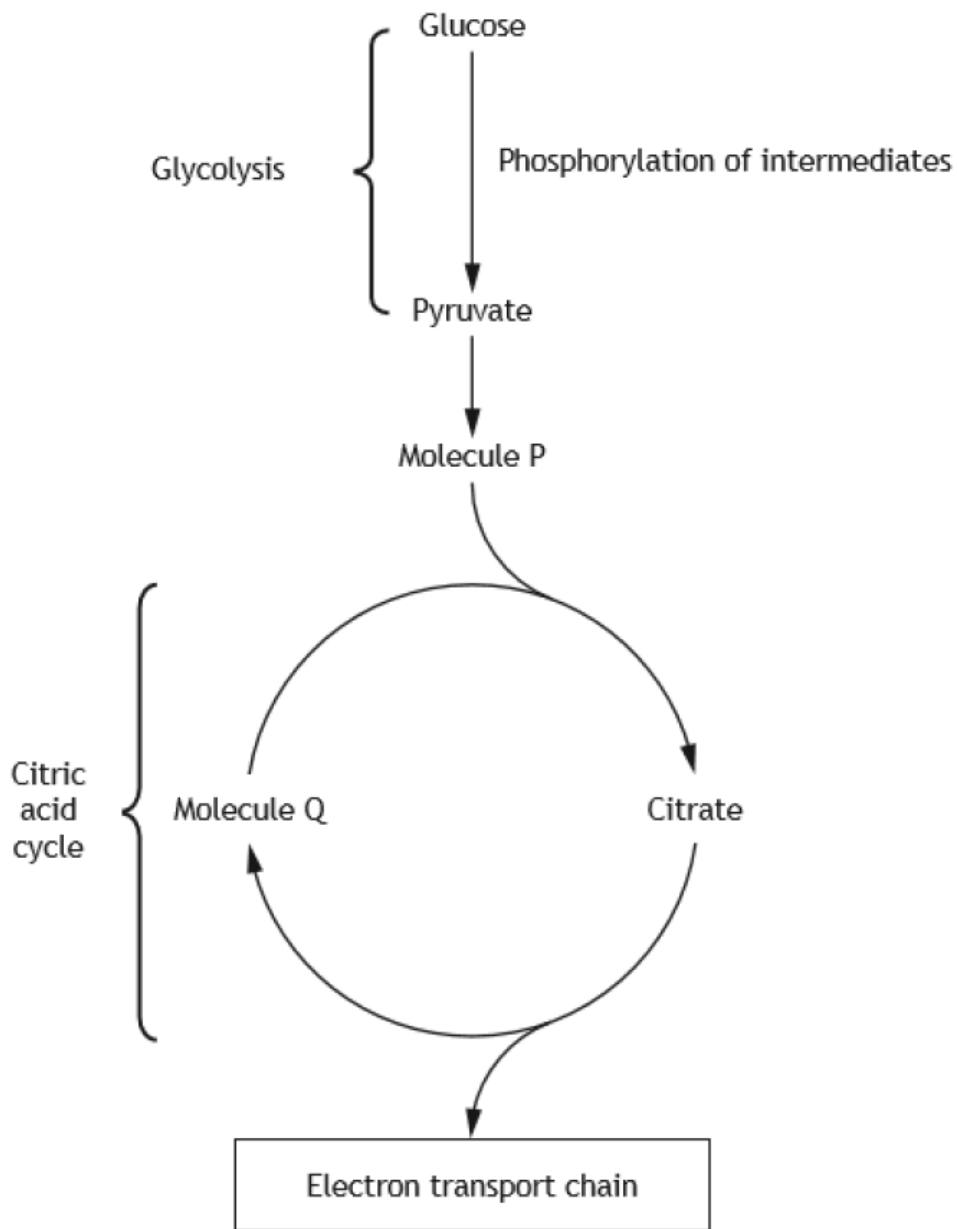
2

7 continued

(c) Draw a conclusion from these results.

1

8. The diagram below shows some stages in the aerobic respiration of glucose.



(a) Name molecules P and Q.

Molecule P _____

Molecule Q _____

2

8 continued

(b) Explain why the phosphorylation of intermediates in glycolysis is referred to as an energy investment stage.

2

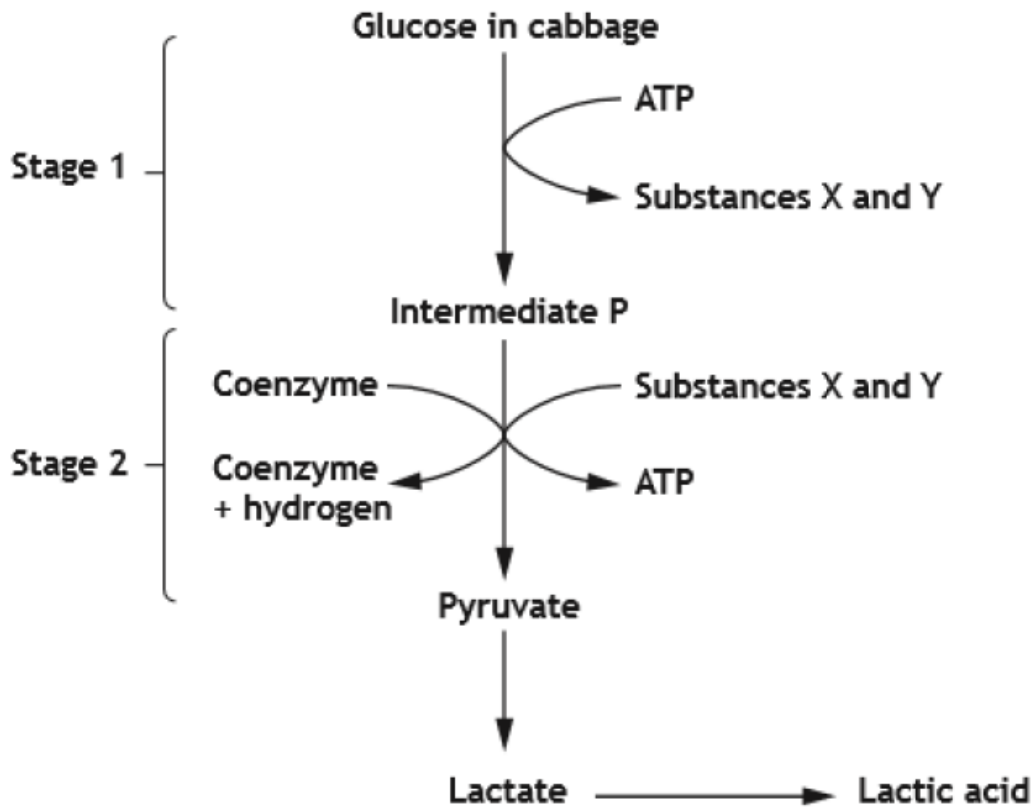
(c) Describe the role of the coenzymes NAD and FAD.

2

(d) People who suffer from chronic fatigue syndrome have mitochondria in which some of the proteins embedded in the inner mitochondrial membrane are damaged. Explain how this might result in the tiredness that is a feature of this condition.

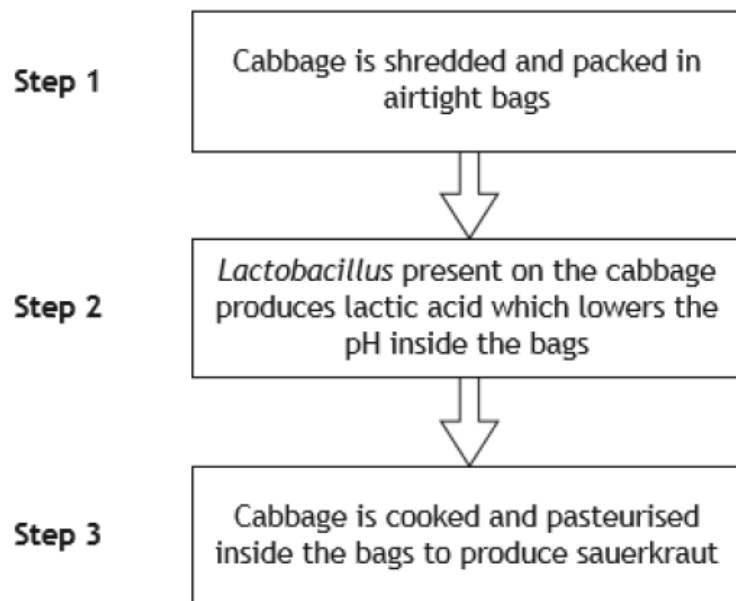
2

9.



- (a)** (i) Identify substances X and Y in the diagram.
- X _____
- Y _____ **1**
- (ii) Name the coenzyme, shown in the diagram, which carries hydrogen to the electron transport chain.
- _____ **1**
- (iii) Explain why the ATP produced at Stage 2 in the diagram is referred to as an energy pay off.
- _____
- _____ **1**

(b) The flow chart below shows how cabbage can be processed to produce sauerkraut.



(i) Explain why shredding the cabbage in Step 1 increases the rate of production of sauerkraut.

1

(ii) Explain why the process encourages the growth of *Lactobacillus* but inhibits the growth of other bacteria.

1