Aerobic Respiration & Fermentation

1. The following statements relate to cellular processes:

   1. Completed in the mitochondria.
   2. Affected by temperature.
   3. Release oxygen.

   Which of the statements are correct for aerobic respiration?

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

2. Which of the following reactions takes place during fermentation in plant cells?

   A pyruvate ⟶ carbon dioxide + ethanol
   B glucose ⟶ carbon dioxide + water
   C glucose ⟶ water + ethanol
   D pyruvate ⟶ lactate

3. Fermentation in yeast cells occurs in the

   A cytoplasm
   B mitochondria
   C plasmids
   D ribosomes.

4. The energy released from glucose is used to synthesise

   A Pi
   B ADP
   C ATP
   D pyruvic acid.

5. What is the number of ATP molecules produced per glucose molecule by fermentation?

   A 2
   B 36
   C 38
   D 40

6. Which of the following processes releases energy used to form ATP?

   A Muscle cell contraction
   B Breakdown of glucose
   C Protein synthesis
   D Nerve impulse transmission

7. Four reactions in the respiration pathway are shown below.

   1 Glucose → pyruvic acid
   2 Pyruvic acid → carbon dioxide + water
   3 Pyruvic acid → lactic acid
   4 Pyruvic acid → carbon dioxide + ethanol

   Which of the reactions can occur in yeast?

   A 2 and 3 only
   B 2 and 4 only
   C 1, 2 and 3 only
   D 1, 2 and 4 only

Aerobic Respiration & Fermentation

8. Which substance enters animal cells by diffusion and is used to produce ATP?

A Carbon dioxide

B Starch

C Water

D Glucose

9. Which of the following stages in respiration would occur in the mitochondria

A Glucose to pyruvate

B Pyruvate to lactate

C Pyruvate to carbon dioxide and water

D Glucose to carbon dioxide and water

10. An oxygen debt is created when cells can no longer take in sufficient oxygen to undergo aerobic respiration and instead switch to fermentation pathways.

Which of the following increases in the muscles of an athlete when an oxygen debt has been created when exercising.

A Lactate

B Carbon dioxide and ethanol

C Oxygen

D Carbon dioxide and water

11. The following are statements about respiration.

1 ATP is produced

2 Lactate is produced

3 Carbon dioxide is produced

4 Ethanol is produced

Which of the statements are true of fermentation in human muscle tissue?

A 2 only

B 2 and 3 only

C 1 and 2 only

D 1, 3 and 4 only

12. Yeast switches to fermentation when there is a

A high concentration of ethanol

B low concentration of oxygen

C high concentration of carbon dioxide

D low concentration of glucose

13. The fermentation of one molecule of glucose in plants results in the net gain of

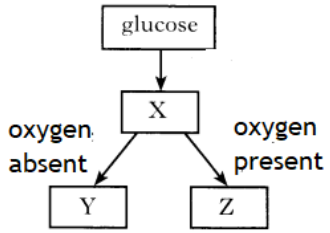
A 2 molecules of ATP

B 2 molecules of ADP

C 38 molecules of ATP

D 38 molecules of ADP

14. The diagram below shows the respiratory pathway in an animal cell.



Which line in the table below identifies correctly X, Y and Z?

	X	*Y*	*Z*
A	lactic acid	pyruvic acid	carbon dioxide and water
B	carbon dioxide and water	pyruvic acid	lactic acid
C	pyruvic acid	carbon dioxide and water	lactic acid
D	pyruvic acid	lactic acid	carbon dioxide and water

15. Which of the following statements is **not** true of aerobic respiration?

A Produces carbon dioxide and water

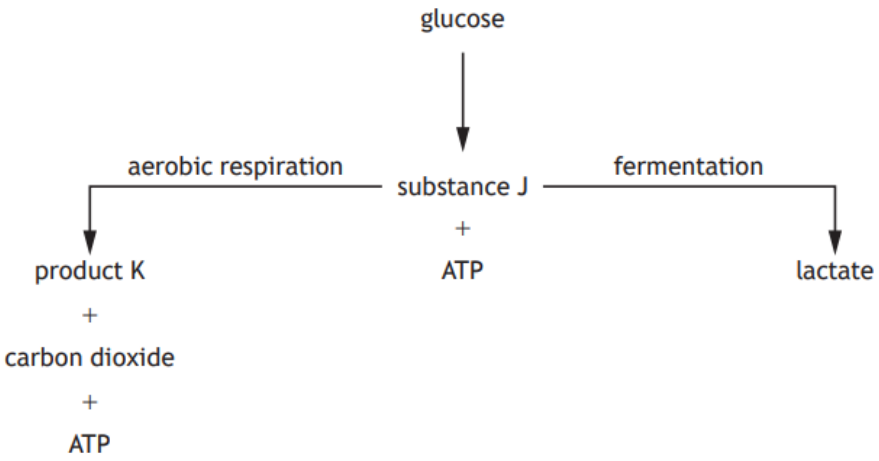
B Begins in the cytoplasm

C Controlled by enzymes

D Requires light energy

Aerobic Respiration & Fermentation

1 The diagram represents processes that generate ATP in muscle cells.



(a) (i) Name substance J and product K. **2**

Substance J _____

Product K _____

(ii) State the number of ATP molecules that would be produced from each molecule of glucose during fermentation. **1**

_____

(b) Name the cell structure where aerobic respiration is completed. **1**

_____

(c) Suggest why a muscle cell might carry out fermentation rather than aerobic respiration. **1**

_____

_____

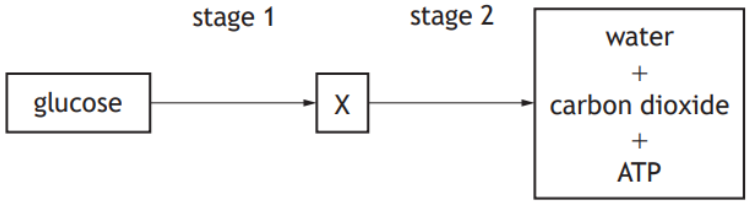
2 Muscle cells can carry out different types of respiration.

MARK

(a) Name the type of respiration that yields the most ATP per glucose molecule. **1**

_____

(b) The diagram shows a summary of one type of respiration in muscle cells.



(i) Name substance X. **1**

_____

(ii) Name the substance that must be present for stage 2 to occur. **1**

_____

(c) The number of mitochondria found in four different cells is shown in the table.

Cell	Number of mitochondria per cell
Red blood	0
Skin	800
Liver	1300
Muscle	7000

State why a muscle cell requires more mitochondria than a skin cell. **1**

_____

_____

Aerobic Respiration & Fermentation

3 (a) The table shows information about two types of respiration in animal cells.

Tick the boxes in the table to indicate whether the statements apply to aerobic respiration, fermentation or both. **2**

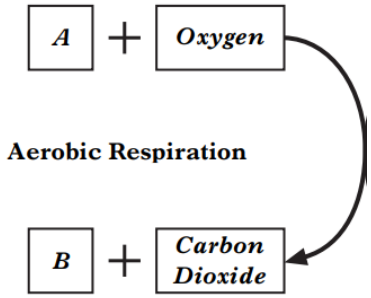
	Type of respiration	
Statement	*Aerobic*	*Fermentation*
Oxygen is required		
Pyruvate is formed		
Lactate is formed		
Carbon dioxide is formed		

(b) ATP is an energy-rich molecule formed by respiration.

Name a cellular process which requires energy from ATP. **1**

_____

4



(i) Name substances A, B

A _____

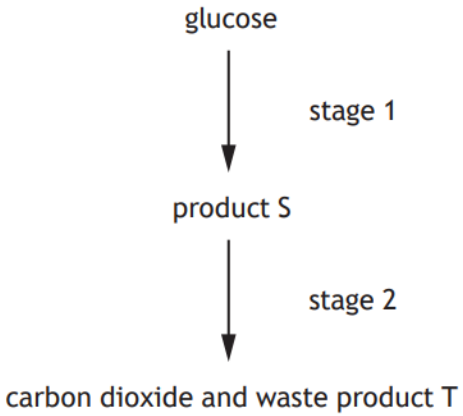
B _____

(ii) Some energy released in respiration can be used for protein synthesis.

State one other cellular activity that uses energy.

_____ **1**

5. The diagram represents the process of aerobic respiration in yeast cells.



(a) (i) Name product S and waste product T. **2**

S _____

T _____

(ii) Name the substance that must be present for yeast to respire aerobically. **1**

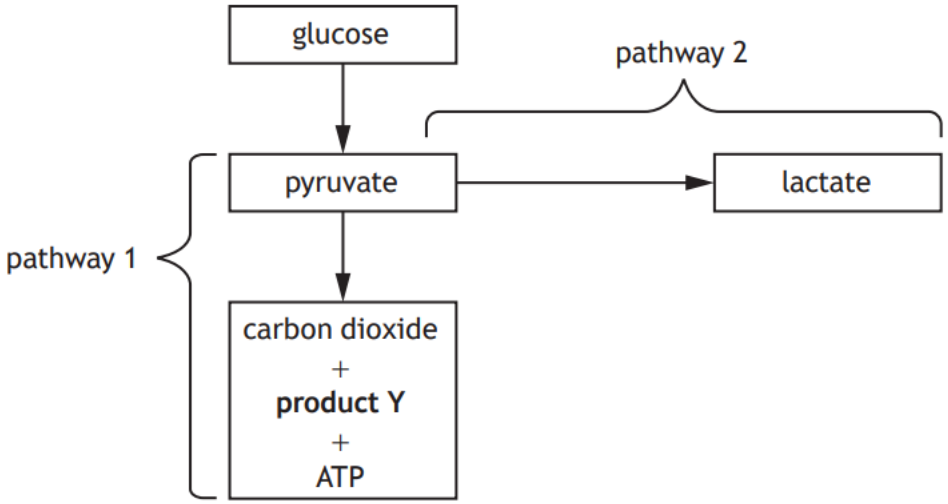
_____

(iii) Identify which of the two stages releases the larger quantity of ATP. **1**

Stage _____

Aerobic Respiration & Fermentation

6 (a) The diagram represents two possible pathways when glucose is broken down in muscle cells.



(i) Name product Y.

_____

(ii) Pathway 2 only occurs in the absence of a particular substance.

Name this substance.

_____

(iii) State the yield of ATP molecules when a glucose molecule is broken down to pyruvate.

_____

7 The table gives information on the numbers of mitochondria in different types of mammalian cells.

Cell type	Number of mitochondria per cell			
	Cell 1	Cell 2	Cell 3	Average
Muscle	1352	1203	1450	1335
Skin epithelium	250	330	275	
Lymphocyte	953	1112	860	975

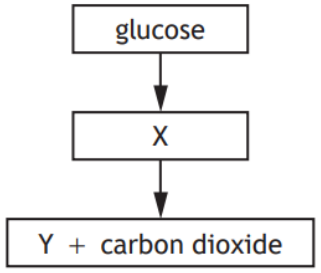
Compared to skin epithelium cells, muscle and lymphocyte cells have higher numbers of mitochondria.

Suggest why these cells need more mitochondria. **1**

_____

_____

8. The diagram below represents the fermentation pathway in a plant cell.



Choose either molecule X or Y and state its name. **1**

Molecule _____

Name _____

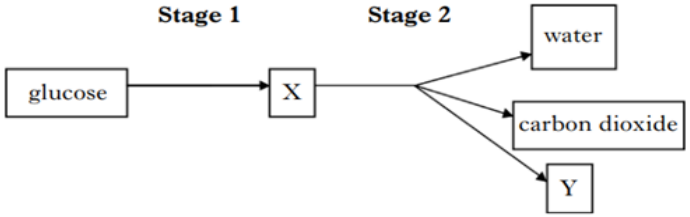
Aerobic Respiration & Fermentation

9 Yeast may carry out two different types of respiration.

(*a*) Name the type of respiration in yeast which has the highest energy yield.

_____

(*b*) The diagram below shows one type of respiration in yeast cells.



(i) Name substances X and Y.

X _____

Y _____

(ii) What other substance must be present for stage 2 to occur?

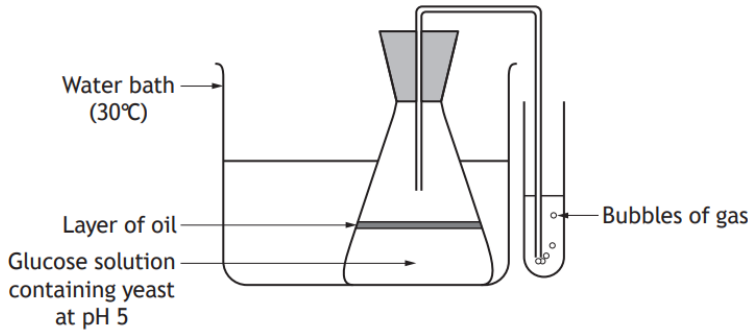
_____

10 Name the cell process which uses oxygen as a raw material.

_____

1

11 An investigation was carried out to find the effect of pH on fermentation by yeast, using the apparatus shown.



Name the gas produced during fermentation in yeast. 1

_____

12 The following list contains some features of aerobic and fermentation in germinating peas.

List

W Does not use oxygen

X Produces carbon dioxide

Y Yields lots of molecules of ATP per glucose molecule

Z Produces ethanol

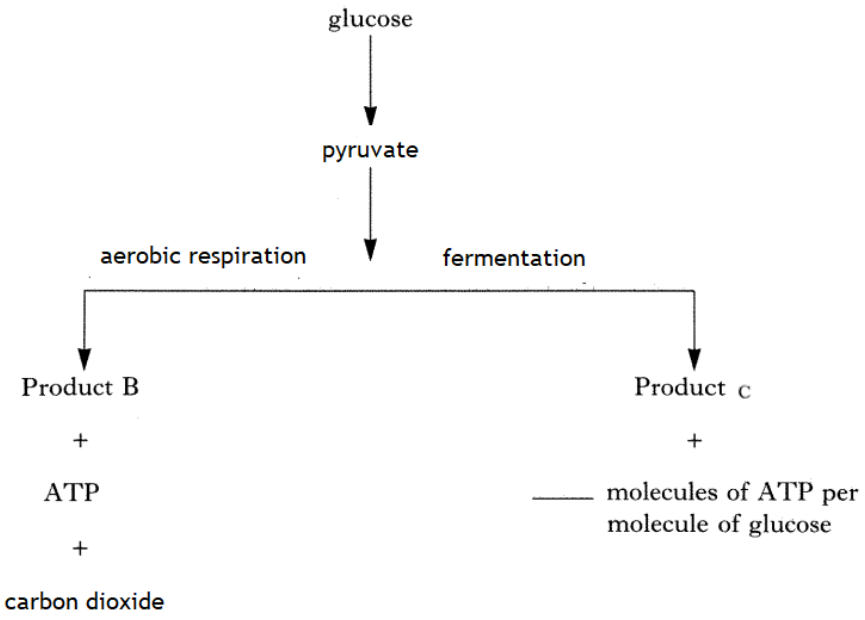
Complete the table below by writing the letters from the list in the correct columns. Each letter may be used once or more than once.

Fermentation	Aerobic Respiration

1

Aerobic Respiration & Fermentation

13 The diagram below shows some steps in respiration in muscle cells.



a) Name the products B, C and D.

B _____

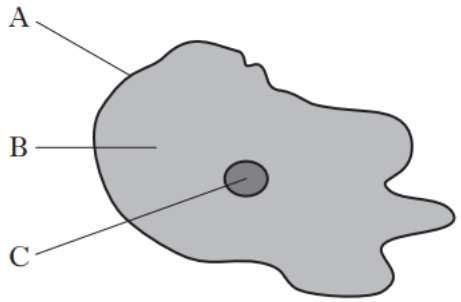
C _____

b) Explain why a cell may switch from aerobic respiration to fermentation.

_____

_____

14 The diagram below represents a single-celled organism called Amoeba. This organism carries out respiration to provide energy for cellular activities



a) (i) State the letter of the part of the cell where fermentation occurs.

_____

(ii) Name the molecule that is a store of chemical energy that is broken down during fermentation.

_____

b) State one cellular activity that uses the energy released by respiration.

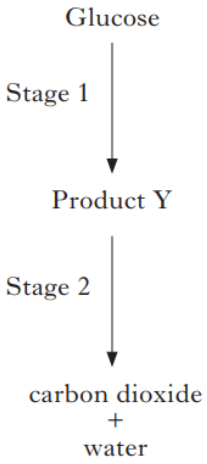
_____

C) Name the cell structure missing from the amoeba to enable it to carry out aerobic respiration.

_____

Aerobic Respiration & Fermentation

15. The process of aerobic respiration in a muscle cell is outlined below.



(*a*) (i) Name product Y from Stage 1.

_____

(ii) What other substance must be present for Stage 2 to occur?

_____

(*b*) ATP is formed during respiration and broken down for uses in cells.

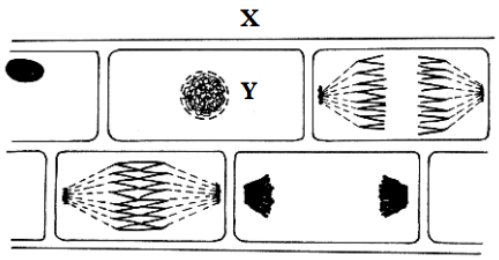
(i) How many molecules of ATP are formed from each glucose molecule during

Stage 1 only? _____

(ii) State **one** use of the energy released when ATP is broken down.

_____ 1

16 The diagram below shows dividing root cells which carry out aerobic respiration.



Carbon dioxide is one waste product of aerobic respiration.

Tick (✓) the appropriate box below to show the direction of diffusion of carbon dioxide.

X ⟶ Y ☐

Y ⟶ X ☐ 1

17 Muscle cells use energy for contraction.

State **one** other cell activity that uses energy.

_____ 1

18 Name the process by which muscle cells use oxygen to release energy from food.

_____

Aerobic Respiration & Fermentation

19 An investigation was carried out into the respiration of yeast. A dough was made containing live yeast and left in optimum conditions. As the yeast respired, the carbon dioxide produced caused the dough to rise. The volume of the dough was measured every 10 minutes for 60 minutes.

The results are shown in the table.

Time (minutes)	Volume of dough (cm^3)
10	8
20	14
30	22
40	26
50	28
60	28

Predict the volume of dough at 50 minutes if the experiment was carried out at a lower temperature. **1**

Give a reason for your answer. **1**

Prediction _____ cm^3

Reason _____

_____

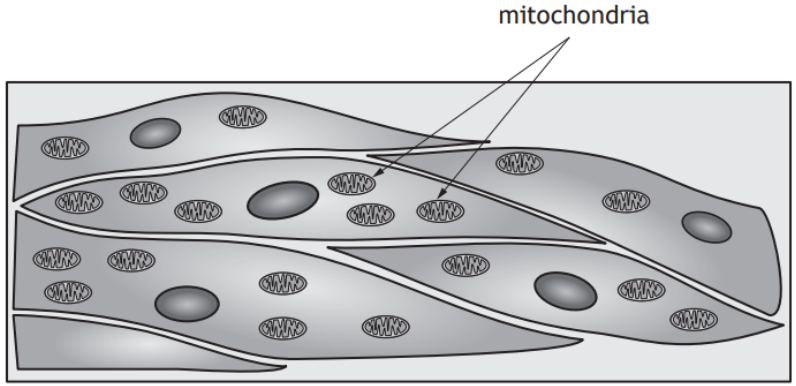
20. Explain why a sperm cell contains more mitochondria than a skin cell. **1**

_____

_____

_____

21 The diagram below shows muscle cells.



(a) (i) Explain why muscle cells require many mitochondria. **1**

_____

_____

(ii) Name **one** substance produced by a cell carrying out aerobic respiration. **1**

_____

MARK

22. Cellular processes occur in different parts of the cell.

Name the energy producing process which starts in the cytoplasm and is completed in the mitochondria. **1**

_____

Aerobic Respiration & Fermentation

23 Muscle tissue can be dark or light in colour.

Dark tissue cells use oxygen to release energy.

Light tissue cells do not use oxygen to release energy.

(a) Name the process by which energy is released in the dark tissue cells. **1**

_____

(b) (i) Name the substance which muscle cells break down to produce pyruvate. **1**

_____

The table below shows the average percentage of dark and light tissue cells. These cells were found in the muscles of athletes training for different events at the 2014 Commonwealth games in Scotland.

Type of Athlete	*Average percentage of dark tissue cells* (%)	*Average percentage of light tissue cells* (%)
cyclist	60	40
swimmer	75	25
shot putter	40	60
marathon runner	82	18
sprinter	38	62

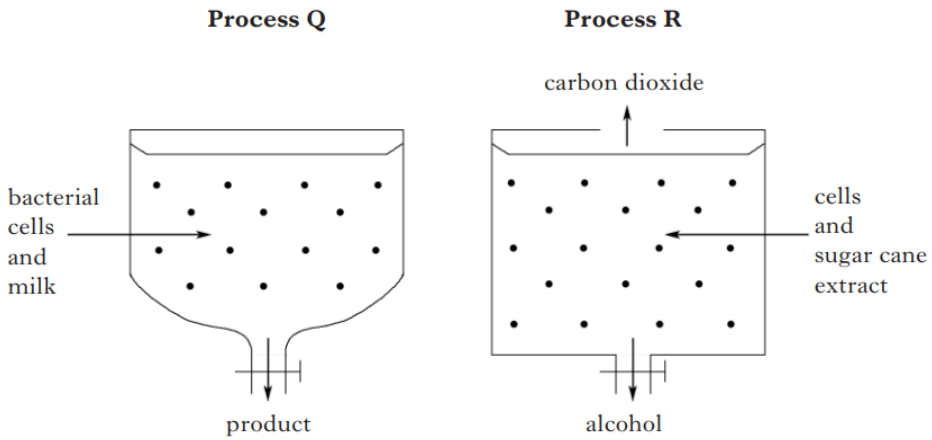
(c) Using information in the table, identify which type of athlete would be likely to produce the most lactic acid in their muscle cells. Justify your answer. **2**

Type of athlete _____

Justification _____

_____

24 The diagrams below represent two industrial processes, Q and R. Each process uses a different type of microbe in its fermentation.



a) Name the microbe used by process R

_____

b) State the location of fermentation within the microbe's cell.

_____

c) Suggest a reason why no cells are alive at the end of process R.

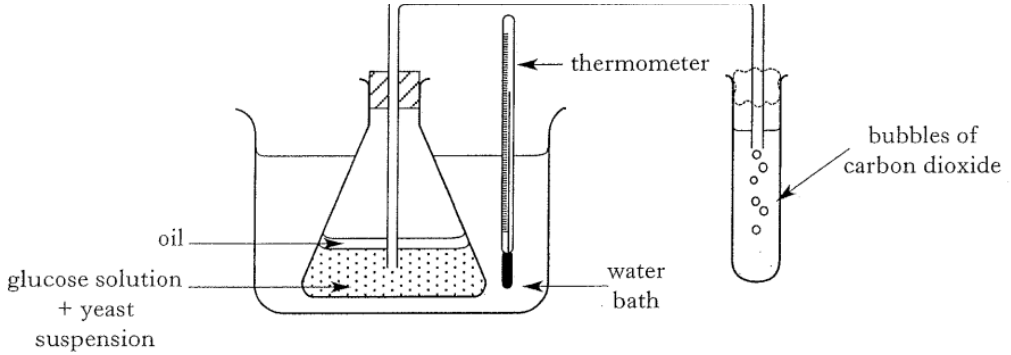
_____

_____

Aerobic Respiration & Fermentation

25. a) An investigation into the effect of temperature on the rate of fermentation in yeast was carried out.

.



(a) In addition to carbon dioxide, what will be produced in the flask during the investigation?

_____ 1

(b) Explain why no carbon dioxide is produced when the temperature is 70 °C.

_____ 1

_____

_____

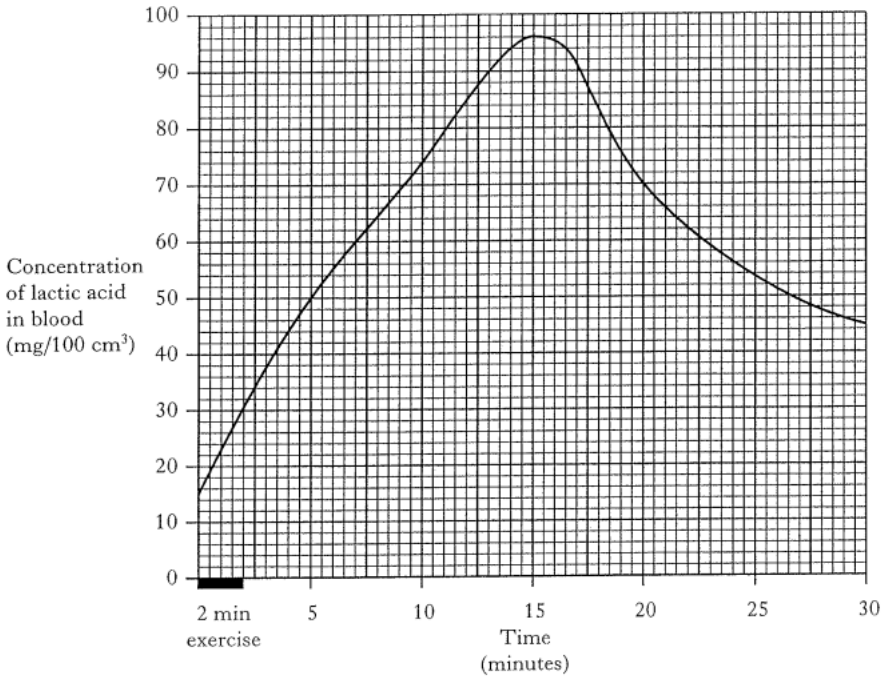
(c) Explain the purpose of the layer of oil.

_____ 1

_____

26 An investigation was carried out into the concentration of lactic acid in the blood before, during and after a two minute period of strenuous exercise.

The results are shown in the graph below.



(a) Explain why the concentration of lactic acid in the blood increased during and immediately after the strenuous exercise.

_____

_____ 1

(b) What caused the lactic acid concentration to decrease 15 minutes after the start of the exercise?

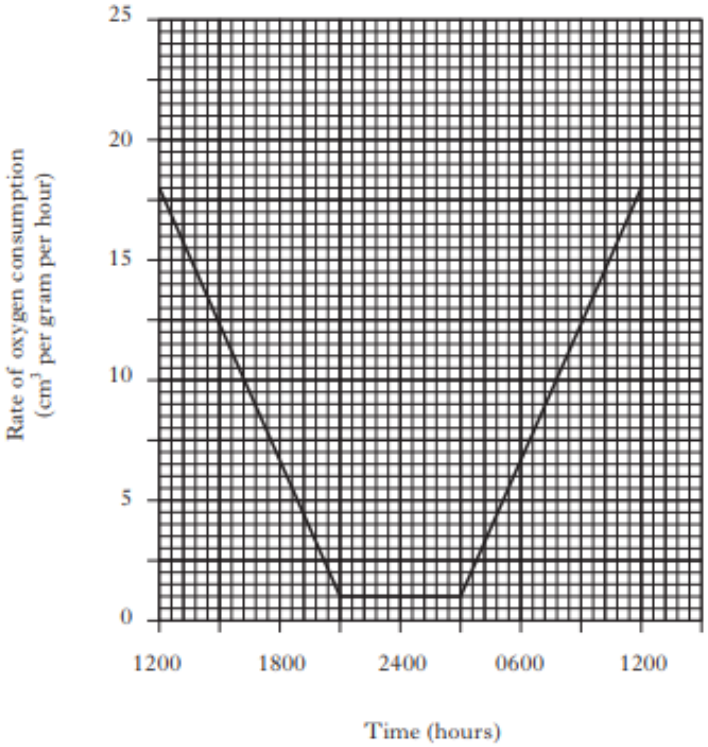
_____

_____ 1

Aerobic Respiration & Fermentation

27 . Hummingbirds use a lot of energy to get their food from flowers during the day.

The graph below shows the rate of oxygen consumption of a hummingbird from 12 noon (1200) one day to 12 noon the next day.



(a) Name the cell process which uses the oxygen taken in by the hummingbird.

_____ 1

b) Predict the effect of colder weather on the rate of oxygen consumption by the hummingbird.

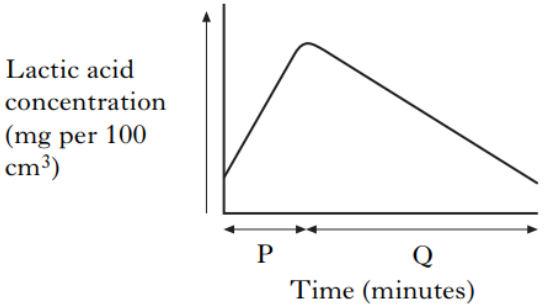
Give a reason for your answer.

Prediction _____ 1

Reason _____

_____ 1

28 The graph below shows lactic acid concentration in blood during a period of vigorous exercise (P) and of complete rest (Q).



Explain why the lactic acid concentration changes during period Q.

_____

_____ 1

Aerobic Respiration & Fermentation

29 Describe similarities and differences in the process of fermentation in yeast cells and muscle cells. **4**

30 A muscle cell will carry out fermentation when oxygen is not available.

Describe the fermentation pathway in muscle cells. **3**

Aerobic Respiration & Fermentation Answers

1. A
2. A
3. A
4. C
5. A
6. B
7. D
8. D
9. C
10. A
11. C
12. B
13. A
14. D
15. D

1. a) J = pyruvate K = ethanol (ii) 2 (b) mitochondria c) No oxygen
2. a) Aerobic respiration b (i) pyruvate (ii) oxygen c) muscle cells require more ATP/energy OR Skin cells require less ATP/energy#
3. a) b)muscle contraction/ cell division/protein synthesis/transmission of nerve impulse/active transport

	Type of respiration	
Statement	*Aerobic*	*Fermentation*
Oxygen is required	√	
Pyruvate is formed	√	√
Lactate is formed		√
Carbon dioxide is formed	√	

Aerobic Respiration & Fermentation Answers

4a) (i) X = glucose Y= water (iii) muscle contraction/ cell division/transmission of nerve impulse/active transport

5a (i) S= pyruvate T= water (ii) oxygen (iii) stage 2

6a (i) water (ii) oxygen (iii) 2

7 They need more ATP

8 X= Pyruvate Y = ethanol

9 a) Aerobic b (i) X= pyruvate Y=ATP (ii) oxygen

10 Aerobic respiration

11 Carbon dioxide✓

12.

Fermentation	Aerobic Respiration
W X Z	X Y

13. a) B = water c= lactate b) no oxygen

14 a(i) B (ii) glucose b) muscle contraction/ cell division/transmission of nerve impulse/active transport c) mitochondria

15 A (i) pyruvate (ii) oxygen b) (i) 2 (ii) muscle contraction/ cell division/transmission of nerve impulse/active transport

16. X ⟶ Y ☐
Y ⟶ X ☑

17. muscle contraction/ cell division/transmission of nerve impulse/active transport

18. Aerobic respiration

19. Prediction: any value greater than 0cm^3 and less than 28cm^3 Reason: Enzymes not as active/less active

20. More energy/ATP required by sperm cell OR less energy/ATP required by skin cell.

Aerobic Respiration & Fermentation Answers

21. a (i) requires a lot of energy/ATP for muscle contraction/movement (ii) carbon dioxide water ATP

22. aerobic respiration

23.a) aerobic respiration b) (i) glucose (c) Sprinter Highest % light tissue/fermentation/cells that do not use oxygen

24. a) yeast b) cytoplasm c) killed by ethanol building up

25 a) ethanol b) enzymes denature at high temperature & fermentation requires enzymes to take place c) to prevent oxygen entering test tube

26.a) no oxygen to muscle to undergo aerobic respiration b) oxygen now available for aerobic respiration

27a) aerobic respiration

b) increase OR decrease

need to make more ATP/energy by aerobic respiration to keep warm enzymes needed for aerobic respiration have a lower activity at lower temperatures

28. Q is complete rest and Lactate levels fall during Q when the cells now has oxygen for aerobic respiration instead of fermentation.

29

Similarities

1. glucose is converted to pyruvate. **(1)**
2. completed/take place in the cytoplasm. **(1)**
3. yields two (molecules of) ATP. **(1)**
4. (pathways) occur without/in the absence of oxygen. **(1)**
5. is enzyme controlled. **(1)**

Max 2 marks

Differences

6. The end products in yeast/fungal cells are ethanol and CO_2 **(1)**
7. In muscle/animal cells the product is lactate. **(1)**

OR

8. In one, the end products are ethanol and CO_2 and the other is lactate. **(1)**

Max 2 marks

30

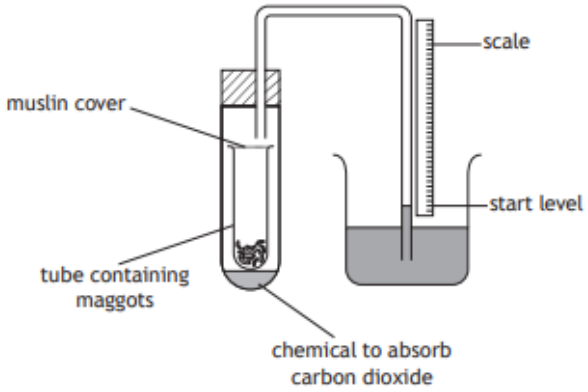
Glucose converted/broken down to pyruvate/pyruvic acid **(1)**

Pyruvate/pyruvic acid converted to lactic acid **(1)**

(2) ATP produced **(1)**

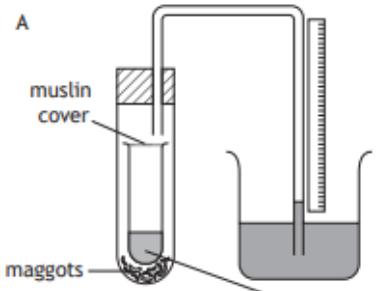
Aerobic Respiration & Fermentation Experiments

1 A respirometer was set up as shown to investigate respiration in maggots.

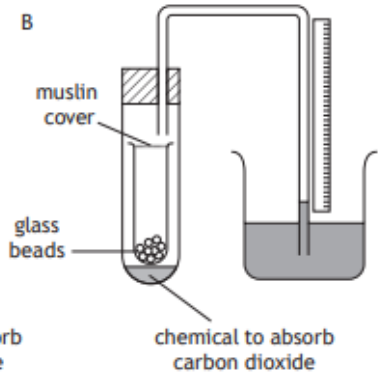


Which of the following would be a suitable control for this investigation?

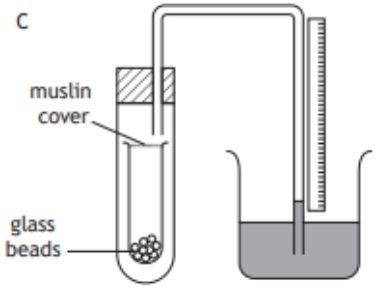
A



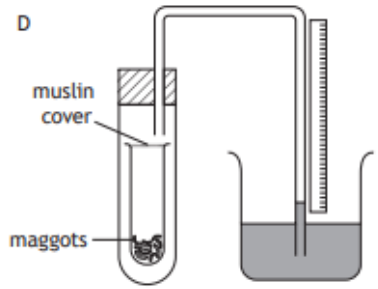
B



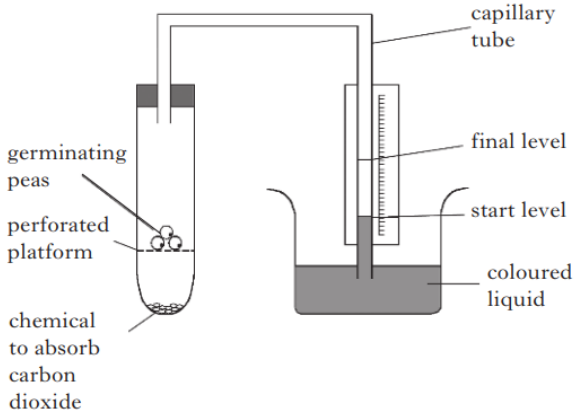
C



D



2 The apparatus below was used to investigate aerobic respiration in germinating peas.



The movement of the coloured liquid in the capillary tube can be used to measure the volume of

A oxygen produced by respiration

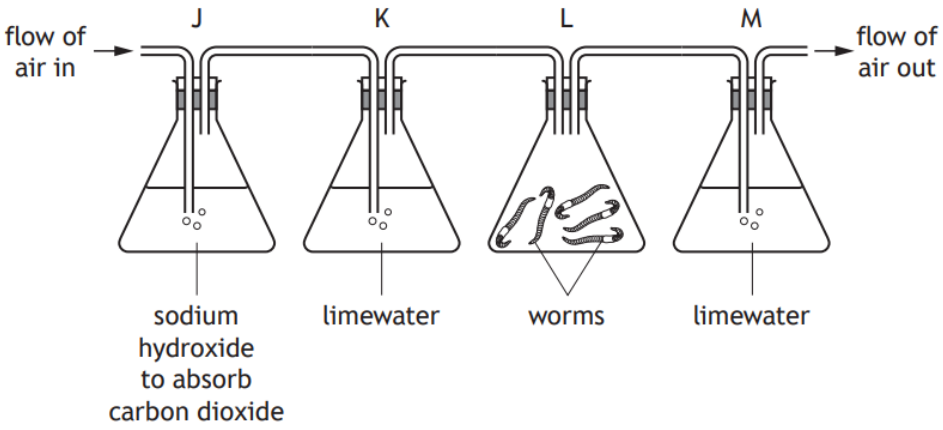
B carbon dioxide used up by respiration

C oxygen used up by respiration

D carbon dioxide produced by respiration

Aerobic Respiration & Fermentation Experiments

3 Four flasks, J, K, L and M, were set up to investigate the production of carbon dioxide during respiration.



Limewater turns increasingly cloudy as more carbon dioxide is passed through it.

Predict what would happen if only one worm was used in flask L.

The limewater in flask

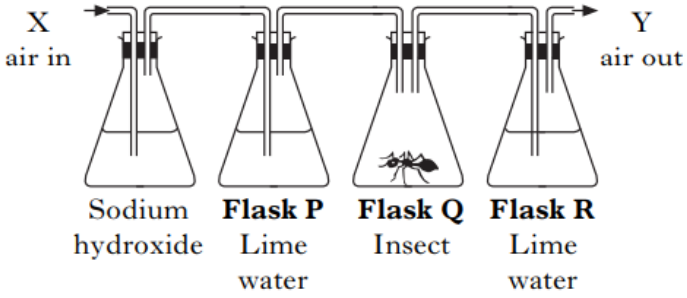
A K would turn cloudy more slowly

B K would turn cloudy more quickly

C M would turn cloudy more slowly

D M would turn cloudy more quickly.

4 The following experiment was set up.



Sodium hydroxide solution absorbs carbon dioxide from air.

Lime water turns from clear to cloudy in the presence of carbon dioxide.

Air is drawn through the apparatus from X to Y, passing through each flask in turn.

Predict what would happen to the results if two insects were used in flask Q. The lime water in

A Flask P turns cloudy more slowly

B Flask P turns cloudy more quickly

C Flask R turns cloudy more slowly

D Flask R turns cloudy more quickly.

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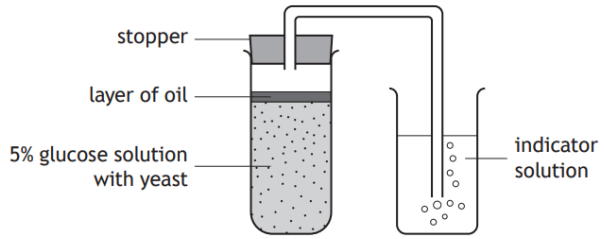
5 The apparatus shown was used to investigate the rate of respiration in yeast at 20 °C.



Which of the following changes would cause a decrease in the rate of respiration of the yeast?

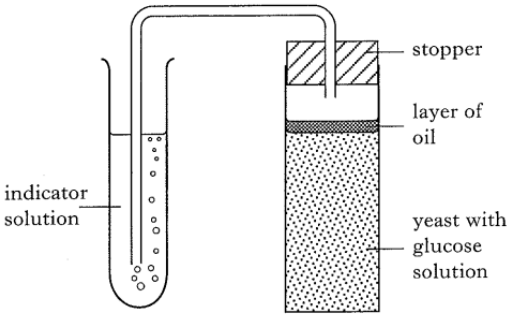
A Increase the thickness of the layer of oil by 1 mm.

B Increase the temperature of the glucose solution by 1 °C.

C Decrease the concentration of the glucose solution by 1%.

D Decrease the volume of indicator solution by 1 cm^3.

6 Respiration in yeast was investigated using the apparatus shown below.



Which of the following changes to the investigation would cause the yeast to respire more slowly?

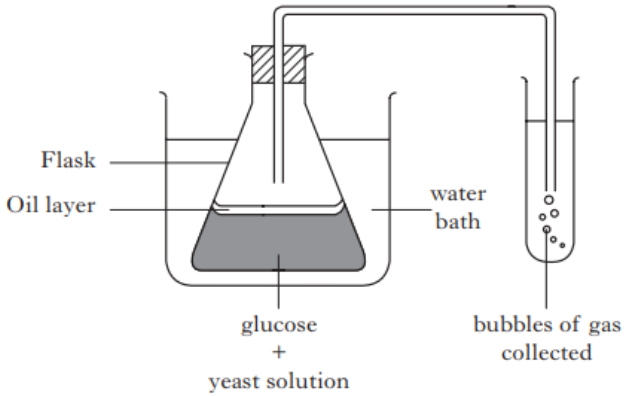
A Use cotton wool instead of a stopper

B Do not add oil to the boiling tube

C Change the indicator solution

D Mix the yeast with water instead of glucose solution

An investigation into fermentation in yeast was carried out.



7 The purpose of the oil layer in the flask is to ensure that

A O_2 from the solution is not released into the flask

B CO_2 from the flask does not enter the solution

C O_2 from the air does not enter the solution

D CO_2 from the solution is not released into the flask.

8 A control flask was set up to show that fermentation is due to the activity of yeast. The solution in the control flask was

A yeast and glucose

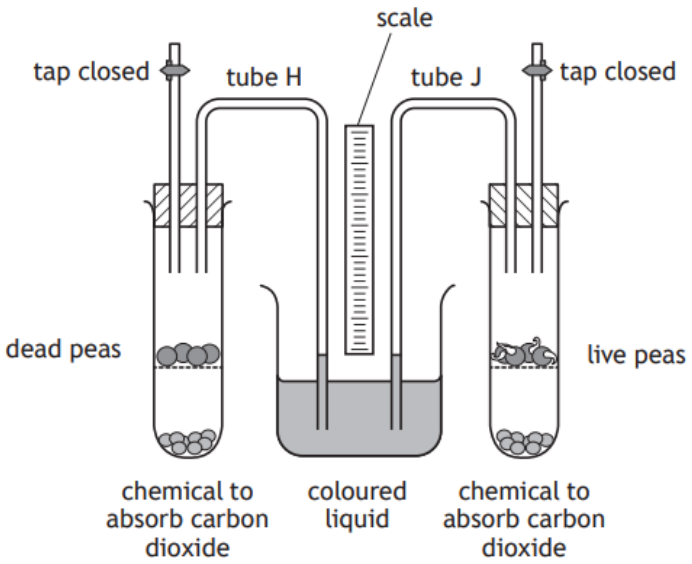
B dead yeast and glucose

C yeast and water

D dead yeast and water.

Aerobic Respiration & Fermentation Experiments

1. The following apparatus was set up to investigate aerobic respiration in peas.



When peas respire this alters the composition of the gases in the test tubes, causing a change in the liquid levels in tubes H and J.

Liquid levels were recorded as shown in the table.

	Liquid level (mm)		
Tube	**At start**	**30 minutes**	**60 minutes**
H	0	0	0
J	0	25.5	40.8

Give a suitable conclusion for this investigation.

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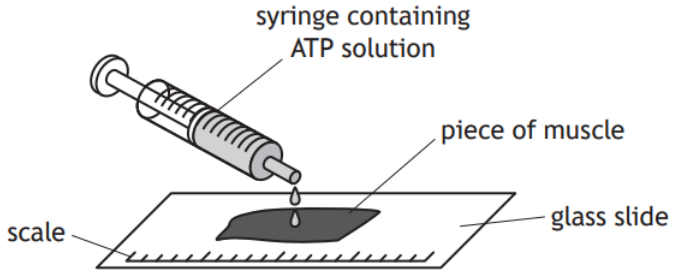
2 Muscles decrease in length as they contract.

The diagram shows part of an investigation into the effect of ATP concentration on muscle contraction.



The table shows the results of the investigation.

ATP concentration (mg/100 ml)	Length of muscle (mm)			Percentage decrease in length
	At start	After 10 minutes	Decrease	
100	25	24·2	0·8	3·2
500	35	31·5	3·5	10
750	30	24·6	5·4	

Describe the relationship between the ATP concentration and muscle contraction. **1**

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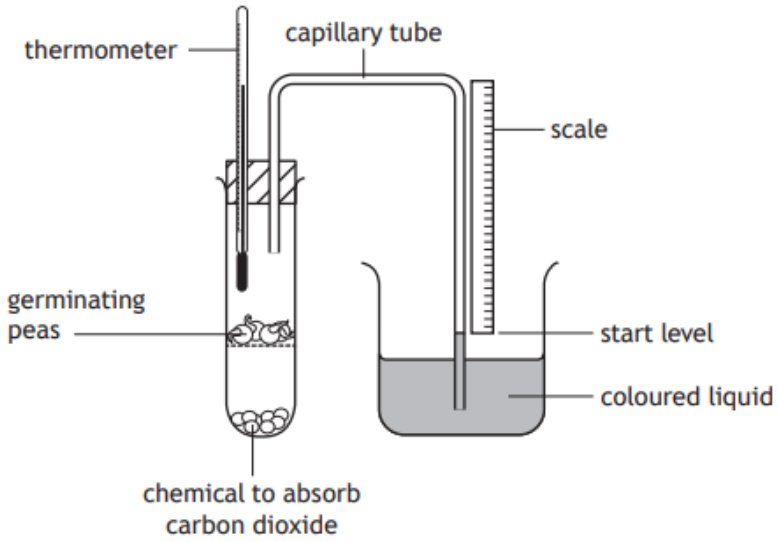
Aerobic Respiration & Fermentation

3 A student investigated the effect of temperature on the rate of respiration in germinating (growing) peas. Using the arrangement shown, four respirometers labelled A–D were set up at the temperatures shown in the table below.



The level of the coloured liquid was measured on the scale at the start of the investigation and again after 20 minutes. The rise in liquid level was due to oxygen uptake by the germinating peas. The results are shown in the table.

Respirometer	*Temperature* (°C)	*Contents*	*Rise in liquid level* (mm)	*Rate of oxygen uptake* (mm per minute)
A	15	Germinating peas	14	0·7
B	15	Dead peas	0	0
C	25	Germinating peas	26	
D	25	Dead peas	0	0

a) Using the results from the table complete the following conclusion by underlining one option in the bracket. **1**

Increasing the { temperature / liquid level / oxygen uptake } increases the rate of respiration in germinating peas.

b) Another respirometer was set up at 60 °C with germinating peas and the coloured liquid did not rise. The student concluded that the peas were not respiring.

Explain why this temperature prevented the peas from carrying out respiration. **2**

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c) Respirometers B and D were set up as control experiments.

Describe the purpose of the controls in **this** investigation. **1**

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Aerobic Respiration & Fermentation Experiment Answers

1. B
2. C
3. C
4. D
5. C
6. D
7. C
8. B

1. Only alive yeast can undergo aerobic respiration (NOT draw liquid up tube)
2. As ATP concentration increases, muscle contraction increase (NOT length of muscle decreases)
3. a) temperature b) enzymes denature at high temperature AND Enzymes needed for aerobic respiration

   c) to prove peas need to be alive to carry out aerobic respiration