EXAM PAPERS PRACTICE

Respiration Pack

These practice questions can be used by students and teachers and is

Suitable for AQA A Level 7402 Biology Topic Question

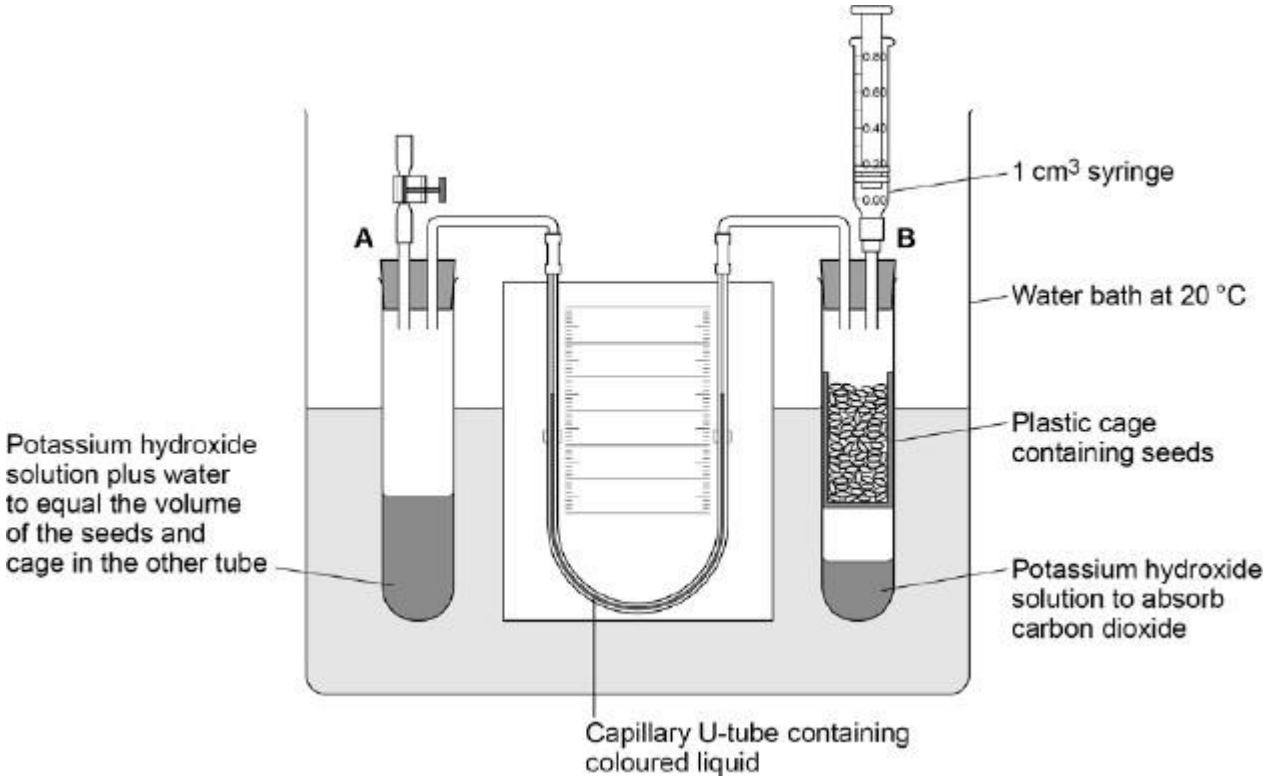
Level: AQA A LEVEL 7402

Subject: Biology

Exam Board: AQA A Level 7402

Topic: Respiration Pack

1 The figure below shows the apparatus used for measuring the rate of oxygen consumption in aerobic respiration by seeds.



(a) For the first 10 minutes, the tap attached to tube **A** was left open and the syringe from tube **B** was removed.

Suggest **three** reasons why the apparatus was left for 10 minutes.

1. _____

_____

2. _____

_____

3. _____

_____

(3)

(b) Suggest and explain why the chosen temperature was 20 °C for this experiment.

_____

_____

_____

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(2)

After 10 minutes, the tap attached to tube **A** was closed and the syringe was attached to tube **B**. Every minute, the syringe plunger was moved until the levels in the U-tube were the same. The reading on the syringe volume scale was then recorded.

The results are shown in the table below.

Time / minutes	**Reading on syringe volume scale / cm^3**
0	0.84
1	0.81
2	0.79
3	0.76
4	0.73
5	0.70
6	0.68
7	0.66
8	0.63
9	0.62
10	0.58

(c) During the experiment, the coloured liquid in the tubing moved towards tube **B**. Explain what caused this.

(Extra space) _____

(3)

(d) The mass of the seeds was 1.6 g. Use the information in the table above to calculate the rate of oxygen consumption in $cm^3\ g^{-1}\ hour^{-1}$ by the seeds.

Show your working.

Rate = _____ $cm^3\ g^{-1}\ hour^{-1}$

(2)

(Total 10 marks)

2 Read the following passage carefully.

A large and growing number of disorders are now known to be due to types of mitochondrial disease (MD). MD often affects skeletal muscles, causing muscle weakness.

We get our mitochondria from our mothers, via the fertilised egg cell. Fathers do not pass on mitochondria via their sperm. Some mitochondrial diseases are caused by mutations of mitochondrial genes inside the mitochondria. Most mitochondrial diseases are caused by mutations of genes in the cell nucleus that are involved in the functioning of mitochondria. These mutations of nuclear DNA produce recessive alleles.

One form of mitochondrial disease is caused by a mutation of a mitochondrial gene that codes for a tRNA. The mutation involves substitution of guanine for adenine in the DNA base sequence. This changes the anticodon on the tRNA. This results in the formation of a non-functional protein in the mitochondrion.

There are a number of ways to try to diagnose whether someone has a mitochondrial disease. One test involves measuring the concentration of lactate in a person's blood after exercise. In someone with MD, the concentration is usually much higher than normal. If the lactate test suggests MD, a small amount of DNA can be extracted from mitochondria and DNA sequencing used to try to find a mutation.

Use information in the passage and your own knowledge to answer the following questions.

(a) Mitochondrial disease (MD) often causes muscle weakness (lines 1–3). Use your knowledge of respiration and muscle contraction to suggest explanations for this effect of MD.

(Extra space)

(3)

Two couples, couple **A** and couple **B**, had one or more children affected by a mitochondrial disease. The type of mitochondrial disease was different for each couple.

None of the parents showed signs or symptoms of MD.

- Couple **A** had four children who were all affected by an MD.
- Couple **B** had four children and only one was affected by an MD.

(b) Use the information in lines 5–9 and your knowledge of inheritance to suggest why:

- all of couple **A**'s children had an MD
- only one of couple **B**'s children had an MD.

Couple **A** _____

_____

_____

_____

Couple **B** _____

_____

_____

_____

(Extra space) _____

_____

_____

_____

(4)

(c) Suggest how the change in the anticodon of a tRNA leads to MD (lines 10–13).

(Extra space)

(3)

(d) If someone has MD, the concentration of lactate in their blood after exercise is usually much higher than normal (lines 15–17). Suggest why.

(Extra space)

(3)

(e) A small amount of DNA can be extracted from mitochondria and DNA sequencing used to try to find a mutation (lines 18–19).

From this sample:

- how would enough DNA be obtained for sequencing?
- how would sequencing allow the identification of a mutation?

_____

_____

_____

_____

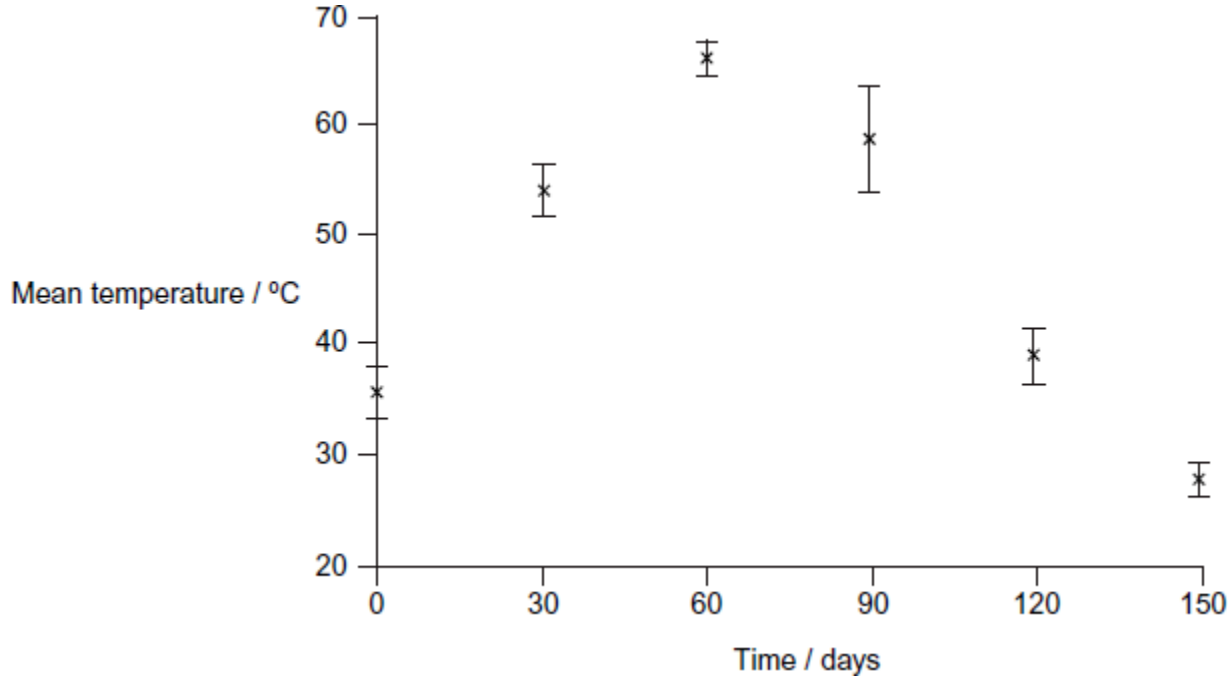
(2)

(Total 15 marks)

3 The organic material in household waste can be used to make compost for use as a fertiliser. Scientists investigated changes during one process used to make this compost. The method involved placing the waste in large containers for 150 days. At regular intervals the containers were rotated. The scientists measured the temperature of samples of waste during the investigation.

Figure 1 shows the results they obtained. The vertical bars show standard deviations.

Figure 1



(a) Explain how microorganisms contributed to the increase in temperature during processing of organic waste.

(2)

(b) Explain the advantage of showing the data using standard deviations rather than ranges.

(2)

(c) Suggest **two** advantages of rotating the containers during the process.

1. _____

_____

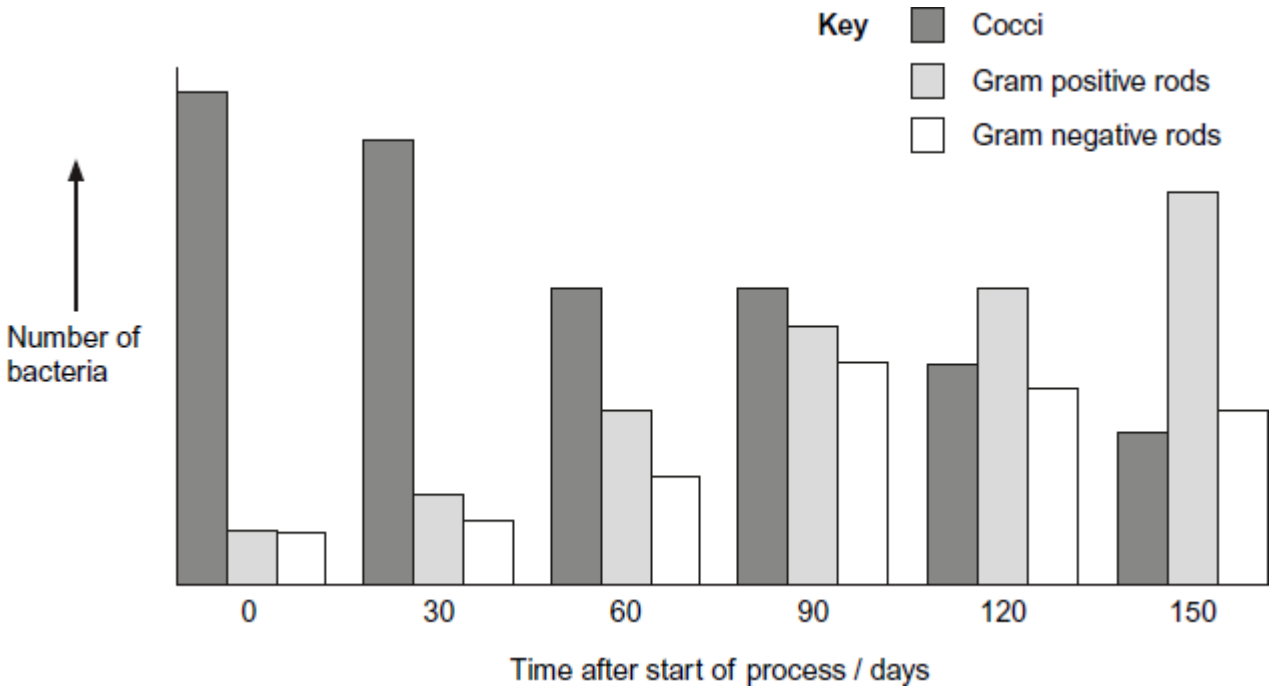
2. _____

_____

(2)

(d) The scientists took a sample of the waste at the start of the process. They then took samples every 30 days. In each sample, they determined the numbers of particular types of bacteria.
Figure 2 shows the changes in the number of three types of bacteria during the process.

Figure 2



The scientists concluded that the results in **Figure 1** and **Figure 2** are evidence for a form of succession during the process.

Use the information to suggest how they reached this conclusion.

(3)
(Total 9 marks)

4 In mammals, the mesenteric artery connects the aorta to blood vessels of the small intestine.

Sport scientists recorded increases in blood flow in the mesenteric artery after different types of meal. The types of meal were:

- carbohydrate only
- fat only
- protein only.

Typical results are shown in the table.

Type of meal	**Maximum percentage increase in blood flow in mesenteric artery**	**Time taken to reach maximum increase in blood flow in mesenteric artery / minutes**
Carbohydrate only	64	15
Fat only	60	30
Protein only	57	45

(a) The sport scientists concluded that the three types of meal had no major effect on maximum percentage increase in blood flow in the mesenteric artery.

What else can be concluded from their results?

_____

_____

_____

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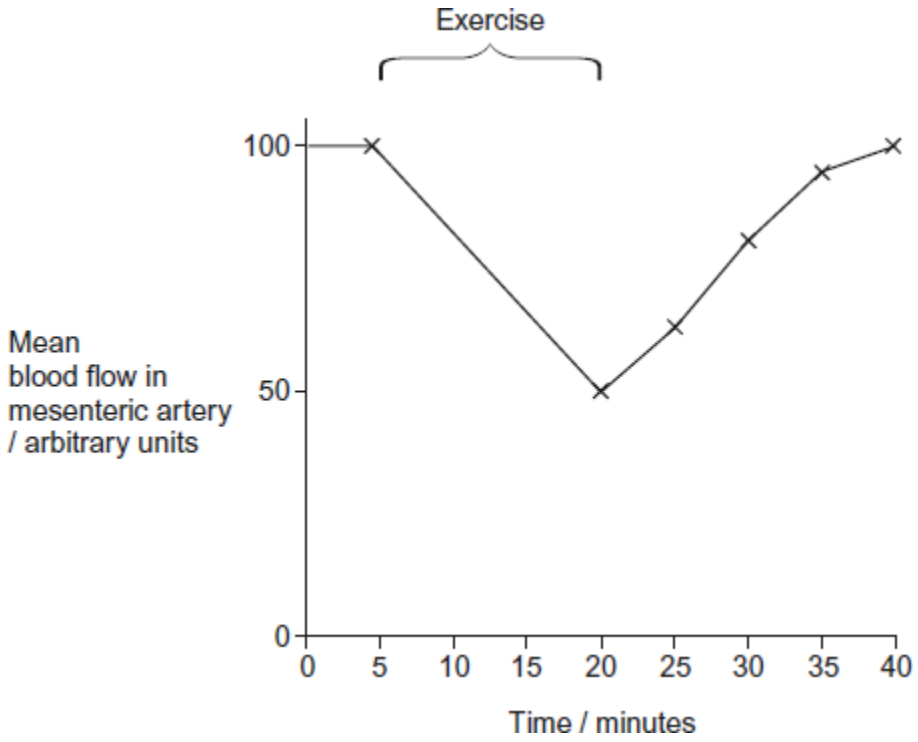
(2)

In another investigation, the sport scientists recorded blood flow in the mesenteric artery before and after vigorous exercise.

The graph shows their results for a large group of volunteers.



(b) Suggest the advantage of the change in blood flow in the mesenteric artery during exercise.

(3)

(c) The sport scientists concluded people should **not** do vigorous exercise after a meal. Does the information from the table and the graph support this conclusion?

(4)

(Total 9 marks)

5 Some plant seeds can respire aerobically and anaerobically. A summary of the process of anaerobic respiration is shown below.

glucose $\xrightarrow{\text{stage 1}}$ pyruvate $\xrightarrow{\text{stage 2}}$ ethanol and carbon dioxide

(a) (i) Where in a cell does **stage 1** occur?

(1)

(ii) Explain how **stage 2** enables **stage 1** to continue.

(2)

(b) The Respiratory Quotient (RQ) can provide information on the type of respiration taking place in an organism. The following equation is used to calculate the RQ.

$$RQ = \frac{\text{volume of carbon dioxide produced during respiration}}{\text{volume of oxygen used during respiration}}$$

(i) What would be the RQ for aerobic respiration of glucose?

(1)

(ii) A student calculated that the RQ of germinating seeds was 1.8.

Use the information provided to explain this result.

(2)

(c) Aerobic respiration produces more ATP per molecule of glucose than anaerobic respiration.

Explain why.

(2)

(Total 8 marks)

6 Multiple sclerosis (MS) is a condition caused when the body's own immune system attacks the myelin sheath around axons. The cell bodies of the neurones themselves can also be damaged or destroyed. People with MS usually have periods of time when their MS gets no worse, followed by relapses when it gets worse.

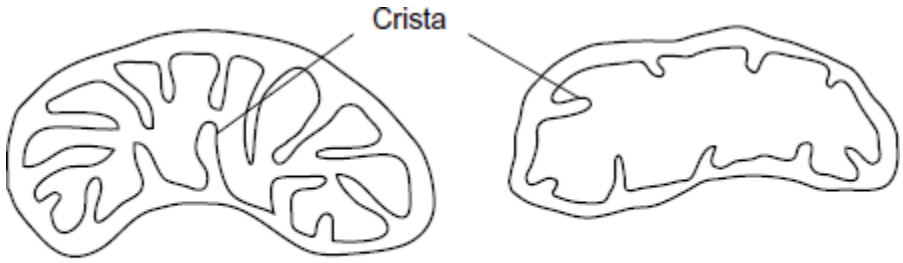
Scientists investigated the effects on neurones of damage to myelin. The scientists obtained a modified antigen from the myelin sheath of humans and injected it into mice. After a number of days, this injection of antigen resulted in the myelin sheaths in the mice being damaged. Some cell bodies of neurones were also damaged.

(a) Suggest how the injection of the antigen resulted in the myelin sheaths being damaged.

(3)

(b) The scientists compared the ultrastructure of normal and damaged neurones. They found that damaged neurones contained many mitochondria with an unusual ultrastructure.

The diagram shows a mitochondrion with normal ultrastructure and one with the unusual ultrastructure.



Mitochondrion with normal ultrastructure

Mitochondrion with unusual ultrastructure

Suggest why having a large number of mitochondria with this unusual ultrastructure could lead to neurones dying.

(3)

(c) The scientists took a large number of photographs of thin sections through neurones. Using these photographs, they found that 40% of mitochondria had the unusual ultrastructure in damaged neurones.

(i) What sort of microscope would the scientists use to take the photographs? Give **one** reason for your answer.

Type of microscope _____

Reason _____

_____

_____

(1)

(ii) Suggest how the scientists found the percentage of mitochondria with the unusual ultrastructure.

_____

_____

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(3)

(Total 10 marks)

7 (a) Describe how acetylcoenzyme A is formed in the link reaction.

_____

_____

_____

_____

_____

(2)

(b) In the Krebs cycle, acetylcoenzyme A combines with four-carbon oxaloacetate to form six-carbon citrate. This reaction is catalysed by the enzyme citrate synthase.

(i) Oxaloacetate is the first substrate to bind with the enzyme citrate synthase. This induces a change in the enzyme, which enables the acetylcoenzyme A to bind.

Explain how oxaloacetate enables the acetylcoenzyme A to then bind to the enzyme.

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_____

(2)

(ii) Another substance in the Krebs cycle is called succinyl coenzyme A. This substance has a very similar shape to acetylcoenzyme A.

Suggest how production of succinyl coenzyme A could control the rate of the reaction catalysed by citrate synthase.

_____

_____

_____

_____

_____

(2)

(c) In muscles, pyruvate is converted to lactate during anaerobic respiration.

(i) Explain why converting pyruvate to lactate allows the continued production of ATP during anaerobic respiration.

_____

_____

_____

_____

_____

(2)

(ii) In muscles, some of the lactate is converted back to pyruvate when they are well supplied with oxygen. Suggest **one** advantage of this.

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(1)

(Total 9 marks)

8 (a) On islands in the Caribbean, there are almost 150 species of lizards belonging to the genus *Anolis*. Scientists believe that these species evolved from two species found on mainland USA. Explain how the Caribbean species could have evolved.

(6)

(b) *Anolis sagrei* is a species of lizard that is found on some of the smallest Caribbean islands. Describe how you could use the mark-release-recapture method to estimate the number of *Anolis sagrei* on one of these islands.

(4)

(c) Large areas of tropical forest are still found on some Caribbean islands. The concentration of carbon dioxide in the air of these forests changes over a period of 24 hours and at different heights above ground.

Use your knowledge of photosynthesis and respiration to describe and explain how the concentration of carbon dioxide in the air changes:

- over a period of 24 hours
- at different heights above ground.

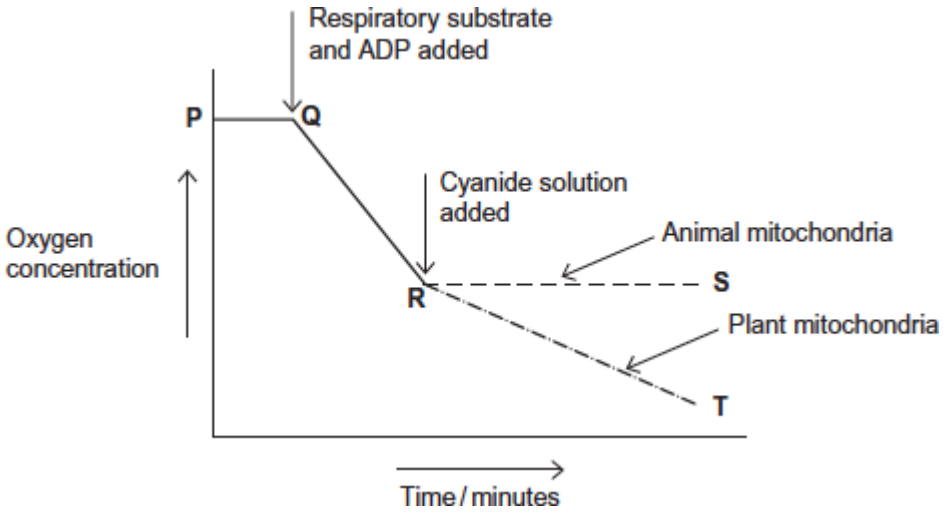
(5)

(Total 15 marks)

9 Researchers investigated the effect of cyanide on oxygen uptake by mitochondria. They prepared a suspension of mitochondria from animal cells and a suspension of mitochondria from plant cells. They placed the suspensions in separate flasks containing isotonic solution, started the timer and began recording the concentration of oxygen in each flask.

- After 5 minutes, they added a respiratory substrate and ADP to each flask.
- After 13 minutes, they added cyanide solution to each flask.

The graph below shows their results. From **P** to **R** the curves for animal and plant mitochondria overlap.



(a) Explain the line between **P** and **Q**.

(2)

(b) (i) Explain the line between **Q** and **R**.

(2)

(ii) The respiratory substrate and ADP added after 5 minutes (**Q**) were part of a buffered isotonic solution.

What other substance would the buffer or solution have to contain?

_____

_____

(1)

(c) Describe and explain the difference between line **R** to **S** (animal mitochondria) and line **R** to **T** (plant mitochondria).

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[Extra space] _____

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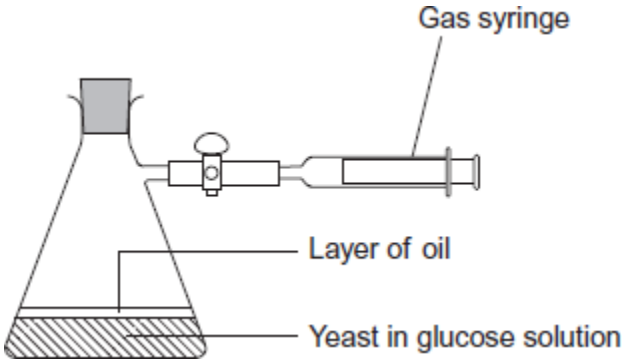
(4)

(Total 9 marks)

10 A student investigated the rate of anaerobic respiration in yeast. She put 5 g of yeast into a glucose solution and placed this mixture in the apparatus shown in the figure below.
She then recorded the total volume of gas collected every 10 minutes for 1 hour.



(a) Explain why a layer of oil is required in this investigation.

_____

_____

(1)

(b) The student's results are shown in the following table.

Time / minutes	Total volume of gas collected / cm^3
10	0.3
20	0.9
30	1.9
40	3.1
50	5.0
60	5.2

(i) Calculate the rate of gas production in $cm^3\ g^{-1}\ min^{-1}$ during the first 40 minutes of this investigation. Show your working.

Answer = _____ $cm^3\ g^{-1}\ min^{-1}$

(2)

(ii) Suggest why the rate of gas production decreased between 50 and 60 minutes.

_____

_____

(1)

(iii) Yeast can also respire aerobically. The student repeated the investigation with a fresh sample of yeast in glucose solution, but without the oil. All other conditions remained the same.
Explain what would happen to the volume of gas in the syringe if the yeast were only respiring aerobically.

_____

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_____

(2)

(c) Respiration produces more ATP per molecule of glucose in the presence of oxygen than it does when oxygen is absent. Explain why.

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_____

_____

_____

(2)

(Total 8 marks)

11 CREB is a transcription factor in the mitochondria of neurones.

(a) What is a **transcription factor**?

_____

_____

_____

_____

(2)

(b) CREB leads to the formation of a protein that removes electrons and protons from reduced NAD in the mitochondrion.

Huntington's disease (HD) causes the death of neurones. People with HD produce a substance called huntingtin. Some scientists have suggested that binding of huntingtin to CREB may lead to the death of neurones.

Suggest how binding of huntingtin to CREB may lead to the death of neurones.

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_____

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_____

(Extra space) _____

_____

_____

(3)

(c) CREB is a protein synthesised in the cytoplasm of neurones. Transport of CREB from the cytoplasm into the matrix of a mitochondrion requires two carrier proteins.

Use your knowledge of the structure of a mitochondrion to explain why transport of CREB requires **two** carrier proteins.

_____

_____

_____

_____

(2)

(Total 7 marks)

12 Scientists measured the rate of respiration in **three** parts of an ecosystem.

They did this by measuring carbon dioxide released into the air by:

- leaves of plants
- stems and roots of plants
- non-photosynthetic soil organisms.

The table below shows the scientists' results for these three parts of the ecosystem.

Part of ecosystem	**Mean rate of carbon dioxide production / $cm^3\ m^{-2}\ s^{-1}$**	**Percentage of total carbon dioxide production measured by the scientists**
Leaves of plants	0.032	25.0
Stems and roots of plants	0.051	
Non-photosynthetic soil organisms	0.045	

(a) Complete the table to show the percentage of total carbon dioxide production by each part of the ecosystem.

Show your working.

(2)

(b) A student who looked at the data in the table concluded that plants carry out more respiration than non-photosynthetic organisms in the ecosystem.

Use the information provided to suggest why these data may **not** support the student's conclusion.

_____

_____

_____

_____

(2)

(c) What measurements would the scientists have made in order to calculate the rate of carbon dioxide production?

_____

_____

_____

_____

(2)

(d) The scientists calculated the mean rate of carbon dioxide production of the leaves using measurements of carbon dioxide release in the dark.

Explain why they did **not** use measurements taken in the light.

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_____

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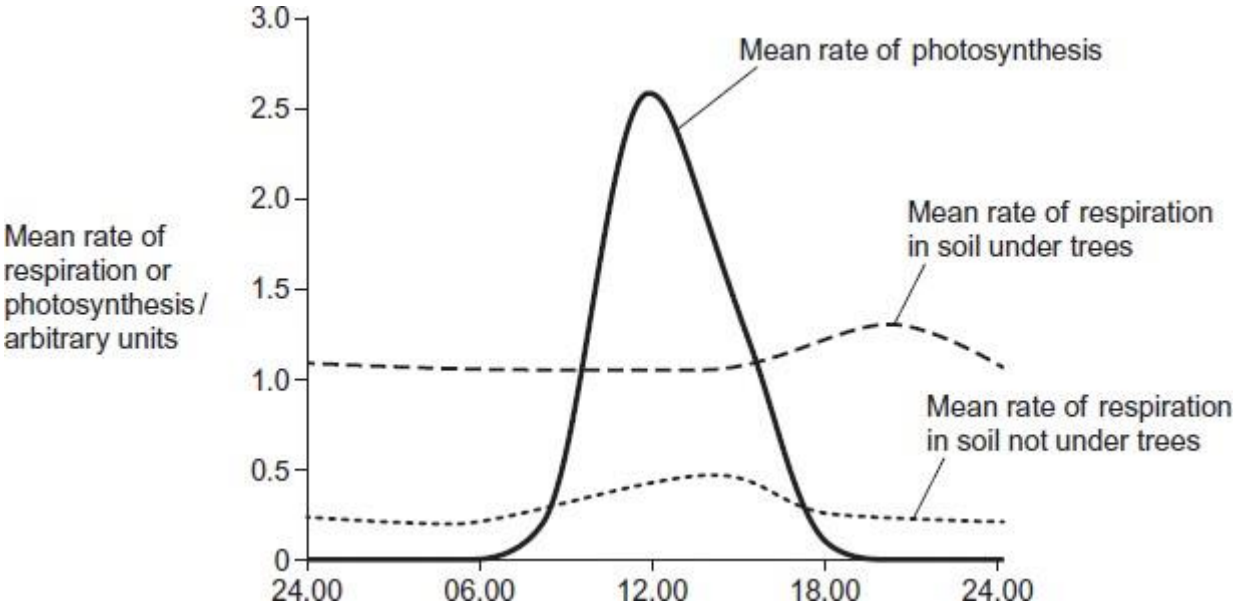
_____

(2)

Another group of scientists measured the mean rate of respiration in soil under trees and soil not under trees in the same wood. They also measured the mean rate of photosynthesis in the trees.

They took measurements at different times of day during the summer.

The figure below shows the scientists' results.



(e) (i) Describe **two** ways in which the mean rate of respiration in soil under trees is different from soil not under trees.

1. _____

_____

2. _____

_____

(2)

(ii) Suggest **one** explanation for the differences in the mean rate of respiration in soil under trees and soil not under trees between 06.00 and 12.00.

_____

_____

_____

_____

(2)

(f) The scientists suggested that the rise in the mean rate of photosynthesis was the cause of the rise in the mean rate of respiration in soil under trees.

(i) Suggest how the rise in the mean rate of photosynthesis could lead to the rise in the mean rate of respiration in soil under trees.

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_____

(2)

(ii) Suggest why there is a delay between the rise in the mean rate of photosynthesis and the rise in the mean rate of respiration.

_____

_____

(1)

(Total 15 marks)

13 Many sports drinks contain water, sodium chloride and carbohydrates. The manufacturers of the sports drinks claim that carbohydrates provide an energy boost. The sodium chloride is used to increase absorption of glucose in the small intestine.

Scientists investigated the effect of a sports drink on the performance of runners in 5 km races. They recruited 100 runners who had previously run a 5 km race in similar times. During this race, Race 1, they had water they could drink.

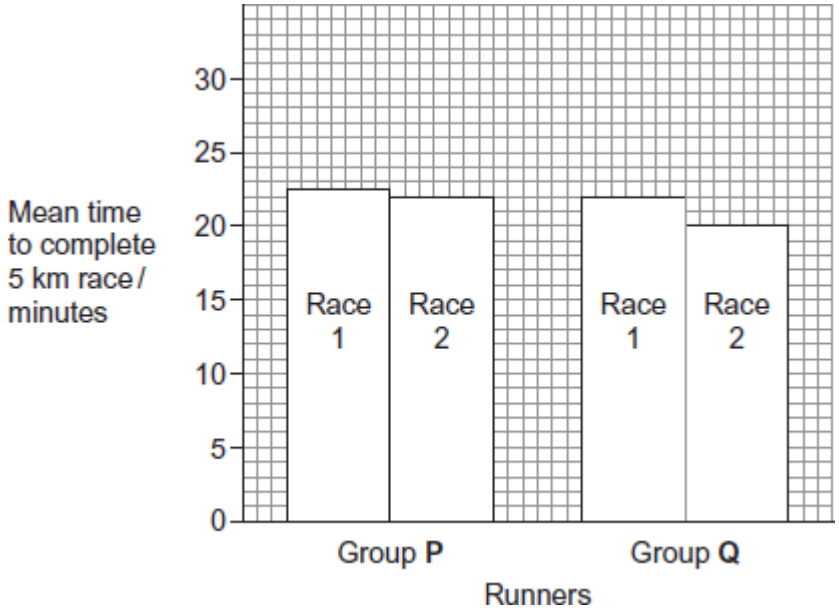
The scientists divided the runners into two equal groups, **P** and **Q**. Both groups ran a second 5 km race, Race 2. During this race:

- group **P** had water available
- group **Q** had the sports drink available.

The scientists recorded the mean time for each group to complete this race.

Figure 1 shows their results.

Figure 1

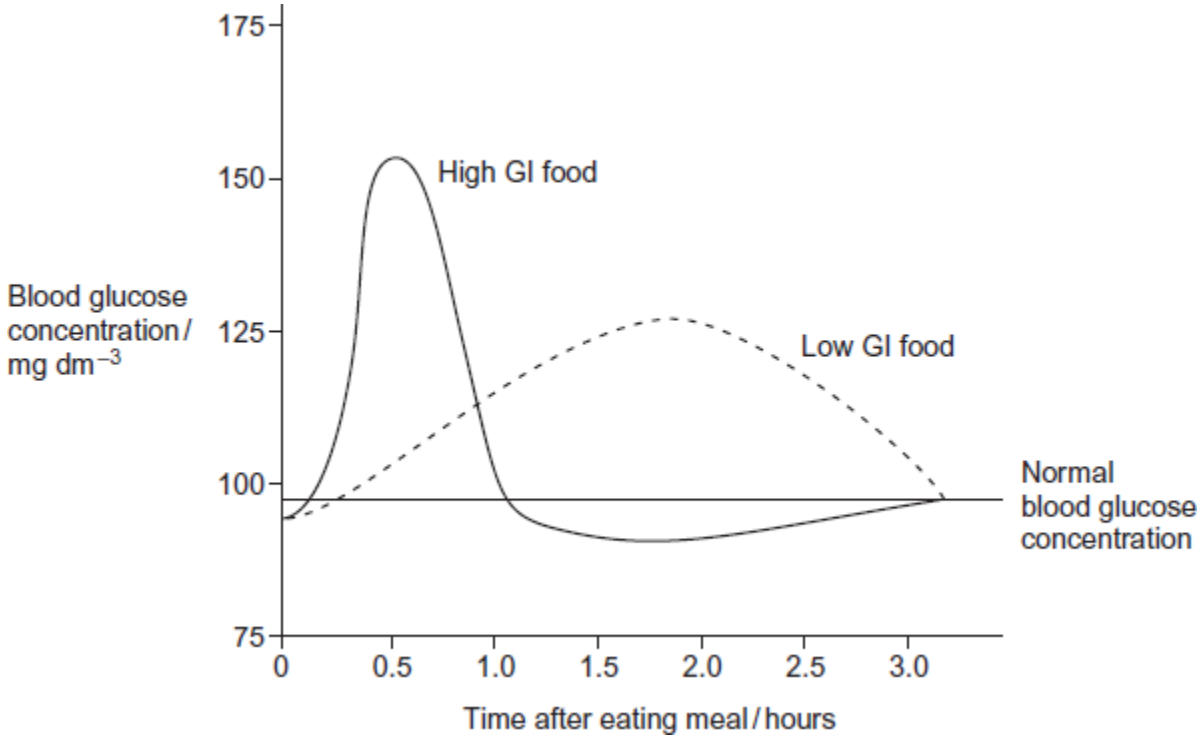


The glycaemic index (GI) is a measure of the increase in blood glucose concentration after eating a given mass of a food compared with eating the same mass of pure glucose. The GI of pure glucose has a value of 100.

The GI of a food depends on several factors such as how much starch and sugars it contains. High GI foods include those containing lots of simple sugars or white flour. The carbohydrates in these foods are rapidly digested and absorbed. Low GI foods include wholegrain bread and breakfast cereals that contain a lot of fibre. The carbohydrates in these foods are digested and absorbed more slowly.

Figure 2 shows changes in blood glucose concentration after eating meals of high GI food and meals of low GI food.

Figure 2



Explain how a sports drink could provide an energy boost when running.

(Extra space)

(3)

(Total 3 marks)

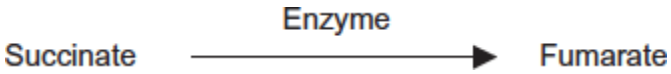
14 (a) The table contains statements about three stages of respiration.

Complete the table with a tick if the statement in the first column is true for each stage of respiration in an animal.

	Glycolysis	**Link reaction**	**Krebs cycle**
Occurs in mitochondria			
Carbon dioxide produced			
NAD is reduced			

(3)

(b) The following reaction occurs in the Krebs cycle.



A scientist investigated the effect of the enzyme inhibitor malonate on this reaction. The structure of malonate is very similar to the structure of succinate. The scientist added malonate and the respiratory substrate, pyruvate, to a suspension of isolated mitochondria. She also bubbled oxygen through the suspension.

(i) Explain why the scientist did not use glucose as the respiratory substrate for these isolated mitochondria.

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_____

_____

_____

(2)

(ii) Explain how malonate inhibits the formation of fumarate from succinate.

_____

_____

_____

_____

_____

(2)

(iii) The scientist measured the uptake of oxygen by the mitochondria during the investigation. The uptake of oxygen decreased when malonate was added. Explain why.

_____

_____

_____

_____

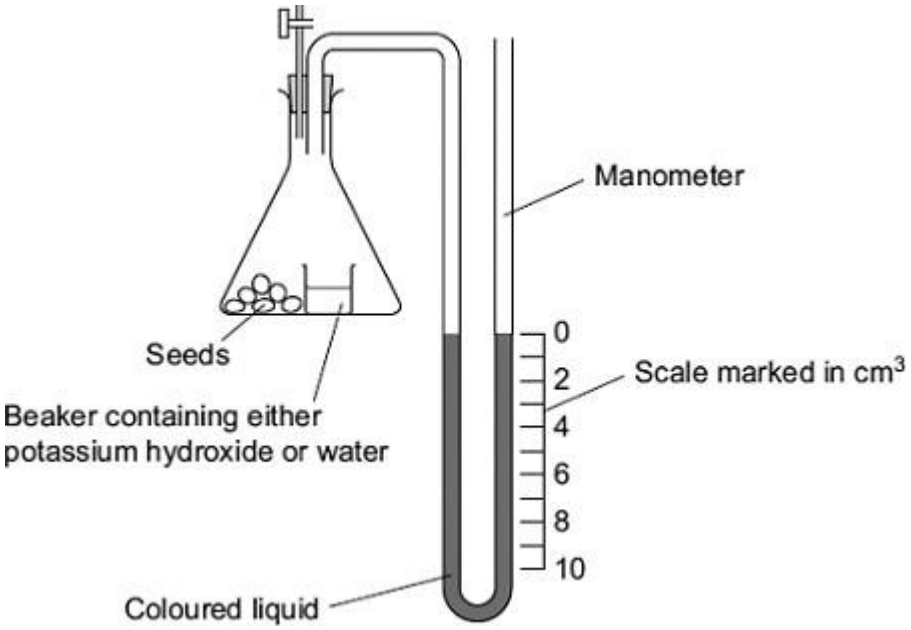
_____

(2)

(Total 9 marks)

15 A student investigated the rate of gas exchange in aerobically respiring seeds using the apparatus shown in the diagram. She carried out two experiments.

- In Experiment **1**, she put potassium hydroxide solution in the beaker. Potassium hydroxide solution absorbs carbon dioxide.
- In Experiment **2**, she put water in the beaker.



(a) Both experiments were carried out at the same temperature. Explain why.

_____

_____

_____

_____

_____

(2)

(b) (i) The level of coloured liquid in the right-hand side of the manometer tube went down during Experiment **1**. Explain why.

_____

_____

_____

_____

_____

_____

*(Extra space)*_____

_____

_____

(3)

The results from both experiments are shown in the table.

Experiment	Solution in beaker	Fall in volume of coloured liquid in right-hand side of manometer / cm^3
1	Potassium hydroxide	5
2	Water	1

(ii) Use these results to calculate the volume of carbon dioxide produced during Experiment **1**.

Answer =_____ cm^3

(1)

(c) The student repeated Experiment 1 using seeds which were respiring anaerobically. What would happen to the level of coloured liquid in the right-hand side of the manometer tube? Explain your answer.

_____

_____

_____

_____

_____

(2)

(Total 8 marks)

16 A student investigated the rate of respiration of yeast cells. He set up a conical flask with a suspension of yeast in some apple juice. He took samples of the mixture at different times and found the number of yeast cells.

His results are recorded in the table below.

Time from start of investigation /days	Mean number of yeast cells ($\times 10^6$) per cm^3
3	7.413
4	8.912
8	16.595
9	19.952
10	23.442
11	23.703

(a) The student set up a suspension of yeast in apple juice. Apple juice contains all the nutrients that yeast requires for growth. Name **two** types of nutrients present in the apple juice that are essential for the growth and reproduction of yeast cells.

1. _____

2. _____

(2)

(b) The student counted the yeast cells in a sample of the suspension.
Give **one** precaution the student should have taken to make sure he obtained a representative sample. Explain how this precaution would result in a representative sample.

_____

_____

_____

_____

_____

(2)

(c) Calculate the percentage increase of yeast cells between day 3 and day 4. *Show your working.*

Answer _____

(2)

(d) The increase in the number of yeast cells was less between days 10 and 11 than it was between days 3 and 4.
Give **two** reasons why.

1. _____

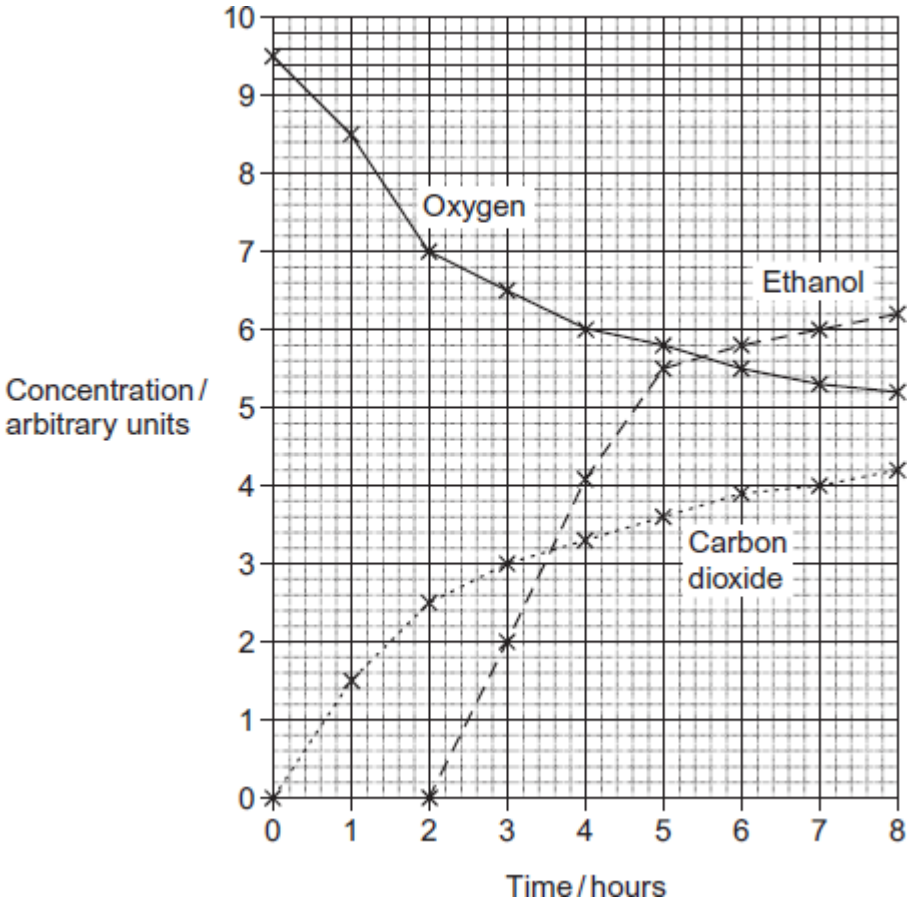
_____

2. _____

_____

(2)
(Total 8 marks)

17 A scientist investigated the use of a new source of carbohydrate in the production of ethanol for biofuel. He wanted to find the optimum time to leave a mixture of yeast and this carbohydrate to produce ethanol. The scientist set up an airtight container containing yeast and this carbohydrate. He then measured the oxygen, carbon dioxide and ethanol concentrations over 8 hours.
The results of his investigation are shown in the graph below.



(a) The scientist used a container that was airtight.
Give **two** explanations why the container had to be airtight.

1. _____

_____

_____

_____

2. _____

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(4)

(b) Explain the relationship between the concentration of oxygen and the concentration of carbon dioxide between 0 and 3 hours.

(2)

(c) The scientist concluded that yeast starts to respire anaerobically when the oxygen concentration falls below a certain concentration. What is the oxygen concentration when the yeast starts to respire anaerobically? Explain your answer.

(2)

(d) (i) The scientist worked for a biofuel company. Give **two** suggestions for further work he should do to make sure that the results he presented to the company were reliable. Explain how each of your suggestions would make the results more reliable.

Suggestion

Explanation

Suggestion

Explanation

(4)

(ii) The scientist recommended that when the ethanol is produced commercially as biofuel the reaction should be stopped at 6 hours. Use the graph to suggest why.

_____

_____

_____

_____

_____

(2)

(iii) The scientist's work was funded by a biofuel company. Explain why the source of funding can cause problems with scientific work.

_____

_____

_____

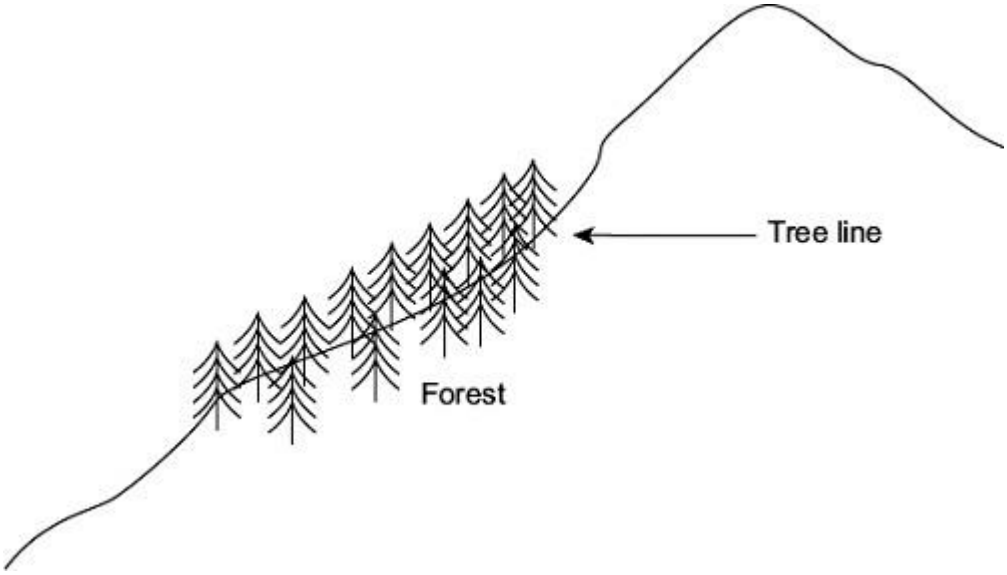
_____

_____

(2)

(Total 16 marks)

18 Mountains are harsh environments. The higher up the mountain, the lower the temperature becomes. The diagram shows a forest growing on the side of a mountain.
The upper boundary of the forest is called the tree line. Trees do not grow above the tree line.



(a) (i) The position of the tree line is determined by abiotic factors.
What is meant by an abiotic factor?

_____

_____

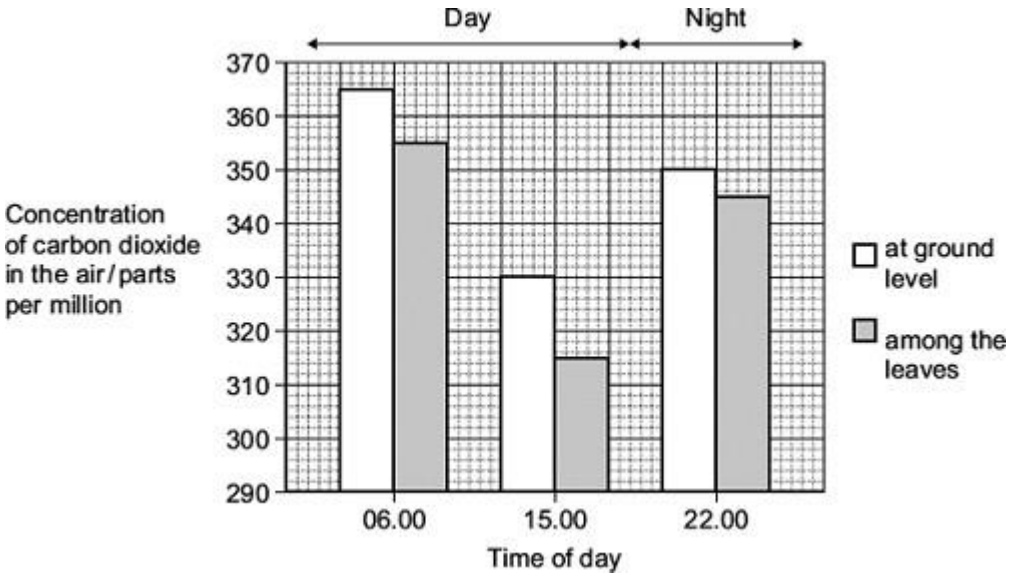
(1)

(ii) Other than temperature, suggest **one** abiotic factor that is likely to affect the position of the tree line on the mountain.

_____

(1)

(b) Scientists measured the concentration of carbon dioxide in the air in one part of the forest. They took measurements at different times of day and at two different heights above the ground. Their results are shown in the bar chart.



Use your knowledge of photosynthesis and respiration to explain the data in the bar chart.

(Extra space)

(4)

(c) The population of trees in the forest evolved adaptations to the mountain environment. Use your knowledge of selection to explain how.

(Extra space)

(3)

(Total 9 marks)

19 (a) ATP is useful in many biological processes. Explain why.

(Extra space)

(4)

(b) Describe how ATP is made in mitochondria.

(Extra space)

(6)

(c) Plants produce ATP in their chloroplasts during photosynthesis. They also produce ATP during respiration. Explain why it is important for plants to produce ATP during respiration in addition to during photosynthesis.

(Extra space)

(5)

(Total 15 marks)

20 (a) The table contains statements about three biological processes.

Complete the table with a tick if the statement in the first column is true, for each process.

	Photosynthesis	**Anaerobic respiration**	**Aerobic respiration**
ATP produced			
Occurs in organelles			
Electron transport chain involved			

(3)

(b) Write a simple equation to show how ATP is synthesised from ADP.

_____

(1)

(c) Give **two** ways in which the properties of ATP make it a suitable source of energy in biological processes.

1. _____

_____

2. _____

_____

(2)

(d) Humans synthesise more than their body mass of ATP each day. Explain why it is necessary for them to synthesise such a large amount of ATP.

_____

_____

_____

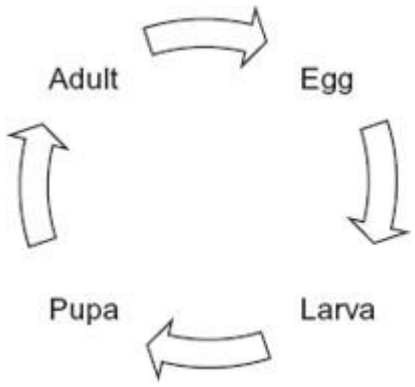
_____

_____

(2)

(Total 8 marks)

21 The diagram shows the life cycle of a fly.



When the larva is fully grown, it changes into a pupa. The pupa does not feed. In the pupa, the tissues that made up the body of the larva are broken down. New adult tissues are formed from substances obtained from these broken-down tissues and from substances that were stored in the body of the larva.

(a) Hydrolysis and condensation are important in the formation of new adult proteins. Explain how.

(2)

(b) Most of the protein stored in the body of a fly larva is a protein called calliphorin. Explain why different adult proteins can be made using calliphorin.

(1)

The table shows the mean concentration of RNA in fly pupae at different ages.

Age of pupa as percentage of total time spent as a pupa	Mean concentration of RNA / µg per pupa
0	20
20	15
40	12
60	17
80	33
100	20

(c) Describe how the concentration of RNA changes during the time spent as a pupa.

(2)

(d) (i) Describe how you would expect the number of lysosomes in a pupa to change with the age of the pupa. Give a reason for your answer.

_____

_____

_____

_____

(2)

(ii) Suggest an explanation for the change in RNA concentration in the first 40% of the time spent as a pupa.

_____

_____

_____

_____

_____

(2)

(e) Suggest an explanation for the change in RNA concentration between 60 and 80% of the time spent as a pupa.

_____

_____

_____

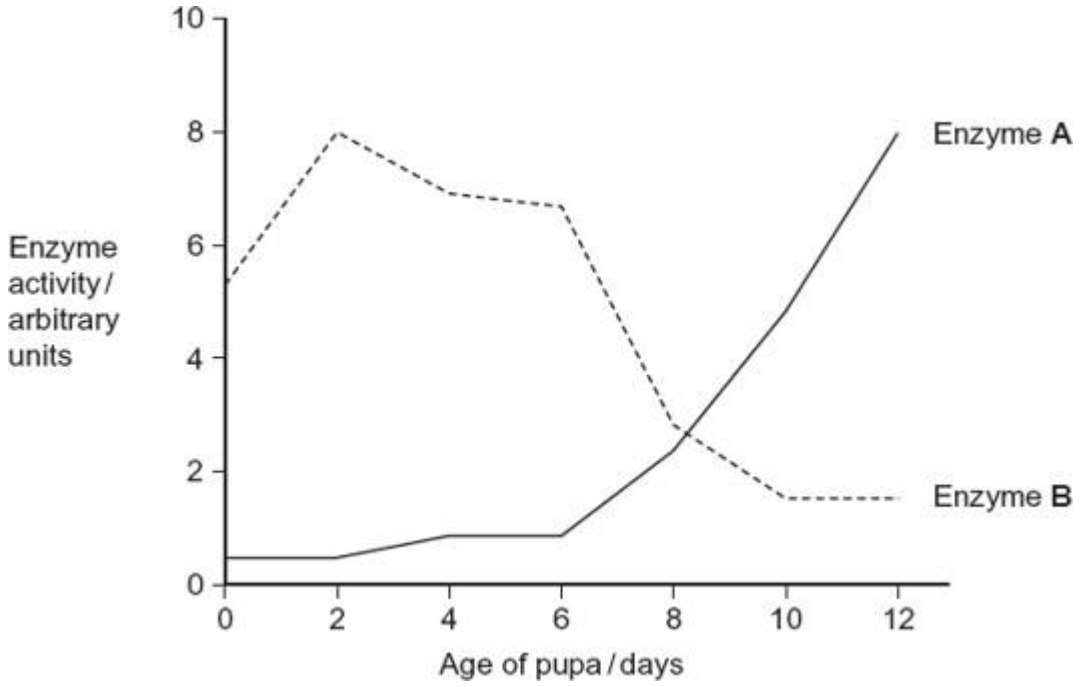
_____

_____

(2)

(f) The graph shows changes in the activity of two respiratory enzymes in a fly pupa.

- Enzyme **A** catalyses a reaction in the Krebs cycle
- Enzyme **B** catalyses the formation of lactate from pyruvate



During the first 6 days as a pupa, the tracheae break down. New tracheae are formed after 6 days. Use this information to explain the change in activity of the two enzymes.

(Extra space)

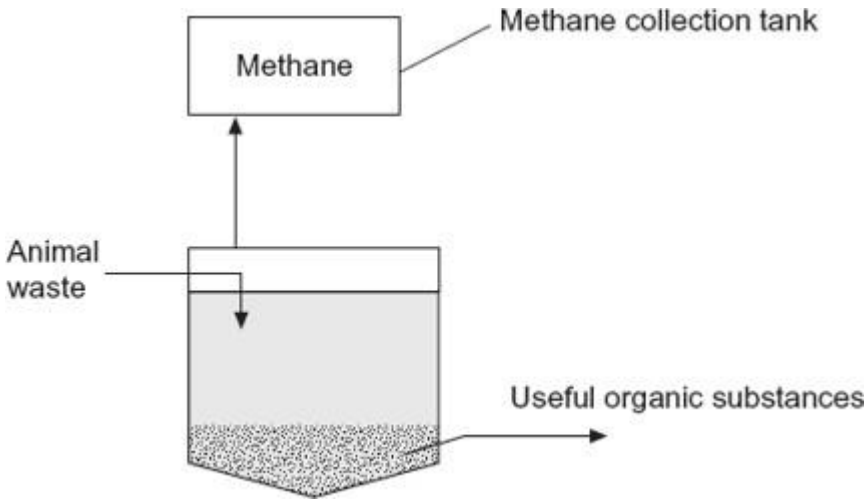
(4)

(Total 15 marks)

22 Intensive rearing of livestock produces large quantities of waste. Some farmers use an anaerobic digester to get rid of the waste.

In an anaerobic digester, microorganisms break down the large, organic molecules in the waste. This produces methane, which is a useful fuel. It also produces organic substances that can be used as a natural fertiliser.

The diagram shows an anaerobic digester.



(a) (i) Suggest **two** advantages of processing waste in anaerobic digesters rather than in open ponds.

1. _____

_____

2. _____

_____

(2)

(ii) The anaerobic digester has a cooling system, which is not shown in the diagram.

Without this cooling system the digester would soon stop working. Explain why.

_____

_____

_____

_____

_____

(2)

(b) (i) The over-application of fertiliser increases the rate of leaching. Explain the consequences of leaching of fertiliser into ponds and lakes.

(*Extra Space*)

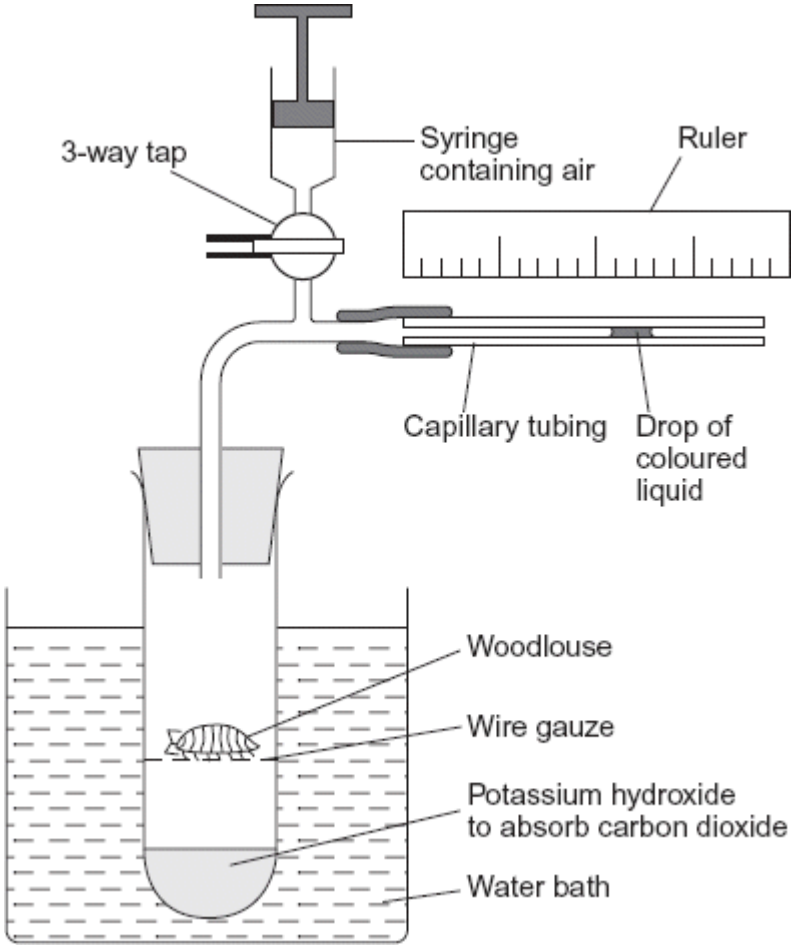
(3)

(ii) Give **one** advantage of using natural fertiliser produced in the digester rather than an artificial fertiliser.

(1)

(Total 8 marks)

23 (a) A student measured the rate of aerobic respiration of a woodlouse using the apparatus shown in the diagram.



(i) The student closed the tap. After thirty minutes the drop of coloured liquid had moved to the left. Explain why the drop of coloured liquid moved to the left.

_____

_____

_____

_____

_____

_____

(3)

(ii) What measurements should the student have taken to calculate the rate of aerobic respiration in mm^3 of oxygen g^{-1} h^{-1}?

_____

_____

_____

_____

_____

_____

(3)

(b) DNP inhibits respiration by preventing a proton gradient being maintained across membranes. When DNP was added to isolated mitochondria the following changes were observed

- less ATP was produced
- more heat was produced
- the uptake of oxygen remained constant.

Explain how DNP caused these changes.

_____

_____

_____

_____

_____

_____

(3)

(Total 9 marks)

24 (a) Describe the part played by the inner membrane of a mitochondrion in producing ATP.

(3)

(b) A scientist investigated ATP production in a preparation of isolated mitochondria. He suspended the mitochondria in an isotonic solution and added a suitable respiratory substrate together with ADP and phosphate. He bubbled oxygen through the preparation.

(i) Why was the solution in which the mitochondria were suspended isotonic?

(1)

(ii) Explain why the scientist did **not** use glucose as the respiratory substrate.

(2)

(iii) Explain why the oxygen concentration would change during this investigation.

(1)

(Total 7 marks)

25 Doctors compared two tests for lactase deficiency.

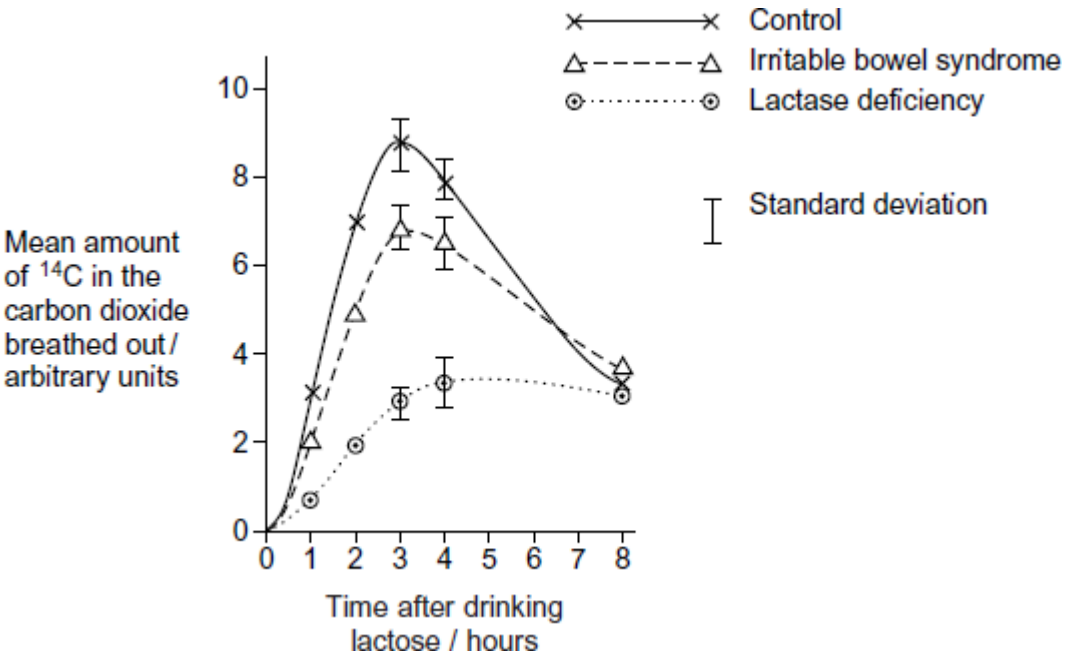
Doctors investigated three groups of people. The people in all three groups were not allowed to eat or drink for 8 hours before the test. They each then drank a solution containing 50 g of lactose made with a radioactive form of carbon called ^{14}C.

- Group **A** were the control group
- Group **B** were lactase deficient
- Group **C** had irritable bowel syndrome (IBS)

Both lactase deficieny and irritable bowel syndrome have similar symptoms.

The carbon dioxide breath test

In this test the doctors measured the amount of ^{14}C in the carbon dioxide breathed out. The doctors took measurements at intervals for 8 hours after each volunteer had drunk the lactose solution. The following figure shows the mean results for each group.



(a) Describe the common trend shown by **all** the curves in the figure.

_____

_____

_____

(1)

(b) Explain why the doctors stopped measuring the amounts of ^{14}C in the carbon dioxide breathed out after 8 hours.

(2)

(c) Carbon dioxide in the breath contained the radioactive form of carbon, ^{14}C. Explain how ^{14}C in carbon dioxide came from ^{14}C in glucose in the blood.

(2)

(d) The doctors concluded that measuring the amount of ^{14}C in the carbon dioxide in the breath after 3 hours was a better way of diagnosing lactase deficiency than the lactose tolerance test. Do you agree with the doctors' conclusion? Give the reasons for your answer.

(2)

(Total 7 marks)

26

Introduction

Resource A – D relate to a single investigation.

Scientists investigated the effect of supplying extra carbon dioxide on the yield of tomatoes growing in a glasshouse. They compared the mean yield of tomatoes from 1995 to 1997 when no extra carbon dioxide was supplied with the mean yield of tomatoes from 1998 to 2000 when extra carbon dioxide was supplied.

Resource A

Tomato plants were grown in two glasshouses, each with an area of 2000 m^2. Figure 1 shows the mean number of hours of sunshine per month during fruit production.

Figure 1

	1995 - 1997 (no extra carbon dioxide)	**1998 - 2000 (extra carbon dioxide)**
Mean number of hours of sunshine per month	148.91	147.00

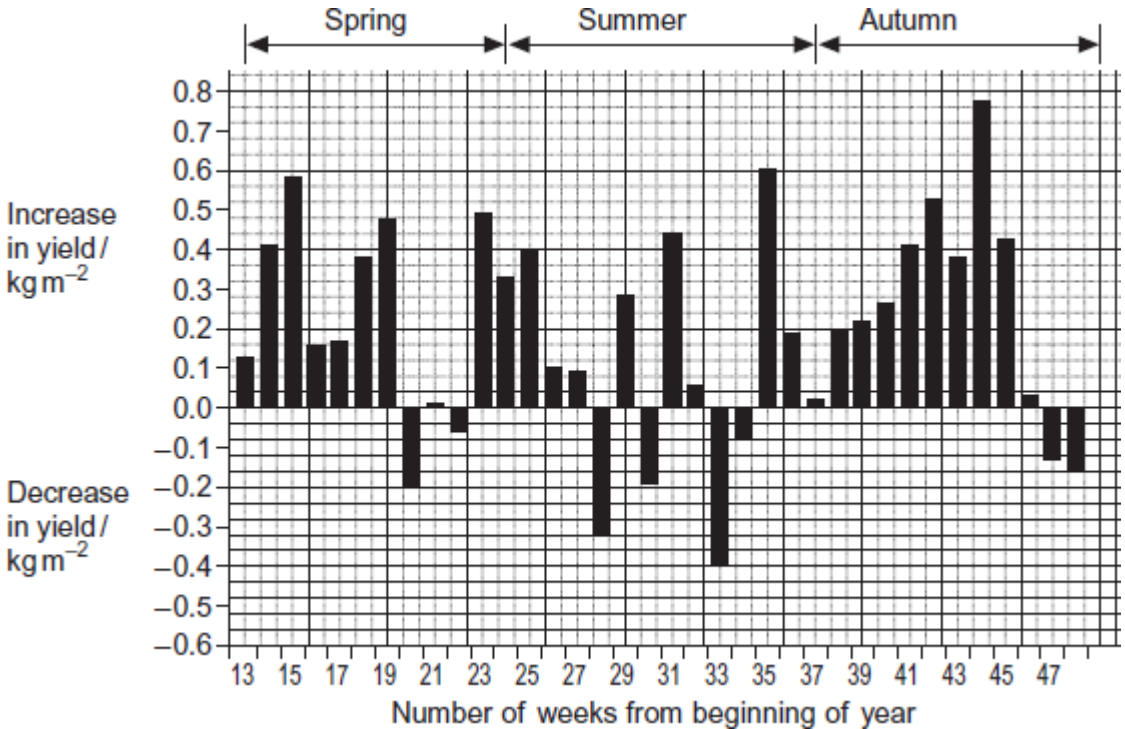
- The scientists used heating to maintain the tempera ture inside the glasshouses above 18 °C. They opened the windows to keep the tempera ture below 30 °C.
- From 1998 to 2000 they maintained the carbon dioxide concentration between 0.06 % and 0.08 % when the windows were closed and between 0.04 % and 0.05 % when the windows were open.
- The carbon dioxide concentra tion in the air outside the glasshouse was 0.04 %.

Resource B

Figure 2 shows the mean difference between the yield of tomatoes with extra carbon dioxide and the yield with no extra carbon dioxide for each week during the harvesting period.

If the yield is greater when extra carbon dioxide is supplied, the difference in yield is shown as an increase. If the yield is lower when extra carbon dioxide is supplied, the difference is shown as a decrease.

Figure 2



Resource C

Figure 3 shows the relationship between the time when the tomatoes were harvested and the yield.

Figure 3

Number of weeks from beginning of year	Mean yield per week with extra carbon dioxide / kg m^{-2}	Mean yield per week without extra carbon dioxide / kg m^{-2}
13 – 19	1.25	0.83
20 – 25	1.62	1.47
26 – 48	1.23	1.06

The commercial price for tomatoes varies with the time of year. The highest price is paid for tomatoes between weeks 13 and 19. The lowest price is paid between weeks 26 and 48.

Resource D

Whiteflies are an important insect pest of tomatoes. The adults can fly from plant to plant. Their young do not have wings. The adults and young feed on the plant sap and introduce viruses into the tomato plants. Feeding and the introduction of viruses both reduce the yield of tomatoes. The scientists controlled the number of whitefly in the glasshouses by releasing parasitic wasps. The wasps lay their eggs in the young of the whitefly. The wasp eggs hatch and feed on the young whitefly, killing them.

(a) (i) An increase in carbon dioxide concentration affected the yield of tomatoes in week 35. Use **Figure 2** to describe how.

_____

_____

(1)

(ii) There was a decrease in yield when extra carbon dioxide was supplied during some weeks of the year. Use information from **Resource A** to suggest why.

_____

_____

(1)

(b) Using **Figure 3**, calculate the percentage increase in yield when extra carbon dioxide was added for weeks 13 to 19. Show your working.

Percentage increase _____

(2)

(c) Additional information is required for tomato growers to decide whether it is economically profitable to add extra carbon dioxide to produce very early tomatoes.

Give **two** pieces of information that the growers would require.

1. _____

_____

2. _____

_____

(2)

(d) Adding extra carbon dioxide during the summer (weeks 24 – 36) is unlikely to be profitable. Use data from the resource sheet explain why.

_____

_____

_____

_____

(2)

(e) The control experiment in this investigation was when data were collected with no extra carbon dioxide added. Some scientists said this control experiment was not satisfactory. Explain how you could improve the control experiment.

_____

_____

_____

_____

(2)

(Total 10 marks)

Mark schemes

1

(a) 1. Equilibrium reached.

Accept equilibrate

2. Allow for expansion / pressure change in apparatus;
3. Allow respiration rate of seeds to stabilise.

Ignore seeds acclimatise

3

(b) 1. Optimum temperature / temperature for normal growth of seeds;
2. (Optimum temperature) for enzymes involved in respiration.

2

(c) 1. Oxygen taken up / used by seeds;
2. CO_2 given out is absorbed by KOH (solution);
3. Volume / pressure (in **B**) decreases.

3

(d) 0.975 / 0.98.

If incorrect,

0.26 × 6 / or incorrect numbers divided by 1.6 for 1 mark

2

[10]

2

(a) 1. Reduction in ATP production by aerobic respiration;
2. Less force generated because fewer actin and myosin interactions in muscle;
3. Fatigue caused by lactate from anaerobic respiration.

3

(b) Couple **A**,

1. Mutation in mitochondrial DNA / DNA of mitochondrion affected;
2. All children got affected mitochondria from mother;
3. (Probably mutation) during formation of mother's ovary / eggs;

Couple **B**,

4. Mutation in nuclear gene / DNA in nucleus affected;
5. Parents heterozygous;
6. Expect 1 in 4 homozygous affected.

4 max

(c) 1. Change to tRNA leads to wrong amino acid being incorporated into protein;
2. Tertiary structure (of protein) changed;
3. Protein required for oxidative phosphorylation / the Krebs cycle, so less / no ATP made.

3

(d) 1. Mitochondria / aerobic respiration not producing much / any ATP;
2. (With MD) increased use of ATP supplied by increase in anaerobic respiration;
3. More lactate produced and leaves muscle by (facilitated) diffusion.

3

(e) 1. Enough DNA using PCR;
2. Compare DNA sequence with 'normal' DNA.

2

[15]

3

(a) 1. Respiration/metabolism/ammonification;
2. (Releases/produces) heat;

Reject: 'produces energy'.

2

(b) 1. SD is spread of data around the mean;

Accept: variation around the mean.

*Accept: range is difference between highest and lowest values/extremes **or** range includes anomalies/outliers.*

2. (SD) reduces effect of anomalies/ outliers;

Reject: (SD) removes anomalies/outliers.

3. (SD) can be used to determine if (difference in results is) significant/not significant/due to chance /not due to chance;

Ignore: reliability/accuracy/validity.

2 max

(c) 1. Distributes heat / prevents 'hot' spots;
2. Distributes microorganisms;
3. More enzyme-substrate complexes;
4. Increases rate of decomposition;

Accept: increases nitrification/ammonification or 'breaks down waste faster'.

5. Aeration/provides oxygen;

2 max

(d) 1. Microorganisms change the abiotic conditions/temperature /organic waste /provide nutrients;

Must refer to microorganisms or bacteria/named bacteria causing the change.

Ignore: change the environment.

2. Less hostile conditions;
3. Decline in Cocci **and** increase in rods;

Accept: 'decrease in cocci, others are going up'.

Accept: decrease in cocci and increase in either rod type or increase in both types.

4. Gram positive outcompete / better competitors;

Accept: rods outcompete (cocci) / better competitors.

3 max

[9]

4

(a) 1. Time taken to reach maximum blood flow varied widely/significantly;

Must be emphasis on idea of 'widely'. Mention only of 'vary' is insufficient. Ignore use of numbers unless a comparison is given

Ignore any mention of a correlation between maximum percentage increase in blood flow and time taken to reach maximum increase in blood flow

2. Quickest after a carbohydrate-only meal;
OR
Slowest after a protein-only meal;

2

(b) 1. More blood flows to (skeletal) muscles (during exercise);

2. (supplying) more oxygen / glucose / removing more carbon dioxide/ lactic acid/ heat;

1 and 2. Idea of 'more' is needed

More blood to muscles delivering oxygen = 2 marks

3. For high (rate of) respiration / to meet increased demand for energy/ATP;
OR
Prevents anaerobic respiration/lactic acid build up;

Accept: reduces/delays for prevent

3

(c) Immediate effect of exercise after meal

1. Meal increases blood flow in (mesenteric) artery AND exercise decreases blood flow in (mesenteric) artery;

1. Will relate to information given in the tables

Overall effect on blood circulation

2. Insufficient blood (flow to small intestines / muscles);

2. Accept: blood diverted away/shunted

Ignore references to 'strain on heart', 'heart disease', 'cardiovascular diseases'

Ignore references to controlling variables and reliability

Effect on blood flow of type of meal

3. Carbohydrate meal quick(er) / during exercise;
OR
Protein/fat meal slow(er) / after exercise;

Effect of reduced blood flow on cells

4. (More) anaerobic (respiration) / lactic acid produced;
OR
less aerobic respiration;

Consequence for person of changed blood flow

5. Less absorption (of digested food) / faeces contains digested food;

6. Cramp / indigestion / discomfort / fatigue;

*Look for **ideas** in each of 5 areas*

MP1 might be spread throughout the answer

6. Ignore references to digestion

Max 4

(c) 1. (blood flows from kidney along) renal vein to vena cava;
2. (along) vena cava to right atrium/side of heart;
3. (along) pulmonary artery to lungs;
4. (along) capillaries to pulmonary vein;
5. (along) pulmonary vein to left atrium/side of heart;
6. (along) aorta to renal artery (to kidney);
7. Blood may pass through several complete circuits before returning to kidney;

Reject: 'blood vessel pumps' only once

Ignore references to valves

Ignore references to heart action/cardiac cycle

Accept labelled diagram must include directional arrows

Max 6

[15]

5

(a) (i) Cytoplasm/cytosol;

1

(ii) 1. Regenerates/produces NAD / oxidises reduced NAD;
2. NAD reduced in stage 1/glycolysis / NAD accepts hydrogen in stage 1/glycolysis;

Note: penalise use of NADP for first marking point obtained.

Do not accept NAD accepts only protons but allow accepts protons and electrons.

2

(b) (i) 1/one/1.0;

1

(ii) 1. Aerobic and anaerobic respiration occurring;

Accept: some/mainly anaerobic respiration occurring.

2. More carbon dioxide produced than oxygen uptake;

2

(c) 1. Oxygen is final/terminal (electron) acceptor / oxygen combines with electrons and protons;
2. (Aerobic respiration) oxidative phosphorylation / electron transfer chain;
3. Anaerobic (respiration) only glycolysis occurs / no Krebs / no link reaction;

Ignore: number of ATP produced.

3. Accept: without oxygen.

3. Ignore: converse.

2 max

[8]

6

(a) 1. Antigen stimulates immune response / activates B/T cells;
2. B/T cells divide OR antibodies produced;
3. Antibodies/T cells attack myelin sheaths;

Ignore references to antigen binding to myelin

3

(b) 1. Fewer cristae/smaller surface area (of cristae);
2. So less electron transport/oxidative phosphorylation;
3. (So) not enough ATP produced

OR

Not enough energy to keep neurones alive;

1. Accept 'inner membrane' as 'cristae'

2. Accept fewer ATP synthase enzymes

2. Accept lower rate of electron transfer/oxidative phosphorylation

3. Accept less use/stimulation of neurone leads to death of cell

3. Accept no/less ATP produced/no energy to keep neurones alive

3. Ignore references to glycolysis/ Krebs cycle

3

(c) (i) (Transmission) electron (microscope) – **no mark**

Need high resolution (to see structure of mitochondria)

Accept 'scanning electron microscope' /TEM/SEM

Accept – optical microscope not high enough resolution

1

(ii) 1. Took photographs/areas at random;
2. Counted total number (of normal) and number of unusual mitochondria;
3. Divided number of unusual mitochondria by total number and multiplied by 100;

1. Accept (very) large number of areas/photos/samples

MP 3 = 2 marks (includes MP2)

3

[10]

7 (a) 1. Oxidation of / hydrogen removed from pyruvate and carbon dioxide released;

2. Addition of coenzyme A.

Accept: NAD reduced for oxidation

2

(b) (i) 1. Change (in shape) of active site / active site moulds around the substrate;

Reject: reference to inhibitor

Accept: change in tertiary structure affecting active site

2. (Substrate / active site) now complementary.

Neutral: references to two active sites

2

(ii) 1. Is a competitive inhibitor / attaches to active site;

Neutral: reference to inhibitor forming an enzyme-substrate complex

2. Reduces / prevents enzyme-substrate / E-S complex forming.

Accept: Reduces / prevents acetylcoenzyme A binding to enzyme / citrate synthase

2

(c) (i) 1. Regenerates / produces NAD / oxidises reduced NAD;

2. (NAD used) in glycolysis.

Accept: description of glycolysis

Accept: glycolysis can continue / begin

2

(ii) (Pyruvate used) in aerobic respiration / (lactate / lactic acid) is toxic / harmful / causes cramp / (muscle) fatigue.

Accept: (pyruvate) can enter link reaction

Accept: reduces cramp / (muscle) fatigue

Neutral: 'reduces muscle aches'

1

[9]

8 (a) 1. Geographic(al) isolation;

2. Separate gene pools / no interbreeding / gene flow (between populations);

Accept: reproductive isolation

This mark should only be awarded in context of during the process of speciation. Do not credit if context is after speciation has occurred.

3. Variation due to mutation;
4. Different selection pressures / different abiotic / biotic conditions / environments / habitats;

Neutral: different conditions / climates if not qualified

Accept: named abiotic / biotic conditions

5. Different(ial) reproductive success / selected organisms (survive and) reproduce;

Accept: pass on alleles / genes to next generation as equivalent to reproduce

6. Leads to change / increase in allele frequency.

Accept: increase in proportion / percentage as equivalent to frequency

6

(b) 1. Capture / collect sample, mark and release;
2. Method of marking does not harm lizard / make it more visible to predators;
3. Leave sufficient time for lizards to (randomly) distribute (on island) before collecting a second sample;
4. (Population =) number in first sample × number in second sample divided by number of marked lizards in second sample / number recaptured.

4

(c) 1. High concentration of / increase in carbon dioxide linked with respiration at night / in darkness;

2. No photosynthesis in dark / night / photosynthesis only in light / day;

Neutral: less photosynthesis

3. In light net uptake of carbon dioxide / use more carbon dioxide than produced / (rate of) photosynthesis greater than rate of respiration;

4. Decrease in carbon dioxide concentration with height;

More carbon dioxide absorbed higher up

Accept: less carbon dioxide higher up / more carbon dioxide lower down

5. (At ground level)
less photosynthesis / less photosynthesising tissue / more respiration / more micro-organisms / micro-organisms produce carbon dioxide.

Neutral: less leaves unqualified or reference to animals

5

[15]

9

(a) 1. No aerobic respiration / electron transfer / oxidative phosphorylation;

Reject reference to anaerobic respiration.

2. (Because) no (respiratory) substrate / nothing to respire;

Reject idea of 'little' or 'less' − this would result in a change in oxygen concentration.

Accept the idea of no residual respiratory substrate in the mitochondria.

2

(b) (i) (Oxygen concentration falls because)

1. Aerobic respiration (uses oxygen);

Accept 'oxidative phosphorylation / electron transfer takes place'.

2. Oxygen is terminal / electron acceptor;

3. (oxygen combines with) protons / H^+ **and** electrons / e^- **to form** water / H_2O;

All aspects are required to gain mark.

2 max

(ii) Phosphate (ions) / inorganic phosphate / P_I;

Reject 'phosphorus' or 'P'.

Accept 'PO_4'.

1

(c) 1. Oxygen concentration continues to fall in plants but stays constant in animals;

For 'plants' accept 'line R to T', for 'animals' accept 'line R to S'.

MP1 and MP2. Accept answers in terms of 'use' of oxygen rather than change in concentration.

2. (Oxygen concentration) falls more slowly in plants than before cyanide added;

3. (Because aerobic) respiration continues in plant (mitochondria);

Accept (because aerobic) respiration stops in animal (mitochondria).

4. (Because) electron transfer / oxidative phosphorylation continues in plant (mitochondria);

Accept (because) electron transfer stops in animal (mitochondria).

*Accept for **one additional mark***

(up to 4 max) use of Resource A i.e: idea that plant cytochrome oxidase is (more) resistant to cyanide

OR

idea that animal cytochrome oxidase not resistant to cyanide.

4

[9]

10 (a) Prevents oxygen being taken up / entering / being absorbed;

Accept: any idea of no contact with oxygen.

Neutral: for anaerobic respiration / anaerobic conditions.

Neutral: prevents entry of air.

Reject: prevents entry of oxygen and another named gas.

1

(b) (i) 0.0155 / 0.016 = 2 marks;;

0.0775 / 0.077 / 0.078 / 0.08 = 1 mark

/ 0.62 = 1 mark

2

(ii) Glucose decreases / is a limiting factor / increase in ethanol / yeast / cells die / toxins build up;

Accept: glucose is used up.

1

(iii) 1. (Stays the) same / level / (relatively) constant;

2. Same volume / amount of oxygen uptake and carbon dioxide release;

Note: if m.p.1 is awarded m.p 2 can be obtained without referring to 'same volume / amount'.

2

(c) 1. Oxygen is final / terminal (electron) acceptor / oxygen combines with electrons and protons;

2. Oxidative phosphorylation / electron transport chain provides (most) ATP / only glycolysis occurs without oxygen / no Krebs / no link reaction;

2

[8]

11 (a) 1. (Protein / molecule) that moves from cytoplasm to DNA;

Accept 'it' as TF.

Accept moves into nucleus

2. (TF) binds to specific gene / genes / to specific part of / site on DNA / binds to promoter / RNA polymerase;

Accept regulator / enhancer region

3. Leads to / blocks (pre)mRNA production / allows / blocks binding of RNA polymerase (to DNA) / allows RNA polymerase to work;

Ignore translation unless context wrong

Max 1 if refer to oestrogen as a transcription factor

2 max

(b) 1. (Binding to CREB) prevents transcription / mRNA formation;

Accept that lack of protein leaves NAD reduced

2. (Binding of huntingtin) prevents production / translation of protein (that removes electrons / protons from NAD);

3. Fewer electrons to electron transport chain / electron transport chain slows / stops / stops / slower oxidative phosphorylation;

4. Fewer protons for proton gradient;

5. Not enough ATP produced / energy supplied to keep cells alive / anaerobic respiration not enough to keep cell alive;

Accept neurones require ATP for active transport of ions

Ignore references to resting potential

3 max

(c) 1. Mitochondrion has two membranes / inner and outer membranes;

Accept cristae for inner membrane

2. For each (different) membrane a (different) carrier required;

Ignore reference to channel proteins

2

[7]

12 (a)

Part of ecosystem	Mean rate of carbon dioxide production / $cm^3\ m^{-2}\ s^{-1}$	Percentage of total carbon dioxide production measured by the scientists
Leaves of plants	0.032	25.0
Stems and roots of plants	0.051	**39.8**
Non-photosynthetic soil organisms	0.045	**35.2**

2 correct = 2 marks;;

Adding rates to get 0.128 = 1;

If rounded to 40 and 35 in table;

- *but working shows decimal points, then award 2 marks*
- *but no working shown, then 1 max*

(b) 1. Data only include (heterotrophic) soil organisms;

2. Doesn't include animals (above ground) / other (non-soil) organisms;

3. Doesn't take into account anaerobic respiration;

Award points in any combination

Accept for 1 mark idea that CO_2 for leaves doesn't take into account photosynthesis – not told in dark until part (d)

(c) **All three** of following = 2 marks;;

Two of them = 1 mark;

Volume of carbon dioxide given off

(From known) area / per m^2 / m^{-2}

In a known / set time

Ignore 'amount' / concentration of CO_2

Accept per second / per unit time

(d) 1. (In the light) photosynthesis / in the dark no photosynthesis;

2. (In light,) carbon dioxide (from respiration) being used / taken up (by photosynthesis);

2 max

2 max

2

2

(e) (i) (Rate of respiration)

Assume "it" means soil under trees

1. In soil under trees (always) higher;
   Accept converse for soil not under trees
   Accept 'in the shade' means under the trees

2. In soil under trees does not rise between 06.00 and 12.00 / in the middle of the day / peaks at 20:00-21.00 / in the evening;

3. In soil **not** under trees, peaks at about 14:00-15:00 / in middle of day;
   2. and 3. No mm grid, so accept 'between 18.00 and 24.00' or 'between 12.00 and 18.00'

2 max

(ii) (Between 06.00 and 12.00, (No Mark))

Respiration higher in soil under tree, (No mark)

Do not mix and match mark points
No list rule

1. Tree roots carry out (a lot of) respiration;

2. More / there are roots under tree;
   Accept converse for soil not under trees

OR

3. More food under trees;

4. So more active / greater mass of / more organisms (carrying out respiration);
   Accept converse for soil not under trees

OR

Soil not under trees respiration increases (No mark)

5. Soil in sunlight gets warmer;

6. Enzymes (of respiration) work faster;
   Accept converse for soil under trees

2 max

(f) (i) 1. Photosynthesis produces sugars;

2. Sugars moved to roots;
   Do not penalise named sugars other than sucrose

3. (Sugars) are used / required for respiration;

2 max

(ii) Takes time to move sugars to roots;

Look for movement idea in (i) – can carry forward to (ii)

1

[15]

13

1. (Drink) contains carbohydrates / sugars **so** High GI / (drink) contains carbohydrates / sugars **so** raises blood glucose concentration quickly;

Each alternative requires both aspects for credit

The second alternative requires a reference to speed eg 'quickly' or 'immediately'

2. Contains salt so glucose more rapidly absorbed;

3. Increases glucose to muscles for respiration;

4. More / faster respiration so more / faster energy release;

Reject reference to energy production

Accept more ATP produced

[3]

14

(a)

	Glycolysis	**Link reaction**	**Krebs cycle**
Occurs in mitochondria		√	√
Carbon dioxide produced		√	√
NAD is reduced	√	√	√

Mark horizontally

3

(b) (i) 1. Glucose is used / broken down during glycolysis / in cytoplasm;

1. Accept: glucose to pyruvate or glucose not converted to pyruvate for one mark

2. Glucose cannot cross mitochondrial <u>membrane(s)</u> / pyruvate can cross mitochondrial <u>membrane(s)</u>;

2

(ii) 1. Is a competitive inhibitor / attaches to active site;

1 Accept: inhibitor / malonate attaches to active site to form an enzyme-substrate complex

2. Reduces / prevents enzyme-substrate / E-S complex forming;

2 Accept: substrate / succinate cannot bind to enzyme

2 Accept mark point 2, but not mp1 in context of non-competitive inhibition

2

(iii) 1. Krebs cycle inhibited as NAD / Coenzyme / FAD not / less reduced;

2. Hydrogens not passed to ETC therefore oxygen not used as (much as a) final / terminal (electron) acceptor;

2

[9]

15 (a) 1. Affects enzymes;

'respiration involves enzymes' = two marks

2. Affects respiration;

Ignore reference to controlling a variable

Or

3. Affects volume / pressure of gases;

Mark point 4 can only be awarded if mark point 3 has been credited

4. Affects readings;

2 max

(b) (i) 1. Oxygen taken up / used (by seeds);

Reject air is taken up for mark point 1

2. Carbon dioxide (given out) is absorbed by solution / potassium hydroxide;

3. Decrease in volume / pressure (inside flask);

Reference to vacuum negates mark point 3

3

(ii) 4;

1

(c) 1. Remains the same;

2. No oxygen uptake / used;

*Any reference to 'carbon dioxide **not** being produced' disqualifies mark point 2*

2

[8]

16 (a) 1. Carbohydrate / sugar / named carbohydrate;

2. Minerals / named mineral ion;

Accept alternatives for mineral such as inorganic substances / ions. Accept symbol for ion. Accept incorrect symbols providing that answers are not ambiguous.

3. Amino acids / protein;

4. Vitamins;

2 max

(b) 1. Shake / stir / mix;

2. Even distribution of yeast / cells;

Accept other terms with a similar meaning for both points

2

(c) Two marks for correct answer of 20 / 20.2 / 20.22;;

One mark for incorrect answer in which student clearly shows increase as 8.912 – 7.413 or as 1.499;

Ignore references to 10^6

2

(d) 1. More competition;

2. Less oxygen;

3. Less glucose / sugar / carbohydrate / respiratory substrate;

4. Ethanol / alcohol becomes toxic / inhibits respiration / inhibits reproduction;

5. Fall in pH;

2 max

[8]

17 (a) 1. No oxygen can enter;

2. Ethanol produced during anaerobic respiration;

OR

3. No ethanol / carbon dioxide can escape;

4. Allows accuracy of measuring;

OR

5. To prevent entry of / contamination with microorganisms;

6. Prevent competition with yeast;

Any two pairs of answers

Second mark of each pair must be related to the first point of the pair.

4 max

(b) 1. Yeast respiring aerobically;

2. Oxygen used equal to carbon dioxide produced;

2

(c) 1. 7.0 / 7;

2. Ethanol production starts;

2

(d) (i) 1. Repeat;

2. Identify anomalies / see if results are similar / enough results for statistical test / give more reliable mean;

3. Carry out statistical test / statistical analysis;

4. Ensure results are significant / find probability of results being due to chance;

5. Peer review;

6. Allows procedure to be checked / see if other scientists get similar results;

Two pairs of linked points, each pair a suggestion and an explanation. The explanation must relate to the suggestion to gain the second point of the pair.

4

(ii) 1. Curve levelling off / rate of increase is decreasing / very little extra ethanol produced;

2. Becomes less cost effective / less profit;

2. Accept a description of cost effectiveness

2

(iii) 1. (Funding agency) might want particular results;

2. Results may be withheld / results may not be published / results may be confidential;

(a) (i) N

ving / physical / chemical factor / non biological;

Do not accept named factor unless general answer given.

2 max

[16]

1

(ii) Accept an abiotic factor that may limit photosynthesis / growth;

Reject altitude / height

Water

Named soil factor

Not "soil" / "weather"

Light

Carbon dioxide

Accept Oxygen

Incline / aspect

Wind / wind speed

1

(b) 1. Correct explanation for differences between day and night e.g. photosynthesises only during the daytime / no photosynthesis / only respiration at night;

2. Net carbon dioxide uptake during the day / in light

OR

No carbon dioxide taken up at night / in dark / carbon dioxide released at night / in dark;

3. At ground level more respiration / in leaves more photosynthesis;

4. Carbon dioxide produced at ground level / carbon dioxide taken up in leaves;

Principles

Comparing day and night / light and dark

1. Explanation in terms of photosynthesis / respiration

2. Effect on carbon dioxide production / uptake

Comparing leaves with ground level

3. Explanation in terms of photosynthesis / respiration

4. Effect on carbon dioxide production / uptake

2 and 4 must relate to why the change occurs

4

(c) 1. Variation in original colonisers / mutations took place;

2. Some better (adapted for) survival (in mountains);

2. Allow "advantage so able to survive"

3. Greater reproductive success;

4. Allele frequencies change;

4. Reject gene / genotype

3 max

[9]

19

(a) 1. Releases energy in small / manageable amounts;

1. Accept less than glucose

2. (Broken down) in a one step / single bond broken immediate energy compound / makes energy available rapidly;

2. Accept easily broken down

3. Phosphorylates / adds phosphate makes (phosphorylated substances) more reactive / lowers activation energy;

3. Do not accept phosphorus or P on its own

4. Reformed / made again;

4. Must relate to regeneration

(b) 1. Substrate level phosphorylation / ATP produced in Krebs cycle;

Accept alternatives for reduced NAD

2. Krebs cycle / link reaction produces reduced coenzyme / reduced NAD / reduced FAD;

2. Accept description of either Krebs cycle or link reaction

3. Electrons released from reduced / coenzymes / NAD / FAD;

4. (Electrons) pass along carriers / through electron transport chain / through series of redox reactions;

5. Energy released;

5. Allow this mark in context of electron transport or chemiosmosis

6. ADP / ADP + Pi;

6. Accept H^+ or hydrogen ions and cristae

7. Protons move into intermembrane space;

7. Allow description of movement through membrane

8. ATP synthase;

8. Accept ATPase. Reject stalked particles

(c) 1. In the dark no ATP production in photosynthesis;

1. In context of in photosynthetic tissue / leaves

2. Some tissues unable to photosynthesise / produce ATP;

3. ATP cannot be moved from cell to cell / stored;

4. Plant uses more ATP than produced in photosynthesis;

5. ATP for active transport / synthesis (of n

amed substance);

4

6 max

5

[15]

20 (a)

	Photosynthesis	Anaerobic respiration	Aerobic respiration
ATP produced	✓	✓	✓
Occurs in organelles	✓		✓
Electron transport chain involved	✓		✓

1 mark per column

Mark ticks only. Ignore anything else if different symbols such as crosses are used as well.

If crosses are used instead of ticks allow cross as equivalent to a tick.

Reject tick with a line through

2

(b) $ADP + P_i \longrightarrow ATP$;

Both sides correct, but allow other recognised symbols or words for phosphate ion. Reject P unless in a circle.

Accept = as equivalent to arrow

Accept reversible arrow

Ignore any reference to kJ / water

(c) 1. Energy released in small / suitable amounts;

2. Soluble;

3. Involves a single / simple reaction;

1. In context of release, not storage. Ignore producing energy / manageable amounts.

2. Reject "broken down easily / readily". Reject "quickly / easily resynthesised".

(d) 1. ATP cannot be stored / is an immediate source of energy;

2. ATP only releases a small amount of energy at a time;

21 (a) 1. Hydrolysis breaks proteins / hydrolyses proteins / produces amino acids (from proteins);

3

1

2 max

2

[8]

2

(b) Amino acids (from calliphorin) can be joined in different sequences / rearranged;

1

(c) 1. Fall, rise and fall;

2. Rise after 40 and fall after 80;

Ignore concentration values.

2

(d) (i) Fall / increase then fall;

Lysosomes associated with tissue breakdown;

2

(ii) 1. Tissues / cells are being broken down;

2. RNA is digested / hydrolysed / broken down;

3. By enzymes from lysosomes;

4. New proteins not made / no new RNA made;

2 max

(e) 1. (RNA) associated with making protein;

2. New / adult tissues are forming;

2

(f) 1. In the first 6 days no / little oxygen supplied / with breakdown of tracheae, no / little oxygen supplied;

2. (Without tracheae) respire anaerobically;

3. Anaerobic respiration involves reactions catalysed by enzyme **B** / conversion of pyruvate to lactate / involves lactate production;

4. Enzyme **A** / Krebs cycle is part of aerobic respiration;

Or, with emphasis on aerobic respiration:

1. Tracheae supply oxygen / after 6 days oxygen supplied;

2. (With tracheae) tissues can respire aerobically.

4

[15]

22

(a) (i) 1. Gases / correct named gas not released;

2. Conditions (in digester) can be controlled;

3. Products / named product can be collected;

4. Open ponds associated with health risk / environmental damage / eutrophication;

Correct named gases include: methane, carbon dioxide, hydrogen sulphide, nitrogen oxides

1. Allow substance = product

4. Accept 'pond' in any context

2 max

(ii) 1. Respiration causes temperature increase / release of heat;

2. Enzymes would be denatured / microorganisms killed;

2

(b) (i) 1. Increase algae / algal bloom causes light to be blocked out;

2. Plants can't photosynthesise / plants and / or algae die;

3. Bacteria / saprobionts / EW feed off / breakdown dead organisms using up oxygen / bacteria respire / BOD rises;

3

(ii) 1. Acts as soil conditioner / improves drainage / aerates soil / increases organic content of soil;

2. Contains other elements / named element / wider range of elements;

3. Production of artificial fertiliser energy-consuming;

4. Less leaching / slow release (of nutrient);

Unspecified answers relate to natural fertiliser. Ignore references to cost / eutrophication

2. i.e. elements other than nitrogen, phosphorus and potassium

1 max

[8]

23

(a) (i) 1. Oxygen taken up / used (by woodlouse);

2. Carbon dioxide (given out) is absorbed by solution / potassium hydroxide;

3. Decrease / change in pressure;

Reference to vacuum negates last marking point

Reject reference to pressure increasing inside tube

3

(ii) 1. Distance (drop moves) and time;

2. Mass of woodlouse;

3. Diameter / radius / bore of tubing / lumen / cross-sectional area;

If answer refers to measuring volume using the syringe allow 2 max –

one mark for measuring volume;

one mark for mass of woodlouse;

3

(b) 1. Less / no proton / H^+ movement so less / no ATP produced;

2. Heat released from electron transport / redox reactions / energy not used to produce ATP is released as heat;

3. Oxygen used as final electron acceptor / combines with electrons (and protons);

3

[9]

24 (a) Electrons transferred down electron transport chain;

Provide energy to take protons / H^+ into space between membranes;

Protons / H^+ pass back, through membrane / into matrix / through ATPase;

Energy used to combine ADP and phosphate / to produce ATP;

Accept: alternatives for electron transport chain.

3 max

(b) (i) Prevent damage to mitochondria caused by water / osmosis / differences in water potential;

Accept: other terms that imply damage e.g. shrink / burst

1

(ii) Glucose is used / broken down during glycolysis in cytoplasm / not in mitochondria;

Accept: 'glucose is converted to pyruvate' for description of breakdown

Glucose cannot cross mitochondrial membrane / does not enter mitochondria;

Accept: only pyruvate can

2

(iii) Terminal / final acceptor (in electron transport chain) / used to make water;

Could be shown by symbols

1

[7]

25 (a) Increase in the first 3 – 4 hours and then decrease;

1

(b) Little / no difference (at 8 hours);

Between all groups;

2

(c) Respiration (produce CO_2);

By cells / tissues;

2

(d) Clear differences between the lactose deficient and IBS / control group;

No overlap in SD;

Accept between all groups

2

[7]

26 (a) (i) Yield increases by 0.6 kg m^{-2} (when extra carbon dioxide present);

1

(ii) Temperature / light intensity so could be lower in these weeks (as temperature / light insensity not fully controlled / monitored) (over period 1998 – 2000);

1

(b) Two marks for correct answer of 50.6%;;
One mark for incorrect answer in which candidate has shown clearly that calculation based on an increase / 0.42 and original mass / 0.83

2

(c) Cost of supplying carbon dioxide;
Price of (very early) tomatoes;

2

(d) Lowest price paid for tomatoes;
Some carbon dioxide lost as windows open in summer;
Little / no mean increase in yield in summer;

2 max

(e) Grow with extra carbon dioxide in one glasshouse and without carbon dioxidein other glasshouse at same time;
So all environmental conditions / light and temperature same for experiment and control;

2

[10]