Respiration

These practice questions can be used by students and teachers and is suitable for GCSE AQA Biology topic Questions 8641

Level: GCSE AQA Biology 8641

Subject: Biology

Exam board: GCSE AQA

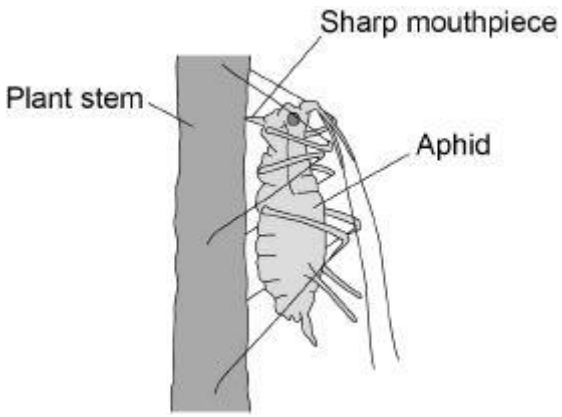
Topic: Respiration

Q1.

Aphids are small insects that carry pathogens.

Figure 1 shows an aphid feeding from a plant stem.

Figure 1



(a) An aphid feeds by inserting its sharp mouthpiece into the stem of a plant.

After feeding, the mouthpiece of an aphid contains a high concentration of dissolved sugars.

Which part of the plant was the aphid feeding from?

Tick **one** box.

- Palisade layer ☐
- Phloem ☐
- Stomata ☐
- Xylem ☐

(1)

(b) What is the process that transports dissolved sugars around a plant?

Tick **one** box.

Filtration ☐

Respiration ☐

Translocation ☐

Transpiration ☐

(1)

(c) Plants infected with aphids have stunted growth.

Explain **one** way the removal of dissolved sugars from the stem of the plant causes stunted growth.

_____

_____

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(2)

(d) Most aphids do not have wings when they hatch. After several generations, some aphids hatch which have wings and can fly.

Explain the advantage to the aphid of being able to fly.

_____

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_____

_____

(2)

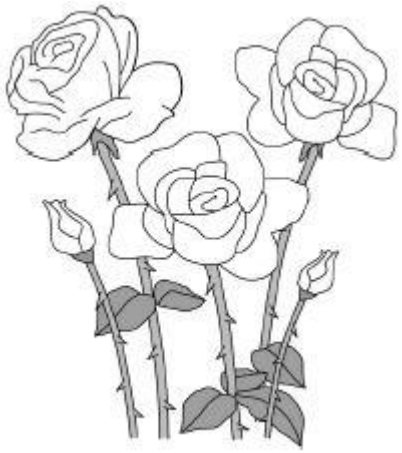
(e) The leaves of some plants release oils onto their surface.

Suggest how the production of oil on the surface of a leaf may protect the plant from aphids.

(1)

Figure 2 shows part of a rose plant.

Figure 2

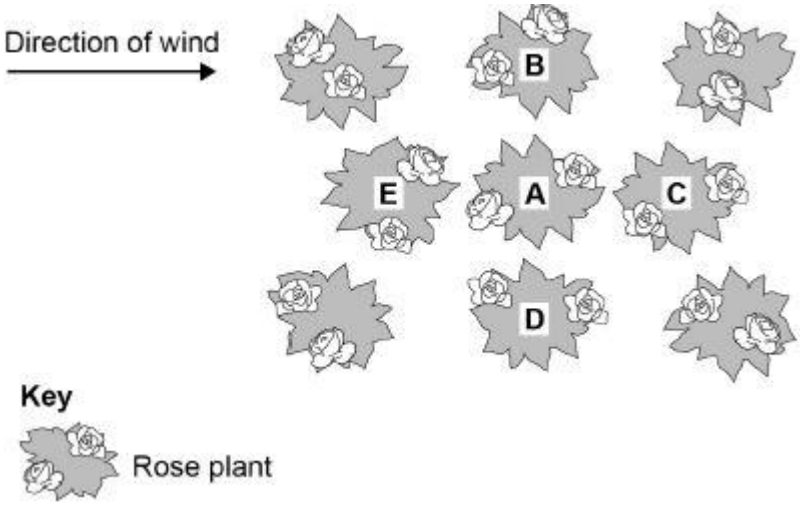


(f) Give **one** adaptation shown in **Figure 2** that helps the rose plant defend itself.

(1)

Figure 3 shows a plan of a garden containing rose plants.

Figure 3



(g) Plant **A** has the fungal disease rose black spot.

Which plant in **Figure 3** is the fungus likely to spread to first?

Give a reason for your answer.

Plant _____

Reason

_____

_____

_____

_____

_____

_____

(2)

(h) Suggest **one** way the gardener could reduce the spread of rose black spot to the other plants in the garden.

_____

_____

_____

_____

(1)

(Total 11 marks)

Q2.

Earthworms are small animals that live in soil. Earthworms have no specialised gas

exchange system and absorb oxygen through their skin.

(a) What is the name of the process in which oxygen enters the skin cells?

Tick **one** box.

Active transport ☐

Diffusion ☐

Osmosis ☐

Respiration ☐

(1)

The table below shows information about four skin cells of an earthworm.

Cell	Percentage of oxygen	
	Outside cell	**Inside cell**
A	9	8
B	12	8
C	12	10
D	8	12

(b) Which cell has the smallest difference in percentage of oxygen between the outside and the inside of the cell?

Tick **one** box.

A ☐ B ☐ C ☐ D ☐

(1)

(c) Which cell will oxygen move **into** the fastest?

Tick **one** box.

A ☐ B ☐ C ☐ D ☐

(1)

(d) Earthworms have a large surface area to volume ratio.

Suggest why a large surface area to volume ratio is an advantage to an earthworm.

_____

_____

_____

_____

(1)

(e) The earthworm uses enzymes to digest dead plants.

Many plants contain fats or oils.

Which type of enzyme would digest fats?

_____

_____

_____

_____

(1)

(f) Earthworms move through the soil.

This movement brings air into the soil.

Dead plants decay faster in soil containing earthworms compared with soil containing **no** earthworms.

Explain why.

_____

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(3)

(g) When earthworms reproduce, a sperm cell from one earthworm fuses with an egg cell from a different earthworm.

Name the process when an egg cell and a sperm cell fuse.

_____

_____

(1)

(h) Some types of worm reproduce by a process called fragmentation.

In fragmentation, the worm separates into two or more parts. Each part grows into a new worm.

What type of reproduction is fragmentation?

_____

_____

(1)

(Total 10 marks)

Q3.

Metabolism is the sum of all the chemical reactions in the cells of the body.

One metabolic reaction is the formation of lipids.

(a) Give **one** other metabolic reaction in cells.

_____

_____

_____

_____

(1)

Table 1 shows the mean metabolic rate of humans of different ages.

Table 1

Age in years	Mean metabolic rate in kJ/m²/hour	
	Males	Females
5	53	53

15	45	42
25	39	35
35	37	35
45	36	35

(b) What **two** conclusions can be made from the data in **Table 1**?

Tick **two** boxes.

As age increases, mean metabolic rate of males and females increases. ☐

Males have a higher metabolic rate than females after five years of age. ☐

The mean metabolic rate of females decreases faster than males up to 25 years of age. ☐

The mean metabolic rate of males and females decreases more quickly after the age of 35. ☐

There is no relationship between age and mean metabolic rate. ☐

(2)

(c) Calculate the percentage decrease in the mean metabolic rate of males between 5 years and 45 years of age.

Use the equation:

$$\text{percentage decrease} = \frac{\text{decrease in metabolic rate}}{\text{original metabolic rate}} \times 100$$

Give your answer to 3 significant figures.

Percentage decrease = _____

(3)

Regular exercise can increase metabolic rate.

Two people did five minutes of gentle exercise from rest.

Table 2 shows the effect of the exercise on their heart rates.

Table 2

Time in minutes	**Heart rate in beats per minute**	
	Person R	**Person S**
0 (at rest)	60	78
1	76	100
2	85	110
3	91	119
4	99	129
5	99	132

(d) Describe **two** differences in the response of person **R** and person **S** to the exercise.

Use information from **Table 2**.

1. _____

_____

2. _____

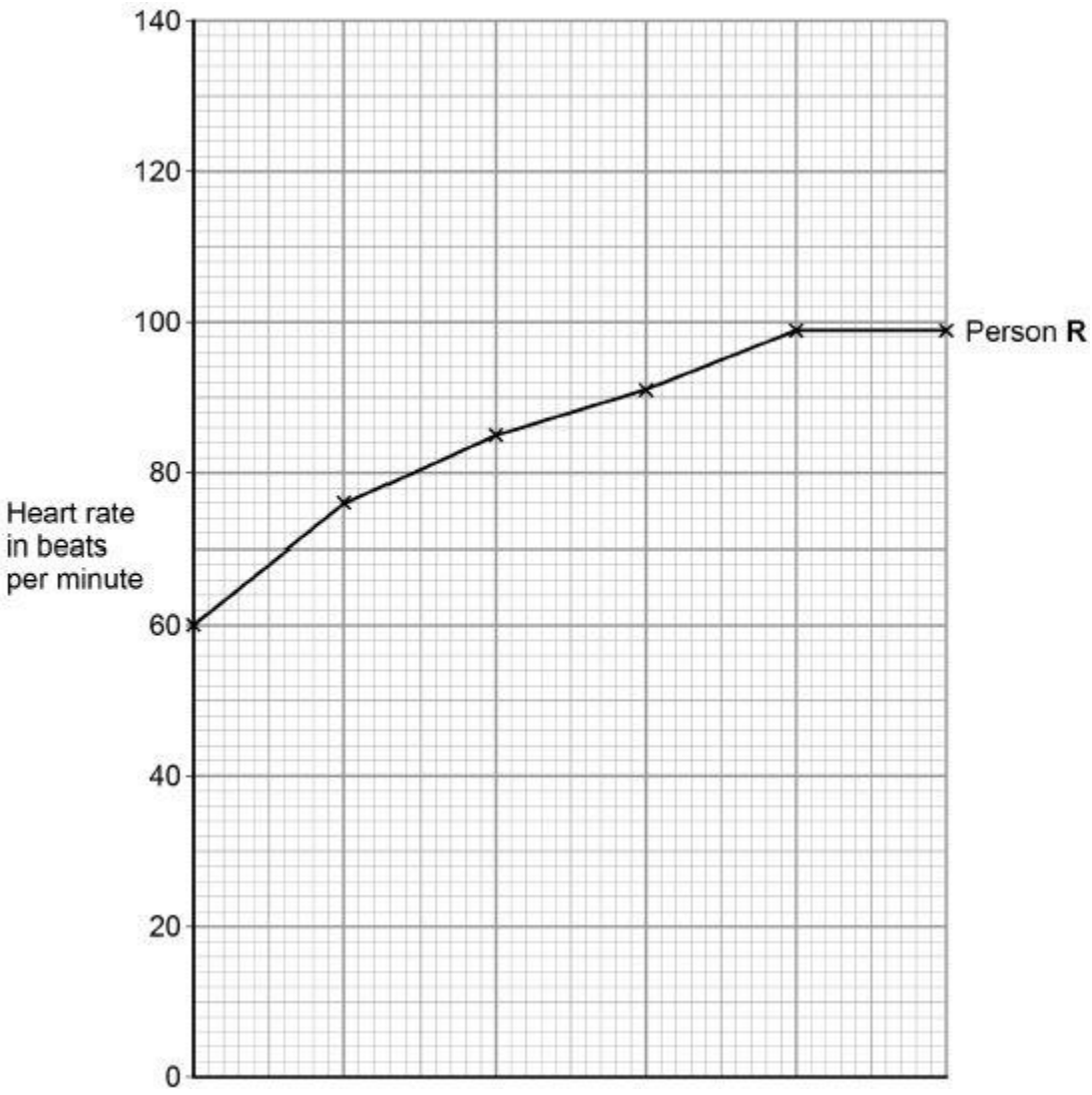
_____

(2)

(e) Complete the line graph below for person **S**.

You should:

- add the scale to the x axis
- label the x axis.



(4)

(f) After five minutes of exercise, the heart rate of person **S** was 132 beats per minute. When person **S** rested, his heart rate decreased steadily at a rate of 12 beats every minute.

Calculate how much time it would take the heart rate of person **S** to return to its resting rate.

_____

_____

_____

_____

Time = _____ minutes

(2)

(g) A student made the following hypothesis about the heart rate of smokers and non-smokers during exercise.

"During exercise, the heart rate of smokers increases more than the heart rate of non-smokers."

Design an investigation that would allow you to test this hypothesis.

(6)

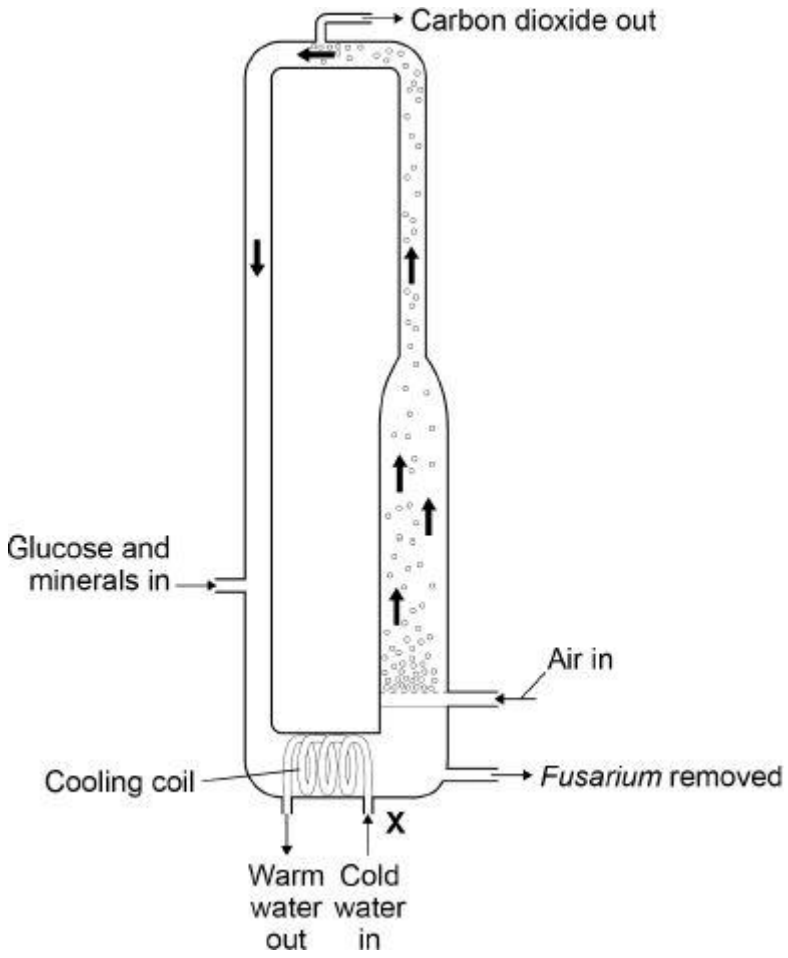
(Total 20 marks)

Q4.

Mycoprotein is a protein-rich food.

Mycoprotein is made from the fungus *Fusarium*.

The diagram below shows a fermenter used for growing *Fusarium*.



(a) Explain why the fermenter is sterilised before use.

_____

_____

_____

_____

_____

_____

_____

_____

(2)

(b) Cold water is pumped through the cooling coil at point **X**.

This maintains a constant temperature inside the fermenter.

Suggest the temperature at which *Fusarium* grows fastest.

Tick **one** box.

5 °C ☐

20 °C ☐

30 °C ☐

85 °C ☐

(1)

(c) Glucose and bubbles of air enter the fermenter.

The bubbles of air supply oxygen.

Explain why *Fusarium* needs glucose and oxygen.

_____

_____

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_____

_____

(2)

(d) The bubbles of air also move materials around the fermenter.

Suggest why it is useful for bubbles of air and materials to move around inside the fermenter.

_____

_____

_____

_____

_____

_____

_____

_____

(2)

(e) 100 grams of chicken meat contains 22 grams of protein.

100 grams of mycoprotein contains 11 grams of protein.

A man ate 100 grams of chicken in one meal.

How many grams of mycoprotein would the man need to eat to get the same mass of protein as in 100 grams of chicken?

Tick **one** box.

100 grams ☐

110 grams ☐

200 grams ☐

220 grams ☐

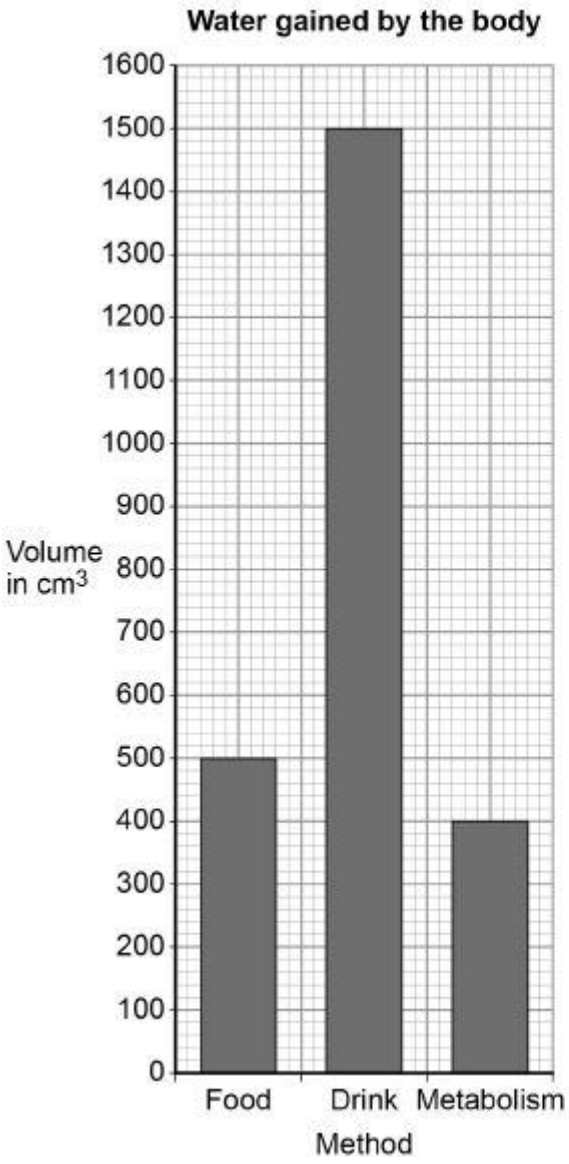
(1)

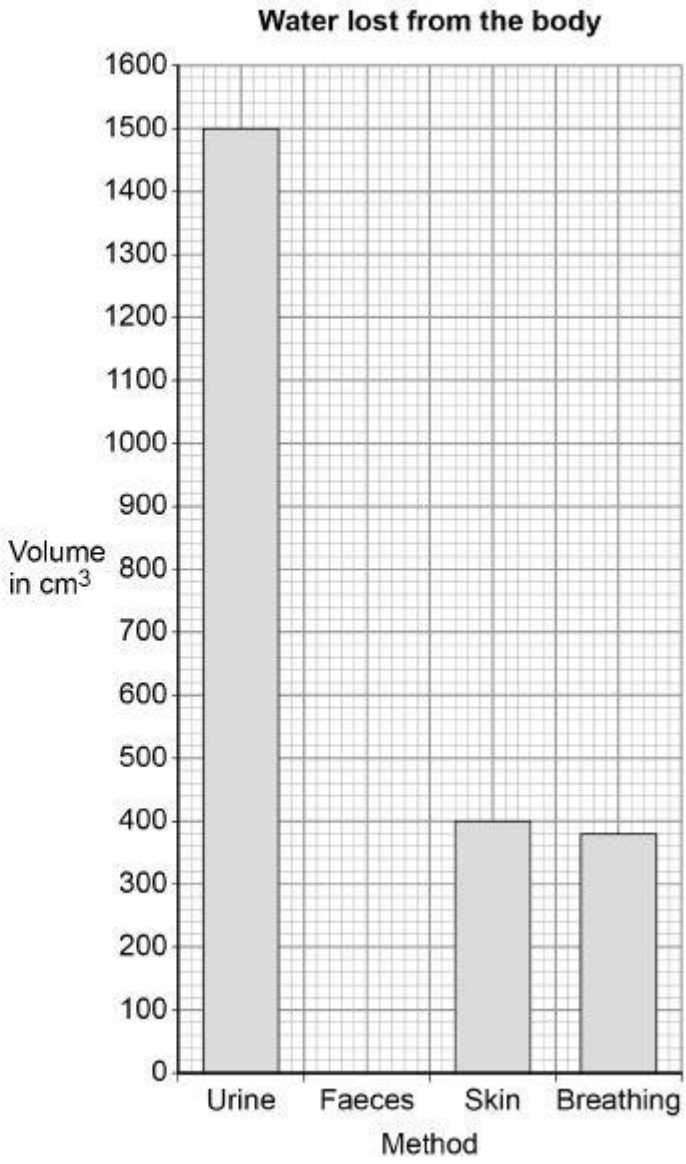
(Total 8 marks)

Q5.

It is important to maintain water balance in the body.

The graphs below show how much water a person gained and lost by different methods in one day.





When water is balanced, the volume of water taken in by the body is equal to the volume of water lost from the body.

(a) Calculate the volume of water the person lost in one day in faeces.

Use information from the graphs above.

_____

_____

_____

_____

_____

_____

Volume lost in faeces = _____ cm^3

(2)

(b) The graphs above show that one method of gaining water is by metabolism.

Which metabolic process produces water?

Tick **one** box.

Breakdown of protein to amino acids	☐
Changing glycogen into glucose	☐
Digestion of fat	☐
Respiration of glucose	☐

(1)

The next day, the person ran a 10-kilometre race.

The volume of water lost from the body through the skin and by breathing increased.

(c) Explain why more water was lost through the skin during the race.

(2)

(d) Explain why more water was lost by breathing during the race.

_____

_____

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_____

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_____

(3)

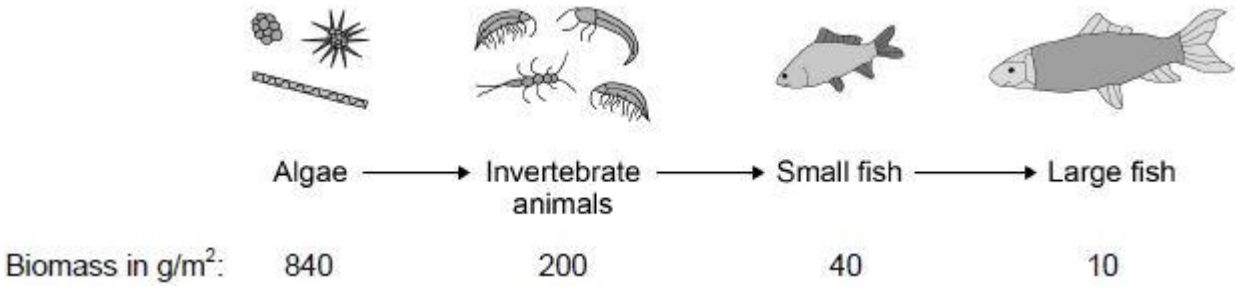
(Total 8 marks)

Q6.

Figure 1 shows:

- a food chain for organisms in a river
- the biomass of the organisms at each trophic level.

Figure 1

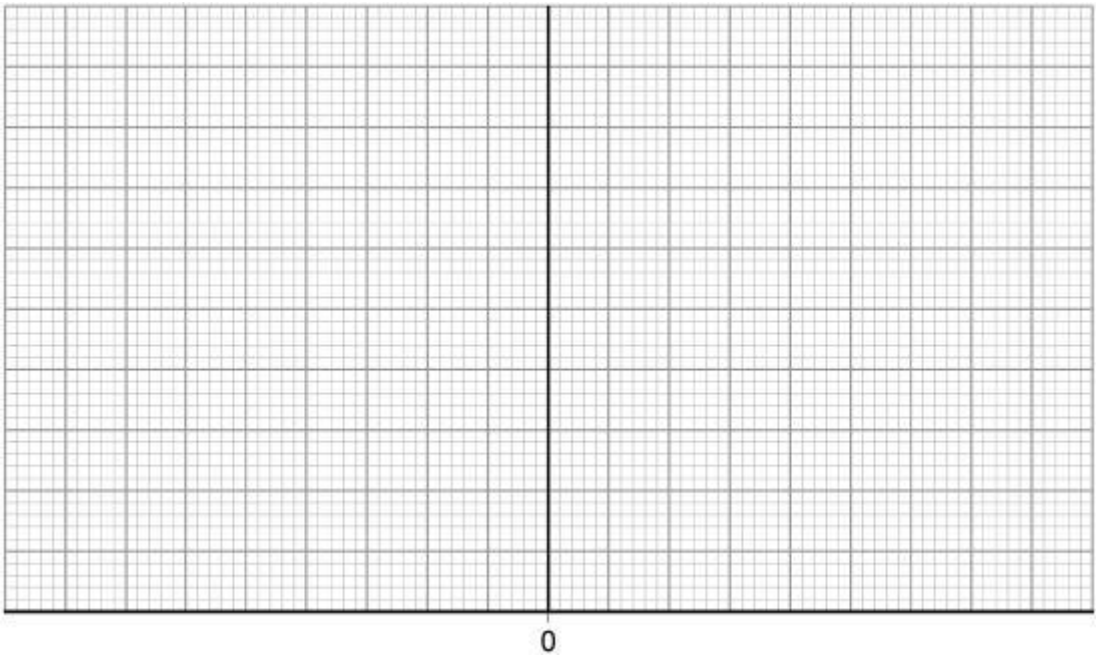


(a) Draw a pyramid of biomass for the food chain in **Figure 1** on **Figure 2**.

You should:

- use a suitable scale
- label the x-axis
- label each trophic level.

Figure 2



(4)

(b) Calculate the percentage of the biomass lost between the algae and the large fish.

Give your answer to 2 significant figures.

Percentage loss = _____

(3)

(c) Give **one** way that biomass is lost between trophic levels.

(1)

(d) A large amount of untreated sewage entered the river. Many fish died.

Untreated sewage contains organic matter and bacteria.

Explain why many fish died.

(5)

(Total 13 marks)

Q7.

Glucose is broken down in respiration.

(a) What is the chemical formula for glucose?

Tick **one** box.

$C_6H_6O_6$ ☐

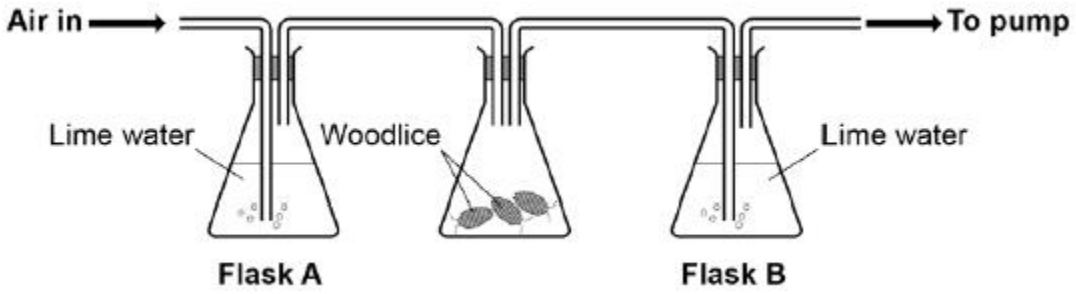
$C_3H_6O_3$ ☐

$C_6H_{12}O_6$ ☐

$C_6H_{10}O_6$ ☐

(1)

The diagram shows the apparatus a student used to investigate aerobic respiration.



Limewater goes cloudy when carbon dioxide is added to it.

(b) After 10 minutes the limewater in flask **B** was cloudy, but the limewater in flask **A** remained colourless.

Explain why.

_____

_____

_____

_____

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_____

_____

_____

(2)

(c) Flask **A** acts as a control in this investigation.

What is the purpose of a control?

_____

_____

_____

_____

(1)

(d) The student repeated the investigation with no woodlice.

Describe the appearance of the limewater in flask **A** and flask **B** after 10 minutes.

Flask **A**

_____

_____

_____

Flask **B**

_____

_____

_____

(2)

Anaerobic respiration is another form of respiration in living organisms.

(e) What is produced during anaerobic respiration in humans?

Tick **one** box.

Carbon dioxide	☐
Carbon dioxide and lactic acid	☐
Lactic acid	☐
Oxygen and water	☐

(1)

(f) Complete the equation for anaerobic respiration in yeast.

glucose → carbon dioxide +

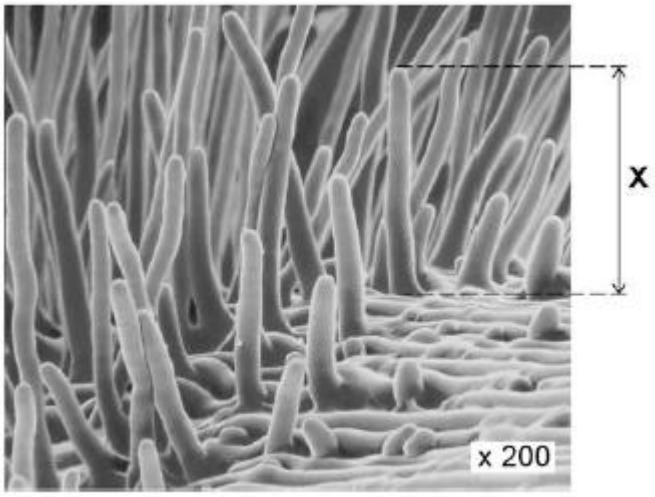
_____

(1)

(Total 8 marks)

Q8.

The image below shows part of a root from a cress plant.



(a) What type of microscope was used to create the image above?

_____

_____

(1)

(b) The magnification of the cress root in the image above is × 200.
There are 1000 micrometres (μm) in a millimetre (mm).

Calculate the real length of the root hair, **X**.
Give your answer in micrometres (μm).

Real length **X** = _____ μm

(2)

(c) Root hair cells take up water from the soil.

Explain **one** way in which the root hair cell is adapted to this function.

(2)

The table shows the water uptake by a plant's roots on two different days.

	Mean water uptake in cm^3 per hour
Cold day	1.8
Hot day	3.4

(d) Explain why the mean rate of water uptake is higher on a hot day than on a cold day.

(3)

(e) The concentration of mineral ions in the soil is lower than in root hair cells.
Root hair cells take up mineral ions from the soil.
Root hair cells contain mitochondria.

Explain why root hair cells contain mitochondria.

(4)

(Total 12 marks)

Q9.

Stem cells can be used to treat some diseases.

(a) What is a stem cell?

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_____

_____

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_____

_____

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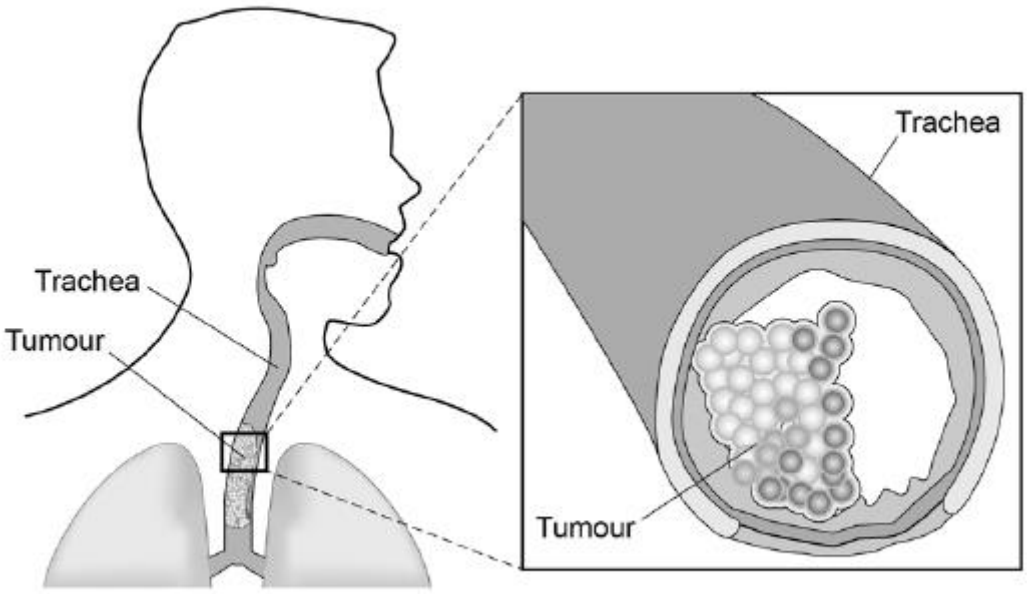
(2)

Figure 1 shows a malignant tumour in the trachea of a patient.

Figure 1



(b) Give **one** way a malignant tumour differs from a benign tumour.

_____

_____

_____

_____

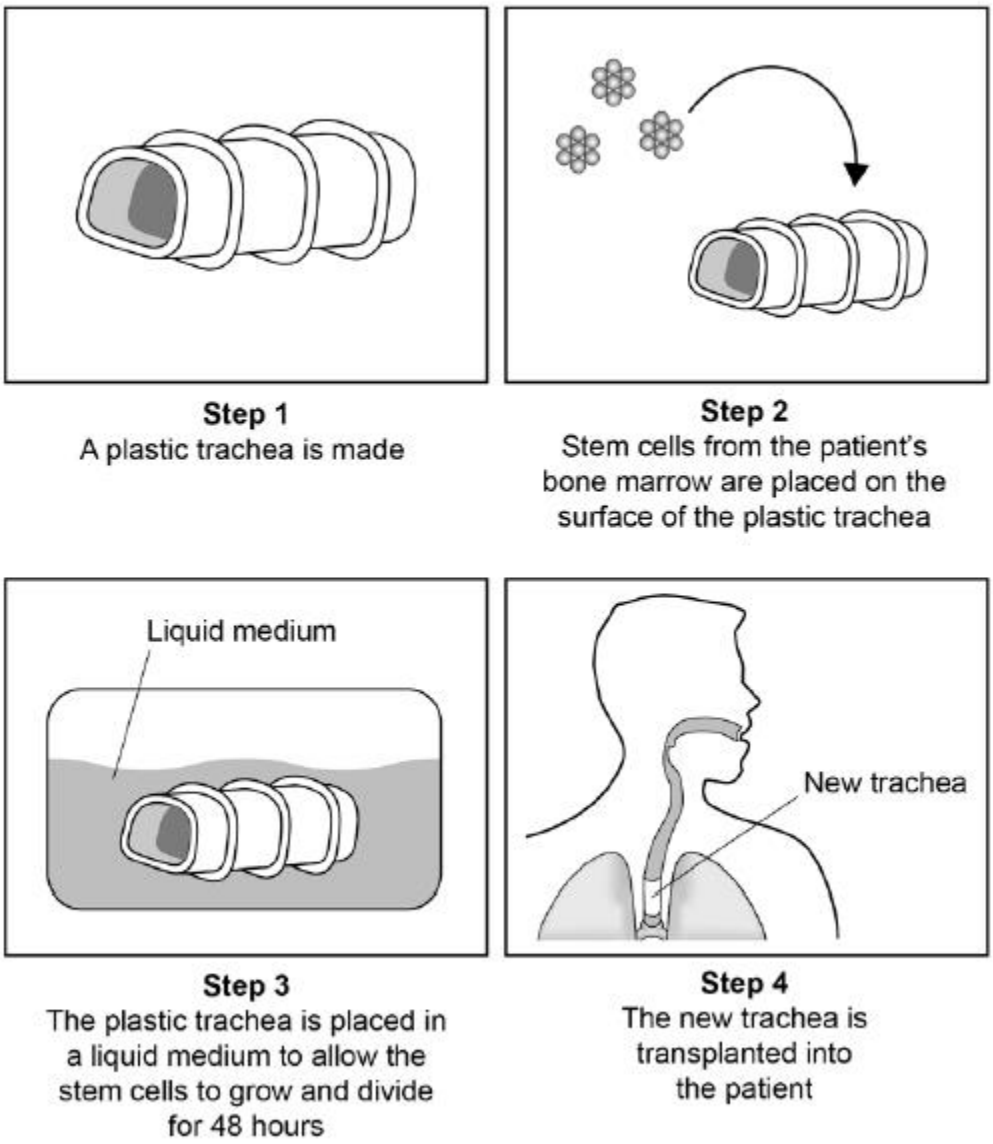
(1)

Scientists can treat the patient's tumour by replacing the trachea with a plastic trachea.

The plastic trachea has a layer of the patient's own stem cells covering it.

Figure 2 shows the procedure.

Figure 2



(c) In **Step 3** the cells are left for 48 hours to divide.

Name the type of cell division in **Step 3**.

_____

_____

(1)

(d) In **Step 3** the cells are given oxygen and water.

Name **two** other substances the cells need so they can grow and divide.

1.

_____

_____

2.

_____

_____

(2)

(e) Give **two** advantages of using the stem cell trachea compared with a trachea from a dead human donor.

1.

_____

_____

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_____

2.

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_____

_____

_____

(2)

(f) Sometimes the stem cell trachea is not strong enough.

Doctors can put a stent into the trachea.

Suggest how a stent in the trachea helps to keep the patient alive.

_____

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_____

(2)

(g) Stem cells can also be obtained from human embryos.

Evaluate the use of stem cells from a patient's own bone marrow instead of stem cells from an embryo.

Give a conclusion to your answer.

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_____

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(6)

(Total 16 marks)

Q10.

Amylase is an enzyme found in the human body.

Amylase breaks down starch into sugars.

(a) Where is amylase produced in the human body?

Tick **one** box.

Liver and pancreas ☐

Liver and stomach ☐

Salivary glands and pancreas ☐

Salivary glands and stomach ☐

(1)

(b) Enzymes speed up chemical reactions.

Explain how amylase breaks down starch.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(c) One sugar in the body is glucose.

Glucose is used for respiration.

Give **one** other use for glucose in the body.

_____

_____

(1)

(d) A student investigated the effect of temperature on the activity of human amylase.

This is the method used.

1. Put 2 cm^3 of 1% starch solution into a boiling tube.

2. Put 2 cm^3 of amylase solution into a second boiling tube.
3. Put both boiling tubes into a water bath at 20 °C.
4. After 5 minutes, mix the amylase and the starch together in one boiling tube.
5. After 30 seconds, add a drop of the starch and amylase mixture to a drop of iodine solution in one well of a spotting tile.
6. Repeat step 5 until the iodine solution no longer changes colour.
7. Repeat steps 1 – 6 at 40 °C and at 60 °C and at 80 °C

Why did the student leave the starch and amylase solutions in the water bath for 5 minutes in step **3**?

_____

_____

_____

_____

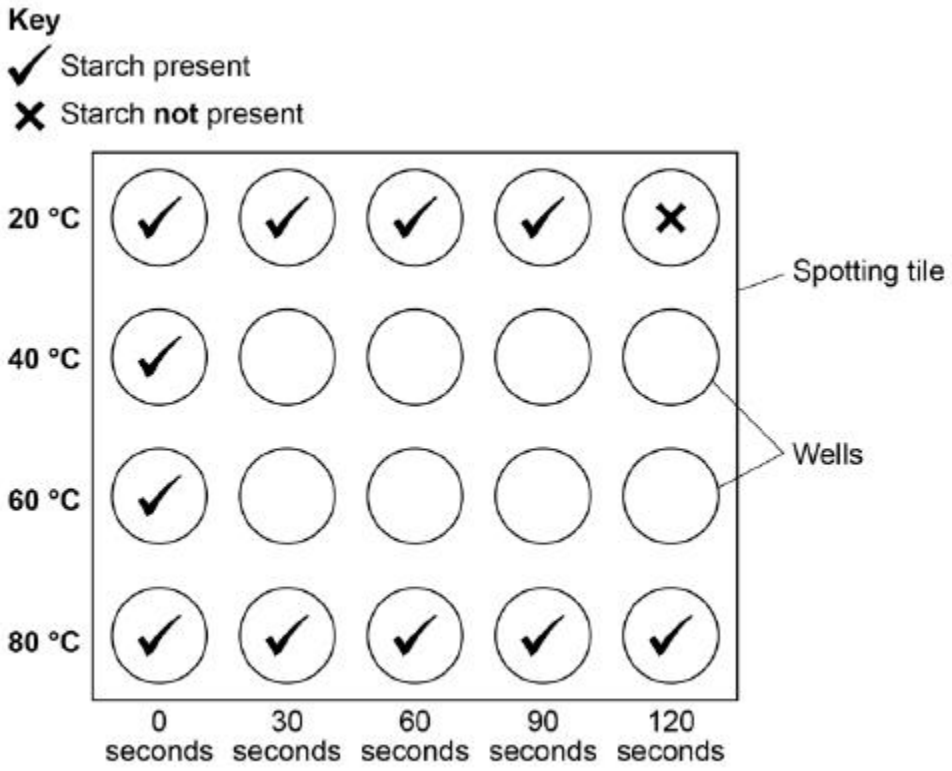
(1)

(e) The temperature of the human body is 37 °C

The diagram below shows the results of the investigation at 20 °C and at 80 °C

Complete the diagram to show the results you would expect at 40 °C and at 60 °C

You should write a tick or a cross in each well of the spotting tile.



(2)

(f) There are different ways to investigate the breakdown of starch by amylase.

One other method is to measure the **concentration** of starch present in the solution every 30 seconds.

Why is this method better than the method the student used?

_____

_____

_____

_____

_____

_____

_____

_____

(2)

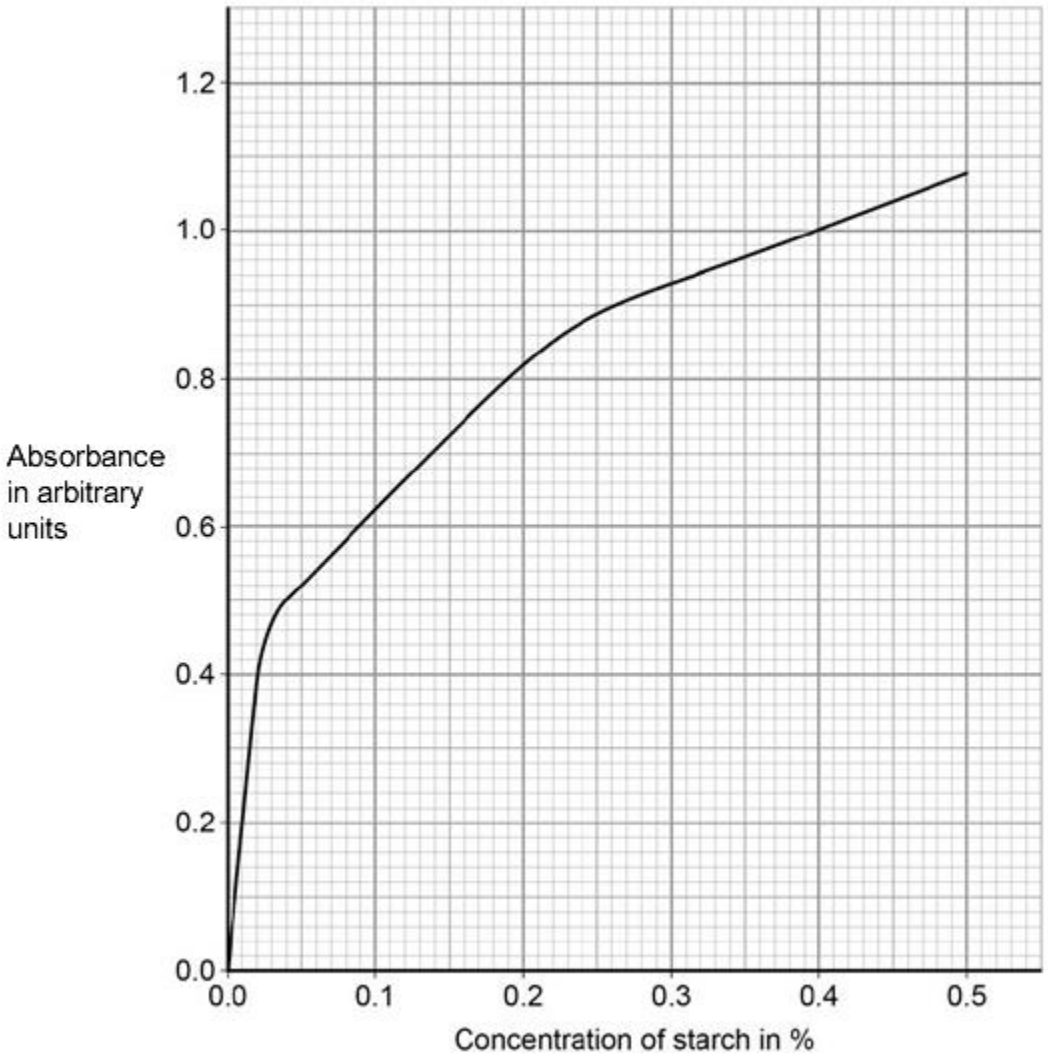
A colorimeter can be used to measure the concentration of starch present in the solution every 30 seconds.

A colorimeter measures the amount of light that **cannot** pass through a

solution.

This is known as absorbance.

Below shows a graph of absorbance against concentration of starch.



(g) The absorbance of the solution at 40 °C was 0.56 arbitrary units after 30 seconds.

What was the concentration of starch in this solution?

_____

_____

Concentration of starch = _____ %

(1)

(h) The concentration of starch in the solution at 20 °C after 1 minute is different from the concentration at 40 °C after 1 minute.

Explain why.

_____

_____

_____

_____

_____

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_____

_____

(2)

(i) Predict the absorbance for the solution at 80 °C after 30 seconds.

Give a reason for your answer.

Absorbance = _____ arbitrary units

Reason

_____

_____

_____

_____

_____

_____

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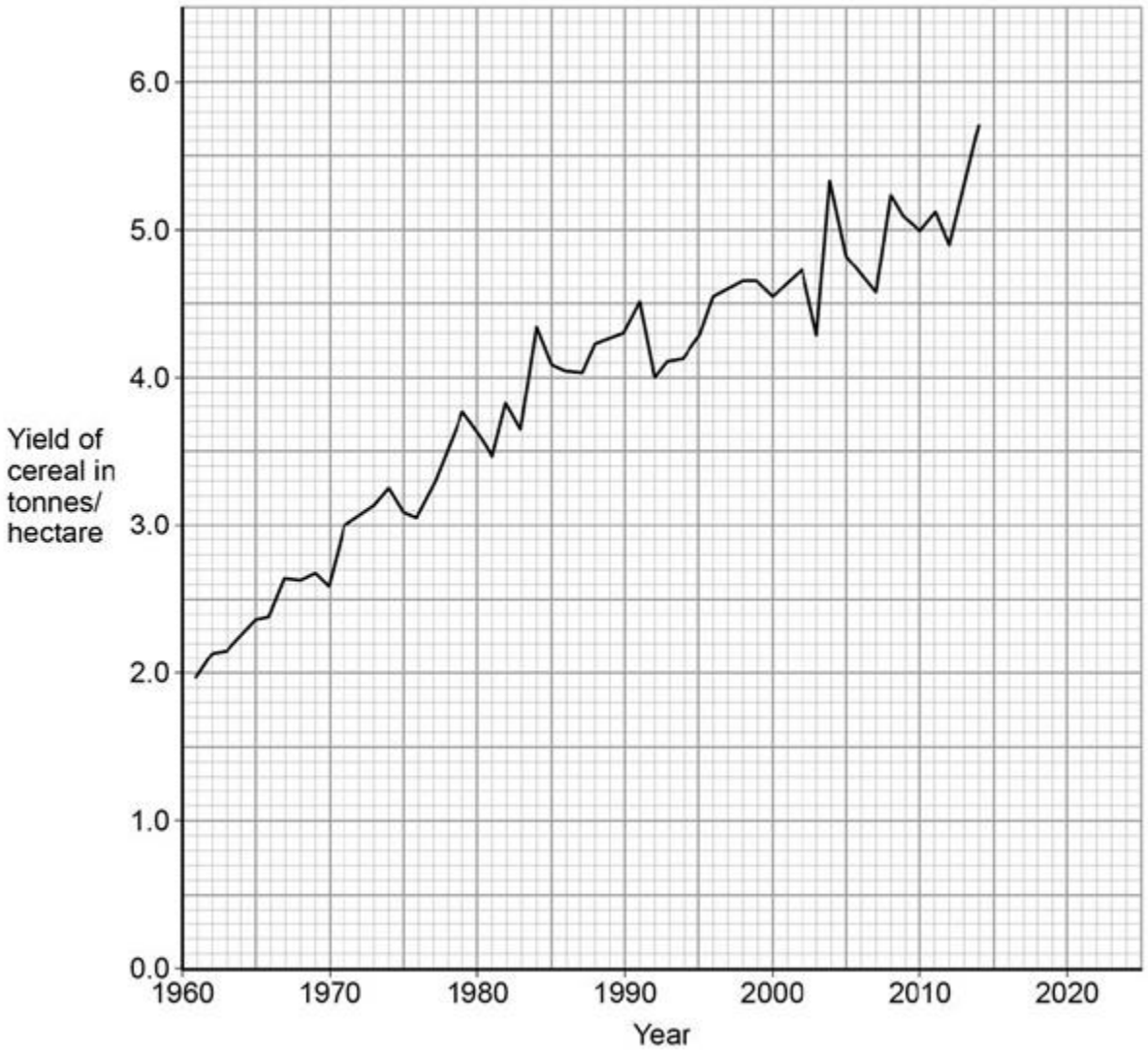
_____

(3)

(Total 16 marks)

Q11.

The graph shows information about the yield of cereal crops grown in the European Union.



(a) Calculate the increase in the yield of cereal between 1970 and 2010.

_____

_____

_____

Increase in yield = _____ tonnes/hectare

(2)

(b) Estimate by what fraction the yield of cereal increased between 1971 and 1992.

Tick **one** box.

$\frac{1}{10}$ ☐ $\frac{1}{3}$ ☐ $\frac{1}{2}$ ☐ $\frac{3}{4}$ ☐

(1)

(c) The increase in yield is partly due to increased use of nitrate fertilisers.

Which substance do plants make using nitrate ions?

Tick **one** box.

Cellulose ☐

Fat ☐

Protein ☐

Starch ☐

(1)

(d) The yield of cereal in 2004 was much greater than the yield in 2003.

Suggest **three** possible reasons for the increased yield in 2004.

Tick **three** boxes.

A genetically-modified variety of seed was sown in 2004. ☐

A pathogenic fungus grew on the cereal in 2004. ☐

Farmers added more nitrate to the soil in 2003. ☐

More cereal seeds were sown in 2003. ☐

More rain fell in spring and early summer in 2004. ☐

The mean summer temperature was lower in 2003. ☐

(3)

Humans eat cereals.

Humans also eat the animals that feed on cereals.

Figure 1 and **Figure 2** show two food chains.

Figure 1

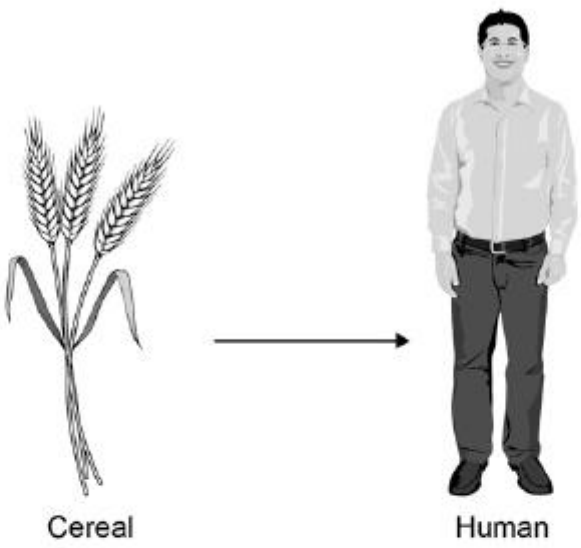
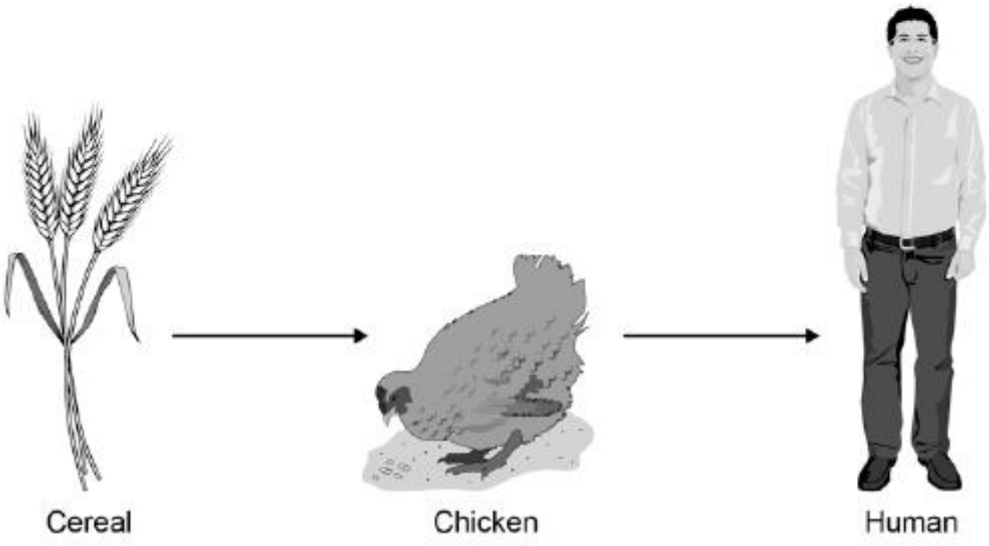
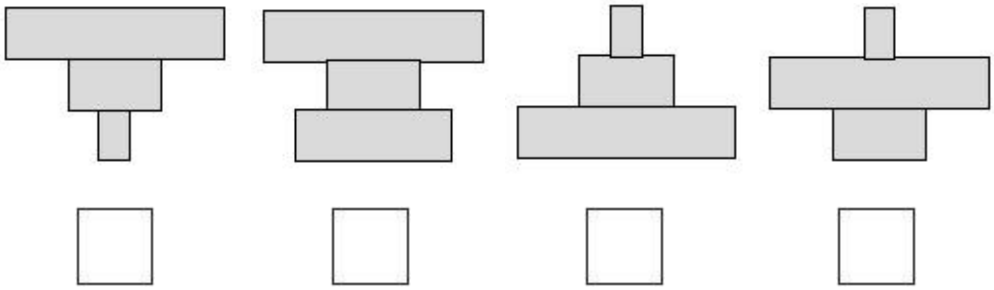


Figure 2



(e) Which pyramid of biomass is correct for the food chain shown in **Figure 2**?

Tick **one** box.



In **Figure 1**, 1 hectare of cereal crop would provide enough energy for 8 people for a year.

In **Figure 2**, 10 hectares of cereal crop would be needed to provide enough energy for only 1 person for a year.

(f) It is much more efficient for humans to get energy by eating cereals than by eating chickens.

Calculate how many times more efficient.

_____

_____

_____

_____

Answer = _____ times

(1)

(g) Why is it more efficient for humans to get energy by eating cereals than by eating chickens?

Tick **two** boxes.

Cereals gain extra energy from mineral ions in the soil. ☐

Chickens contain more protein per gram than cereals. ☐

Chickens use energy for movement and for keeping warm. ☐

Much of the food eaten by chickens is wasted as faeces. ☐

Not all parts of the cereal plants are edible. ☐

(2)

(Total 11 marks)

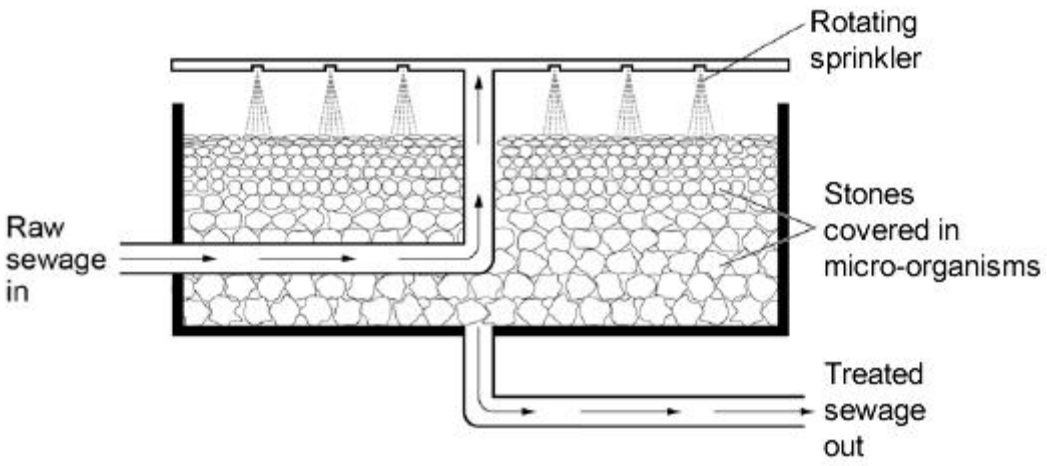
Q12.

Pollution of rivers with untreated sewage can kill plants and animals.

Figure 1 shows a sprinkler bed at a sewage works.

The sewage trickles slowly downwards over the surfaces of the stones.

Figure 1



Some of the microorganisms on the stones feed on organic matter in the sewage.

The treated sewage is safe enough to pass into a river.

(a) Most of the microorganisms in the sprinkler bed respire aerobically.

Describe **two** features of the sprinkler bed that encourage **aerobic** respiration.

Use information from **Figure 1**.

1. _____

2. _____

_____

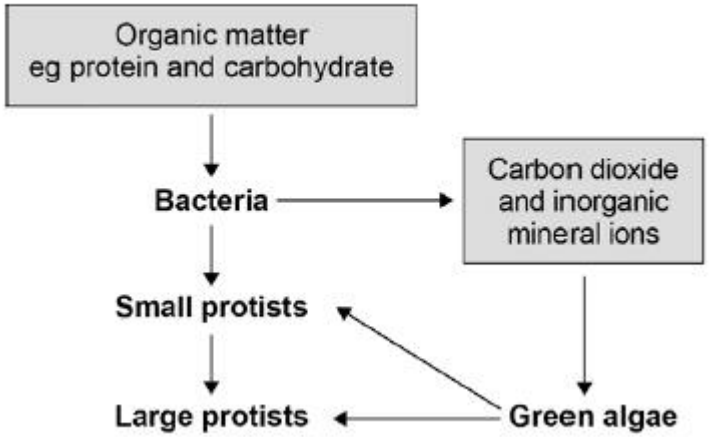
_____

_____

(2)

Figure 2 shows the feeding relationships between the microorganisms in the sprinkler bed.

Figure 2



(b) Which organisms in **Figure 2** are producers?

Tick **one** box.

Bacteria ☐

Green algae ☐

Large protists ☐

Small protists ☐

(1)

(c) Name **one** organism in **Figure 2** which is both a primary and a secondary consumer.

_____

_____

(1)

(d) The bacteria are decomposers.

Figure 2 shows that the bacteria change organic matter into carbon dioxide and inorganic mineral ions.

Describe how the bacteria do this.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 8 marks)

Q13.

Anaerobic respiration happens in muscle cells and yeast cells.

The equation describes anaerobic respiration in muscle cells.

glucose → **lactic acid**

(a) How can you tell from the equation that this process is anaerobic?

_____

_____

_____

_____

(1)

(b) Exercise **cannot** be sustained when anaerobic respiration takes place in muscle cells.

Explain why.

_____

_____

_____

_____

_____

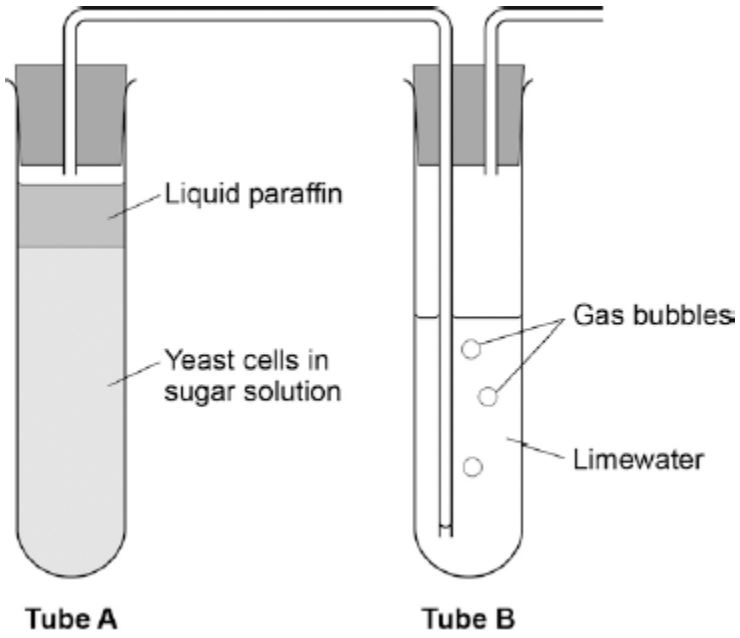
_____

_____

_____

(2)

(c) The diagram below shows an experiment to investigate **anaerobic** respiration in yeast cells.



What gas will bubble into Tube **B**?

Tick **one** box.

Carbon dioxide ☐

Nitrogen ☐

Oxygen ☐

Water vapour ☐

(1)

(d) Describe how you could use tube **B** to measure the rate of the reaction in tube **A**.

_____

_____

_____

_____

_____

_____

_____

_____

(2)

(e) Anaerobic respiration in yeast is also called fermentation.

Fermentation produces ethanol.

Give **one** use of fermentation in the food industry.

_____

_____

(1)

(Total 7 marks)

Q14.

All living cells respire.

(a) Respiration transfers energy from glucose for muscle contraction.

Describe how glucose from the small intestine is moved to a muscle cell.

_____

_____

_____

_____

_____

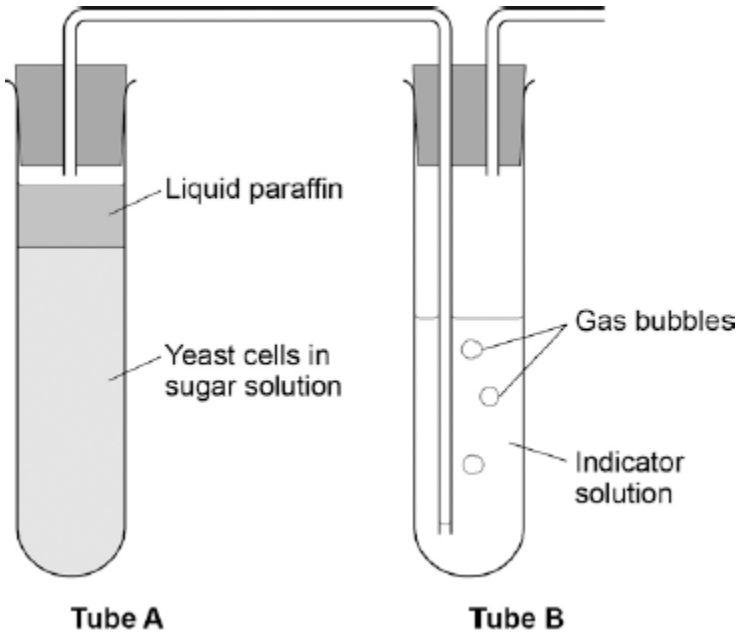
_____

_____

_____

(2)

(b) The diagram below shows an experiment to investigate **anaerobic** respiration in yeast cells.



What is the purpose of the liquid paraffin in Tube **A**?

Tick **one** box.

To prevent evaporation ☐

To stop air getting in ☐

To stop the temperature going up ☐

To stop water getting in ☐

(1)

(c) The indicator solution in Tube **B** shows changes in the concentration of carbon

dioxide (CO_2).

The indicator is:

- **blue** when the concentration of CO_2 is very low
- **green** when the concentration of CO_2 is low
- **yellow** when the concentration of CO_2 is high.

What colour would you expect the indicator to be in Tube **B** during maximum rate of anaerobic respiration?

Tick **one** box.

Blue ☐

Green ☐

Yellow ☐

(1)

(d) Suggest how the experiment could be changed to give a reproducible way to measure the rate of the reaction.

Include any apparatus you would use.

_____

_____

_____

_____

_____

_____

_____

_____

(2)

(e) Compare anaerobic respiration in a yeast cell with anaerobic respiration in a muscle cell.

_____

_____

_____

(3)

(Total 9 marks)

Q15.

A gardener wants to add compost to the soil to increase his yield of strawberries.

The gardener wants to make his own compost.

(a) An airtight compost heap causes anaerobic decay.

Explain why the gardener might be against producing compost using this method.

(2)

(b) The gardener finds this research on the Internet:

'A carbon to nitrogen ratio of 25:1 will produce fertile compost.'

Look at the table below.

Type of material to compost	Mass of carbon in sample in g	Mass of nitrogen in sample in g	Carbon:nitrogen ratio
Chicken manure	8.75	1.25	7:1
Horse manure	10.00	0.50	20:1
Peat moss	9.80	0.20	**X**

Determine the ratio **X** in the table above.

Ratio _____

(1)

(c) Which type of material in the table above would be **best** for the gardener to use to make his compost?

Justify your answer.

(1)

(d) Some of the leaves from the gardener's strawberry plant die.

The dead leaves fall off the strawberry plant onto the ground.

The carbon in the dead leaves is recycled through the carbon cycle.

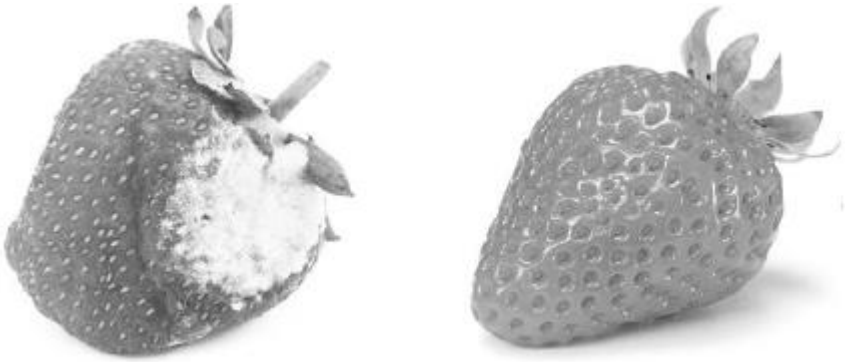
Explain how the carbon is recycled into the growth of new leaves.

(6)

(e) The diagram below shows two strawberries.

- Both strawberries were picked from the same strawberry plant.
- Both strawberries were picked 3 days ago.
- The strawberries were stored in different conditions.

Strawberry A **Strawberry B**



A © sarahdoow/iStock/Thinkstock, B © Mariusz Vlack/iStock/Thinkstock

Give **three** possible reasons that may have caused strawberry **A** to decay.

1.

2.

_____

_____

_____

3.

_____

_____

_____

(3)

(Total 13 marks)

Q16.

Students investigated decomposition.

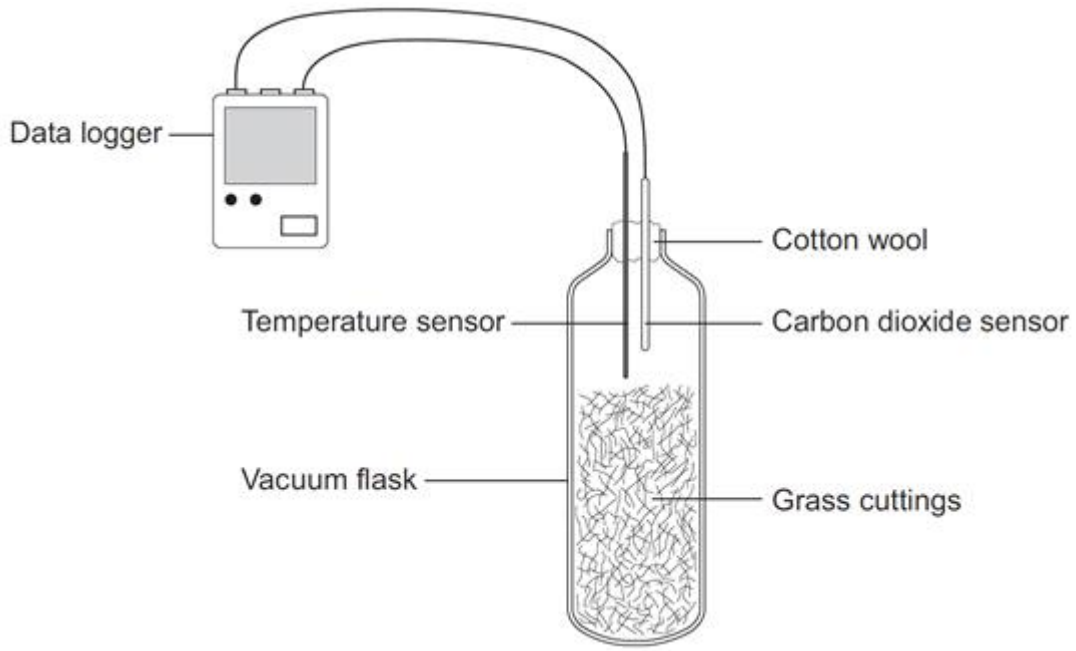
The students:

- put some decaying grass cuttings into a vacuum flask
- put a carbon dioxide sensor and a temperature sensor in the flask
- attached the sensors to a data logger
- closed the flask with cotton wool.

A vacuum flask was used to reduce the loss of thermal energy.

Figure 1 shows the investigation.

Figure 1



(a) Give **one** advantage of using a temperature sensor attached to a data logger instead of a thermometer.

_____

_____

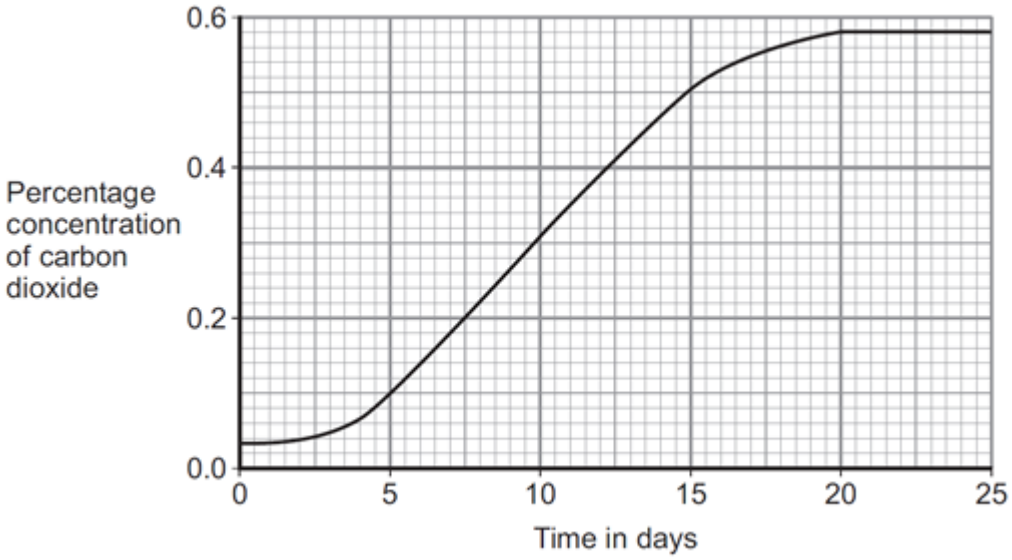
_____

_____

(1)

(b) **Figure 2** shows the results from the data logger for carbon dioxide concentration in the flask for the next 25 days.

Figure 2



(i) Why did the concentration of carbon dioxide in the flask increase?

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(ii) Suggest what has happened in the flask to cause the carbon dioxide concentration to level off after 20 days.

_____

_____

_____

_____

(1)

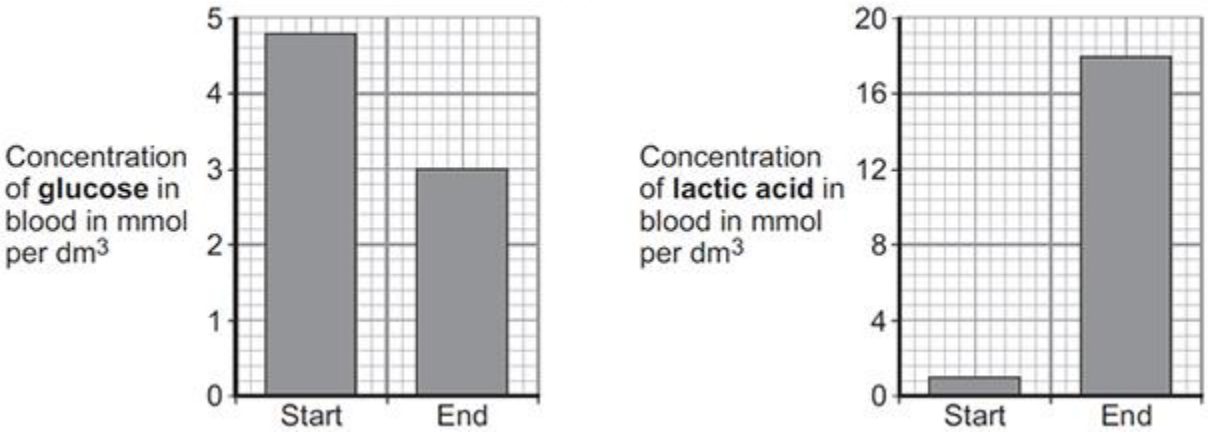
(Total 5 marks)

Q17.

An athlete ran as fast as he could until he was exhausted.

(a) **Figure 1** shows the concentrations of glucose and of lactic acid in the athlete's blood at the start and at the end of the run.

Figure 1



(i) Lactic acid is made during anaerobic respiration.

What does anaerobic mean?

_____

_____

_____

_____

(1)

(ii) Give evidence from **Figure 1** that the athlete respired anaerobically during the run.

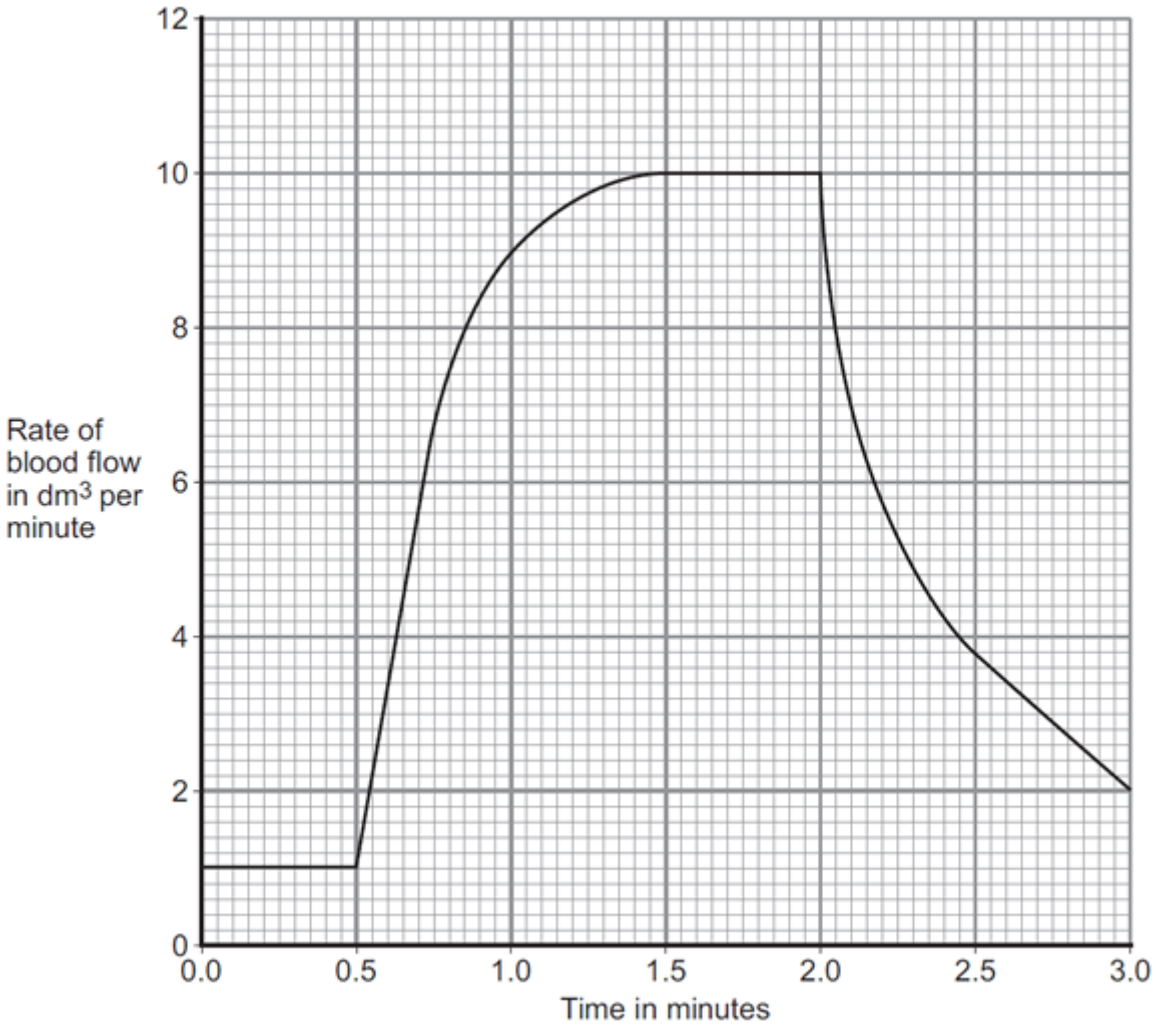
_____

_____

(1)

(b) **Figure 2** shows the effect of running on the rate of blood flow through the athlete's muscles.

Figure 2



(i) For how many minutes did the athlete run?

Time = _____ minutes

(1)

(ii) Describe what happens to the rate of blood flow through the athlete's

muscles during the run.

Use data from **Figure 2** in your answer.

(2)

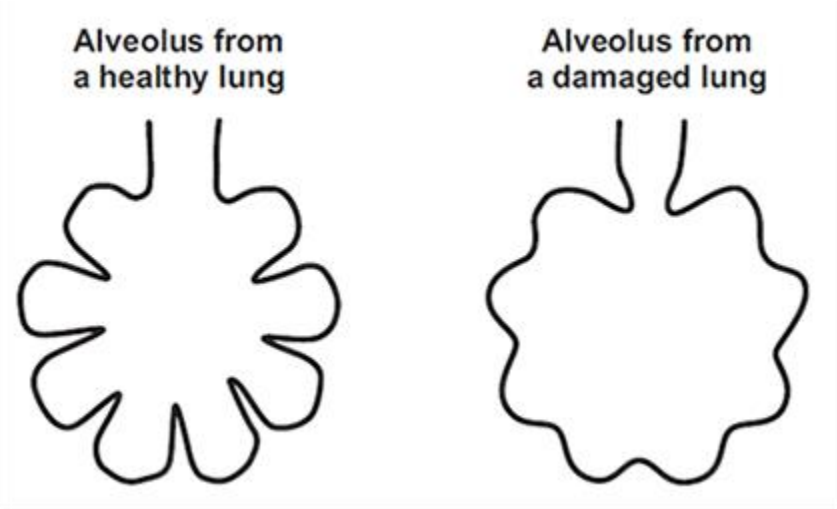
(iii) Explain how the change in blood flow to the athlete's muscles helps him to run.

(4)

(Total 9 marks)

Q18.

The diagram below shows an alveolus from a healthy lung and an alveolus from a damaged lung.



(a) Which **one** of the following is a difference between the alveolus from the damaged lung and the alveolus from the healthy lung?

Tick (✓) **one** box.

The damaged alveolus has a smaller surface area. ☐

The damaged alveolus has a shorter diffusion pathway. ☐

The damaged alveolus has a better blood supply. ☐

(1)

(b) A person with damaged alveoli finds exercising difficult.

Which **one** of the following is the reason why the damaged alveoli will make exercising difficult?

Tick (✓) **one** box.

Less carbon dioxide is taken in. ☐

Less energy is needed for exercise. ☐

Less oxygen is taken in. ☐

(1)

(Total 2 marks)

Q19.

The heart is part of the circulatory system.

(a) (i) Name **one** substance transported by the blood in the circulatory system.

_____

(1)

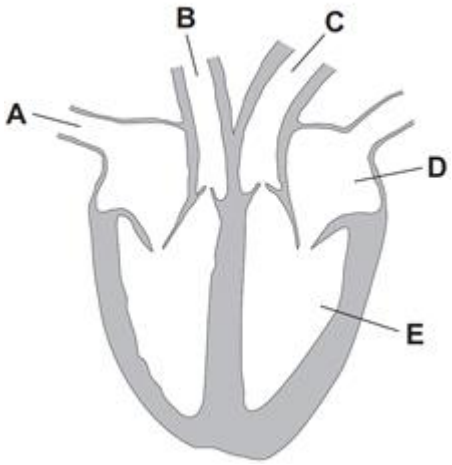
(ii) What is the main type of tissue in the heart wall?

_____

(1)

(b) **Figure 1** shows the human heart.

Figure 1



(i) Which blood vessel, **A**, **B** or **C**, takes blood to the lungs? ☐

(1)

(ii) Name parts **D** and **E** shown in **Figure 1**.

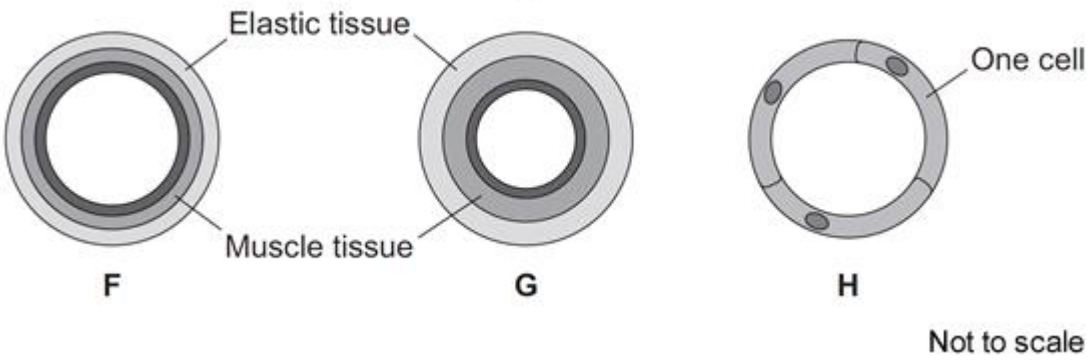
D _____

E _____

(2)

(c) **Figure 2** shows three types of blood vessel, **F**, **G** and **H**.

Figure 2



(i) What type of blood vessel is **F?**

Tick (✓) **one** box.

an artery ☐

a capillary ☐

a vein ☐

(1)

(ii) A man needs to have a stent fitted to prevent a heart attack.

In which type of blood vessel would the stent be placed?

Tick (✓) **one** box.

an artery ☐

a capillary ☐

a vein ☐

(1)

(iii) Explain how a stent helps to prevent a heart attack.

_____

_____

_____

_____

(2)

(Total 9 marks)

Q20.

Photosynthesis needs light.

(a) Complete the **balanced symbol** equation for photosynthesis.

$$6CO_2 + \underline{\qquad\qquad} \xrightarrow{\text{light}} \underline{\qquad\qquad} + 6O_2$$

(2)

(b) A green chemical indicator shows changes in the concentration of carbon dioxide (CO_2) in a solution.

The indicator solution is **green** when the concentration of CO_2 is normal.

The indicator solution turns **yellow** when the concentration of CO_2 is high.

The indicator solution turns **blue** when the concentration of CO_2 is very low or when there is no CO_2.

The indicator solution does not harm aquatic organisms.

Students investigated the balance of respiration and photosynthesis using an aquatic snail and some pondweed.

The students set up four tubes, **A**, **B**, **C** and **D**, as shown in the table below.

The colour change in each tube, after 24 hours in the light, is recorded.

Tube A	Tube B	Tube C	Tube D

			
Indicator solution only	Indicator solution + pondweed	Indicator solution + snail	Indicator solution + pondweed + snail
Stays green	Turns blue	Turns yellow	Stays green

(i) What is the purpose of **Tube A**?

_____

_____

_____

_____

(1)

(ii) Explain why the indicator solution in **Tube C** turns yellow.

_____

_____

_____

_____

_____

_____

_____

_____

(2)

(iii) Predict the result for **Tube D** if it had been placed in the dark for 24 hours and **not** in the light.

Explain your prediction.

Prediction

_____

Explanation

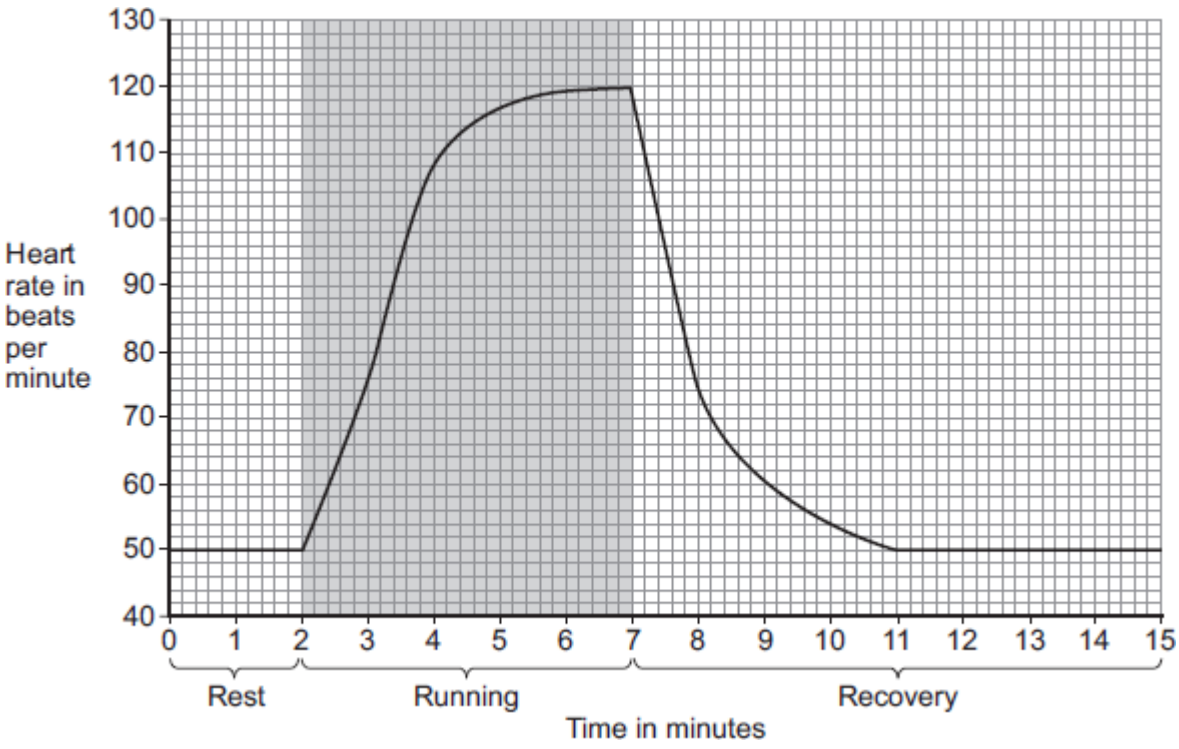
(3)
(Total 8 marks)

Q21.

A student ran on a treadmill for 5 minutes.

The speed of the treadmill was set at 12 km per hour.

The graph below shows the effect of the run on the student's heart rate.



(a) (i) What was the student's heart rate at rest?

_____ beats per minute

(1)

(ii) After the end of the run, how long did it take for the student's heart rate to return to the resting heart rate?

_____ minutes

(1)

(b) During the run, the student's muscles needed larger amounts of some substances than they needed at rest.

(i) Which **two** of the following substances were needed in larger amounts during the run?

Tick (✓) **two** boxes.

carbon dioxide ☐

glucose ☐

lactic acid ☐

oxygen ☐

protein ☐

(2)

(ii) Why are the two substances you chose in part **(b)(i)** needed in larger amounts during the run?

Tick (✓) **one** box.

To help make more muscle fibres ☐

To release more energy ☐

To help the muscles to cool down ☐

(1)

(c) After exercise, a fit person recovers faster than an unfit person.

Let the student's heart rate at the end of exercise = **a**.

Let the student's heart rate after 2 minutes of recovery = **b**.

The table below shows how the difference between **a** and **b**, (**a** − **b**), is related to a person's level of fitness.

(a − b)	**Level of fitness**
< 22	Unfit
22 to 52	Normal fitness
53 to 58	Fit
59 to 65	Very fit
> 65	Top athlete

What is the student's level of fitness?

Use information from the graph and the table.

a = _____ beats per minute

b = _____ beats per minute

(**a − b**) = _____ beats per minute

Level of fitness = _____

(3)

(d) The student repeated the run with the treadmill set at 16 km per hour.

The student's heart rate took 3 minutes longer to return to the normal resting rate than when running at 12 km per hour.

Give reasons why it took longer to recover after running faster.

_____

_____

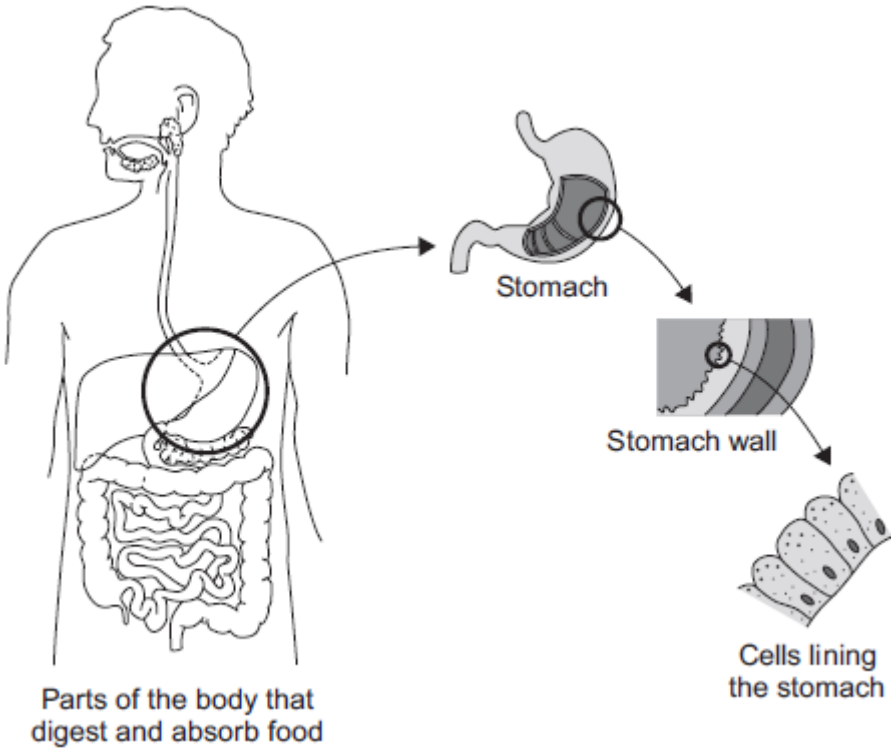
(4)

(Total 12 marks)

Q22.

The diagram below shows the parts of the body that digest and absorb food.

It also shows some details about the structure of the stomach.



(a) Complete the table to show whether each structure is an organ, an organ system or a tissue.

For each structure, tick (✓) **one** box.

Structure	**Organ**	**Organ system**	**Tissue**
Stomach			
Cells lining the stomach			
Mouth, oesophagus, stomach, liver, pancreas, small and large intestine			

(2)

(b) (i) The blood going to the stomach has a high concentration of oxygen.
The cells lining the stomach have a low concentration of oxygen.

Complete the following sentence.

Oxygen moves from the blood to the cells lining the stomach by

the process of _____ .

(1)

(ii) What other substance must move from the blood to the cells lining the stomach so that respiration can take place?

Draw a ring around the correct answer.

glucose **protein** **starch**

(1)

(iii) In which part of a cell does aerobic respiration take place?

Draw a ring around the correct answer.

cell membrane **mitochondria** **nucleus**

(1)

(Total 5 marks)

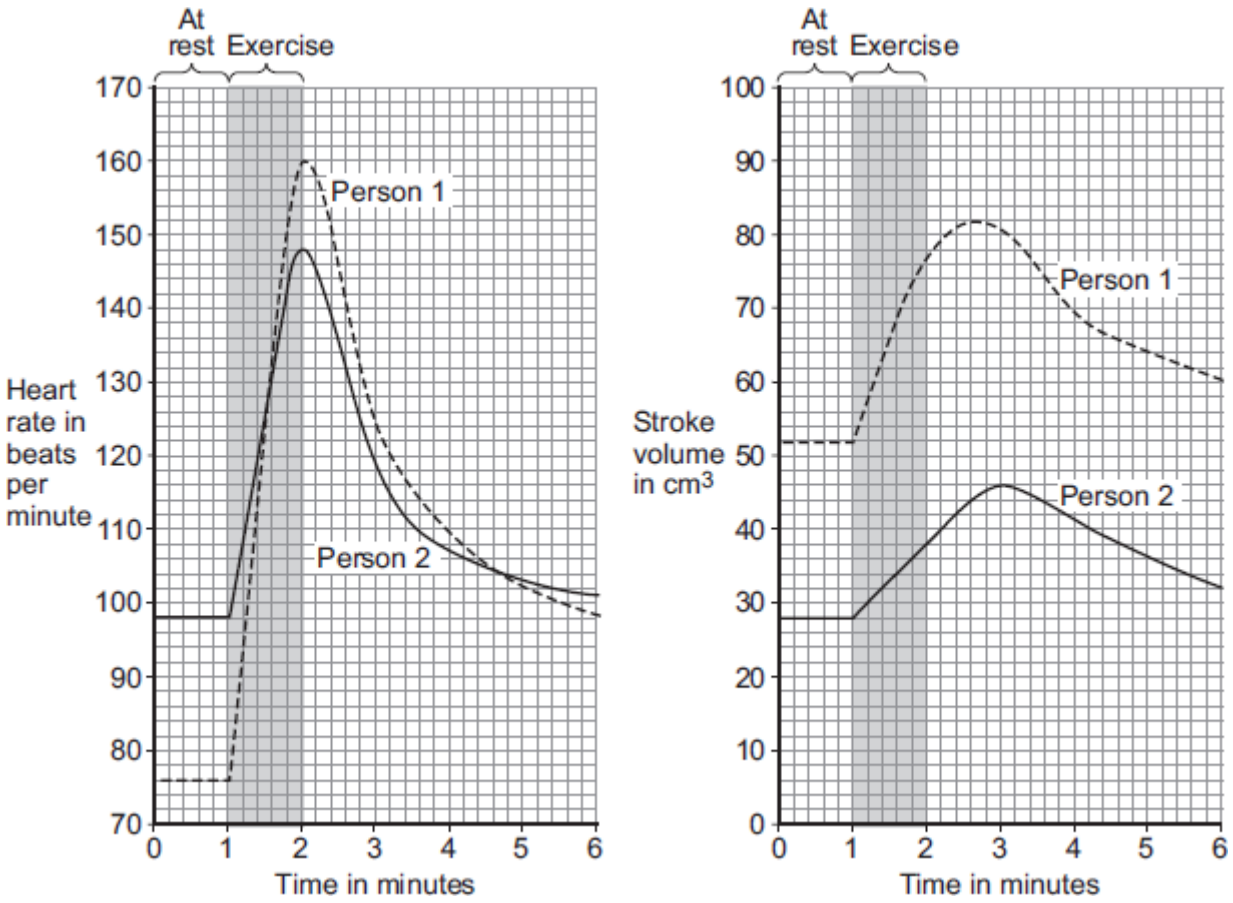
Q23.

During exercise, the heart beats faster and with greater force.

The 'heart rate' is the number of times the heart beats each minute.The volume of blood that travels out of the heart each time the heart beats is called the 'stroke volume'.

In an investigation, **Person 1** and **Person 2** ran as fast as they could for 1 minute. Scientists measured the heart rates and stroke volumes of **Person 1** and **Person 2** at rest, during the exercise and after the exercise.

The graph below shows the scientists' results.



(a) The 'cardiac output' is the volume of blood sent from the heart to the muscles each minute.

Cardiac output = Heart rate × Stroke volume

At the end of the exercise, **Person 1**'s cardiac output = 160 × 77 = 12 320 cm^3 per minute.

Use information from the figure above to complete the following calculation of **Person 2**'s cardiac output at the end of the exercise.

At the end of the exercise:

Person 2's heart rate = _____ beats per minute

Person 2's stroke volume = _____ cm^3

Person 2's cardiac output = _____ cm^3 per minute

(3)

(b) **Person 2** had a much lower cardiac output than **Person 1.**

(i) Use information from the figure above to suggest the **main** reason for the lower cardiac output of **Person 2**.

(1)

(ii) **Person 1** was able to run much faster than **Person 2**.

Use information from the figure above and your own knowledge to explain why.

(5)

(Total 9 marks)

Q24.

Many runners drink sports drinks to improve their performance in races.

A group of students investigated the effects of three brands of sports drink, **A**, **B** and **C**, on the performance of three runners on a running machine. One of the runners is shown in the image below.

© Keith Brofsky/Photodisc/Thinkstock

Table 1 gives information for each drink.

Table 1

	Brand of sports drink		
Nutrient per dm^3	**A**	**B**	**C**
Glucose in g	63	31	72
Fat in g	9	0	2
Ions in mg	312	332	495

(a) (i) In the investigation, performance was measured as the time taken to reach the point of exhaustion.

Exhaustion is when the runners could not run anymore.

All three runners:
- ran on a running machine until the point of exhaustion
- each drank 500 cm^3 of a different brand of sports drink
- rested for 4 hours to recover
- ran on the running machine again and recorded how much time

they ran until the point of exhaustion.

The speed at which the runners ran was the same and all other variables were controlled.

The students predicted that the runner drinking brand **B** would run for the shortest time on the second run before reaching the point of exhaustion.

Use information from **Table 1** to suggest an explanation for the students' prediction.

_____

_____

_____

_____

_____

_____

_____

_____

(2)

(ii) If the balance between ions and water in a runner's body is not correct, the runner's body cells will be affected.

Describe **one** possible effect on the cells if the balance between ions and water is **not** correct.

_____

_____

_____

_____

(1)

(b) When running, a runner's body temperature increases.

Describe how the brain monitors body temperature.

_____

_____

_____

_____

_____

_____

(3)

(c) (i) **Table 2** is repeated here to help you answer this question.

Table 2

	Brand of sports drink		
Nutrient per dm^3	**A**	**B**	**C**
Glucose in g	63	31	72
Fat in g	9	0	2
Ions in mg	312	332	495

People with diabetes need to be careful about drinking too much sports drink.

Use information from **Table 2** to explain why drinking too much sports drink could make people with diabetes ill.

(3)

(ii) Other than paying attention to diet, how do people with diabetes control their diabetes?

_____

_____

(1)

(Total 10 marks)

Q25.

Freshwater streams may have different levels of pollution. The level of pollution affects which species of invertebrate will live in the water.

Table 1 shows the biomass of different invertebrate species found in two different streams, **X** and **Y**.

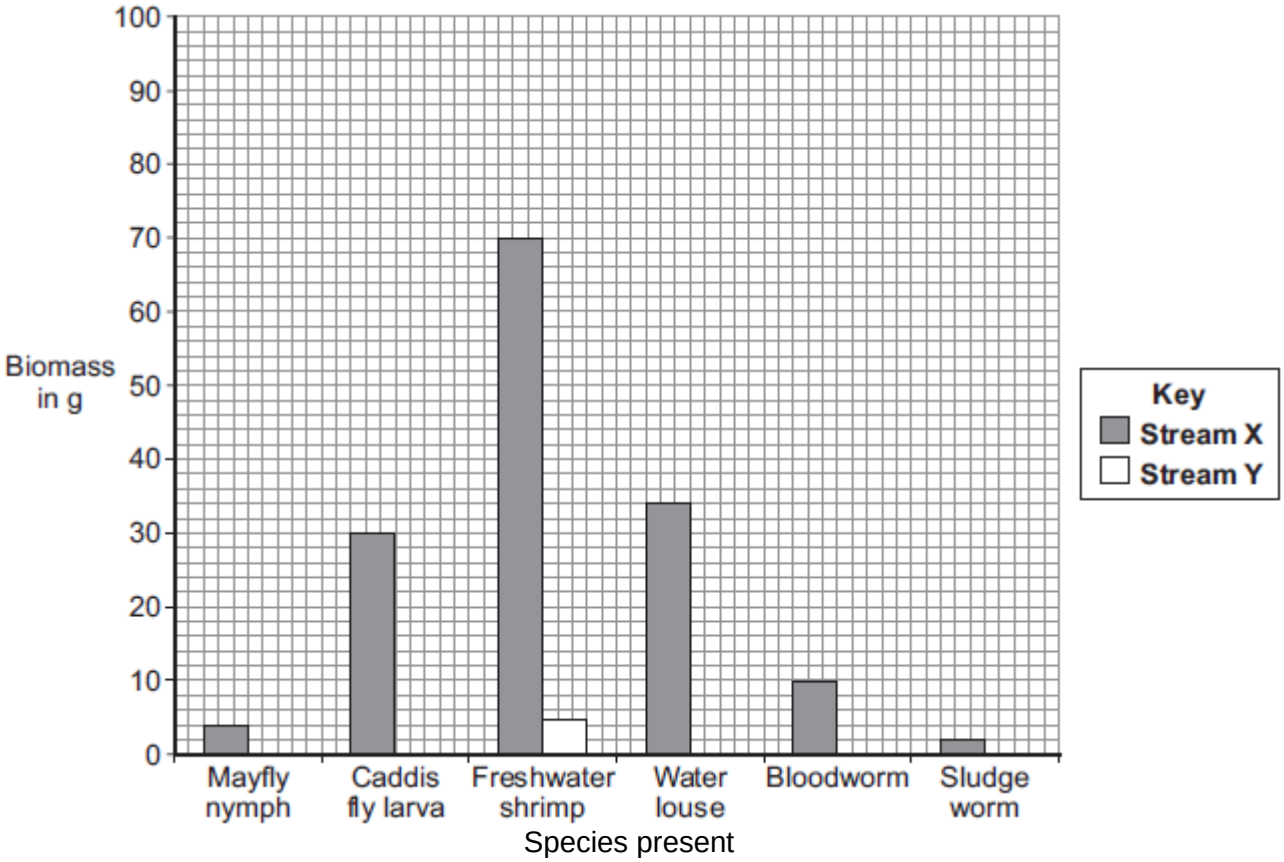
Table 1

	Biomass in g	
Invertebrate species	**Stream X**	**Stream Y**
Mayfly nymph	4	0
Caddis fly larva	30	0
Freshwater shrimp	70	5
Water louse	34	10
Bloodworm	10	45
Sludge worm	2	90
Total	**150**	**150**

(a) The bar chart below shows the biomass of invertebrate species found in **Stream X**.

(i) Complete the bar chart by drawing the bars for water louse, bloodworm and sludge worm in **Stream Y**.

Use the data in **Table 1**.



(2)

(ii) **Table 2** shows which invertebrates can live in different levels of water pollution.

Table 2

Pollution level	Invertebrate species likely to be present
Clean water	Mayfly nymph
Low pollution	Caddis fly larva, Freshwater shrimp
Medium pollution	Water louse, Bloodworm
High pollution	Sludge worm

Which stream, **X** or **Y**, is more polluted?
Use the information from **Table 1** and **Table 2** to justify your answer.

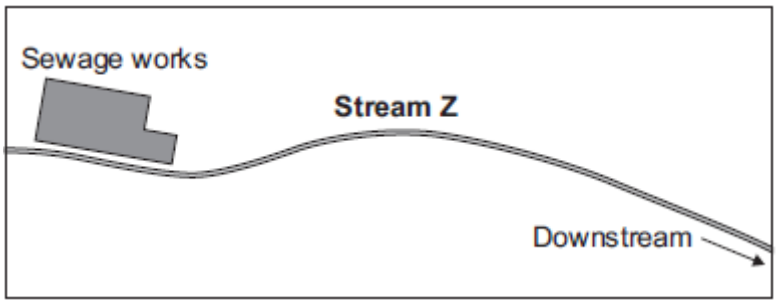
_____

_____

_____

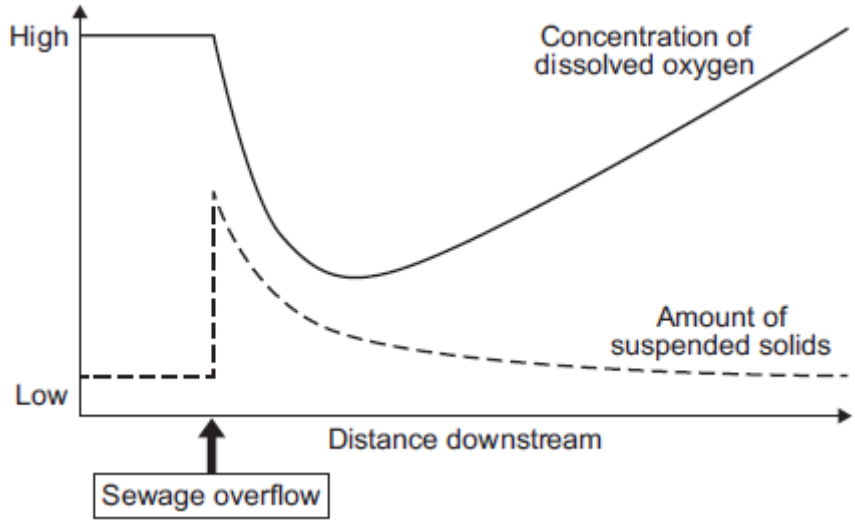
(2)

(b) There is a sewage works near another stream, **Z**.

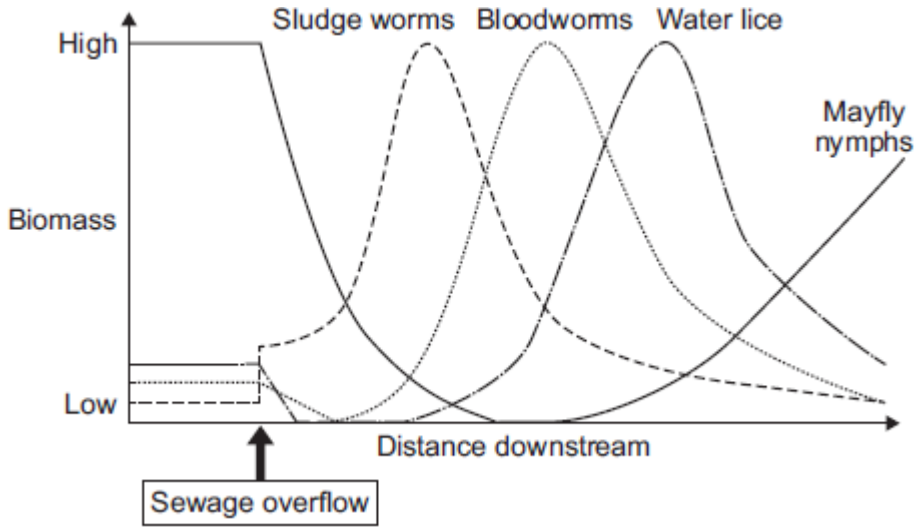


An accident caused sewage to overflow into **Stream Z**.
Two weeks later scientists took samples of water and invertebrates from the stream.
They took samples at different distances downstream from where the sewage overflowed.
The scientists plotted the results shown in **Graphs P** and **Q**.

Graph P: change in water quality downstream of sewage overflow



Graph Q: change in invertebrates found downstream of sewage overflow



(i) Describe the patterns shown in **Graph P**.

(4)

(ii) Describe the relationship between dissolved oxygen and the survival of mayfly nymphs in **Stream Z**. Suggest a reason for the pattern you have described.

(3)

(c) Many microorganisms are present in the sewage overflow.

Explain why microorganisms cause the level of oxygen in the water to decrease.

(2)

(Total 13 marks)

Q26.

Figure 1 shows an athlete running on a treadmill.

Figure 1

After running for several minutes, the athlete's leg muscles began to ache.
This ache was caused by a high concentration of lactic acid in the muscles.

(a) The equation shows how lactic acid is made.

glucose ⟶ lactic acid (+ energy)

Name the process that makes lactic acid in the athlete's muscles.

_____

_____

(1)

(b) Scientists investigated the production of lactic acid by an athlete running at different speeds.

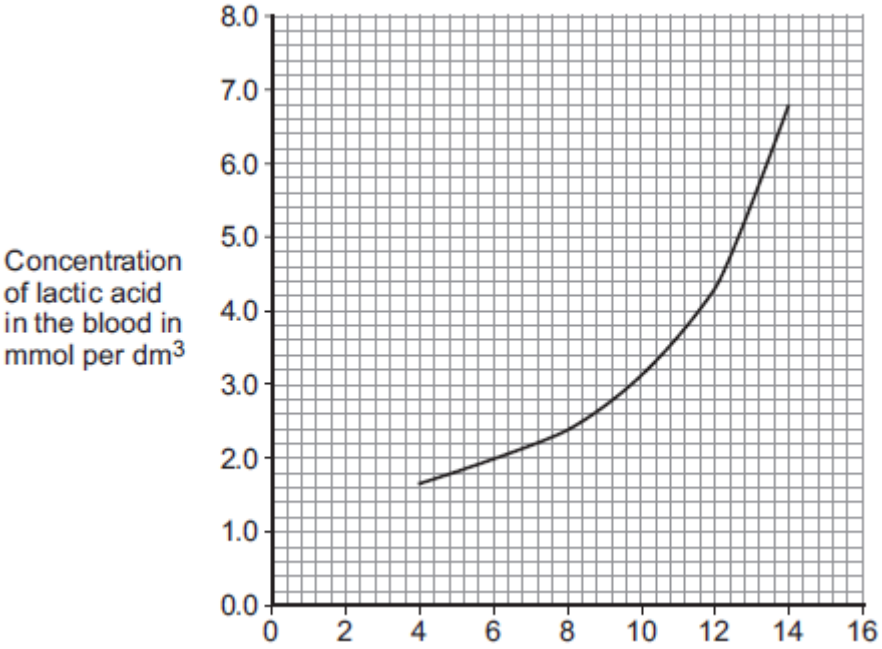
In the investigation:

- the athlete ran on the treadmill at 4 km per hour
- the scientists measured the concentration of lactic acid in the athlete's blood after 2 minutes of running.

The investigation was repeated for different running speeds.

Figure 2 shows the scientists' results.

Figure 2



(i) How much more lactic acid was there in the athlete's blood when he ran at 14 km per hour than when he ran at 8 km per hour?

_____

_____

_____

Answer = _____ mmol per dm^3

(2)

(ii) Why is more lactic acid made in the muscles when running at 14 km per hour than when running at 8 km per hour?

_____

_____

_____

_____

_____

_____

(3)

(Total 6 marks)

Q27.

Scientists investigated how exercise affects blood flow to different organs in the body.

The scientists made measurements of blood flow to different organs of:

- a person resting in a room at 20°C
- the same person, in the same room, doing vigorous exercise at constant speed on an exercise cycle.

The table shows the scientists' results.

Organ	Blood flow in cm^3 per minute whilst …	
	resting	**doing vigorous exercise**
Brain	750	750
Heart	250	1000
Muscles	1200	22 000
Skin	500	600
Other	3100	650

(a) In this investigation, it was better to do the exercise indoors on an exercise cycle than to go cycling outdoors on the road.

Suggest **two** reasons why.

Do **not** include safety reasons.

1.

_____

_____

_____

_____

2.

_____

_____

_____

_____

_____

(2)

(b) Blood flow to **one** organ did **not** change between resting and vigorous exercise.

Which organ?_____

(1)

(c) (i) How much more blood flowed to the muscles during vigorous exercise than when resting?

_____

_____

_____

_____

Answer = _____ cm^3 per minute

(2)

(ii) Name **two** substances needed in larger amounts by the muscles during vigorous exercise than when resting.

1.

_____

_____

2.

_____

_____

(2)

(iii) Tick (✓) **one** box to complete the sentence.

The substances you named in part (c)(ii) helped the muscles to

make more lactic acid. ☐

respire aerobically. ☐

make more glycogen. ☐

(1)

(iv) The higher rate of blood flow to the muscles during exercise removed larger amounts of waste products made by the muscles.

Which **two** substances need to be removed from the muscles in larger amounts during vigorous exercise?

Tick (✓) **two** boxes.

Amino acids ☐

Carbon dioxide ☐

Glycogen ☐

Lactic acid ☐

(2)

(d) The total blood flow was much higher during exercise than when resting.

One way to increase the total blood flow is for the heart to pump out a larger volume of blood each beat.

Give **one** other way to increase the blood flow.

_____

_____

_____

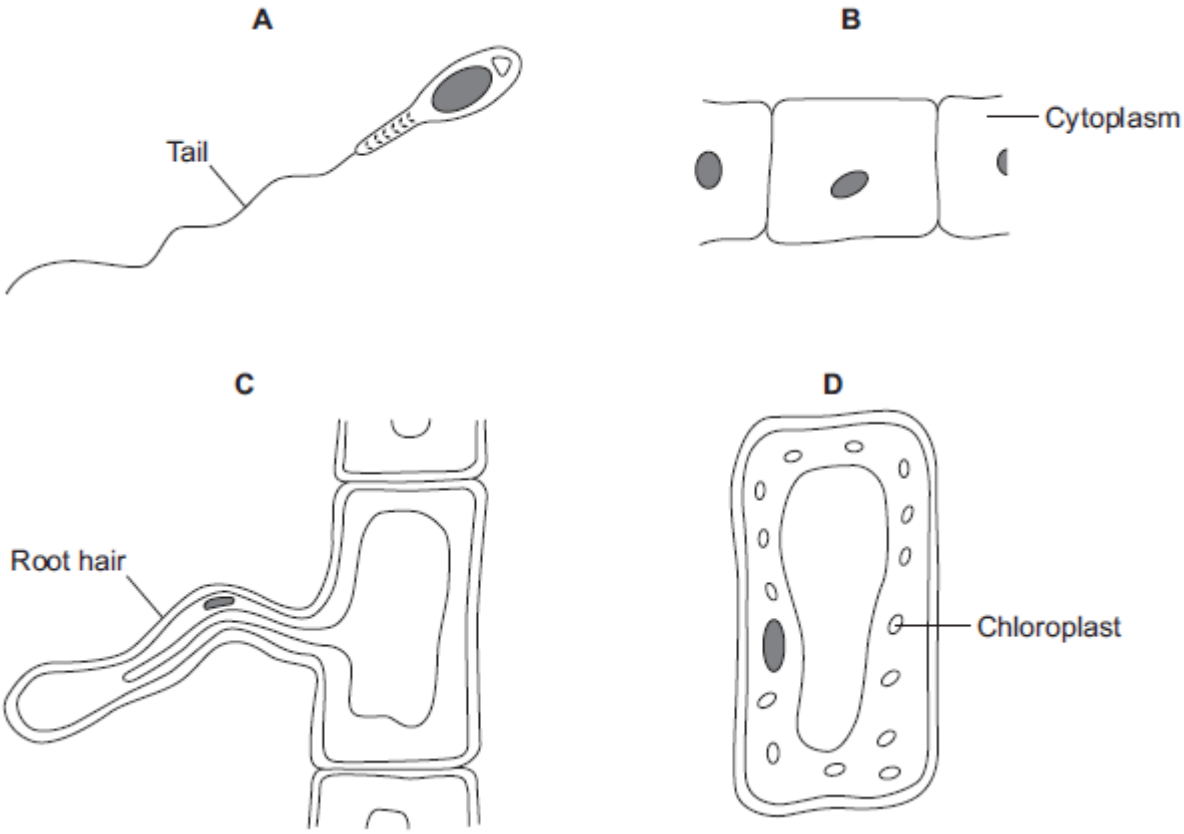
_____

(1)

(Total 11 marks)

Q28.

The diagrams show four types of cell, **A**, **B**, **C** and **D**.
Two of the cells are plant cells and two are animal cells.



(a) (i) Which **two** of the cells are plant cells?

Tick (✓) **one** box.

A and **B** ☐

A and **D** ☐

C and **D** ☐

(1)

(ii) Give **one** reason for your answer.

_____

_____

_____

_____

(1)

(b) (i) Which cell, **A**, **B**, **C** or **D**, is adapted for swimming? ☐

(1)

(ii) Which cell, **A**, **B**, **C** or **D**, can produce glucose by photosynthesis? ☐

(1)

(c) Cells **A**, **B**, **C** and **D** all use oxygen.

For what process do cells use oxygen?

Draw a ring around **one** answer.

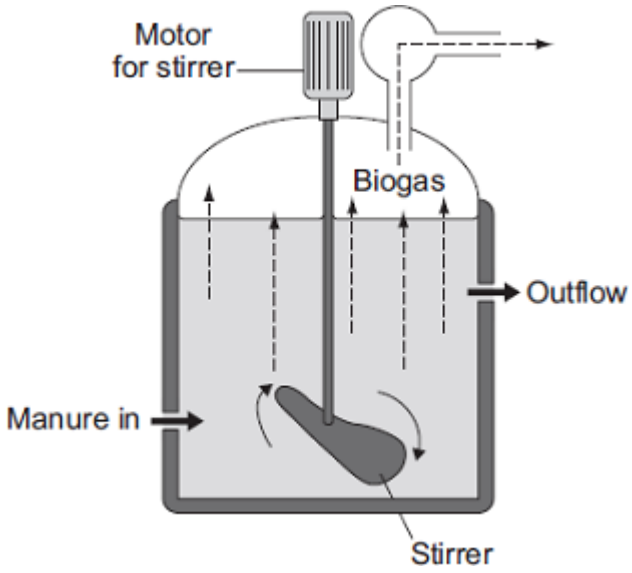
osmosis **photosynthesis** **respiration**

(1)

(Total 5 marks)

Q29.

The diagram shows one type of biogas generator.



(a) With this type of biogas generator, the concentration of solids that are fed into

the
reactor must be kept very low.

Suggest **one** reason for this.

Tick (✓) **one** box.

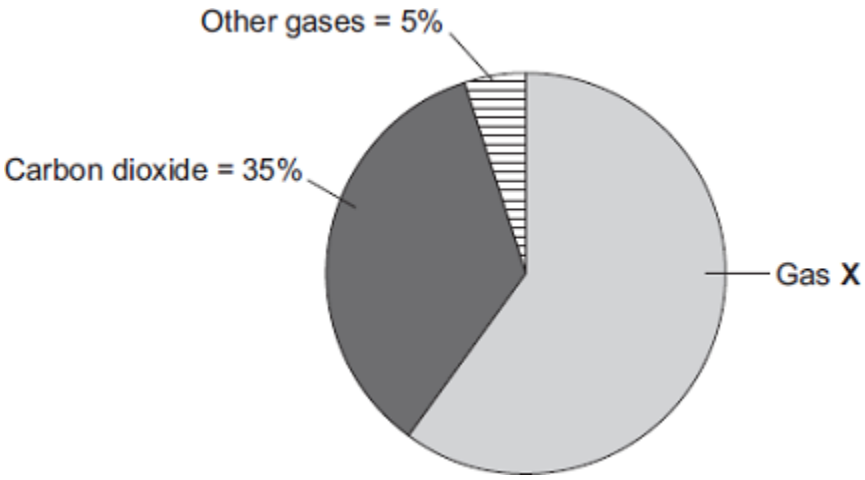
A higher concentration contains too little oxygen. ☐

A higher concentration would be difficult to stir. ☐

A higher concentration contains too much carbon dioxide. ☐

(1)

(b) The pie chart shows the percentages of the different gases found in the biogas.



Gas **X** is the main fuel gas found in the biogas.

(i) What is the name of gas **X**?

Draw a ring around **one** answer.

methane **nitrogen** **oxygen**

(1)

(ii) What is the percentage of gas **X** in the biogas?

Show clearly how you work out your answer.

_____

_____

_____

_____

Percentage of gas **X** = _____

(2)

(c) If the biogas generator is not airtight, the biogas contains a much higher percentage of carbon dioxide.

Draw a ring around **one** answer in each part of this question.

(i) The air that leaks in will increase the rate of

aerobic respiration.

anaerobic respiration.

fermentation.

(1)

(ii) The process in part (c)(i) occurs because the air contains

ammonia.

nitrogen.

oxygen.

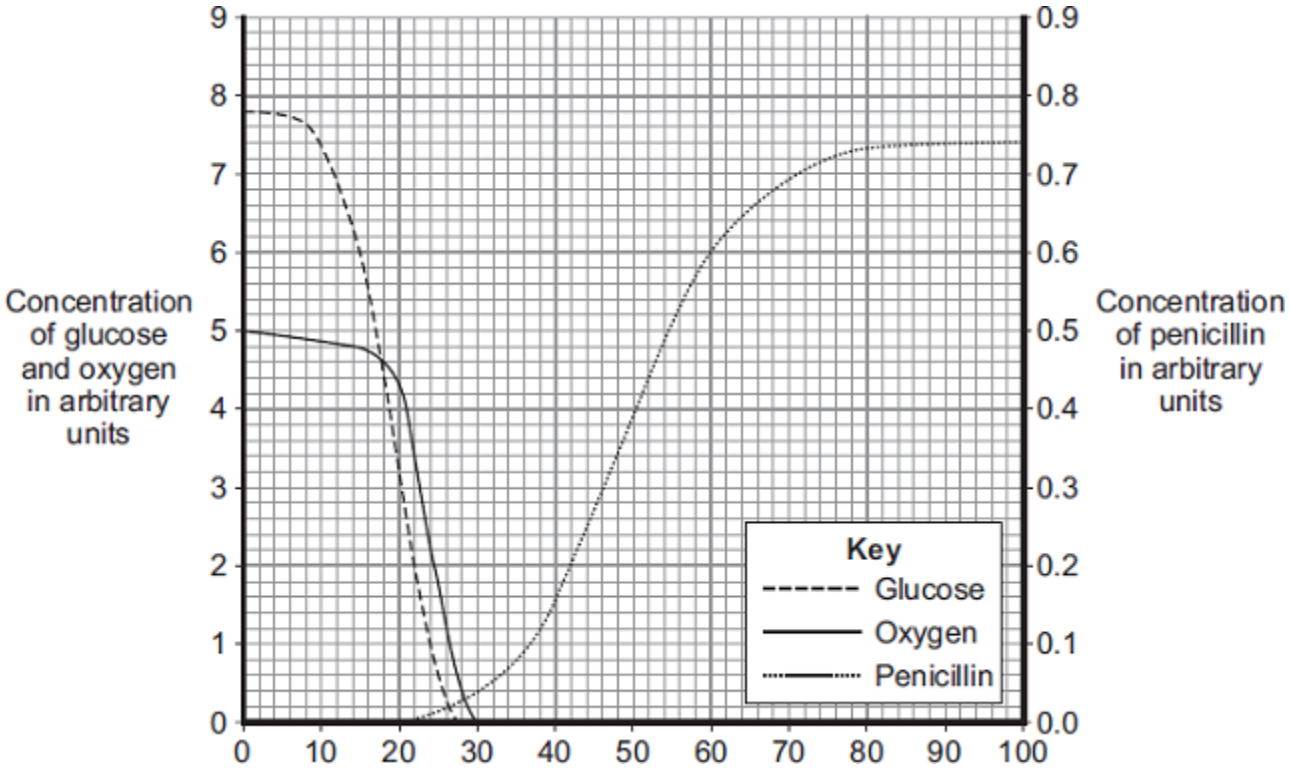
(1)

(Total 6 marks)

Q30.

The mould *Penicillium* can be grown in a fermenter. *Penicillium* produces the antibiotic penicillin.

The graph shows changes that occurred in a fermenter during the production of penicillin.



(a) During which time period was penicillin produced most quickly?

Draw a ring around **one** answer.

0 – 20 hours **40 – 60 hours** **80 – 100 hours**

(1)

(b) (i) Describe how the concentration of glucose in the fermenter changes between 0 and 30 hours.

_____

_____

_____

_____

(2)

(ii) How does the change in the concentration of oxygen in the fermenter compare with the change in concentration of glucose between 0 and 30 hours?

Tick (✓) **two** boxes.

The oxygen concentration changes after the glucose concentration. ☐

The oxygen concentration changes before the glucose concentration. ☐

The oxygen concentration changes less than the glucose concentration. ☐

The oxygen concentration changes more than the glucose concentration. ☐

(2)

(iii) What is the name of the process that uses glucose?

Draw a ring around **one** answer.

distillation **filtration** **respiration**

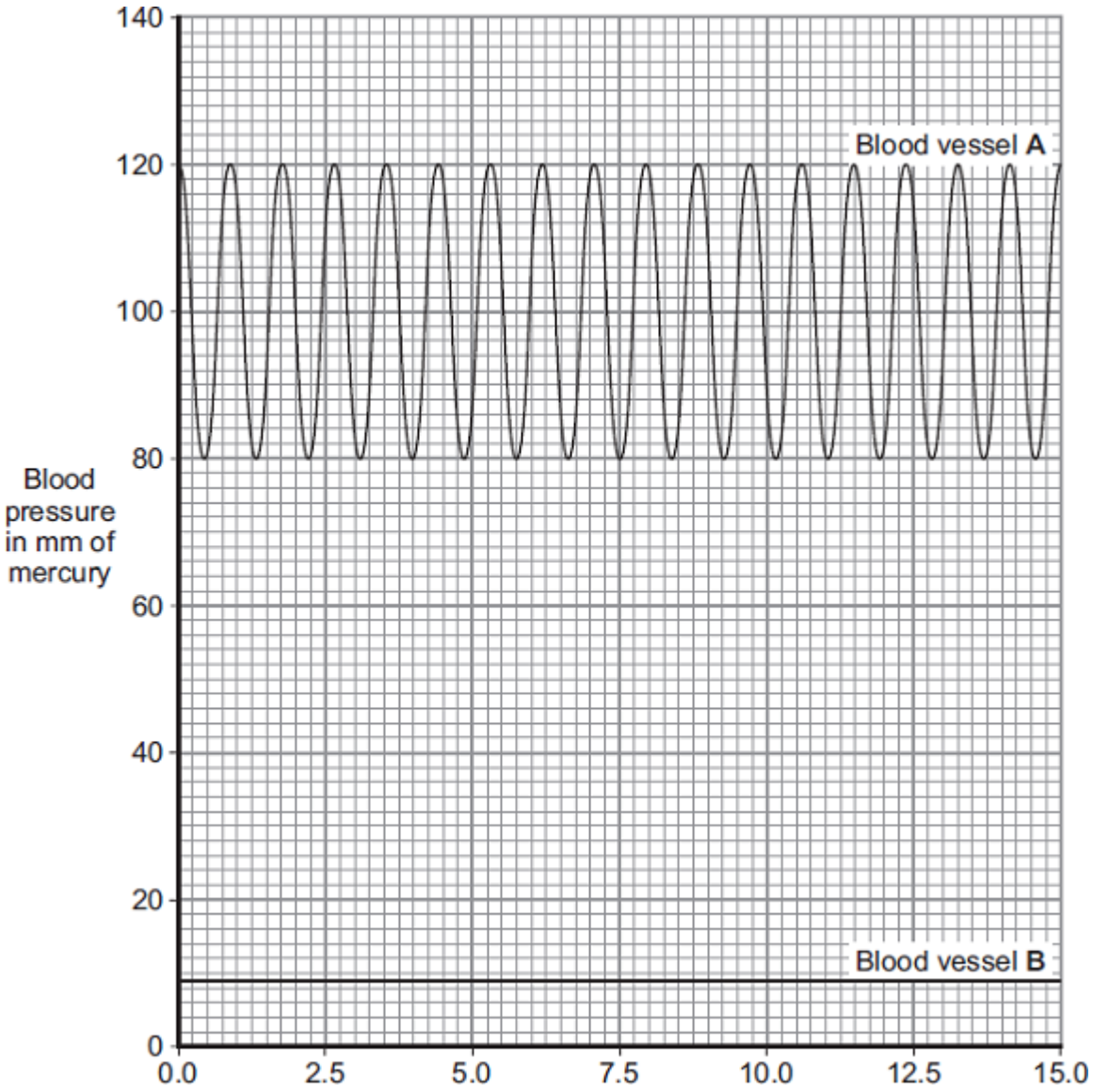
(1)

(Total 6 marks)

Q31.

The heart pumps the blood around the body. This causes blood to leave the heart at high pressure.

The graph shows blood pressure measurements for a person at rest.
The blood pressure was measured in an artery and in a vein.



(a) Which blood vessel, **A** or **B**, is the artery?

Blood vessel _____

Give **two** reasons for your answer.

Reason 1

_____

_____

Reason 2

_____

_____

(2)

(b) Use information from the graph to answer these questions.

(i) How many times did the heart beat in 15 seconds? _____

(1)

(ii) Use your answer from part (b)(i) to calculate the person's heart rate per minute.

_____

_____

Heart rate = _____ beats per minute

(1)

(c) During exercise, the heart rate increases.

The increased heart rate supplies useful substances to the muscles at a faster rate.

Name **two** useful substances that must be supplied to the muscles at a faster rate
during exercise.

1. _____

2. _____

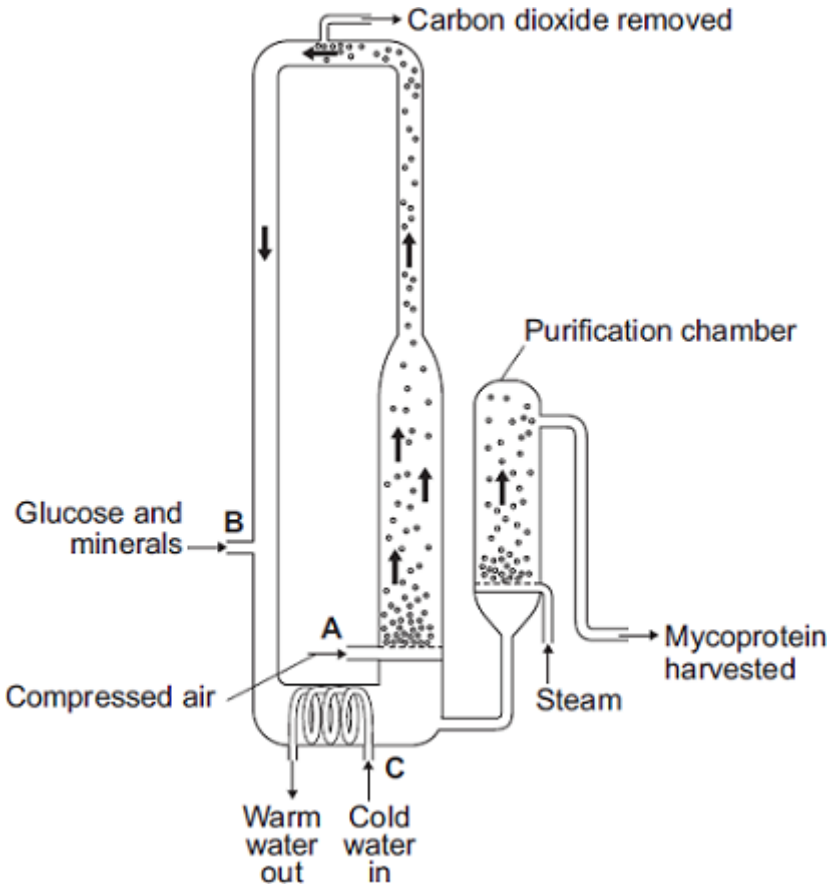
(2)

(Total 6 marks)

Q32.

The diagram shows a fermenter. This fermenter is used for growing the fungus *Fusarium*.

Fusarium is used to make mycoprotein.



(a) Bubbles of air enter the fermenter at **A**.

Give **two** functions of the air bubbles.

1. _____

_____

_____

2. _____

_____

_____

(2)

(b) Why is glucose added to the fermenter?

_____

_____

_____

_____

(1)

(c) The fermenter is prevented from overheating by the cold water flowing in through the heat exchanger coils at **C**.

Name the process that causes the fermenter to heat up.

_____

_____

(1)

(d) It is important to prevent microorganisms other than *Fusarium* growing in the fermenter.

(i) Why is this important?

_____

_____

_____

_____

(1)

(ii) Suggest **one** way in which contamination of the fermenter by microorganisms could be prevented.

_____

_____

_____

_____

(1)

(e) Human cells cannot make some of the amino acids which we need. We must obtain these amino acids from our diet.

The table shows the amounts of four of these amino acids present in mycoprotein, in beef and in wheat.

Name of amino acid	**Amount of amino acid per 100 g in mg**			**Daily amount needed by a 70 kg human in mg**
	Mycoprotein	**Beef**	**Wheat**	
Lysine	910	1600	300	840
Methionine	230	500	220	910

Phenylalanine	540	760	680	980
Threonine	610	840	370	490

A diet book states that mycoprotein is the best source of amino acids for the human diet.

Evaluate this statement.

Remember to include a conclusion in your evaluation.

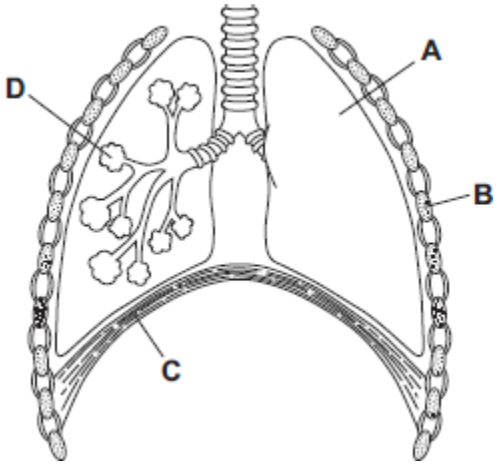
(4)

(Total 10 marks)

Q33.

(a) **Diagram 1** shows part of the breathing system.

Diagram 1



(i) Use words from the box to name the parts labelled **A**, **B**, **C** and **D**.

alveolus	**diaphragm**	**lung**	**rib**	**trachea**

A _____

B _____

C _____

D _____

(4)

(ii) Parts **B** and **C** move when we breathe **in**.

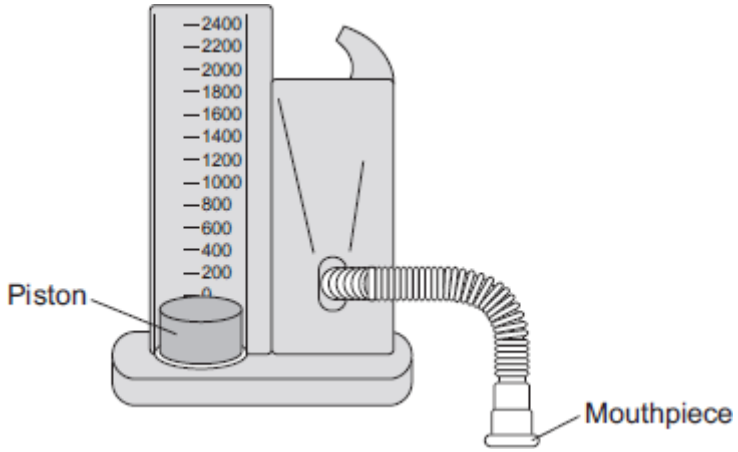
Part **B** moves _____

Part **C** moves _____

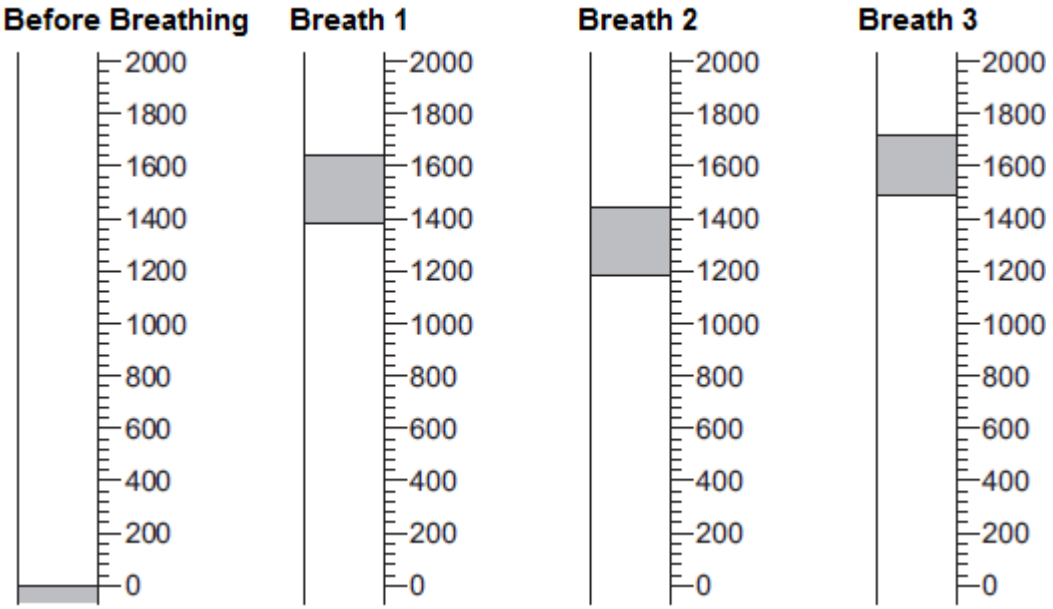
(2)

(b) A student used the apparatus shown in **Diagram 2** to measure the maximum volume of air that he could breathe in one breath.
When the student breathes in, the piston moves upwards.
The piston moves back down after the student has breathed out.

Diagram 2



The student breathes in through the apparatus three times.
The drawings show the position of the piston after each of the three breaths.
The volumes are measured in cm^3.



(i) Read the volume of each breath and write the volume in the table.

	Breath 1	Breath 2	Breath 3
Volume in cm^3	_____	_____	_____

(3)

(ii) Calculate the mean volume of air breathed in.

_____
_____

Mean volume of air breathed in = _____ cm^3

(2)

(c) A teacher asks the student to investigate if students who take part in sports activities can breathe in a larger volume of air than students who do not take part.

Describe briefly how the student could use the **same** apparatus to do the investigation.

(3)

(d) **Photograph 1** shows a different piece of apparatus used to measure the volume of air that a person can breathe in one breath.

Photograph 1

When the student breathes out through the apparatus the pointer on the scale moves. The pointer stays in the same position when the student has finished.

Explain **one** advantage, apart from size, of using this apparatus rather than the apparatus described in part **(b)**.

_____

_____

_____

_____

_____

_____

_____

_____

(2)

(e) **Photograph 2** shows one type of mechanical ventilator.

Photograph 2

(i) Use information from **Photograph 2** to suggest how this type of ventilator works.

_____

_____

_____

_____

_____

_____

_____

_____

(2)

(ii) Use information from **Photograph 2** to suggest two disadvantages of this type of ventilator.

1.

_____

_____

_____

_____

2.

_____

_____

_____

_____

(2)

(Total 20 marks)

Q34.

The photograph shows an athlete at the start of a race.

© Wavebreakmedia Ltd./Thinkstock

(a) The athlete's sense organs contain special cells.
These special cells detect changes in the environment.

(i) **List A** shows changes in the environment.

List B shows some of the athlete's sense organs.

Draw **one** line from each change in the environment in **List A** to the sense organ detecting the change in **List B**.

List A **Change in the environment**	**List B** **Sense organ**
Sight of the finishing line	Ear
Sound of the starting gun	Nose
Pressure of the ground on the fingers	Eye

Skin

(3)

(ii) Which cells detect changes in the environment?

Tick (✓) **one** box.

Gland cells ☐

Muscle cells ☐

eceptor cells ☐

(1)

(b) During the race, the concentration of sugar in the athlete's blood decreases.

Why?

_____

_____

(1)

(c) Some athletes use anabolic steroids to improve performance.

(i) Draw a ring around the correct answer to complete the sentence.

Anabolic steroids increase

breathing rate.

growth of muscles.

heart rate.

(1)

(ii) Sporting regulations ban the use of anabolic steroids.

Suggest **one** reason why.

_____

_____

_____

(1)

(Total 7 marks)

Q35.

One factor that may affect body mass is *metabolic rate*.

(a) (i) What is meant by *metabolic rate* ?

_____

_____

_____

_____

(1)

(ii) Metabolic rate is affected by the amount of activity a person does.

Give **two** other factors that may affect a person's metabolic rate.

1.

_____

_____

_____

_____

2.

_____

_____

_____

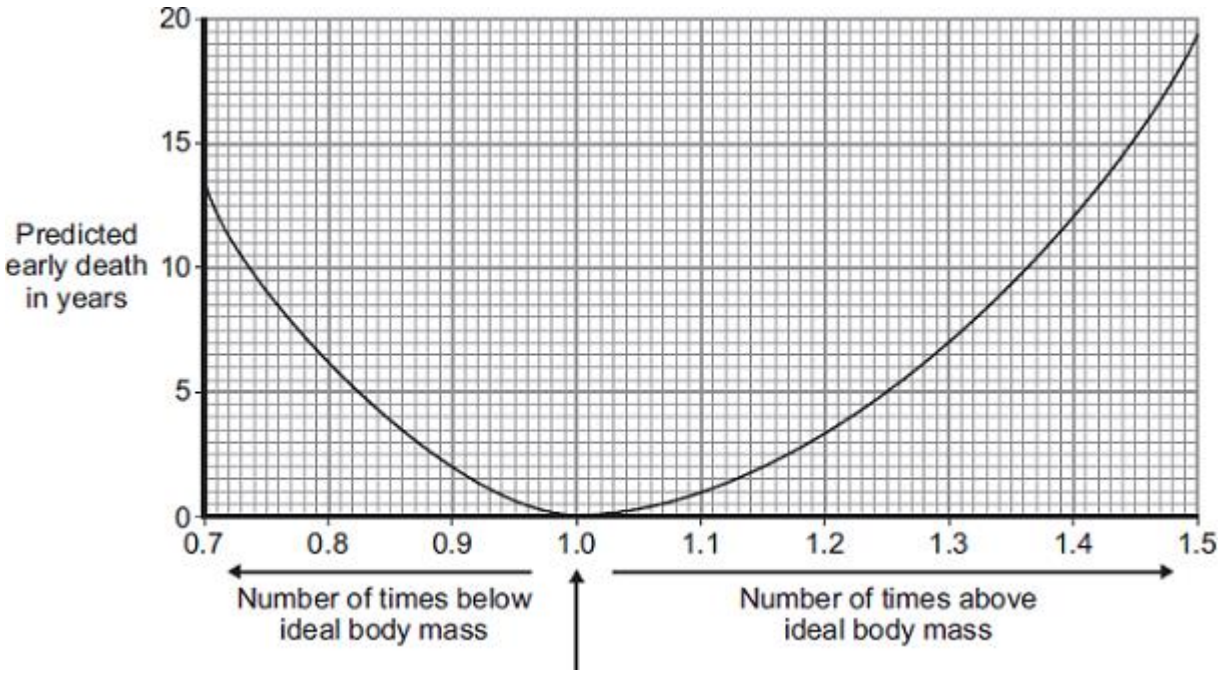
_____

(2)

(b) Predicted early death is the number of years that a person will die before the mean age of death for the whole population. The predicted early death of a person is affected by their body mass.

Scientists have calculated the effect of body mass on predicted early death.

The graph shows the results of the scientists' calculations.



The number of times above or below ideal body mass is given by the equation:

$$\frac{\text{Actual body mass}}{\text{Ideal body mass}}$$

In the UK the mean age of death for women is 82.

A woman has a body mass of 70 kg. The woman's ideal body mass is 56 kg.

(i) Use the information from the graph to predict the age of this woman when she dies.

_____

_____

_____

_____

_____

_____

Age at death = _____ years

(2)

(ii) The woman could live longer by changing her lifestyle.

Give **two** changes she should make.

1. _____

_____

2. _____

_____

(2)

(Total 7 marks)

Mark schemes

Q1.

(a) phloem

1

(b) translocation

1

(c) either:

less (sugars for) respiration

1

(so) less energy released

1

or

less amino acids made (1)

(so) less protein produced **or** less protein synthesis (1)

or

less cellulose made (1)

(so) weaker cell walls (1)

(d) (aphids) can fly to another plant **or** part of the plant

ignore to fly unqualified

1

to get (more) food

allow to find a mate
allow idea of less competition for food
allow to escape predators
*do **not** accept escape prey*

1

(e) (oil) prevents aphids from attaching to leaf **or** causes aphids to slide off leaf

ignore 'the leaf is slippery'

or
idea that oil may harm / kill the aphid

allow oil may be unpleasant to the aphid

1

(f) (plant / stem has) thorns

allow spines / spikes / prickles
ignore stings
*do **not** accept thorns protect (the plant) from predators*

1

(g) C

if any other letter given then no marks for the question

1

(fungi / spores) blown by / in direction of the wind

allow black spot / disease is blown by / in direction of the wind

or

it's the closest plant (to A)

*do **not** accept reference to bacteria / viruses / pollen being blown*

1

(h) any **one** from:

- spread rose bushes out more

  allow isolate the infected plant
  allow idea of barrier around infected plant
  ignore separate unless qualified

- remove any infected parts of the plant

  allow remove infected plant / A

- use a fungicide

  ignore pesticide
  *do **not** accept insecticides / herbicide*

1

[11]

Q2.

(a) diffusion

1

(b) A

1

(c) B

1

(d) (earthworm) can absorb more oxygen (in a given time)

or

increases / more gas exchange

allow get / obtain / take in more oxygen
ignore easier absorption of oxygen
ignore references to food

1

(e) lipase

1

(f) more oxygen (in soil with earthworms)

allow earthworms bring oxygen to soil

1

(for) more (aerobic) respiration

*do **not** accept anaerobic respiration*

1

(of) bacteria / fungi / microorganisms / microbes / decomposers

1

reference to more is only needed once for the first two marking points

(g) fertilisation

ignore sexual reproduction

1

(h) asexual (reproduction)

allow cloning

1

[10]

Q3.

(a) any **one** from:

- respiration
- formation of proteins
- formation / breakdown of glycogen
- breakdown of (excess) protein **or** formation of urea
- photosynthesis **or** formation of glucose / starch (in plants)

ignore formation of carbohydrates

1

allow other correct reference to metabolic reactions in cells
ignore reference to digestion

(b) males have a higher metabolic rate than females after five years of age

1

the mean metabolic rate of females decreases faster than males up to 25 years of age

1

each additional tick negates a mark

(c) $\frac{17}{53} \times 100$

1

32.075472…

allow correct rounding of this to at least 4 significant figures

1

32.1

allow a correct reduction to 3 significant figures from an incorrect calculation for marking point 2

1

*an answer of 32.1 scores **3** marks*

(d) any **two** from:

allow converse

- (person) R heart rate rose / increased more slowly than (person) S
- (person) R heart rate levelled off whereas (person) S continued to increase
- (person) R heart rate rose less (overall / after 5 minutes of exercise) than S

allow correct use of figures
e.g. R increased (overall) by 39 bpm / 65% and S by 54 bpm / 69%
ignore lack of units

2

(e) correct scale and axis labelled

allow min(s)
*do **not** accept 'm'*
the zero is not required on the x-axis

1

all points plotted correctly (to within ± ½ square)

*allow 4 or 5 correct plots for **1** mark*

2

line joined point to point or correct curved line of best fit

1

(f) $\frac{132-78}{12}$

allow $\frac{54}{12}$

allow sequential deductions of 12 four or five times

1

4.5 (minutes) / 4½ minutes / 4 minutes 30 seconds / 4:30

*do **not** accept 4:50 **or** 4 minutes 50 seconds*

1

*an answer of 4.5 minutes scores **2** marks*

(g) **Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.

5–6

Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.

3–4

Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

1–2

No relevant content

0

Indicative content

- two groups of people − non-smokers and smokers
- have at least five people in each group or large groups
- get each person to do (named) exercise
- controlled variables:
  - same number of people in each group or large groups
  - same gender
  - same level of activity / exercise
  - same age
  - no health issues / illnesses
  - same type of exercise
  - same time for exercise
- record heart rate for each person before and after exercise
- calculate increase in heart rate for each person after exercise
- compare results for each group

for **level 3**, students should refer to at least 5 smokers and 5 non-smokers, carrying out exercise with control variables and a means of determining an increase in heart rate

for **level 2**, students should refer to 'groups' of smokers and non-smokers exercising

[20]

Q4.

(a) kills microorganisms / bacteria / fungi / viruses / microbes

allow to remove microorganisms / bacteria / fungi / viruses / microbes

ignore germs

allow so mycoprotein is not contaminated

1

(which) compete for food / oxygen
or
which make toxins

allow so mycoprotein is safe to eat

or
which are pathogens
or
which might kill the fungus / *Fusarium*

1

(b) 30 °C

1

(c) for (aerobic) respiration

*do **not** accept anaerobic*

1

(which) releases energy (for growth)

*do **not** accept produces energy*

allow glucose is used to make other organic substances e.g. protein

1

(d) any **two** from:

so *Fusarium* can

- grow faster / better
- get sufficient food / glucose / minerals

  allow more / enough

- get sufficient oxygen

  allow more / enough

- get rid of sufficient carbon dioxide

  allow more / enough
  allow waste

- be kept at a (suitable) temperature

  allow to avoid 'clumping'

2

(e) 200 grams

1

[8]

Q5.

(a) 2400 **and** 2280
or
500 **and** 380

1

120

1

*an answer of 120 scores **2** marks*

(b) respiration of glucose

1

(c) (more) sweating

ignore reference to vasodilation / vasoconstriction

1

(because) exercise releases heat
or
need to cool the body
or
need to lose heat
or
need to maintain body temperature

*do **not** accept energy being produced*

1

(d) more energy needed

*do **not** accept energy production*
*do **not** accept energy needed for respiration*

1

(so) more (aerobic) respiration

1

(so) increased breathing (rate / depth) (to supply oxygen **or** remove carbon dioxide / water)

1

'more' does not need to be stated a second time to gain marking point 1 and marking point 2

[8]

Q6.

(a) *x*-axis: scale + labelled, including units

scale ≥ ½ width of graph paper label: biomass in g/m²

1

bar widths correct

± ½-square each side
allow 1 mark if 3 correct

2

all 4 bars correctly labelled

large fish + small fish + invertebrate (animals) + algae
or
(trophic level) 4 + 3 + 2 + 1
or
tertiary consumer + secondary consumer + primary consumer + producer

ignore bar heights

1

(b) $\frac{840-10}{840} \times 100$

allow equivalent calculation

1

98.809523... / 98.810 / 98.81 / 98.8

1

99

allow answer given to two significant figures from an incorrect calculation in step 2

1

*an answer of 99 scores **3** marks*

(c) inedible parts / example

*allow eaten by other animals **or** not all organisms*

eaten

or

egested / faeces

allow not digested
allow excretion / urine
ignore waste

or

respiration / as CO_2

ignore energy losses
ignore movement

1

(d) bacteria decay organic matter / sewage / algae / dead plants

1

(by) digestion

allow example such as starch broken down to sugar
or
protein broken down to amino acids

1

(and) bacteria respire aerobically
or
respire using oxygen

1

(which) lowers oxygen concentration (in water)
or
fish have less oxygen

allow reduced respiration of fish

1

(so) reduced energy supply causes death of fish

allow toxins in the sewage kill fish
ignore pathogens or (pathogenic) bacteria cause disease in fish and kills them

1

[13]

Q7.

(a) $C_6H_{12}O_6$

1

(b) atmospheric air contains less carbon dioxide than exhaled air

allow converse

1

(flask B goes more cloudy because) carbon dioxide is produced in (aerobic) respiration (by woodlice)

*do **not** accept anaerobic respiration*

1

(c) for comparison / to compare

allow answers in the context of the investigation e.g.

or

to check that no other factor / variable is influencing the results

to prove that the results obtained were due to the woodlice respiring and nothing else

or

to prove that the woodlice produced the carbon dioxide and nothing else

1

(d) (flask **A**) would remain colourless

ignore references to clear

allow not cloudy

1

(flask **B**) would remain colourless

1

(e) lactic acid

1

(f) alcohol / ethanol

1

[8]

Q8.

(a) electron (microscope)

1

(b) $\frac{30000}{200}$

*an answer of 150 (µm) scores **2** marks*

1

150 (µm)

*if answer is incorrect allow for **1** mark sight of 0.015 / 0.15 / 1.5 / 15*

*allow ecf for incorrect measurement of line **X** for max **1** mark*

1

(c) **either**

large surface area

allow (vacuole contains) cell sap that is more concentrated than soil water (1)

1

for more / faster osmosis

create / maintain concentration / water potential gradient (1)

or

allow thin (cell) walls

for short(er) diffusion distance

1

(d) (on hot day) more water lost

allow converse for a cold day if clearly indicated

1

more transpiration
or
more evaporation

1

so more water taken up (by roots) to replace (water) loss (from leaves)

1

(e) (aerobic) respiration occurs in mitochondria

*do **not** accept anaerobic respiration*

1

(mitochondria / respiration) release energy

*do **not** accept energy produced / made / created*

1

(energy used for) active transport

1

to transport ions, against the concentration gradient
or
from a low concentration to a high concentration

1

[12]

Q9.

(a) an undifferentiated / unspecialised cell

1

that can differentiate / become / change into (many) other cell types

1

(b) (malignant tumours) invade / spread to other tissues via the blood (benign don't)
or
(malignant tumours) form secondary tumours in other organs

ignore cancer unqualified
allow converse
allow metastasises

1

(c) mitosis

correct spelling only

1

(d) glucose

answers in any order

ignore sugar

1

protein / amino acids

1

(e) no need to wait for a donor
or
can be done immediately

1

(so) no risk of rejection
or
no need for immunosuppressant drugs

*if no other marks awarded, allow for **1** mark idea of ethics surrounding the use of tissue from another / dead person*

1

(f) stent opens up the trachea

1

allowing air to flow through
or
allowing patient to breathe

1

(g) **Level 3 (5-6 marks):**
A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.

Level 2 (3-4 marks):
Some logically linked reasons are given. There may also be a simple judgement.

Level 1 (1-2 marks):
Relevant points are made. They are not logically linked.

Level 0
No relevant content

Indicative content

embryos advantages
- can create many embryos in a lab
- painless technique
- can treat many diseases / stem cells are pluripotent / can become any type of cell (whereas bone marrow can treat a limited number)

embryos disadvantages
- *harm / death to embryo*
- *embryo rights / embryo cannot consent*
- *unreliable technique / may not work*

bone marrow advantages
- no ethical issues / patient can give permission
- can treat **some** diseases
- procedure is (relatively) safe / doesn't kill donor
- tried and tested / reliable technique

- patients recover quickly from procedure

bone marrow disadvantages

- *risk of infection from procedure*
- *can only treat a few diseases*
- *procedure can be painful*

both procedures advantage

can treat the disease / problem

both procedures disadvantages

- *risk of transfer of viral infection*
- *some stem cells can grow out of control / become cancerous*

[16]

Q10.

(a) salivary glands and pancreas

1

(b) starch / substrate fits into active site (of enzyme)

1

shape of active site is unique / complementary to substrate

allow converse

or

substrate is specific to active site / enzyme

allow enzyme has a high specificity for substrate

1

bonds (within starch / substrate

or

between sugar molecules) are broken

1

(c) converted to new carbohydrates / glycogen / named organic compound (e.g. protein / fat)

1

(d) to allow (the starch and amylase / solutions) to equilibrate (to the temperature of the water bath)

or

to get the starch and amylase / solutions to the same temperature / 20 °C

or

to get the starch and amylase / solutions to the (same) temperature of the water bath

1

(e) **40 °C**

all wells contain a symbol

and

must contain at least two crossed (×) wells at the end

allow final three wells crossed

(×)

1

60 °C
all wells contain a symbol
and

must have fewer crossed (×) wells at the end than at 40 °C

allow all wells ticked (✓)

*for either mp do **not** allow a crossed well followed by a ticked well*

1

(f) more accurate

allow (so) closer to (the) true value

1

(because) it is a quantitative measure

allow (it's) an actual value as opposed to an opinion

or
less / not subjective

allow colour is only qualitative

1

(g) 0.07 (%)

1

(h) starch is broken down less quickly (at 20 °C)

allow converse

1

because, at 20 °C, substrates / enzymes / molecules have less (kinetic) energy

1

(i) 1.08 (arbitrary units)

1

at 80 °C, enzyme / amylase has denatured

allow description of denaturation

*do **not** allow enzyme is killed*

1

so starch is not broken down (at all)

allow the concentration of starch is still 0.5%

1

[16]

Q11.

(a) correct figures from graph: 5.0 / 5 and 2.60 / 2.6

2.40 / 2.4

*an answer of 2.40 / 2.4 scores **2** marks*

1

*allow correct answer from candidate's figures from graph for **1** mark*

1

(b) $\frac{1}{3}$

1

(c) protein

1

(d) a genetically-modified variety of seed was sown in 2004

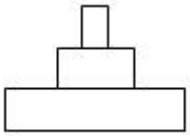
1

more rain fell in spring and early summer in 2004

1

the mean summer temperature was lower in 2003

1

(e) 

1

(f) 80

1

(g) chickens use energy for movement and for keeping warm

1

much of the food eaten by chickens is wasted as faeces

1

[11]

Q12.

(a) any **two** from:
- sprinkled through air
- air spaces between stones
- thin layer over stones (for efficient diffusion)
- slow flow (for efficient diffusion)

2

(b) green algae

1

(c) (large / small) protist

1

(d) **Level 2 (3-4 marks):**
Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.

Level 1 (1-2 marks):
Facts, events or processes are identified and simply stated but their relevance is not clear.

No relevant content (0 marks)

Indicative content

digestion:
- (external) enzymes released
- role of enzymes – e.g. amylase / protease / lipase
- substrates & products – e.g. starch ⟶ sugar / protein ⟶ amino acids / fat ⟶ fatty acids

absorption:
- by diffusion / active transport

deamination:
- amino acids ⟶ ammonia / ammonium ions

release of other ions:
- e.g. phosphate / nitrate / magnesium

respiration:
- produces carbon dioxide (+ water)
  or
  equation is given
- release of energy allows other processes to take place e.g. active transport

[8]

Q13.

(a) no oxygen (is used)

1

(b) muscles become fatigued / stop contracting

1

because not enough energy is transferred

1

(c) carbon dioxide

1

(d) count the bubbles
or
measure volume of gas

1

in a given time

1

(e) brewing / bread making

allow other suitable use of fermentation in food industry

1

[7]

Q14.

(a) glucose is absorbed by diffusion into the bloodstream

1

then blood delivers glucose to muscles in capillaries

1

(b) to stop air getting in

1

(c) yellow

1

(d) collect the CO_2 / gas with a measuring cylinder / gas syringe

1

(volume collected) in a certain time using a timer / watch

1

(e) yeast produces ethanol but muscles produce lactic acid

marks can be awarded from correct word or balanced symbol equations

1

yeast produces CO_2 but muscles do not

answers must be comparative

1

both release small amounts of energy

1

ignore both occur without oxygen

[9]

Q15.

(a) methane is produced

ignore bad smell

1

which is a greenhouse gas / causes global warming

1

(b) (9.80 / 0.20 = 49 therefore) 49:1

1

(c) horse (manure)

*allow ecf from **11.2***

closest to 25:1 (ratio)

1

(d) **Level 3 (5–6 marks):**
A detailed and coherent explanation is given, which logically links how carbon is released from dead leaves and how carbon is taken up by a plant then used in growth.

Level 2 (3–4 marks):
A description of how carbon is released from dead leaves and how carbon is taken up
by a plant, with attempts at relevant explanation, but linking is not clear.

Level 1 (1–2 marks):
Simple statements are made, but no attempt to link to explanations.

0 marks:
No relevant content.

Indicative content

statements:
- (carbon compounds in) dead leaves are broken down by microorganisms / decomposers / bacteria / fungi
- photosynthesis uses carbon dioxide

explanations:
- (microorganisms) respire
- (and) release the carbon from the leaves as carbon dioxide
- plants take in the carbon dioxide released to use in photosynthesis to produce glucose

use of carbon in growth:
- glucose produced in photosynthesis is used to make amino acids / proteins / cellulose
- (which are) required for the growth of new leaves

6

(e) any **three** from:
(storage conditions)
- (at) higher temperature / hotter
- (had) more oxygen
- (had) more water / moisture
- (contained) more microorganisms (that cause decay)

allow reference to bacteria / fungi / mould

3

[13]

Q16.

(a) any **one** from:
- continuous readings
- do not need to be there

allow automatic readings
- (more likely to be) accurate

allow greater resolution

*do **not** allow valid*
- reduces human error

allow easier to read

1

(b) (i) microorganisms

allow microbes / bacteria / fungi / decomposers for microorganisms, throughout

1

(microorganisms) respire

1

respiration / decay / microorganisms releases carbon dioxide

ignore carbon released

1

(ii) all grass decomposed / decayed / rotted

*allow idea that all microorganisms dead (due to accumulation of waste **or** lack of oxygen)*

allow lack of / no oxygen (for respiration of microorganisms)

1

[5]

Q17.

(a) (i) without <u>oxygen</u>

allow not enough oxygen

ignore air

ignore production of CO_2

ignore energy

1

(ii) more / high / increased lactic acid (at end)

allow approximate figures (to show increase)

ignore reference to glucose

1

(b) (i) 1.5

allow only 1.5 / 1½ / one and a half

1

(ii) increases at first **and** levels off

ignore subsequent decrease

1

suitable use of numbers eg
rises to 10 / by 9 (dm^3 per min)
or
increases up to 1.5 (min) / levels off after 1.5 (min) (of x axis timescale)

allow answer in range 1.4 to 1.5

or
after the first minute (of the run)

1

(iii) supplies (more) oxygen

1

supplies (more) glucose

1

need 'more/faster' once only for full marks

*allow removes (more) CO_2 / lactic acid / heat as an alternative for either marking point one **or** two, **once** only*

for (more) respiration

1

releases (more) energy (for muscle contraction)

*do **not** allow energy production or for respiration*

1

[9]

Q18.

(a) The damaged alveolus has a smaller surface area.

1

(b) Less oxygen is taken in.

1

[2]

Q19.

(a) (i) any **one** from:

- glucose
- oxygen
- carbon dioxide
- urea
- water

allow hormones

allow named example of a product of digestion

1

(ii) (cardiac) muscle

allow muscular

1

(b) (i) **B**

1

(ii) **D** atrium / atria

ignore references to left or right

1

E ventricle(s)

ignore references to left or right

1

(c) (i) a vein

1

(ii) an artery

1

(iii) keeps artery open / wider

allow ecf from part cii

1

(so) blood / oxygen can pass through (to the heart muscle)

1

[9]

Q20.

(a) $6H_2O$

in the correct order

1

$C_6H_{12}O_6$

1

(b) (i) control

do not accept *'control variable'*

allow:

to show the effect of the organisms

or

to allow comparison

or

to show the indicator doesn't change on its own

1

(ii) snail respires

1

releases CO_2

1

(iii) turns yellow

1

plant can't photosynthesise so CO_2 not used up

1

but the snail (and plant) still respires so CO_2 produced

1

[8]

Q21.

(a) (i) 50

1

(ii) 4

accept 3.9 − 4.0

1

(b) (i) glucose

1

oxygen

1

(ii) to release more energy

1

(c) correct readings from graph:

a = 120

b = 60

allow 60 - 61

1

calculation correct for candidate's figures:

e.g. a − b = 60

1

level of fitness correct for candidate's figures:

e.g. very fit

1

(d) any **four** from:

- higher heart rate (at 16 km / h) (so takes longer to slow to normal)
- more energy needed
- not enough O_2 supplied / more O_2 needed / reference to O_2-debt
- (more) anaerobic respiration
- (more) lactic acid made / to be broken down / to remove / to oxidise
- higher blood flow needed to deliver (the required amount of) oxygen.

'more' must be given at least once for full marks

do not allow more energy produced

allow higher blood flow to remove lactic acid / remove (additional) CO_2

4

[12]

Q22.

(a)

Structure	Organ	Organ system	Tissue
Stomach	✓		
Cells lining the stomach			✓
Mouth, oesophagus, stomach, liver, pancreas, small and large intestine		✓	

all 3 correct = 2 marks
2 correct = 1 mark
1 or 0 correct = 0 marks

2

(b) (i) diffusion

allow phonetic spelling

1

(ii) glucose

1

(iii) mitochondria

1

[5]

Q23.

(a) 5624

allow 2 marks *for:*

- *correct HR = 148* ***and*** *correct SV = 38 plus wrong answer / no answer*

or

- *only one value correct* ***and*** *ecf for answer*

allow 1 mark *for:*

- *incorrect values* ***and*** *ecf for answer*

or

- *only one value correct*

3

(b) (i) **Person 2** has low(er) stroke volume / SV / described

eg ***Person 2*** *pumps out smaller volume each beat*

do ***not*** *allow* ***Person 2*** *has lower heart rate*

1

(ii) **Person 1** sends <u>more blood</u> (to muscles / body / lungs)

1

(which) supplies (more) oxygen

1

(and) supplies (more) glucose

1

(faster rate of) respiration **or** transfers (more) energy for use

ignore aerobic / anaerobic

allow (more) energy release

allow aerobic respiration transfers / releases more energy (than anaerobic)

do ***not*** *allow makes (more) energy*

1

removes (more) CO_2 / lactic acid / heat

allow less oxygen debt

or less lactic acid made
or (more) muscle contraction / less muscle fatigue

if no other mark awarded,

allow person 1 is fitter (than person 2) for max 1 mark

1

[9]

Q24.

(a) (i) has the least amount of glucose

*allow least amount of fat **or** no fat*

1

(to) transfer energy (for the run)

allow (to) release energy (for the run)

*do **not** allow produces energy*

*do **not** allow 'energy for respiration'*

1

(ii) any **one** from:

- cells will work inefficiently
- absorb too much water / swell / overhydrate
- lose too much water / shrink / dehydrate

ignore turgid / flaccid

cells burst is insufficient

allow cramp in muscle.

1

(b) any **three** from:

- thermoregulatory centre
- (has temperature) receptors
- (which) monitor blood temperature (as it flows through the brain)
- (temperature) receptors in the skin
- (receptors) send impulses to the brain

ignore vasoconstriction / vasodilation / sweating

allow hypothalamus

impulses sent to the thermoregulatory centre = 2 marks.

3

(c) (i) (sports drinks) contain a lot of glucose

1

(a person with diabetes) does not produce insulin **or** does not produce enough insulin

allow (person with diabetes) has cells which do not respond to insulin

*do **not** allow insulin produced by liver*

1

so blood glucose / sugar levels will rise too high **or** to a dangerous level

1

(ii) inject insulin

or

have an insulin pump (fitted)

*do **not** allow swallow insulin*

accept exercise

accept inhale insulin

*accept take metformin **or** other correctly named drug*

allow pancreatic transplant

1

[10]

Q25.

(a) (i) correct bar heights

*three correct **2** marks*
*two correct **1** mark*
*one or none correct **0** marks*
ignore width

2

(ii) (Stream Y)

has many sludge worms / bloodworms

or

has no mayflies / caddis or few shrimp

*allow **1** mark if invertebrate not named but correct association given*

1

which indicate medium or high pollution

1

(b) (i) suspended solids increase (as a result of sewage overflow)

1

then decrease downstream / return to original levels

1

oxygen levels decrease (after sewage overflow)

1

and then rise again

1

(ii) any **three** from:

- mayflies decrease (to zero) near overflow

  accept 'have died out'
- because oxygen is low **or** mayflies have high oxygen demand
- mayflies repopulate / increase as oxygen increases again
- can't be sure if dissolved oxygen or suspended solids is the cause

3

(c) they respire / respiration

*aerobic respiration gains **2** marks*

1

this requires / uses up the oxygen

1

[13]

Q26.

(a) <u>anaerobic respiration</u>

allow phonetic spelling

1

(b) (i) 4.4

4.2, 4.3, 4.5 or 4.6 with figures in tolerance (6.7 to 6.9 and 2.3 to 2.5) and correct working gains 2 marks

4.2, 4.3, 4.5 or 4.6 with no working shown or correct working with one reading out of tolerance gains 1 mark

correct readings from graph in the ranges of 6.7 to 6.9 ***and*** *2.3 to 2.5 but no answer / wrong answer gains 1 mark*

2

(ii) more energy is needed / used / released

do ***not*** *allow energy production*

(at 14 km per hour)

ignore work

1

not enough oxygen (can be taken in / can be supplied to muscles)

allow reference to oxygen debt

do ***not*** *allow less / no oxygen*

1

so more anaerobic respiration (to supply the extra energy) **or** more glucose changed to lactic acid

allow not enough aerobic respiration

1

[6]

Q27.

(a) any **two** from:

or *allow converse for outdoors*

- constant speed
  - *variable speed*
- constant effort
  - *variable terrain*
- constant temperature
  - *traffic conditions*
  - *variable temperature*
  - *wind (resistance)*
  - *rain / snow*

allow weather

allow pollution only if qualified by effect on body function but ignore pollution unqualified

if no other marks obtained allow variable conditions outdoors

2

(b) Brain

1

(c) (i) 20 800

*correct answer with or without working gains **2** marks*

*if answer incorrect, allow **1** mark for use of 1200 and 22 000 only*

2

(ii) oxygen

apply list principle

1

*do **not** accept other named substances eg CO_2 water*

glucose / sugar

allow glycogen

ignore food / carbohydrate

1

(iii) respire aerobically

1

(iv) carbon dioxide

1

lactic acid

1

(d) increased heart rate

ignore adrenaline / drugs

accept heart beats more but not heart pumps more

1

[11]

Q28.

(a) (i) **C** and **D**

no mark if more than one box is ticked

1

(ii) any **one** from:

*do **not** allow if other cell parts are given in a list*

- (have) cell wall(s)
- (have) vacuole(s)

1

(b) (i) **A**

apply list principle

1

(ii) **D**

apply list principle

1

(c) respiration

apply list principle

1

[5]

Q29.

(a) a higher concentration would be difficult to stir

1

(b) (i) methane

1

(ii) 60

100 - (5 + 35) but incorrect answer allow 1 mark

2

(c) (i) aerobic respiration

1

(ii) oxygen

1

[6]

Q30.

(a) 40 – 60 hours

1

(b) (i) decrease

1

1st slowly then faster / appropriate detail from the graph – e.g. from 7.8 to 0 / faster after 4 – 10h

1

(ii) oxygen after glucose

extra box ticked cancels 1 mark

1

oxygen less than glucose

1

(iii) respiration

1

[6]

Q31.

(a) A

no mark - can be specified in reason part
if B given - no marks throughout
if unspecified + 2 good reasons = 1 mark

high(er) pressure in A

allow opposite for B
*do **not** accept 'zero pressure' for B*

pulse / described in A
accept fluctuates / 'changes'
allow reference to beats / beating
ignore reference to artery pumping

2

(b) (i) 17

1

(ii) 68
accept correct answer from student's (b)(i) × 4

1

(c) oxygen / oxygenated blood
allow adrenaline
ignore air

glucose / sugar
extra wrong answer cancels - eg sucrose / starch / glycogen / glucagon / water
allow fructose
ignore energy
ignore food

2

[6]

Q32.

(a) circulating / mixing / described **or** temperature maintenance

1

supply oxygen
or for aerobic conditions
or for faster respiration
*do **not** allow oxygen for anaerobic respiration*

1

(b) energy supply / fuel / use in respiration
*do **not** allow just food / growth*
ignore reference to aerobic / anaerobic

or material for growth / to make mycoprotein

1

(c) respiration
allow exothermic reaction
allow catabolism
ignore metabolism
ignore aerobic / anaerobic

1

(d) (i) any **one** from:

- compete (with *Fusarium*) for food / oxygen **or** reduce yield of *Fusarium*
- make toxic waste products or they might cause disease / pathogenic **or** harmful to people / to *Fusarium*

*do **not** allow harmful unqualified*

1

(ii) steam / heat treat / sterilise fermenter (before use)

***not** just clean*

or
steam / heat treat / sterilise
glucose / minerals / nutrients / water (before use)
or
filter / sterilise air intake
or
check there are no leaks

*allow sterilisation unqualified **not** just use pure glucose*

1

(e) any **three** from:

- beef is best or beef is better than mycoprotein
- mycoprotein <u>mainly</u> better than wheat
- more phenylalanine in wheat than in mycoprotein

allow equivalent numerical statements

- but no information given on other amino acids / costs / foods

3

<u>overall conclusion:</u>

statement is incorrect because
either
it would be the best source for vegetarians
or
for given amino acids, beef is the best source
or
three foods provide insufficient data to draw a valid conclusion

1

[10]

Q33.

(a) (i) **A** lung

1

B rib

1

C diaphragm

1

D alveolus / alveoli

1

(ii) (**B** moves) up(wards) / out / up and out

1

(**C** moves) down(wards) / flattens

*do **not** allow inwards*
ignore outwards
*if neither mark gained allow **1** mark for correct reference to muscle contraction*

1

(b) (i) 1640

1

1440

1

1720

*allow max **1** for 3 correct values using of bottom of piston:*
1380 + 1180 + 1480 to 1485

1

(ii) 1600

*correct answer gains **2** marks*
*if answer incorrect allow **1** mark for evidence of (1640 + 1440 + 1720) ÷ 3*
*allow ecf from **(b)(i)***
allow use of two numbers divided by two if one is considered anomalous:
$\frac{(1640 + 1720)}{2}$ *= 1680*
*for **2** marks*

2

(c) two groups of students − one group sports activity participants, other not

allow students as a group

1

fair test eg groups same height / same mass / same sex

1

measure air breathed in by each student / repeat previous experiment then calculate mean for group

1

(d) pointer remains still after breathing / cylinder will move down after breathing (in)

1

error reading volume less likely

allow more accurate / reliable

1

(e) (i) operator squeezes bag

1

air forced / pushed into lungs

or

positive pressure ventilator

1

(ii) any **two** from:

- air pressure / volume not regulated
- operator will tire / must be present <u>at all times</u> / variable intervals
- too much / too little air

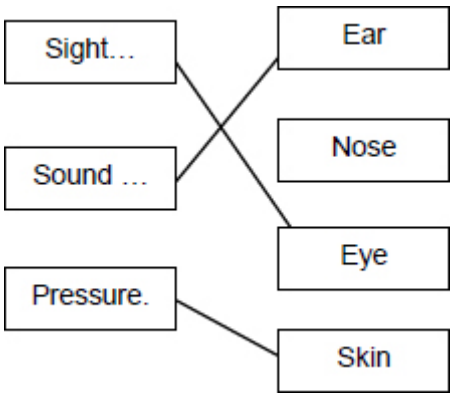
allow may 'overbreathe' the patient

2

[20]

Q34.

(a) (i)



1 *mark for each line*

do ***not*** *award a mark for a 'change' that has two lines*

3

(ii) receptor cells

1

(b) used to provide (extra) energy

allow (more) used in respiration

allow suitable reference to muscles

do ***not*** *accept used for sweat*

1

(c) (i) growth of muscles

1

(ii) (these drugs have) possible side / harmful effects

or

answers that refer to 'fairness of competition' e.g. cheating

1

[7]

Q35.

(a) (i) rate of chemical reactions (in the body)

1

(ii) any **two** from:

- heredity / inheritance / genetics
- proportion of muscle to fat **or** (body) mass
  allow (body) weight / BMI
- age / growth rate
- gender
  accept hormone balance or environmental temperature
  ignore exercise / activity

2

(b) (i) 77

*correct answer with or without working gains **2** marks*
*allow **1** mark for 70 / 56 **or** 1.25 **or** 5*

2

(ii) increase exercise

accept a way of increasing exercise

1

reduce food intake

accept examples such as eat less fat / sugar
*allow go on a diet **or** take in fewer calories*
ignore lose weight
ignore medical treatments such as gastric band / liposuction

1

[7]

Q1.

One factor that may affect body mass is *metabolic rate*.

(a) (i) What is meant by *metabolic rate* ?

_____

_____

(1)

(ii) Metabolic rate is affected by the amount of activity a person does.

Give **two** other factors that may affect a person's metabolic rate.

1. _____

_____

2. _____

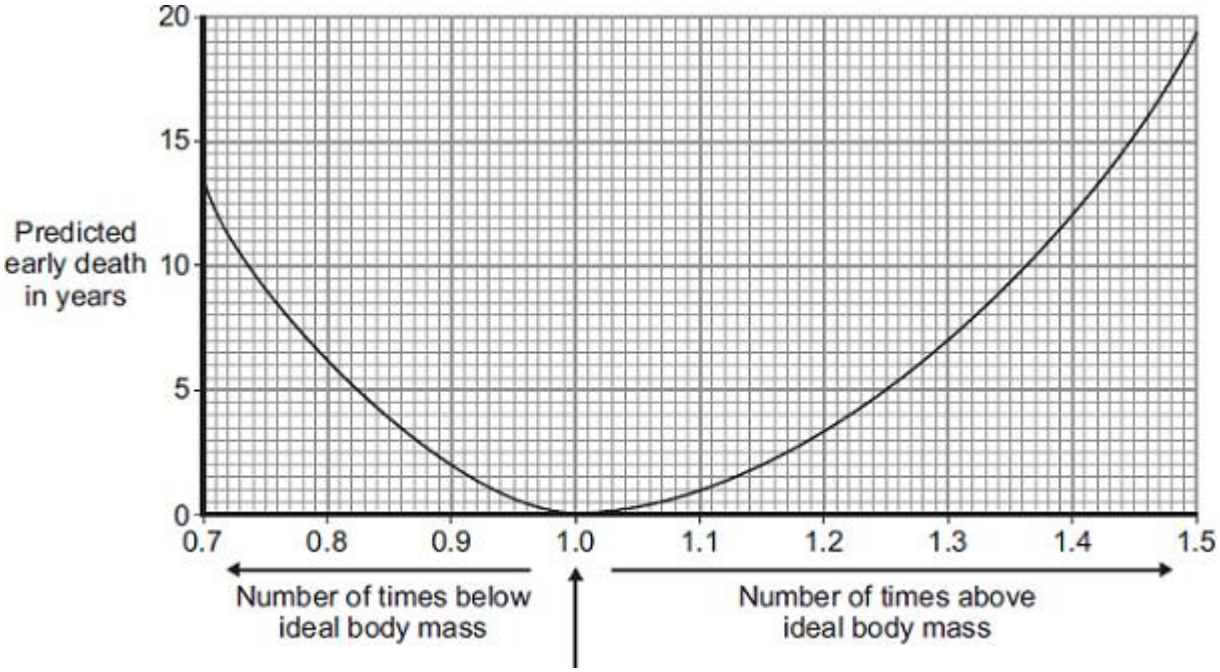
_____

(2)

(b) Predicted early death is the number of years that a person will die before the mean age of death for the whole population. The predicted early death of a person is affected by their body mass.

Scientists have calculated the effect of body mass on predicted early death.

The graph shows the results of the scientists' calculations.



The number of times above or below ideal body mass is given by the equation:

$$\frac{\text{Actual body mass}}{\text{Ideal body mass}}$$

In the UK the mean age of death for women is 82.

A woman has a body mass of 70 kg. The woman's ideal body mass is 56 kg.

(i) Use the information from the graph to predict the age of this woman when she dies.

_____

_____

_____

Age at death = _____ years

(2)

(ii) The woman could live longer by changing her lifestyle.

Give **two** changes she should make.

1. _____

_____

2. _____

_____

(2)

(Total 7 marks)

Q2.

(a) Use words from the box to complete the equation for aerobic respiration.

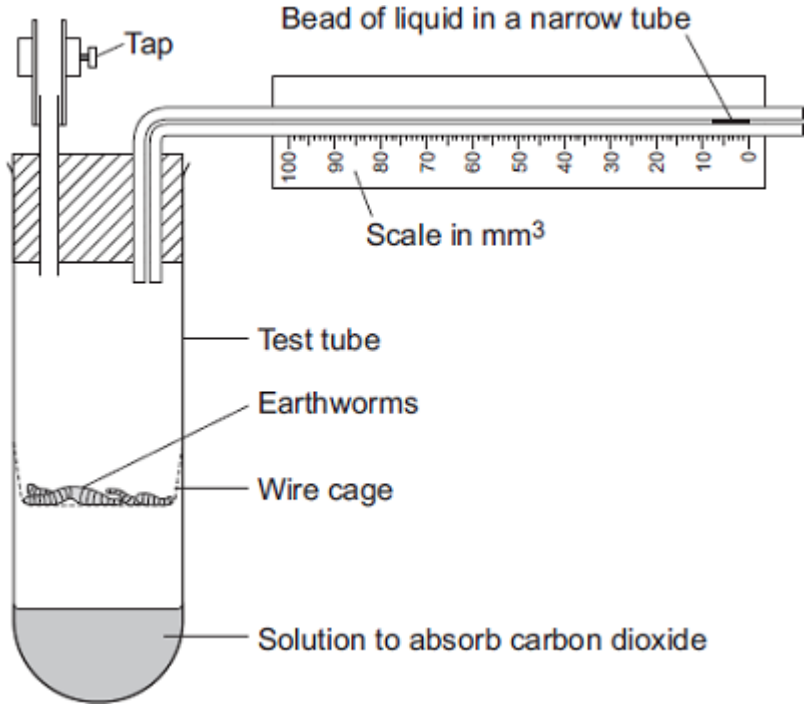
alcohol	**glucose**	**lactic acid**	**water**

_____ + oxygen ⟶ carbon dioxide + _____ (+ energy)

(2)

(b) Some students investigated the effect of temperature on the rate of aerobic respiration in earthworms.

The diagram shows the apparatus the students used.
When the tap is closed, the bead of liquid moves to the left as the earthworms take in oxygen.



The students put the test tube into a water bath at 20°C for 10 minutes.
They left the tap open during this time.

Why did the students put the test tube in the water bath at 20°C for 10 minutes?

Tick (✓) **one** box.

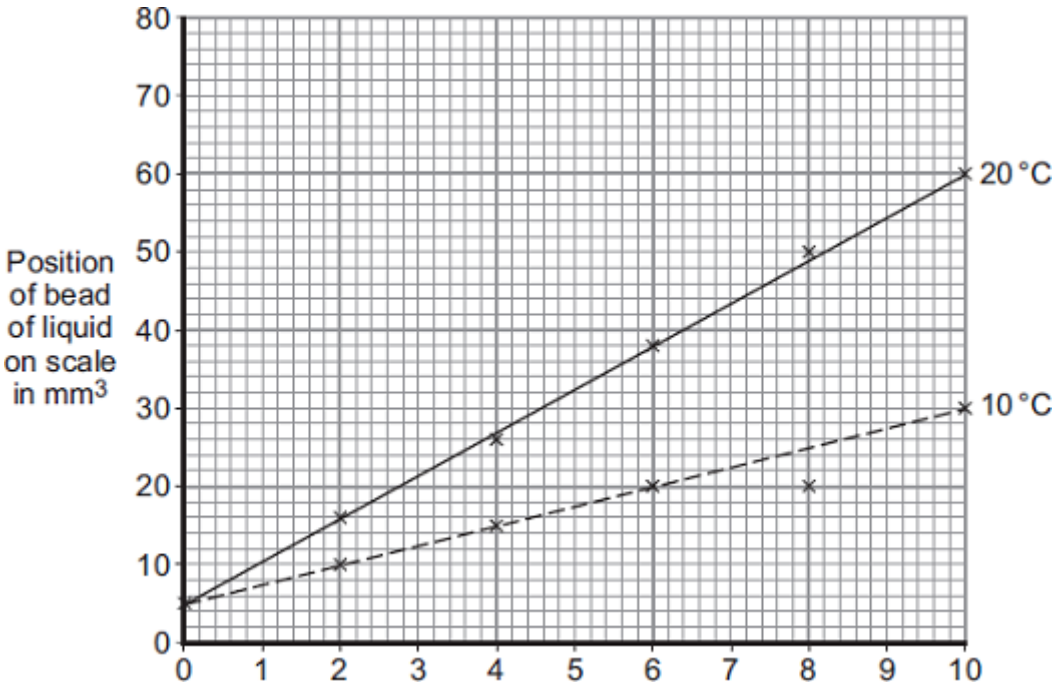
Because the air contains more oxygen at 20°C.	☐
Because the air contains less carbon dioxide at 20°C.	☐
So the earthworms' body temperature would change to 20°C.	☐

(1)

(c) The students then:

- closed the tap
- started a stopwatch
- recorded the position of the bead of liquid every 2 minutes for 10 minutes
- repeated the experiment at 10°C.

The graph shows the students' results.



(i) How much oxygen did the earthworms take in during the 10 minutes at 20°C?

Use information from the graph to work out your answer.

_____

Volume of oxygen taken in = _____ mm^3

(2)

(ii) The earthworms took in this volume of oxygen in 10 minutes.

Use your answer from part (c)(i) to calculate how much oxygen the earthworms took in each minute.

Volume of oxygen taken in = _____ mm^3 per minute

(1)

(iii) The earthworms took in less oxygen each minute at 10°C than they took in at 20°C.

Explain why.

(2)

(d) When drawing the line on the graph for the experiment at 10°C, the students ignored the reading at 8 minutes.

(i) Suggest why they ignored the reading at 8 minutes.

(1)

(ii) One student suggested they should repeat the experiment twice more at each temperature.

How would repeating the experiment improve the investigation?

(1)

(Total 10 marks)

Q3.

(a) Yeast cells can respire anaerobically.

The equation for anaerobic respiration in yeast is:

glucose ⟶ alcohol + carbon dioxide (+ energy)

Give **one** way in which anaerobic respiration in yeast cells is different from anaerobic respiration in human muscle cells.

_____

_____

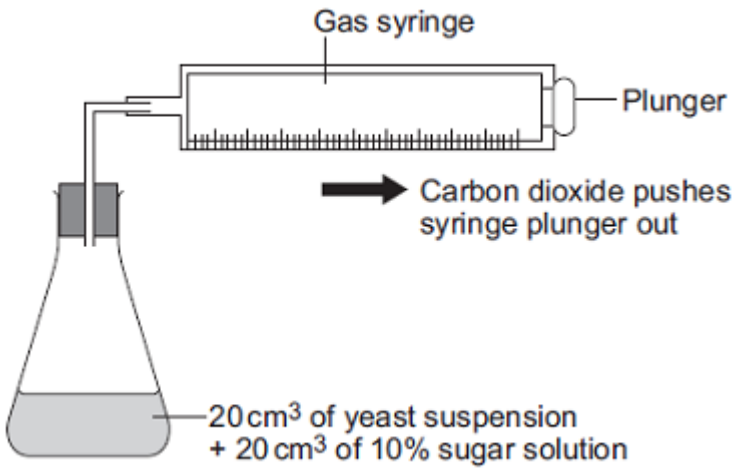
(1)

(b) Yeast can use other types of sugar instead of glucose.
Some scientists investigated the effect of three different types of sugar on the rate of anaerobic respiration in yeast.

The scientists:

- used the apparatus shown in **Diagram 1** with glucose sugar
- kept the apparatus at 20 °C
- repeated the investigation with fructose sugar and then with mannose sugar
- repeated the investigation with water instead of the sugar solution.

Diagram 1



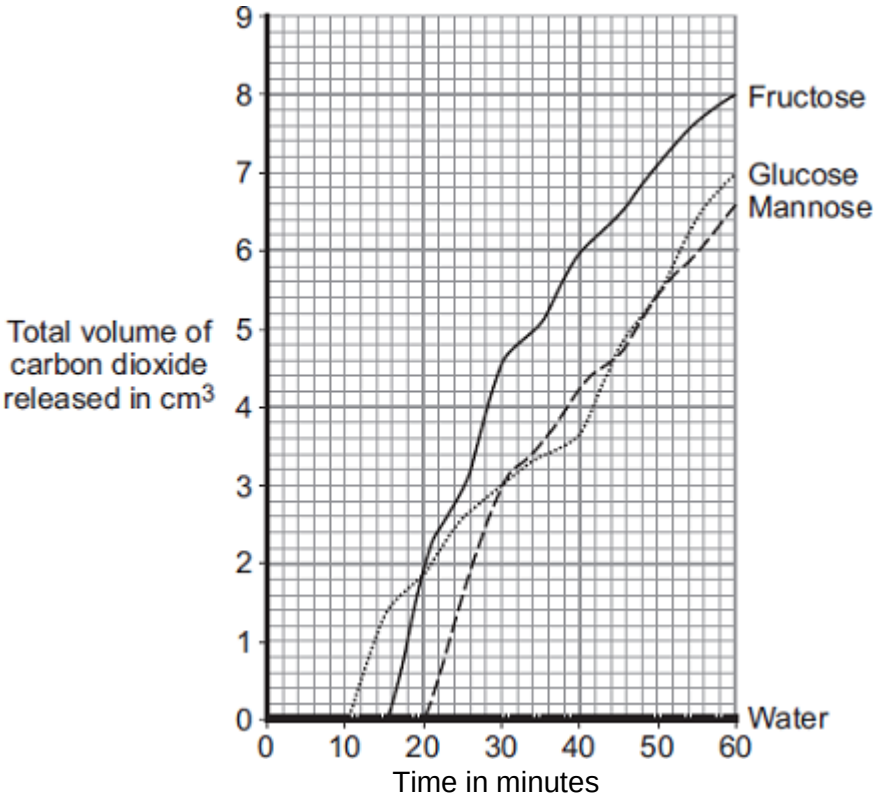
(i) Give **two** control variables the scientists used in this investigation.

_____

_____

(2)

(ii) The graph shows the scientists' results.



From this information, a company decided to use fructose to produce alcohol and **not** mannose or glucose.

Explain the reason for the company's choice.

_____

_____

_____

_____

(2)

(Total 5 marks)

Q4.

Some students investigated the best temperature for gas production by yeast.

The students set up the apparatus as shown in **Diagram 1**.

Diagram 1

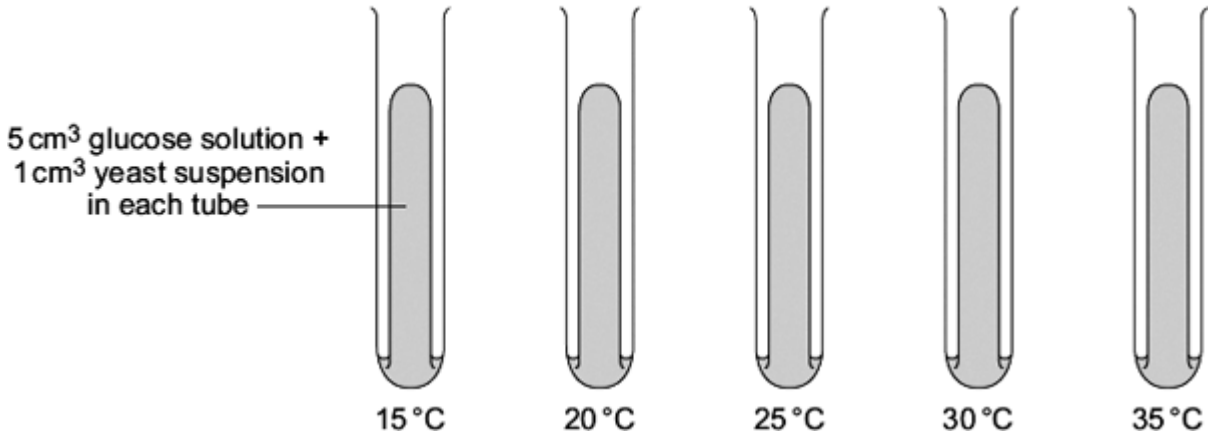
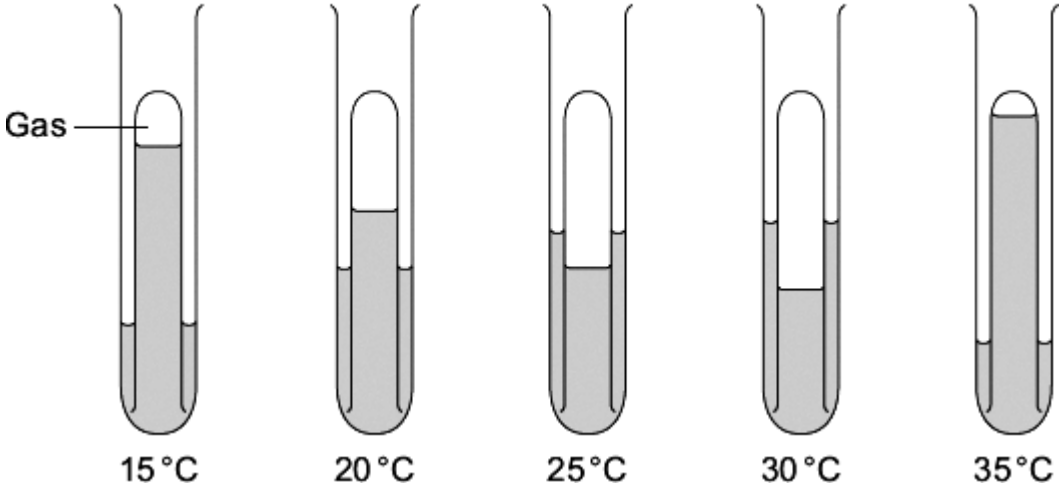


Diagram 2 shows the results after one hour.

Diagram 2



(a) In each apparatus the yeast produced a gas.

(i) Name this gas.

_____

(1)

(ii) Name the process which produces this gas.

_____

(1)

(b) One student said that the best temperature for the yeast to produce the gas was 30 °C.

What is the evidence for this in **Diagram 2?**

_____

_____

(1)

(c) A second student said that the investigation might not have produced reliable results.

(i) What should the students do next to check the reliability of their results?

_____

_____

(1)

(ii) How would the students then know if their results were reliable?

_____

_____

(1)

(d) A third student said that the investigation might not have produced an accurate value for the best temperature for gas production.

What should the students do next to check that 30 °C was an accurate value for the best temperature?

_____

_____

_____

_____

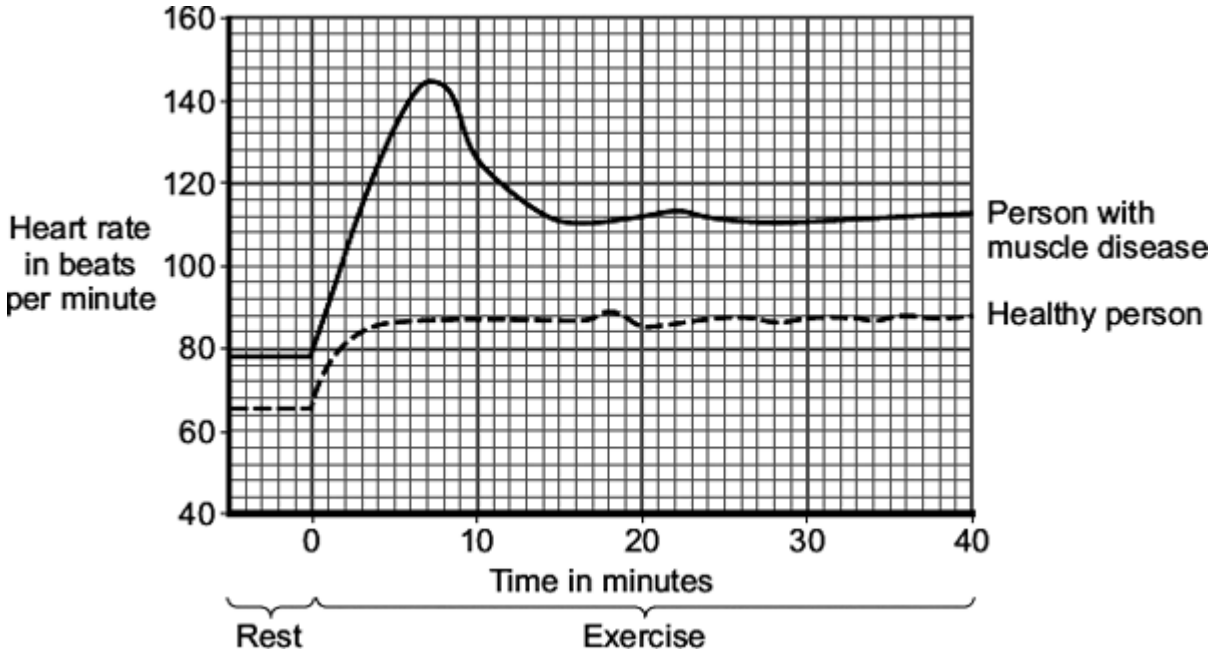
(2)

(Total 7 marks)

Q5.

Two people did the same amount of gentle exercise on an exercise cycle.
One person had a muscle disease and the other had healthy muscles.

The graph shows the effect of the exercise on the heart rates of these two people.



(a) Describe **three** ways in which the results for the person with the muscle disease are different from the results for the healthy person.

To gain full marks in this question you need to include data from the graph in your answer.

1. _____

_____

2. _____

_____

3. _____

_____

(3)

(b) The blood transports glucose to the muscles at a faster rate during exercise than when a person is at rest.

(i) Name **one** other substance that the blood transports to the muscles at a faster rate during exercise.

_____

(1)

(ii) People with the muscle disease are not able to store glycogen in their muscles.

The results shown in the graph for the person with the muscle disease are different from the results for the healthy person.

Suggest an explanation for the difference in the results.

(3)

(Total 7 marks)

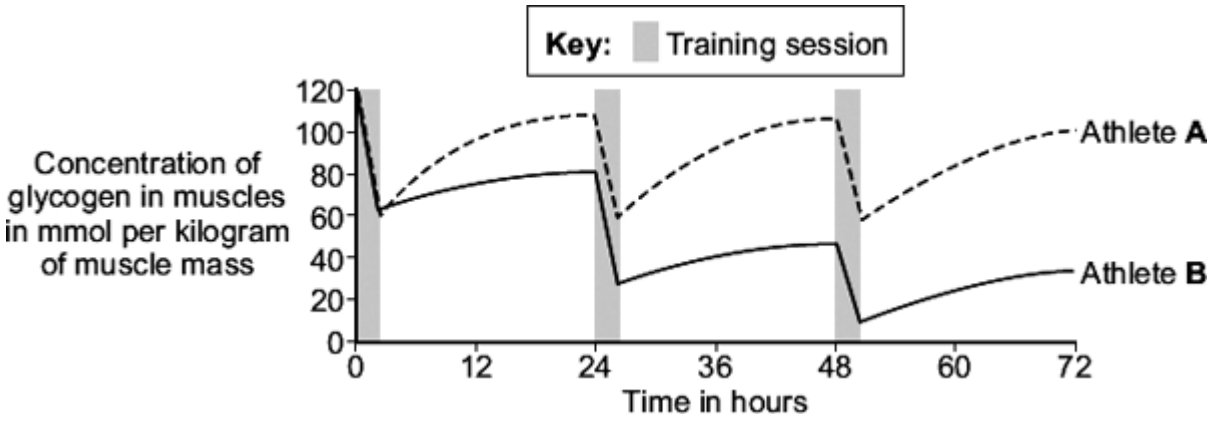
Q6.

Glycogen is stored in the muscles.

Scientists investigated changes in the amount of glycogen stored in the muscles of two 20-year-old male athletes, **A** and **B**.
Athlete **A** ate a high-carbohydrate diet. Athlete **B** ate a low-carbohydrate diet.

Each athlete did one 2-hour training session each day.

The graph shows the results for the first 3 days.



(a) (i) Give **three** variables that the scientists controlled in this investigation.

_____

_____

(3)

(ii) Suggest **two** variables that would be difficult to control in this investigation.

_____

_____

_____

_____

(2)

(iii) Describe **one** way in which the results of Athlete **B** were different from the results of Athlete **A**.

_____

_____

(1)

(b) Both athletes were training to run a marathon.

Which athlete, **A** or **B**, would be more likely to complete the marathon?

Use information from the graph to explain your answer.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 10 marks)

Q7.

(a) Complete the equation for photosynthesis.

_____ + _____ $\xrightarrow{\text{light energy}}$ _____ + oxygen

(2)

(b) Scientists investigated how temperature affects the rate of photosynthesis.
The scientists grew some orange trees in a greenhouse.
They used discs cut from the leaves of the young orange trees.

The scientists used the rate of oxygen production by the leaf discs to show the rate of photosynthesis.

(i) The leaf discs did not produce any oxygen in the dark.

Why?

_____

_____

(1)

(ii) The leaf discs took in oxygen in the dark.

Explain why.

_____

_____

_____

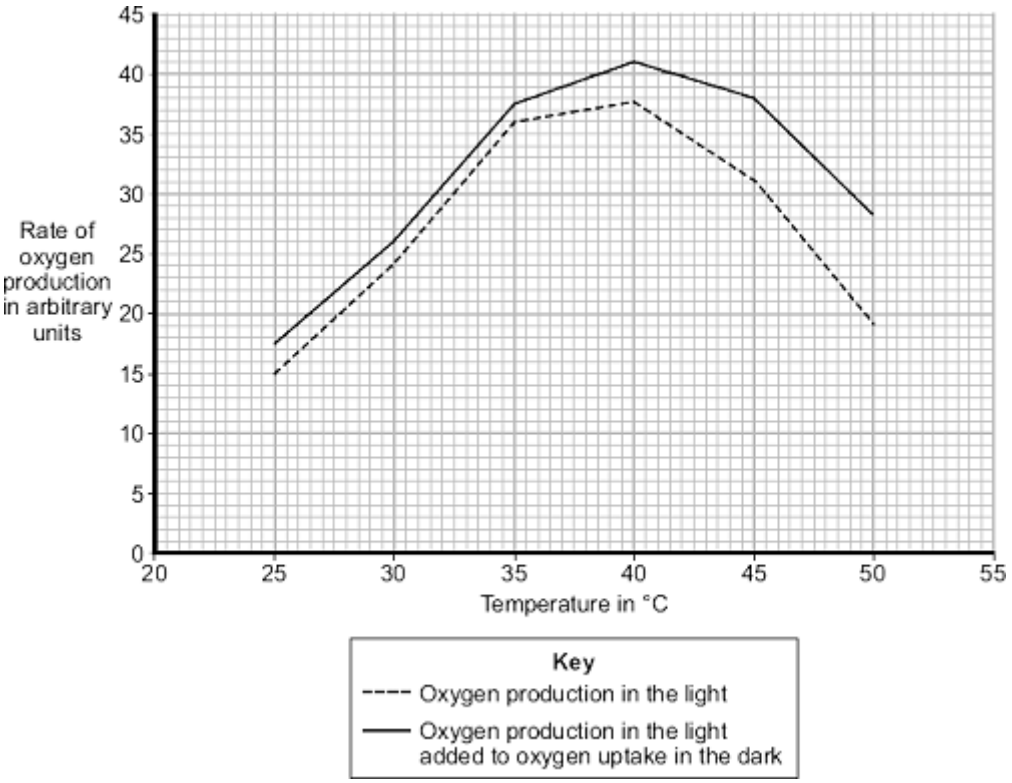
_____

(2)

(c) In their investigation, the scientists measured the rate of oxygen release by the leaf discs in the light. The scientists then measured the rate of oxygen uptake by the leaf discs in the dark.

The graph shows the effect of temperature on

- oxygen production in the light
- oxygen production in the light added to oxygen uptake in the dark.



Use the information from the graph to answer each of the following questions.

(i) Describe the effect of temperature on oxygen production in the light.

(2)

(ii) Explain the effect of temperature on oxygen production in the light when the temperature is increased:

from 25 °C to 35 °C

from 40 °C to 50 °C.

(2)

(d) A farmer in the UK wants to grow orange trees in a greenhouse. He wants to sell the oranges he produces at a local market.
He decides to heat the greenhouse to 35 °C.

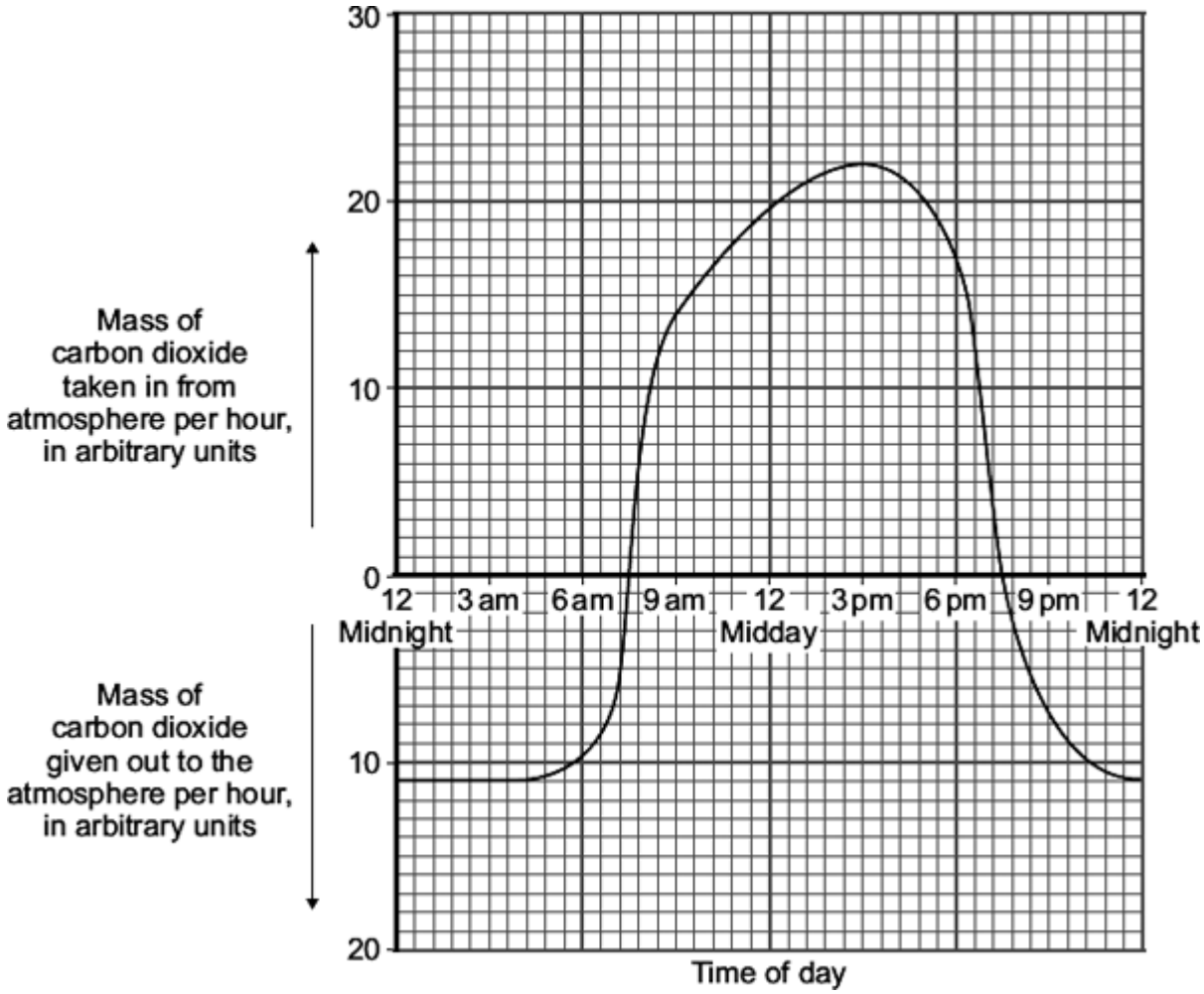
Explain why he should **not** heat the greenhouse to a temperature higher than 35 °C.
Use information from the graph in your answer.

(3)

(Total 12 marks)

Q8.

The graph shows the uptake of carbon dioxide and the release of carbon dioxide by a bean plant on a hot summer's day.



(a) At which **two** times in the day did the rate of photosynthesis exactly match the rate of respiration in the bean plant?

1. _____ 2. _____

(1)

(b) The bean plant respires at the same rate all through the 24 hour period.

(i) How much carbon dioxide is released each hour during respiration?

_____ arbitrary units

(1)

(ii) How much carbon dioxide is used by photosynthesis in the hour beginning at 3 pm?

_____

_____

Answer = _____ arbitrary units

(1)

(c) Over the 24 hour period, the total amount of carbon dioxide taken in by the bean plant was greater than the total amount of carbon dioxide given out by the bean

plant.

Explain, in detail, why this was important for the bean plant.

_____

_____

_____

_____

_____

_____

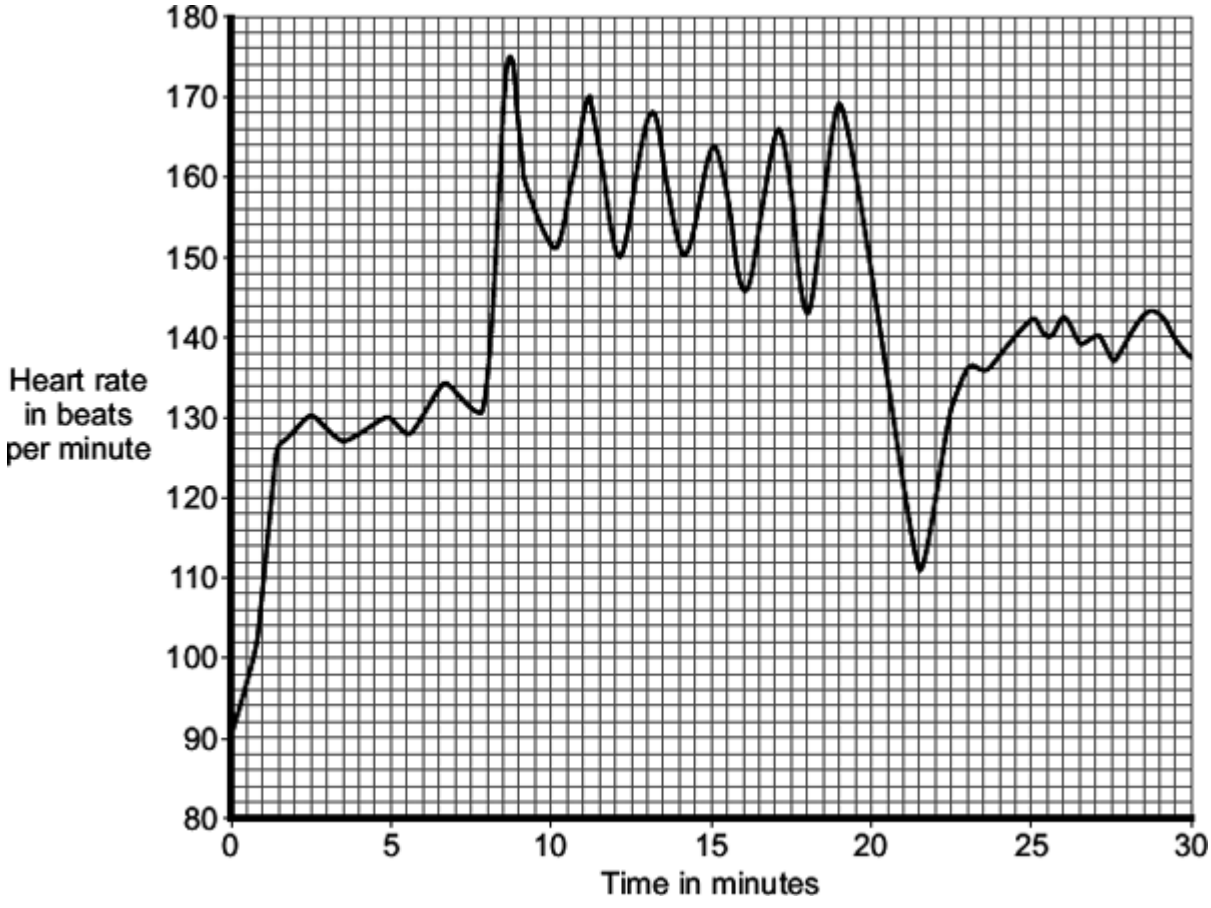
(2)

(Total 5 marks)

Q9.

One type of training exercise involves alternating periods of walking and running.

The graph shows how an athlete's heart rate changed during one 30-minute training session.



(a) (i) The athlete ran 6 times during the 30-minute training session.

Describe the evidence for this in the graph.

_____

_____

(1)

(ii) Immediately after the final run, the athlete rested for a short time before he started to walk again.

For how many minutes did this rest last?

_____ minutes

(1)

(b) The heart rate increases during exercise.

This increase in heart rate increases blood flow to the muscles.

Explain, as fully as you can, why this increase in heart rate is necessary.

_____

_____

_____

_____

_____

_____

_____

_____

_____

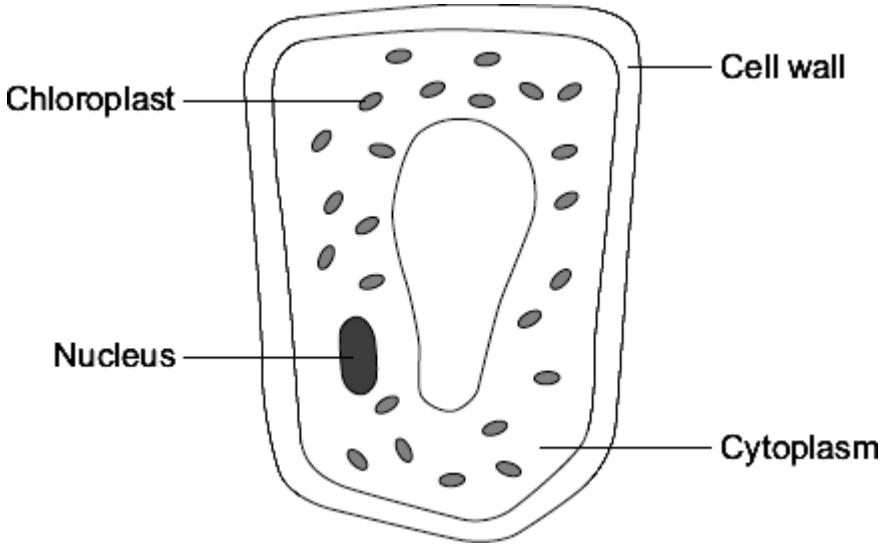
_____

(4)

(Total 6 marks)

Q10.

The diagram shows a plant cell from a leaf.



(a) **List A** gives the names of three parts of the cell.
List B gives the functions of parts of the cell.

Draw a line from each part of the cell in **List A** to its function in **List B**.

List A **Parts of the cell**	**List B** **Functions**
	Where most of the chemical reactions take place
Nucleus	
	Absorbs light energy to make food
Cytoplasm	
	Strengthens the cell
Chloroplast	
	Controls the activities of the cell

(3)

(b) Respiration takes place in the cell.

Draw a ring around the correct answer to complete the sentence.

All cells use respiration to release | energy | oxygen.

sugar.

(1)

(Total 4 marks)

Q11.

The table shows the volume of blood flowing through different organs at three levels of exercise.

Organ(s)	Volume of blood flowing through organ(s) in cm^3 per minute		
	Light exercise	**Moderate exercise**	**Heavy exercise**
Gut	1 100	600	300
Kidneys	900	600	250
Brain	750	750	750
Heart muscles	350	750	1 000
Skeletal muscles	4 500	12 500	22 000
Skin	1 500	1 900	600
Other	400	500	100
Total	**9 500**	**17 600**	**25 000**

(a) (i) Which organ has a constant flow of blood through it?

_____

(1)

(ii) Which organ has the greatest reduction in the volume of blood supplied during heavy exercise compared with light exercise?

_____

(1)

(iii) What proportion of the blood flows through the heart muscle during heavy exercise?

_____

(1)

(b) The volume of blood flowing through the skeletal muscles increases greatly during exercise.

Give **two** ways in which the body brings about this increase.

1. _____

_____

2. _____

_____

(2)

(c) During exercise, the concentration of carbon dioxide in the blood increases.

Explain what causes this increase.

_____

_____

_____

_____

_____

_____

(3)

(Total 8 marks)

Q12.

Muscles need energy during exercise.

Draw a ring around the correct answer in parts (a) and (b) to complete each sentence.

(a) (i) The substance stored in the muscles and used during exercise is

glycogen.
lactic acid.
protein.

(1)

(ii) The process that releases energy in muscles is

digestion.
respiration.
transpiration.

(1)

(b) The table shows how much energy is used by two men of different masses when swimming at different speeds.

Speed of swimming in	**Energy used in kJ per hour**

metres per minute	34 kg man	70 kg man
25	651	1155
50	1134	2103

(i) When the 34 kg man swims at 50 metres per minute instead of at 25 metres per minute,

the extra energy he uses each hour is

- 36 kJ.
- 483 kJ.
- 948 kJ.

(1)

(ii) When swimming at 50 metres per minute, each man's heart rate is faster than when swimming at 25 metres per minute.

A faster heart rate helps to supply the muscles with more

- carbon dioxide.
- glycogen.
- oxygen.

(1)

(iii) During the exercise the arteries supplying the muscles would

- constrict.
- dilate.
- pump harder.

(1)

(c) When a person starts to swim, the breathing rate increases.

Give **one** way in which this increase helps the swimmer.

_____

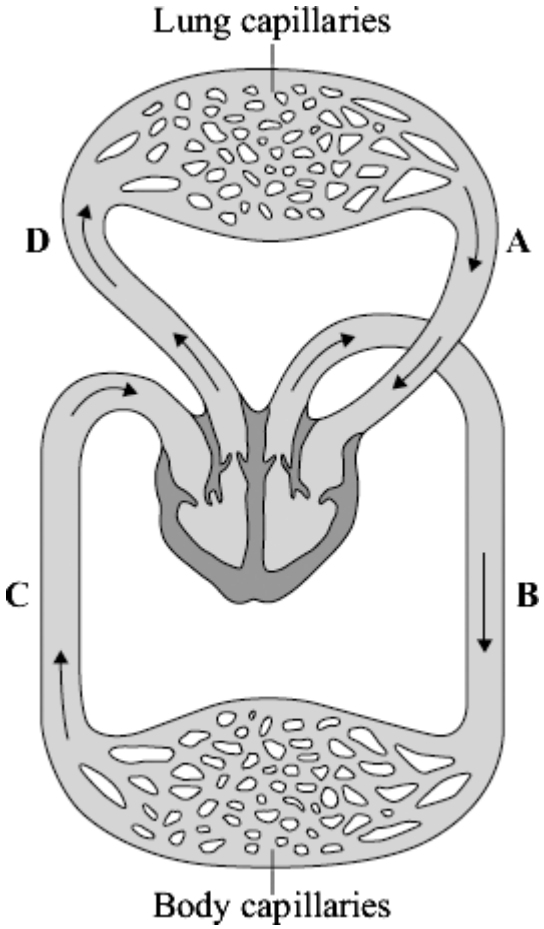
_____

(1)

(Total 6 marks)

Q13.

The diagram shows the human circulation system.



(a) (i) Give the letter of **one** blood vessel that is an artery.

(1)

(ii) Give the letter of **one** blood vessel that carries oxygenated blood.

(1)

(b) During exercise, the heart rate increases.

Explain, as fully as you can, why this increase is necessary.

(4)

(Total 6 marks)

Q14.

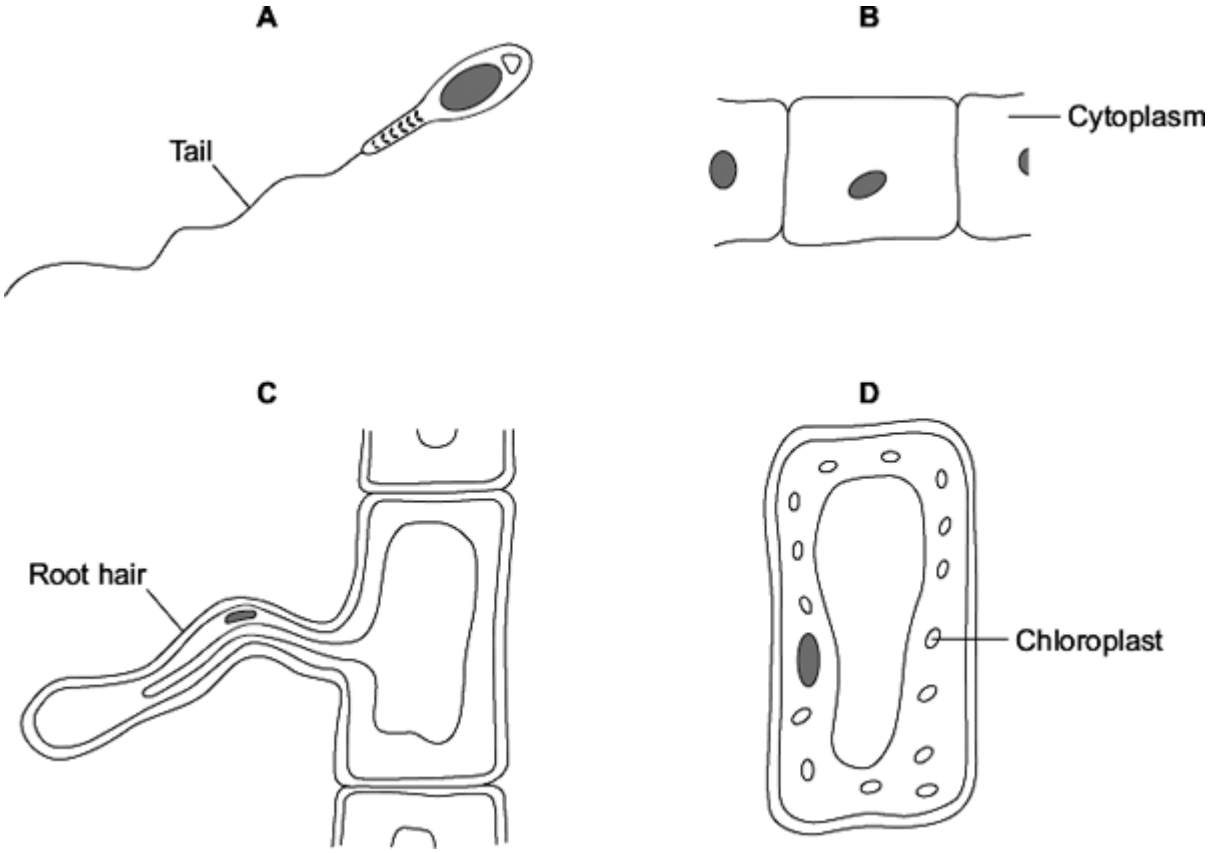
Lactic acid production during exercise affects an athlete's performance.

Explain why lactic acid is produced during exercise.

(Total 2 marks)

Q15.

The diagrams show four types of cell, **A**, **B**, **C** and **D**.
Two of the cells are plant cells and two are animal cells.



(a) (i) Which **two** of the cells are plant cells?

Tick (✓) **one** box.

A and **B** ☐

A and **D** ☐

C and **D** ☐

(1)

(ii) Which part is found **only** in plant cells?

Draw a ring around **one** answer.

cell membrane **cell wall** **nucleus**

(1)

(b) (i) Which cell, **A**, **B**, **C** or **D**, is adapted for swimming? ☐

(1)

(ii) Which cell, **A**, **B**, **C** or **D**, can produce glucose by photosynthesis? ☐

(1)

(c) Cells **A**, **B**, **C** and **D** all use oxygen.

For what process do cells use oxygen?

Draw a ring around **one** answer.

osmosis **photosynthesis** **respiration**

(1)

(Total 5 marks)

Q16.

This question is about what happens during decay.

Draw a ring around the correct word to complete each sentence.

(a) After living things die, they are decayed by

animals.
microorganisms.
plants.

(1)

(b) Decay happens faster when there is plenty of oxygen and conditions are

cold.
dry.
moist.

(1)

(c) During decay carbon dioxide is produced by

osmosis.
respiration.
photosynthesis.

(1)

(d) Decay releases mineral salts into the soil.

These mineral salts are absorbed by plant

leaves.
roots.
stems.

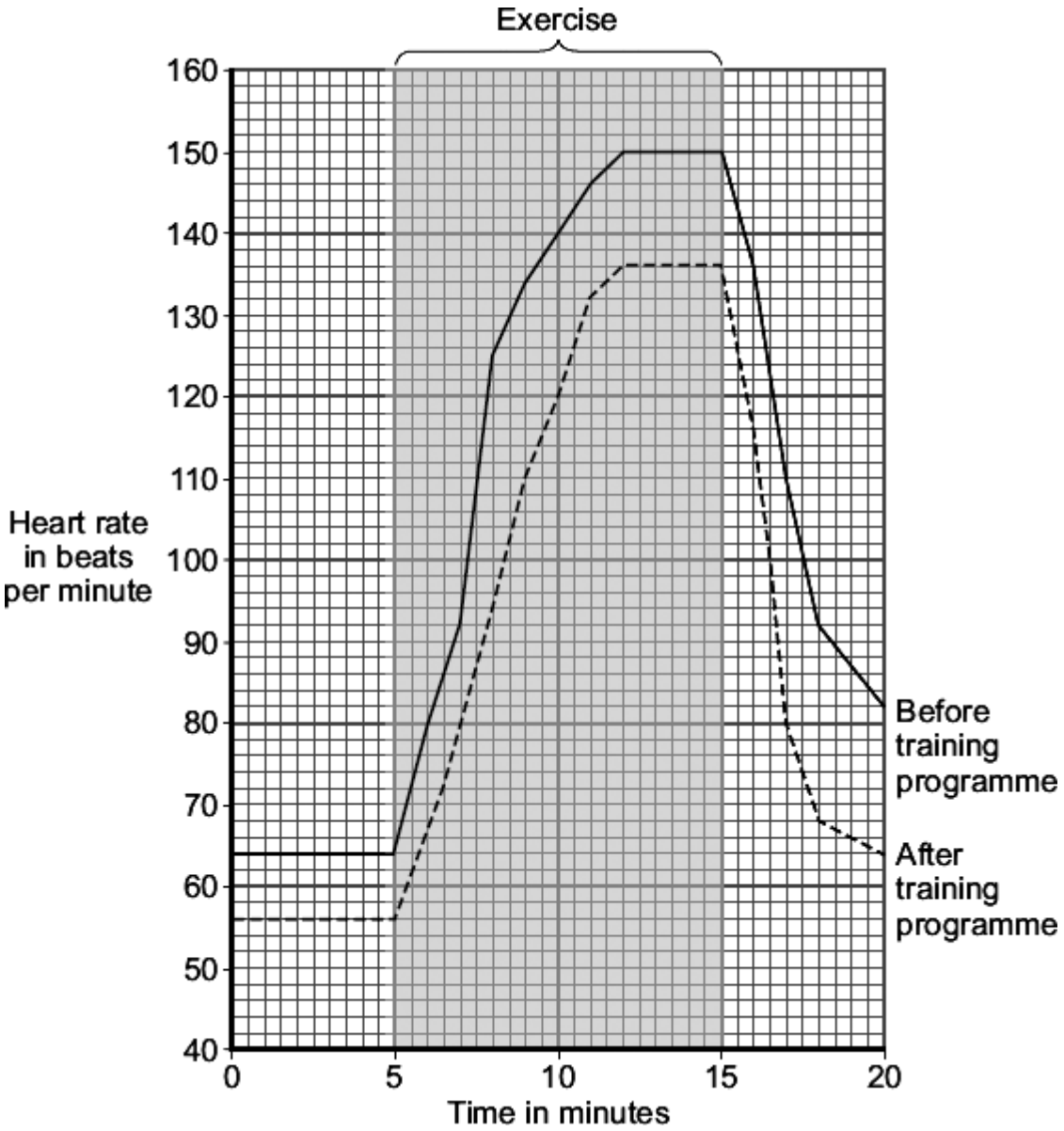
(1)

(Total 4 marks)

Q17.

An athlete did a 6-month training programme.

The graph shows the effect of the same amount of exercise on his heart rate before and after the training programme.



(a) (i) What was the maximum heart rate of the athlete during exercise before the training programme?

_____ beats per minute

(1)

(ii) Give **two** differences between the heart rate of the athlete before and after the training programme.

After the training programme

Difference 1 _____

_____

Difference 2 _____

_____

(2)

(b) Which **two** substances need to be supplied to the muscles in larger amounts during exercise?

Tick (✓) **two** boxes.

Carbon dioxide	☐
Glucose	☐
Lactic acid	☐
Oxygen	☐
Urea	☐

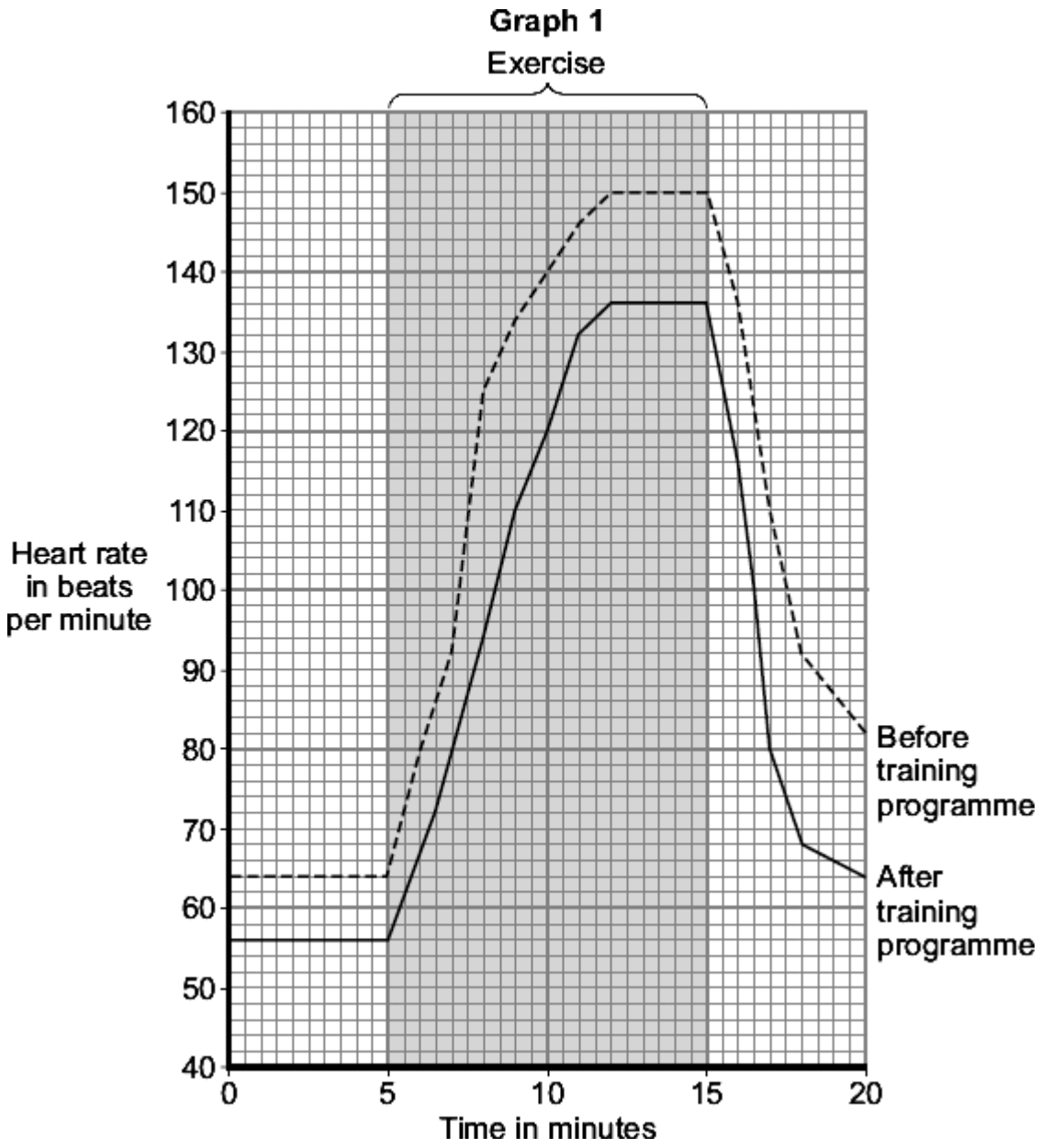
(2)

(Total 5 marks)

Q18.

An athlete carried out a 6-month training programme.

Graph 1 shows the effect of the same amount of exercise on his heart rate before and after the training programme.



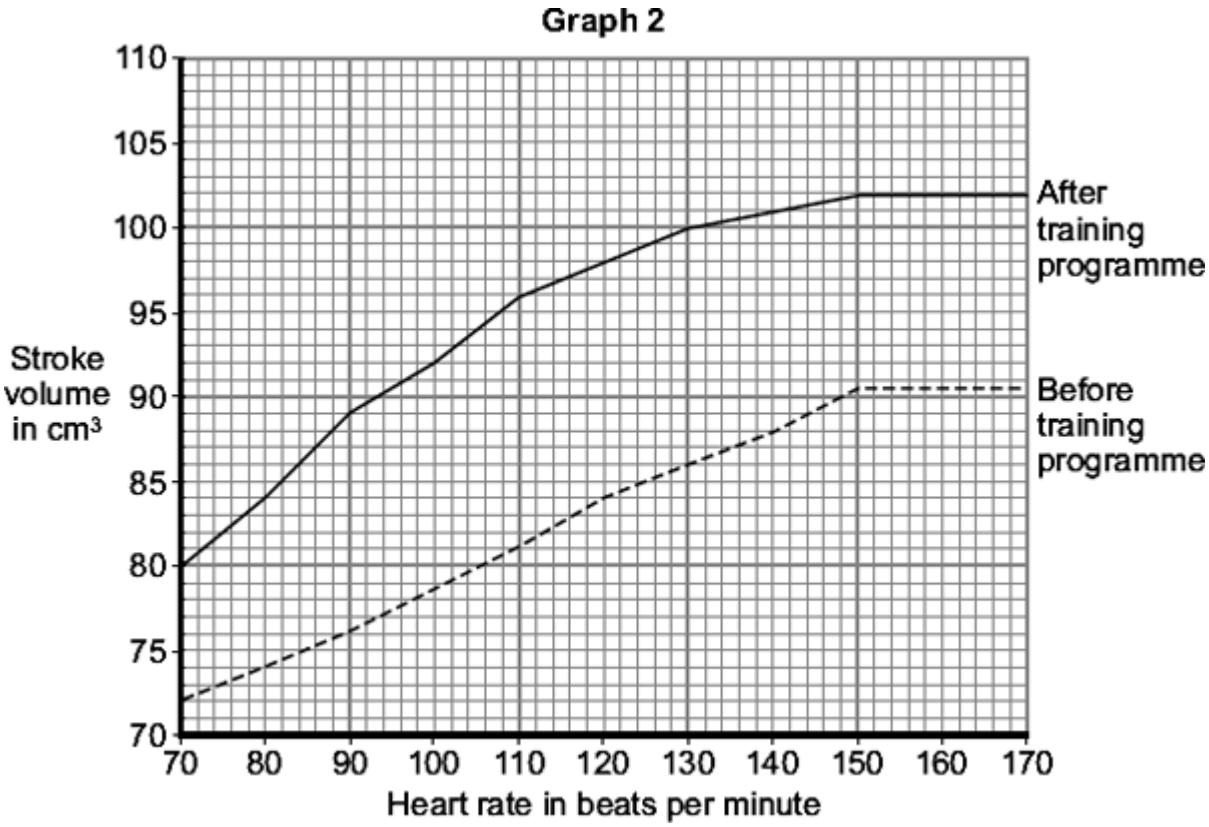
(a) (i) Use **Graph 1** to find the heart rate of the **trained** athlete 5 minutes after the start of the exercise.

Heart rate = _____ beats per minute

(1)

The stroke volume of the heart is the volume of blood pumped out of the left side of the heart in one heart beat.

Graph 2 shows the relationship between the stroke volume and the heart rate before and after the athlete did the training programme.



(ii) The *cardiac output* is defined as

cardiac output = heart rate × stroke volume

Calculate the cardiac output of the **trained** athlete 5 minutes after the start of the exercise. Use your answer to part (a)(i), and information from **Graph 2**.

Show clearly how you work out your answer.

_____

_____

Cardiac output = _____ cm^3 blood per minute

(2)

(b) **Graph 1** shows that, for the same amount of exercise, the heart of the trained athlete was beating more slowly than it did before the training programme.

Use information from **Graph 2** to explain why.

_____

_____

_____

_____

(2)

(c) An increased cardiac output will provide more oxygen and more glucose to the working muscles.

Explain how this helps the athlete during exercise.

(4)

(Total 9 marks)

Q19.

(a) The table shows the effect of exercise on the action of one person's heart.

	At rest	During exercise
Heart rate in beats per minute	72	165
Volume of blood leaving the heart in each beat in cm^3	75	120
Heart output in cm^3 per minute	5400	

(i) Calculate the heart output for this person during exercise.

Show clearly how you work out your answer.

Answer = _____ cm^3 per minute

(2)

(ii) During exercise, more oxygen is carried to the working muscles.

Explain why this is helpful during exercise.

_____

_____

_____

_____

_____

(2)

(b) Give **two** other changes in the body that help to increase the amount of oxygen delivered to the working muscles during exercise.

1. _____

_____

2. _____

_____

(2)

(Total 6 marks)

Q20.

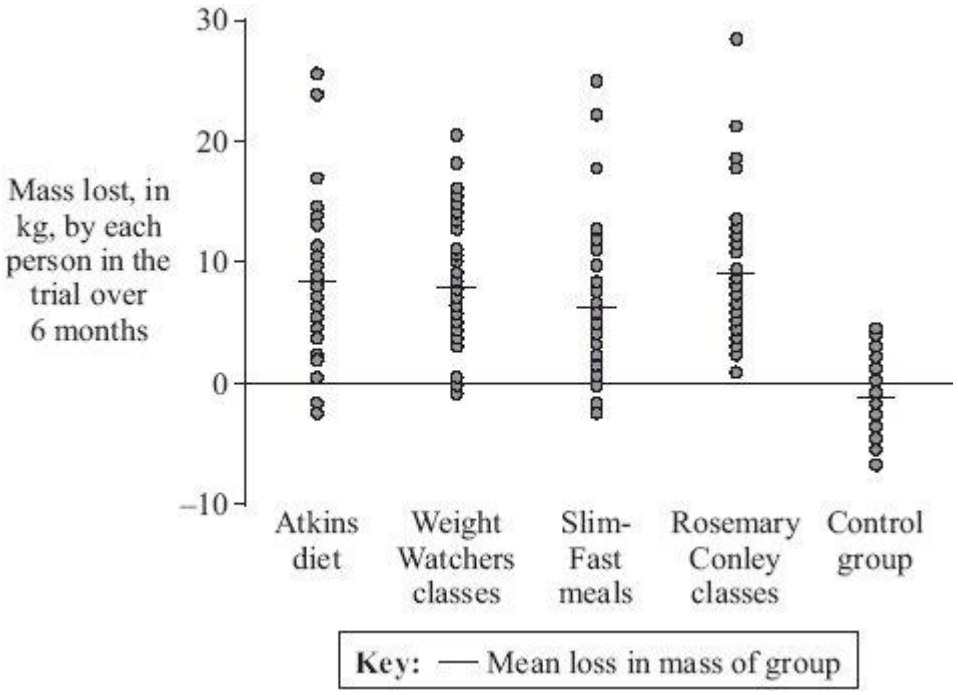
Many people who are overweight try slimming programmes.

A research study evaluated four different slimming programmes over 6 months.

Scientists selected a group of 40 people for each slimming programme and a control group.

Each of the five groups was matched for age, gender and mass.

The graph shows the results of the study.



Adapted from British Medical Journal, 2006, volume 332, pages 1309 –1314.

(a) Give **two** control variables that were used in this study.

1. _____

2. _____

(2)

(b) Give **two** conclusions that can be drawn from the results of this study.

1. _____

_____

2. _____

_____

(2)

(c) The costs of the four programmes were:

- Atkins book cost £3
- Rosemary Conley classes cost £140 for 6 months
- Weight Watchers classes cost £170 for 6 months
- Twice-daily Slim-Fast meal replacements cost £240 for 6 months.

Use this information and the graph to answer this question.

Which is the most cost effective of the four programmes?

_____

Explain the reason for your answer.

(2)

(d) Some slimming programmes include daily exercise.

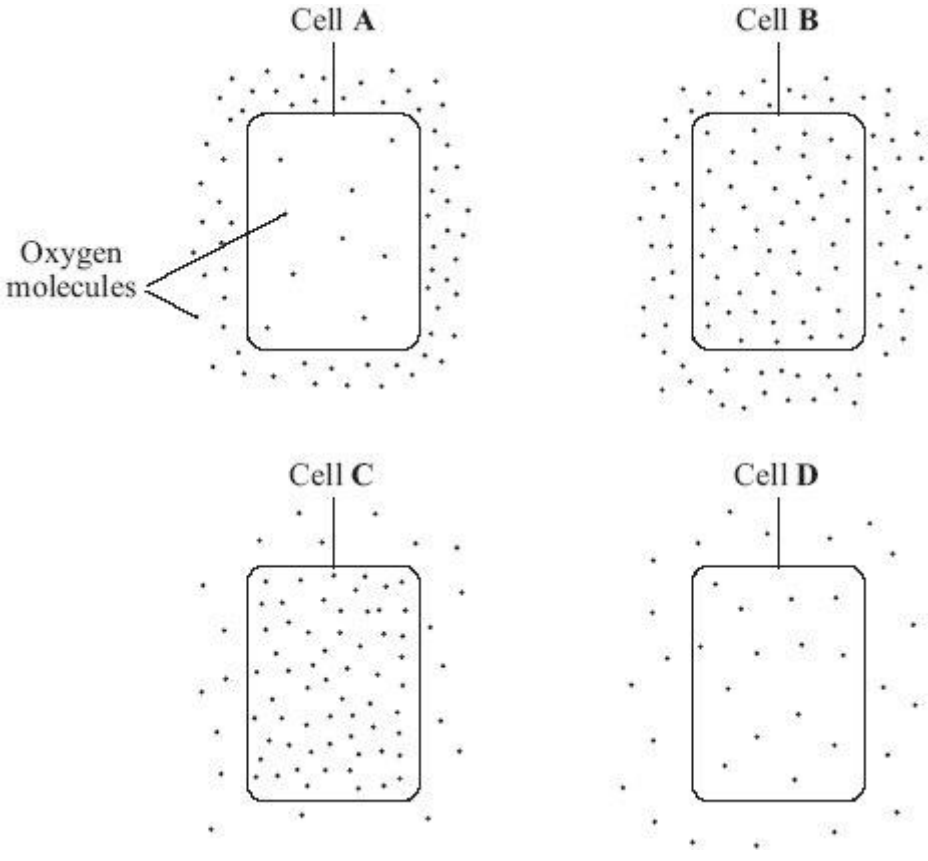
Explain how daily exercise helps a person to lose mass.

(2)

(Total 8 marks)

Q21.

(a) The diagrams show cells containing and surrounded by oxygen molecules.
Oxygen can move into cells or out of cells.



Into which cell, **A**, **B**, **C** or **D**, will oxygen move the fastest?

Write your answer, **A**, **B**, **C** or **D**, in the box. ☐

(1)

(b) Draw a ring around the correct word to complete each sentence.

(i) Oxygen is taken into cells by the process of

diffusion
osmosis
respiration

.

(1)

(ii) Cells need oxygen for

breathing
photosynthesis
respiration

.

(1)

(iii) The parts of cells that use up the most oxygen are the

membranes
mitochondria
nuclei

.

(1)

(iv) Some cells produce oxygen in the process of

diffusion
photosynthesis
respiration

.

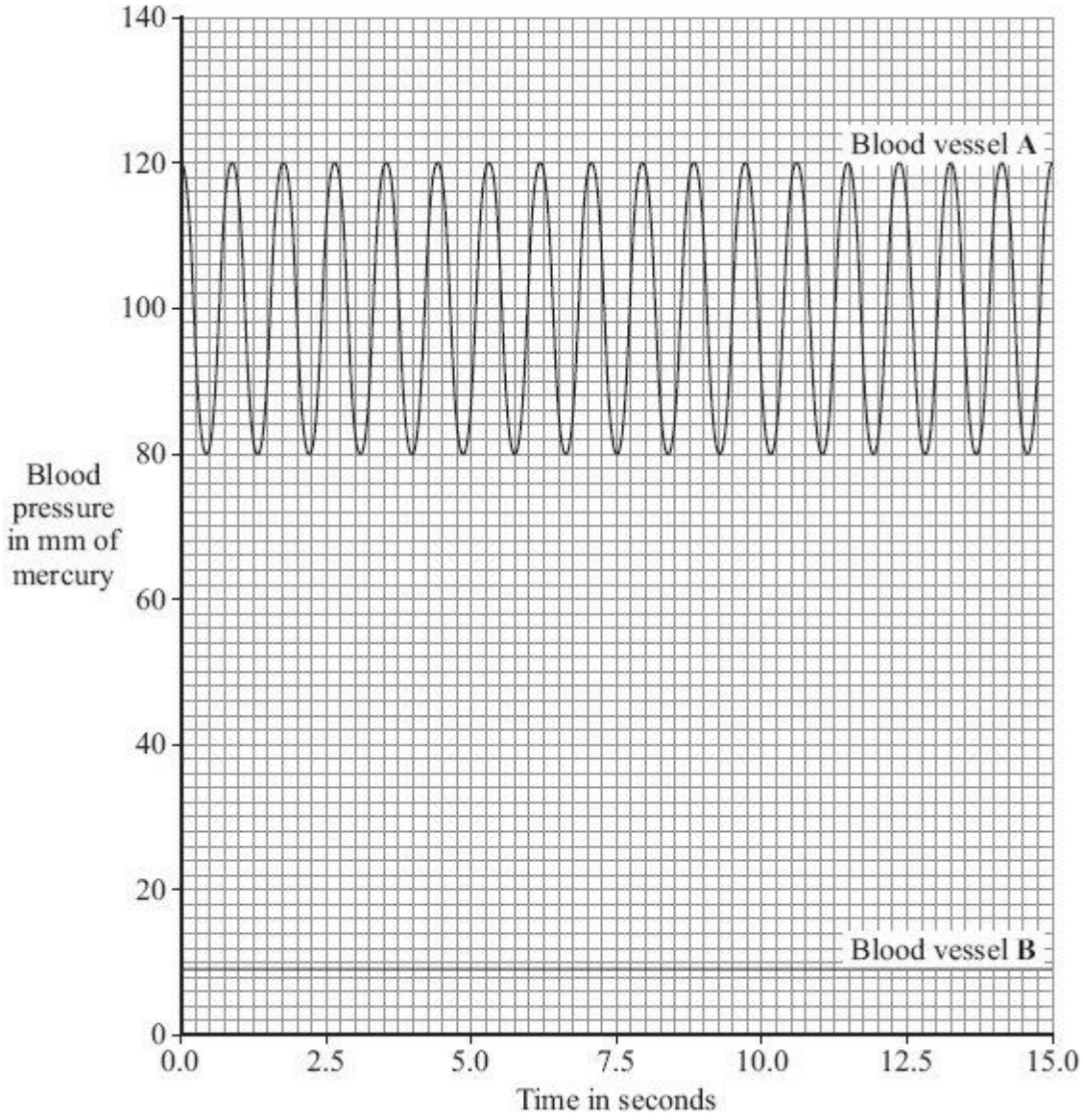
(1)

(Total 5 marks)

Q22.

The heart pumps blood around the body. This causes blood to leave the heart at high pressure.

The graph shows blood pressure measurements for a person at rest.
The blood pressure was measured in an artery and in a vein.



(a) Which blood vessel, **A** or **B**, is the artery?

Blood vessel _____

Give **two** reasons for your answer.

Reason 1 _____

_____

Reason 2 _____

_____

(2)

(b) Use information from the graph to answer these questions.

(i) How many times did the heart beat in 15 seconds? _____

(1)

(ii) Use your answer from part (b)(i) to calculate the person's heart rate per minute.

_____

_____

Heart rate = _____ beats per minute

(1)

(c) During exercise, the heart rate increases. This supplies useful substances to the muscles and removes waste materials from the muscles at a faster rate.

(i) Name **two** useful substances that must be supplied to the muscles at a faster rate during exercise.

1. _____

2. _____

(2)

(ii) Name **one** waste substance that must be removed from the muscles at a faster rate during exercise.

_____

(1)

(Total 7 marks)

Q23.

(a) The concentration of sulfate ions was measured in the roots of barley plants and in the water in the surrounding soil.

The table shows the results.

	Concentration of sulfate ions in mmol per dm^3
Roots of barley plants	1.4
Soil	0.15

Is it possible for the barley roots to take up sulfate ions from the soil by diffusion?

Draw a ring around your answer. **Yes / No**

Explain your answer.

_____

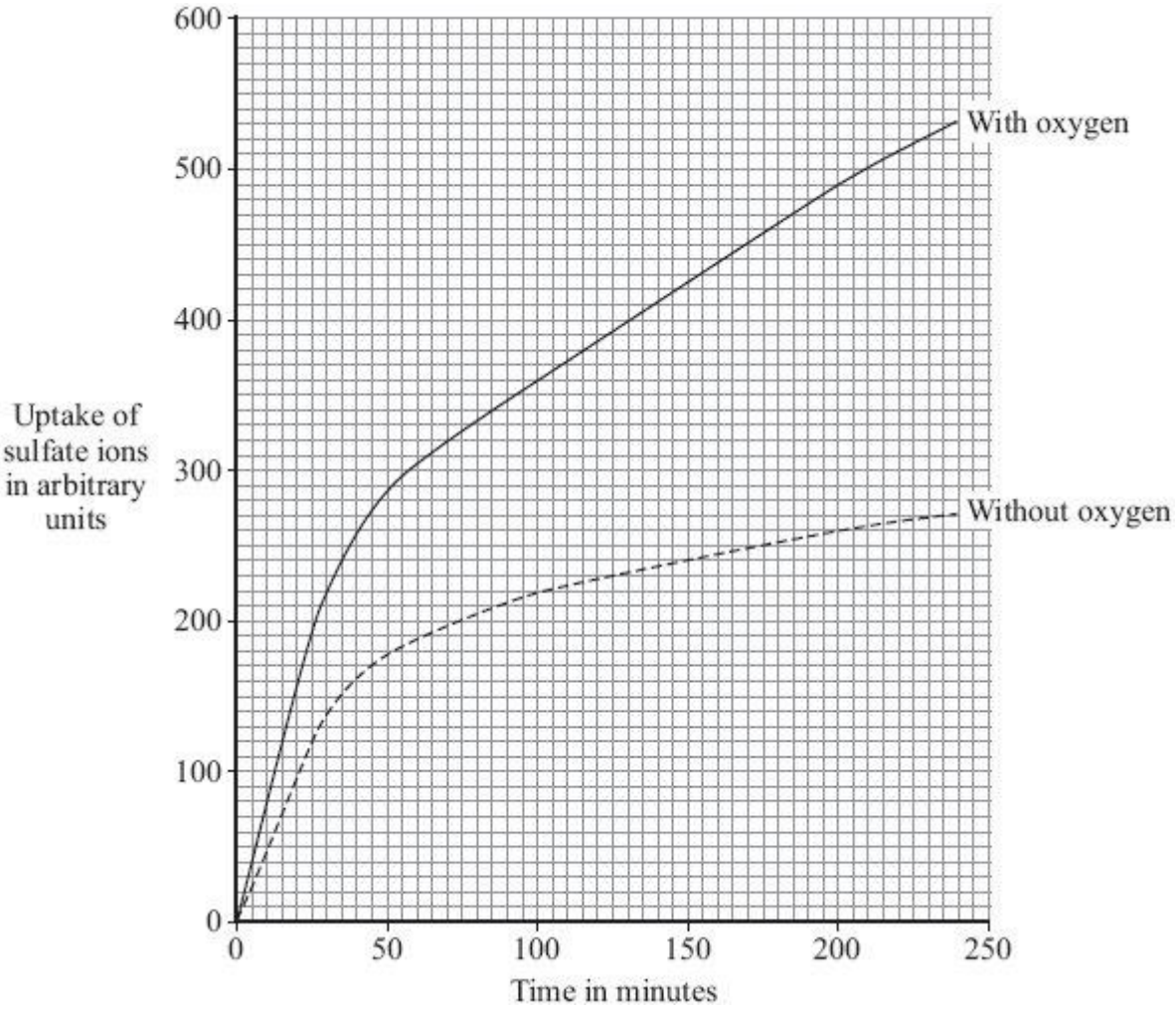
_____

_____

(2)

(b) Some scientists investigated the amounts of sulfate ions taken up by barley roots in the presence of oxygen and when no oxygen was present.

The graph below shows the results.



(i) The graph shows that the rate of sulfate ion uptake between 100 and 200 minutes, **without** oxygen, was 0.4 arbitrary units per minute.

The rate of sulfate ion uptake between 100 and 200 minutes, **with** oxygen, was greater.

How much greater was it? Show clearly how you work out your answer.

Answer _____ arbitrary units

(2)

(ii) The barley roots were able to take up more sulfate ions with oxygen than without oxygen.

Explain how.

_____

_____

_____

_____

_____

_____

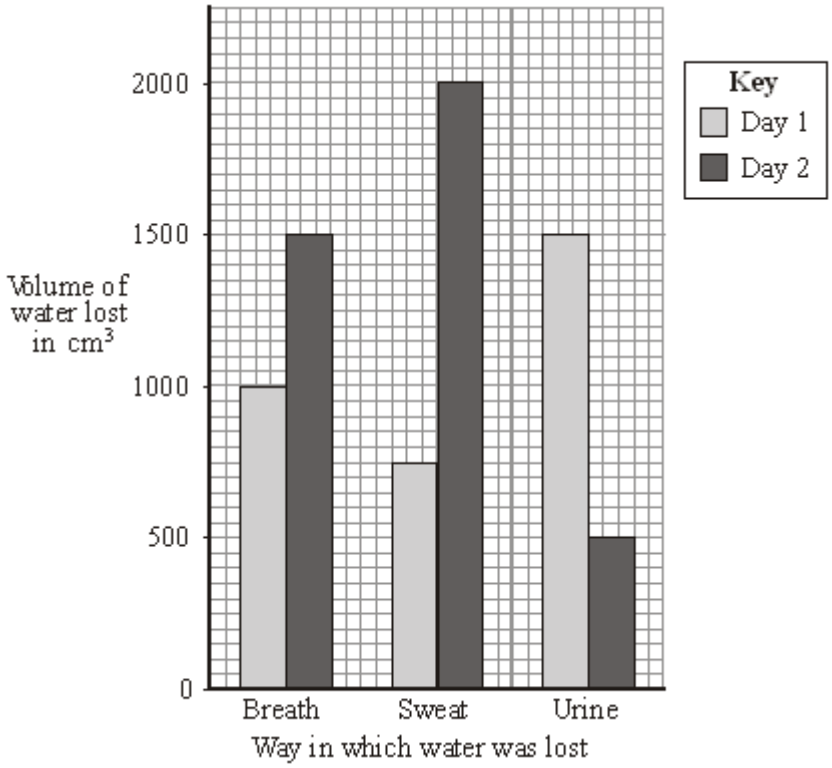
(3)

(Total 7 marks)

Q24.

The bar chart shows the amount of water lost from the body of a student on two different days.

The student ate the same amount of food and drank the same amount of liquid on the two days. The temperature of the surroundings was similar on the two days.



(a) The total volume of water lost on day 1 was 3250 cm^3.

How much water was lost on day 2? Show all your working.

_____

_____ cm^3

(2)

(b) The student did much more exercise on one of the days than on the other.

On which day did he do more exercise? Day _____

Give **two** reasons for your answer.

1. _____

_____

2. _____

_____

(2)

(c) (i) Which **one** of these is a chemical reaction that produces water in the body?

Put a tick (✓) in the box next to your choice.

Breathing	☐
Osmosis	☐
Respiration	☐
Sweating	☐

(1)

(ii) How does sweating help the body?

_____

_____

(1)

(iii) If the body loses more water than it gains, it becomes dehydrated.
The concentration of the solution surrounding the body cells increases.
This causes the cells to lose water.

By which process do cells lose water?

Put a tick (✓) in the box next to your choice.

Breathing	☐
Osmosis	☐

Respiration ☐

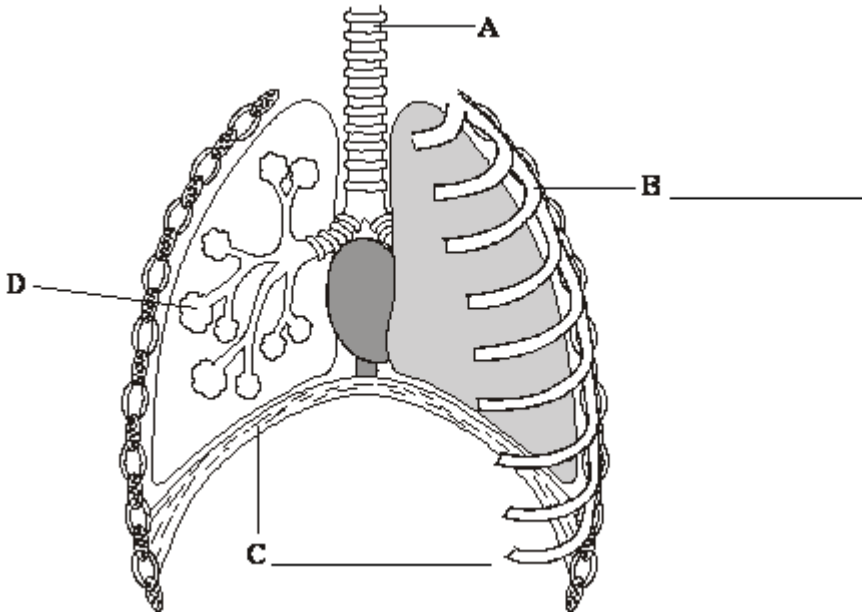
Sweating ☐

(1)

(Total 7 marks)

Q25.

The diagram shows the human breathing system.



(a) On the diagram, label structures **B** and **C**.

Choose your answers from the list in the box.

alveoli	**diaphragm**	**rib**	**trachea**

(2)

(b) (i) Which letter, **A**, **B**, **C** or **D**, shows the site of gas exchange? _____

(1)

(ii) Which **one** of the following gases has a higher concentration in exhaled air than in inhaled air?

Draw a circle around **one** answer.

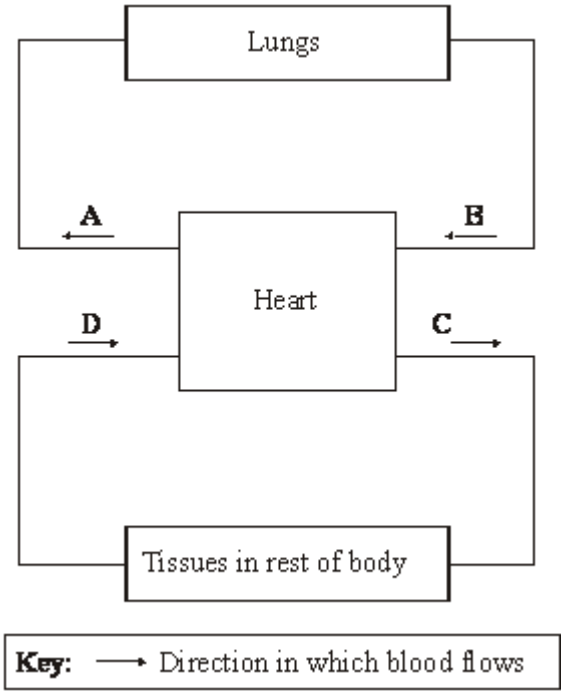
carbon dioxide **nitrogen** **oxygen**

(1)

(Total 4 marks)

Q26.

The diagram represents the human blood circulation system.



(a) **A**, **B**, **C** and **D** are blood vessels.

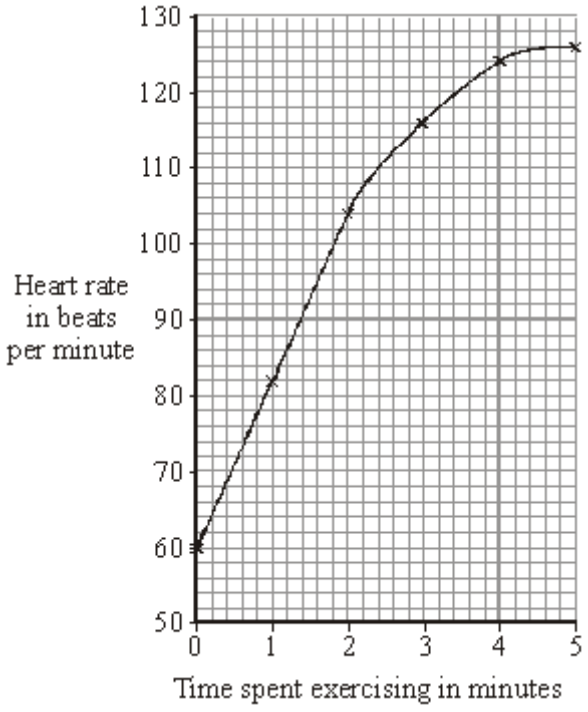
(i) Give the letter of **one** blood vessel that is an artery. _____

(1)

(ii) Give the letter of **one** blood vessel that is a vein. _____

(1)

(b) A student pedalled an exercise cycle at constant speed for 5 minutes. The student's heart rate was recorded at one-minute intervals during the exercise. The results are shown in the graph.



(i) What was the student's heart rate before the exercise began?

_____ per minute

(1)

(ii) How long was it before the student's heart rate reached 124 beats per minute?

_____ minutes

(1)

(c) Which of the following parts of the blood carries most oxygen?

Draw a circle around **one** answer.

plasma **red blood cells** **white blood cells**

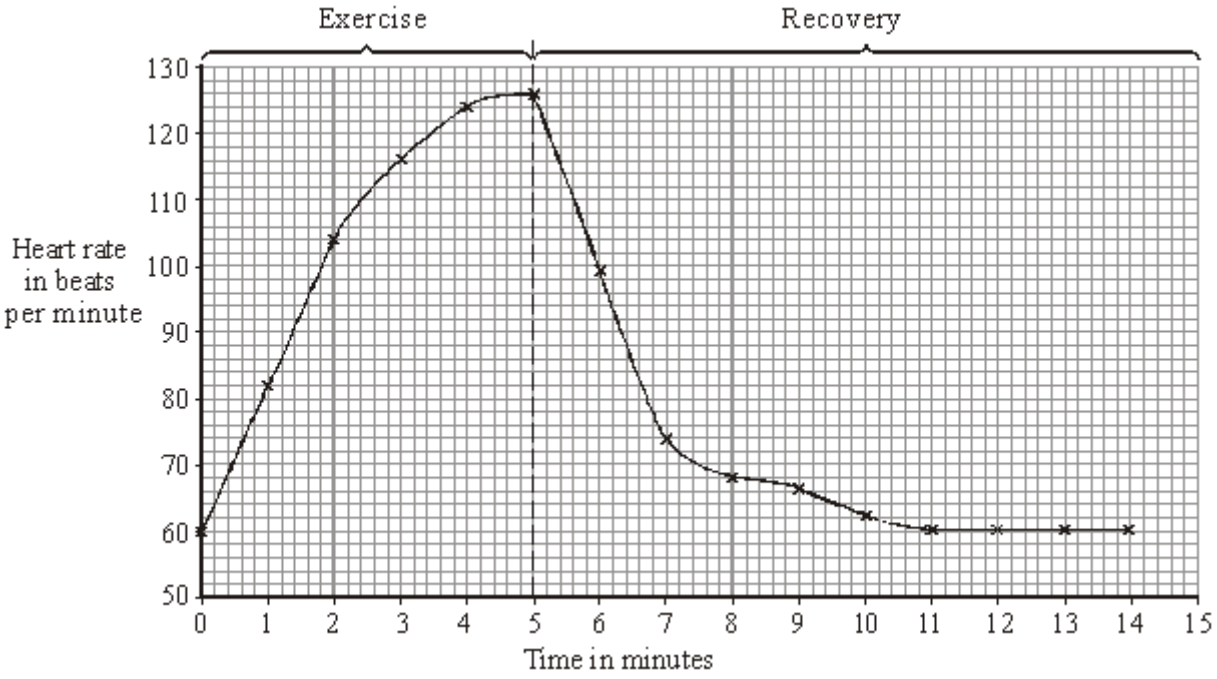
(1)

(Total 5 marks)

Q27.

A student pedalled an exercise cycle at constant speed for 5 minutes. The student's heart rate was recorded at one-minute intervals during the exercise and also during recovery.

The results are shown in the graph.



(a) Describe, in as much detail as you can, the changes in heart rate between 0 and 14 minutes.

_____

_____

_____

(3)

(b) How do arteries supplying the leg muscles alter the rate of blood flow through them during exercise?

(1)

(c) Explain how an increase in heart rate helped the student during exercise.

(4)

(Total 8 marks)

Q28.

The table shows the amounts of energy used in running and in walking at different speeds by people of different body masses.

Activity	Energy used in kilojoules per hour			
	34 kg person	50 kg person	70 kg person	90 kg person
Running, 9 km per hour	1530	1850	2770	3700
Running, 11 km per hour	2140	2560	3860	5120
Running, 16 km per hour	2980	3570	5380	7140
Walking, 3 km per hour	530	670	1010	1340

Walking, 5 km per hour	740	880	1340	1760
Walking, 7 km per hour	1030	1240	1850	2480

(a) Describe **two** patterns you can see in the data.

1. _____

_____

2. _____

_____

(2)

(b) Our breathing rate is much higher when running than when walking.

Explain the advantage of this to the body.

_____

_____

_____

_____

_____

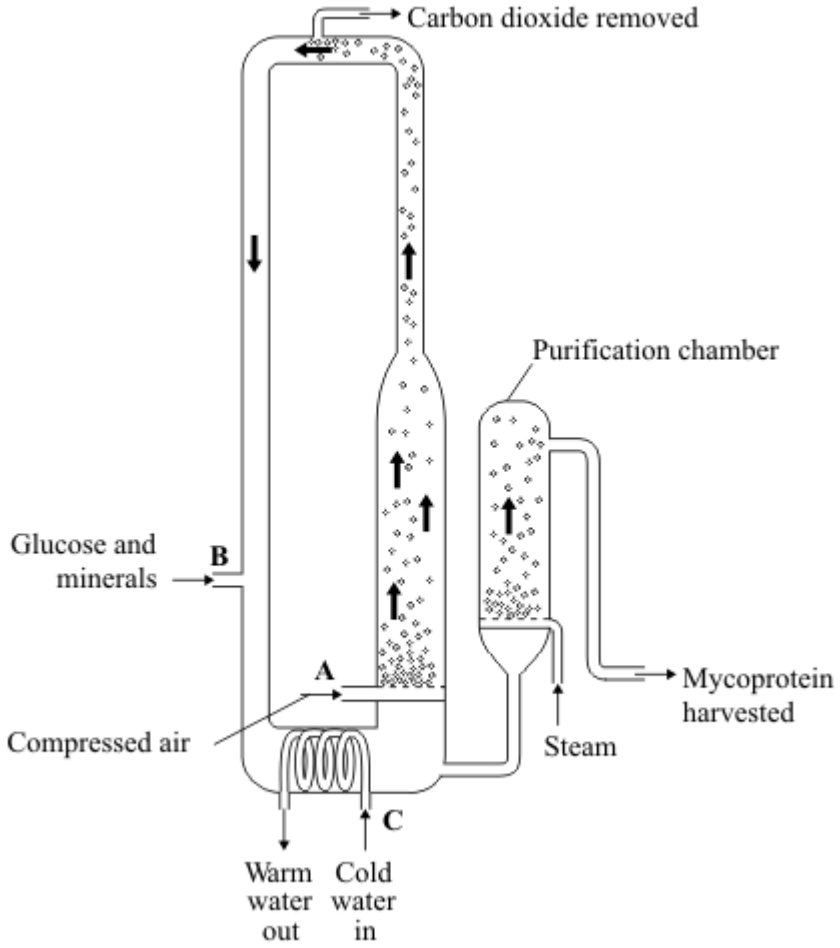
_____

(3)

(Total 5 marks)

Q29.

The diagram shows a fermenter. This fermenter is used for growing the fungus *Fusarium* which is used to make mycoprotein.



(a) Bubbles of air enter the fermenter at **A.**

Give **two** functions of the air bubbles.

1. _____

_____

2. _____

_____

(2)

(b) Glucose is added to the fermenter at **B.**

Explain why glucose is added.

_____

_____

(1)

(c) The fermenter is prevented from overheating by the cold water flowing in through the heat exchanger coils at **C.**

Explain what causes the fermenter to heat up.

_____

_____

(1)

(d) It is important to prevent microorganisms other than *Fusarium* from growing in the fermenter.

(i) Why is this important?

_____

_____

(1)

(ii) Suggest **two** ways in which contamination of the fermenter by microorganisms could be prevented.

1. _____

_____

2. _____

_____

(2)

(e) Human cells cannot make some of the amino acids which we need. We must obtain these amino acids from our diet.

The table shows the amounts of four of these amino acids present in mycoprotein, in beef and in wheat.

Name of amino acid	Amount of amino acid per 100 g in mg			Daily amount needed by a 70 kg human in mg
	Mycoprotein	Beef	Wheat	
Lysine	910	1600	300	840
Methionine	230	500	220	910
Phenylalanine	540	760	680	980
Threonine	610	840	370	490

A diet book states that mycoprotein is the best source of amino acids for the human diet.

Evaluate this statement.

Remember to include a conclusion in your evaluation.

_____

(4)

(Total 11 marks)

Q30.

A runner might drink a special 'sports drink' at intervals during a marathon race. The table shows the substances present in a sports drink.

Substance	Percentage
Water	
Sugar	5.0
Ions	0.2

(a) Complete the table to show the percentage of water in the sports drink.

(1)

(b) The runner sweats and also breathes heavily during the race.

(i) Why does the runner need to sweat?

(1)

(ii) Which **two** substances in the table are lost from the body in sweat?

(1)

(iii) Which substance in the table is lost from the body during breathing?

(1)

(c) How does the sugar in the sports drink help the athlete during the marathon?

(2)

(Total 6 marks)

Q31.

Complete the table by writing the correct process next to its description.

Choose your answers from the list in the box

breathing	**diffusion**	**digestion**	**osmosis**	**respiration**

Description	Process
Moving air in and out of the lungs	
The movement of particles of a substance from high to low concentration	
The release of energy from glucose	

(Total 3 marks)

Q32.

Paula is training for a marathon. When she runs, her heart beats faster than it does when she is resting.

Complete the sentences, using words from the box.

blood	**breathe**	**carbon dioxide**	**glucose**
heat	**nitrogen**	**oxygen**	**respire**

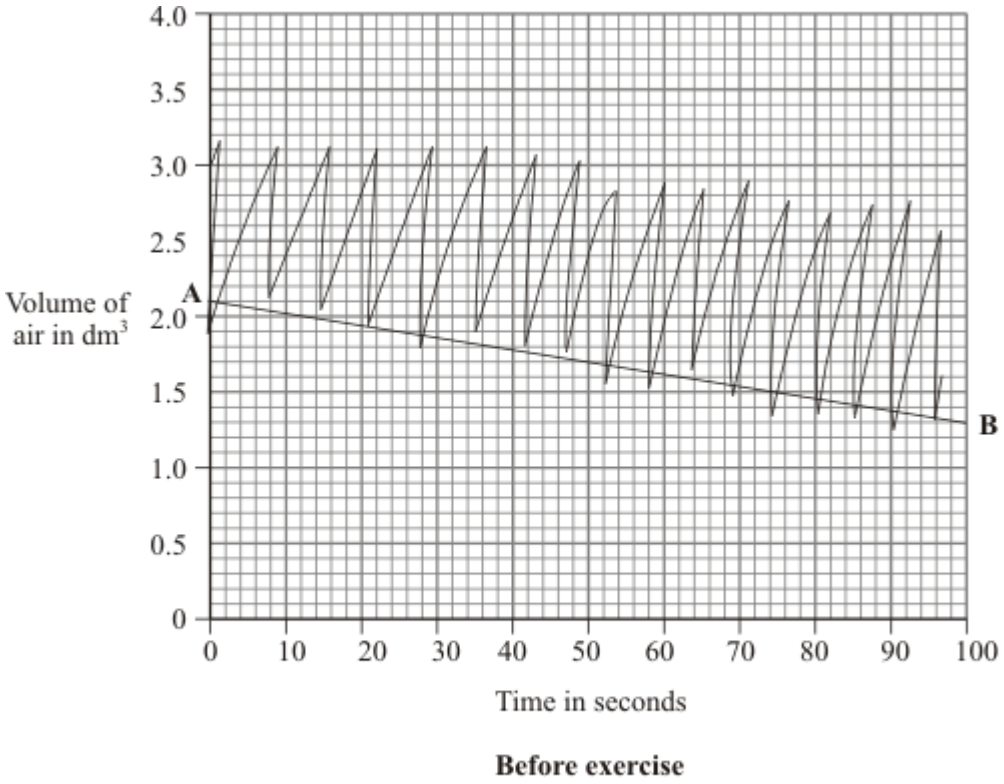
When she is running, Paula's muscle activity increases. To do this, her muscle cells _____ at a faster rate to give her more energy. Her muscles need to be supplied with _____ and _____ more quickly. Her heart beats faster to increase the flow of _____ which carries the products _____ and _____ away from her muscles.

(Total 6 marks)

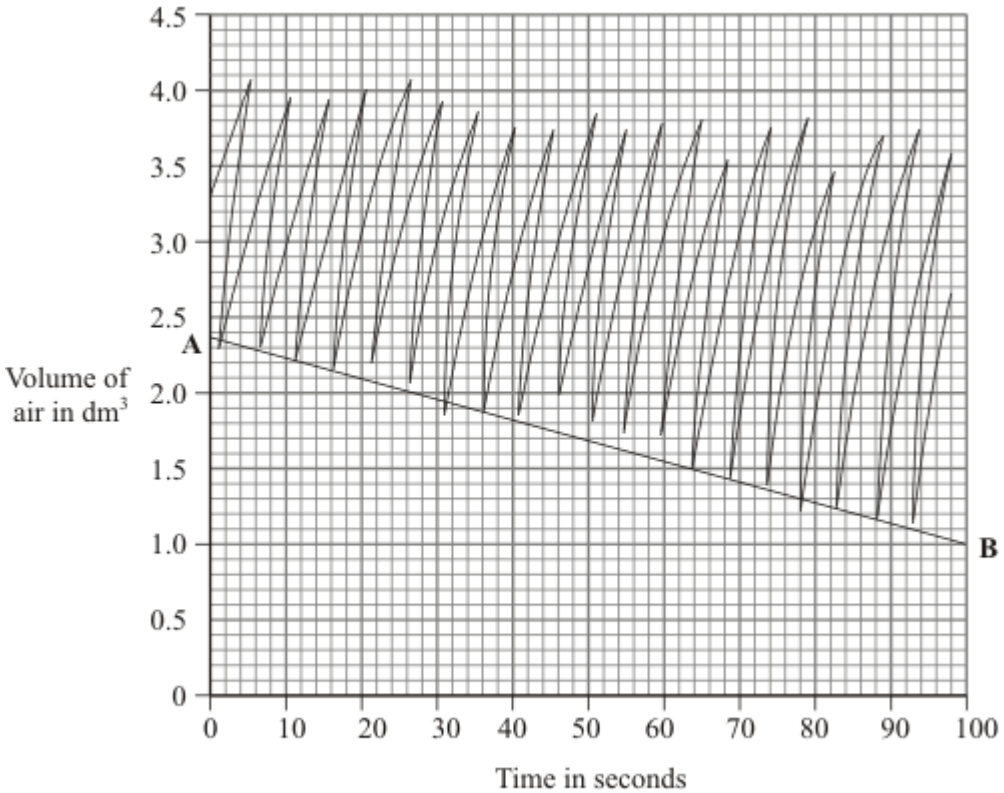
Q33.

A student's breathing was monitored before and after vigorous exercise. The student breathed in and out through a special apparatus. The graphs show the changes in the

volume of air inside the apparatus. Each time the student breathed in, the line on the graph dropped. Each time the student breathed out, the line went up.



Before exercise



After exercise

(a) How many times did the student breathe in per minute:

before exercise; _____

after exercise? _____

(1)

(b) On each graph, the line **A** – **B** shows how much oxygen was used. The rate of oxygen use before exercise was 0.5 dm^3 per minute. Calculate the rate of oxygen use after exercise.

_____

_____

_____

Rate of oxygen use after exercise = _____ dm^3 per minute

(2)

(c) The breathing rate and the amount of oxygen used were still higher after exercise, even though the student sat down to rest. Why were they still higher?

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 7 marks)

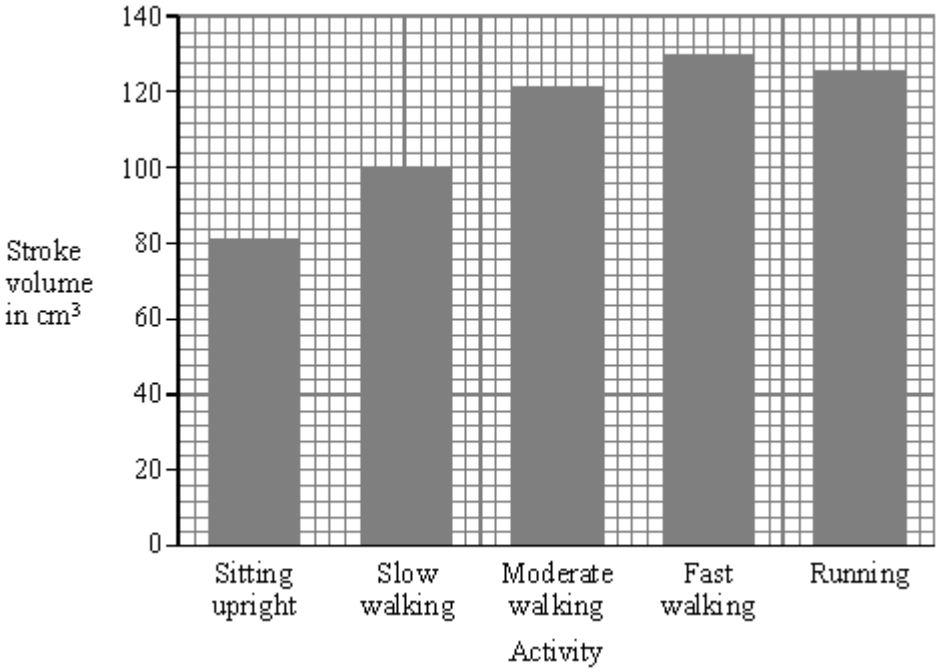
Q34.

A person did five different activities in turn. These activities needed increasing amounts of energy. For each activity two measurements were made. These were the rate of contraction of the left ventricle and its stroke volume (the volume of blood pumped at each beat). From these measurements the cardiac volume was calculated.

Some of these results are shown in the table and the bar chart.

Activity	Rate of contraction of left ventricle in beats per minute	Cardiac output in cm^3 per minute
Sitting upright	68	5 500
Slow walking		8 000

Moderate walking	98	12 000
Fast walking	130	17 500
Running	150	19 000



(a) (i) Describe how a person can count the rate of beating of the left ventricle.

_____

_____

(1)

(ii) Calculate the rate of ventricle contraction in beats per minute when the person was walking slowly. Show clearly how you work out your final answer.

_____

_____

_____

_____

Rate of ventricle contraction _____ beats per minute.

(2)

(iii) The pattern of results for stroke volume shows an anomalous result when the person is running. In what way is it anomalous?

_____

_____

(1)

(iv) There was a change in cardiac output when the person's movement changed from fast walking to running. How did the heart produce this change?

_____

_____

(1)

(b) Over a period of time, regular exercise can strengthen the heart muscle. This change in the heart muscle enables a person to run for longer before lactic acid build up occurs. Explain the reason for this.

_____

_____

_____

_____

(2)

(Total 7 marks)

Q35.

Regular exercise is important, as it helps to maintain an efficient supply of blood to the muscles, the heart and the lungs. This is helped by an increase in the heart rate during exercise.

Explain why it is necessary for the heart rate to increase during exercise.

_____

_____

_____

_____

_____

_____

_____

_____

(Total 4 marks)

Mark schemes

Q1.

(a) (i) rate of chemical reactions (in the body)

1

(ii) any **two** from:

- heredity / inheritance / genetics
- proportion of muscle to fat **or** (body) mass
  allow (body) weight / BMI
- age / growth rate
- gender
  accept hormone balance or environmental temperature
  ignore exercise / activity

2

(b) (i) 77

*correct answer with or without working gains **2** marks*
*allow **1** mark for 70 / 56 **or** 1.25 **or** 5*

2

(ii) increase exercise

accept a way of increasing exercise

1

reduce food intake

accept examples such as eat less fat / sugar
*allow go on a diet **or** take in fewer calories*
ignore lose weight
ignore medical treatments such as gastric band / liposuction

1

[7]

Q2.

(a) LHS – glucose

1

RHS – water

allow H_2O / H2O

1

(b) so the earthworms' body temperature would change to 20°C

1

(c) (i) 56 or 55 or 54

*if incorrect answer given accept 60 - 5 for **1** mark*
*or 60 – 6 for **1** mark*

*or 60 – 4 for **1** mark*

2

(ii) one-tenth of answer to (c)(i) eg 5.5

1

(at 10°C / lower temperature):

lower rate of respiration

allow chemical reactions slower or enzymes less active
ignore breathing
do not allow anaerobic

1

worms less active / worms release less energy / worms use less energy

1

(d) (i) anomalous result / not in line with other data / does not fit the pattern

1

(ii) more representative / more reliable / can check 'repeatability' / see if get similar values / identify anomalies

ignore valid / more fair
ignore reproducible
ignore 'to remove' anomalies
do not accept more accurate or more precise

1

[10]

Q3.

(a) in yeast:

'it' equals yeast

makes alcohol / makes CO^2 / does not make lactic acid

do not allow uses / involves alcohol / CO^2

1

(b) (i) any two from:

allow amount of yeast

- volume of yeast / suspension
- volume of sugar / solution
- concentration of sugar

amount of sugar = max 1 for sugar

- temperature

(total) volume = 1 mark if no other volume
ignore concentration of yeast

2

(ii) most / more CO^2 given off with fructose **or**

'it' equals fructose

faster CO^2 production

or

faster respiration

allow faster fermentation

1

*do **not** allow aerobic respiration*

so (rate of) alcohol production will be greatest / more (with fructose)

1

[5]

Q4.

(a) (i) carbon dioxide

accept CO_2 / CO2

*do **not** accept CO^2*

1

(ii) fermentation / respiration

ignore aerobic / anaerobic

1

(b) most / more gas (produced)

*do **not** allow 'a lot'*

or

allow alternative descriptions

liquid level lowest

ignore name of gas

1

(c) (i) repeat

ignore reference to average or mean

or

compare with results of others

1

(ii) if reliable - get same / similar results

*allow same pattern but **not** pattern alone*

or

allow no anomalies

small range

ignore anomalies unqualified

1

(d) use smaller intervals

can be implied

1

around 30°C **or** between 25°C and 35°C

*do **not** allow for temperatures below 25°C above 35°C*
ignore references to sensitivity or precision (of thermometer)
*NB do at 28°C, 30°C and 32°C = **2** marks*

1

[7]

Q5.

(a) person with muscle disease:

allow reverse argument for healthy person

any **three** from:

NB all points are comparative except peak (point 3)
*allow use of **two** approximate figures as a comparison*

- higher resting rate **or** higher at start
- when exercise starts / then increases more / more rapidly
  accept description eg rise …. fall
- peaks (then falls)
- levels off later than healthy person
- higher rate during exercise
  *if no other marks awarded allow **1** mark for 'it's higher'*
- greater range

3

(b) (i) oxygen

accept adrenaline
accept O_2
*do **not** accept O, O2 or O^2*

1

(ii) cannot release sugar / glucose (from glycogen)

or

cannot store glucose / sugar (as glycogen)

1

need to receive glucose / sugar (from elsewhere)

ignore oxygen

1

for energy / respiration / cannot store energy

ignore aerobic / anaerobic

1

[7]

Q6.

(a) (i) any **three** from:

*if diet given as answer = max **2***

- age (of athlete)
- gender (of athlete)
- starting concentration of glycogen
- type / intensity of exercise
- length of exercise period
- number of training sessions

*if none of these points gained amount of exercise = **1** mark*

- time interval between exercise sessions
- exercise at same time of day

*if last four points not awarded allow time (for exercise) for **1** mark*
ignore references to amount of energy
ignore they are both athletes

3

(ii) any **two** from:

- intensity of exercise
- amount of exercise between sessions
- starting concentration of glycogen
- fitness / health
- metabolic rate / respiration rate
- amount / mass of muscle / physique
- aspects of diet qualified, eg amount of food eaten

*do **not** accept amount of carbohydrate*
*if no other marks awarded allow height / mass / weight for **1** mark*

2

(iii) (B has) less glycogen

he = B

or (B's glycogen) fell more

accept use of approximate figures

or (B's glycogen) built up less

allow other correct observations from graph eg A is lower at

end of first session

ignore rate of fall

1

(b) athlete **A** (no mark)

to gain full marks 'more' must be given at least once

athlete **A** had more glycogen / **B** has less (only if A chosen to complete marathon)

*accept converse argument for **B***

1

(glycogen / glucose) used in respiration

ignore anaerobic

1

(more) energy released / available in athlete **A**

allow 'energy made'

1

and either energy used for movement / muscle action / to run
or
(extra) glycogen → (more) glucose

1

[10]

Q7.

(a) LHS: carbon dioxide **AND** water

in either order

*accept CO_2 **and** H_2O*
allow CO2 and H2O
if names given ignore symbols

*do **not** accept CO^2 / H^2O / Co / CO*
ignore balancing

1

RHS: sugar(s) / glucose / starch / carbohydrate(s)

accept $C_6H_{12}O_6$
allow C6H12O6
*do **not** accept $C^6H^{12}O^6$*

1

(b) (i) light is needed for photosynthesis

or

no photosynthesis occurred (so no oxygen produced)

1

(ii) oxygen is needed / used for (aerobic) respiration

full statement

*respiration occurs **or** oxygen is needed for anaerobic respiration gains **1** mark*

2

(c) (i) (with increasing temperature) rise then fall in rate

1

use of figures, ie

max. production at 40 °C
or maximum rate of 37.5 to 38

1

(ii) <u>25 – 35 °C</u>

either faster movement of particles / molecules / more collisions
or particles have more energy / enzymes have more energy

1

or temperature is a limiting factor over this range

<u>40 – 50 °C</u>

denaturation of proteins / enzymes

ignore denaturation of cells
ignore stomata

1

(d) above 35 °C (to 40 °C) – little increase in rate
or > 40 °C – causes decrease in rate

1

so waste of money **or** less profit / expensive

1

because respiration rate is higher at > 35 °C
or
respiration reduces the effect of photosynthesis

1

[12]

Q8.

(a) 7.15 to 7.45 <u>am</u> **and** 7.15 to 7.45 <u>pm</u>

both *required, either order*
accept in 24 hr clock mode

1

(b) (i) 11

1

(ii) 32.5 to 33

allow answer to (b)(i) + 21.5 to 22

1

(c) any **two** from:

- more photosynthesis than respiration
- more biomass / carbohydrate made than used

allow more food made than used

- so plant able to grow / flower
  accept plant able to store food

2

[5]

Q9.

(a) (i) 6 peaks in heart rate
*accept 6 increases / spikes **or** goes very high 6 times*
allow heart rate increases each time he runs

1

(ii) 2.5 / 2½
allow 2 minutes 30 seconds
*do **not** accept 2.3 / 2:3 / 2.30*

1

(b) *more / faster / a lot **must** be stated at least once for full marks*

(more) oxygen supplied / needed
allow less anaerobic (respiration)

or (more) aerobic respiration
***or** prevents oxygen debt*

1

(more) glucose / sugar / food supplied / needed
ignore feeding

1

(more) energy needed / released
allow energy produced / made

1

(more) carbon dioxide / heat / lactic acid removed (from muscles) **or** more cooling

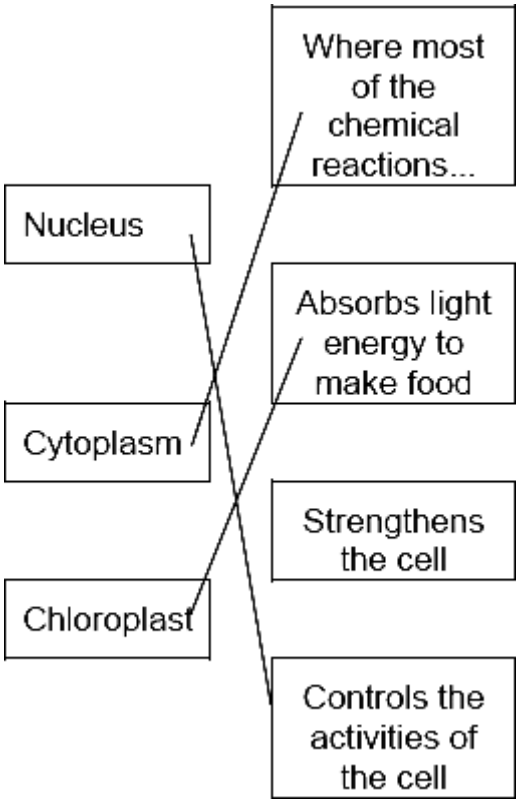
or less lactic acid formed

1

[6]

Q10.

(a)



1 *mark for each correct line*
mark each line from left hand box
two lines from left hand box cancels mark for that box

3

(b) energy

1

[4]

Q11.

(a) (i) brain

1

(ii) skin

1

(iii) 1/25 **or** 4% **or** 0.04 **or** 1 in 25 **or** 1:25 **or** 1 out of 25

allow $\frac{1000}{25000}$

1

(b) any **two** from:

- increased / high heart rate / pulse rate
  *do **not** allow pumps more blood unqualified*
- dilation / widening of <u>arteries / arterioles</u> (to skeletal muscles)
  accept vasodilation unqualified

*do **not** accept reference to veins / capillaries*

or
less blood flow to other organs

- increased stroke volume / described

2

(c) *ignore references to breathing*

more respiration / description
or
more energy required **or** to provide more energy

1

respiration / process described → CO_2
*do **not** accept anaerobic respiration*

1

CO_2 diffuses into blood

1

[8]

Q12.

(a) (i) glycogen

1

(ii) respiration

1

(b) (i) 483 kJ

1

(ii) oxygen

1

(iii) dilate

1

(c) supplies more / a lot of oxygen **or** removes more carbon dioxide
or release more energy / faster respiration

1

[6]

Q13.

(a) (i) B **or** D

1

(ii) A **or** B

1

(b) any **four** from:
more / faster must be implied at least once for full marks

- increased blood (flow)

ignore reference to breathing

- (more) oxygen supplied **or** aerobic respiration
  *allow less anaerobic (respiration) **or** and prevents oxygen debt*
- (more) glucose / sugar / food supplied
  ignore feeding
- (higher rate of) respiration
- (more) energy needed / released
  allow made
- (more) carbon dioxide removed
- (muscles) doing (more) work **or** muscles contracting
- remove heat / cooling
- remove lactic acid **or** less lactic acid formed

4

[6]

Q14.

insufficient / no oxygen available

1

for (just) aerobic respiration

or
respires anaerobically

1

[2]

Q15.

(a) (i) C and D

1

(ii) cell wall

1

(b) (i) A

1

(ii) D

1

(c) respiration

1

[5]

Q16.

(a) microorganisms

1

(b) moist

1

(c) respiration

1

(d) roots

1

[4]

Q17.

(a) (i) 150

1

(ii) any **two** from:

accept correct use of numbers

accept pulse rate

- lower resting rate
- lower rate during exercise
- recovers faster after exercise

allow a general statement about lower rate if neither of the first two points given

2

(b) glucose

1

oxygen

1

[5]

Q18.

(a) (i) 120

1

(ii) 11 760 **or**
correct answer from candidate's answer to (a)(i)

correct answer with or without working

if answer incorrect

120 × 98 ***or***
candidate's answer to (a)(i) × corresponding SV gains ***1*** *mark*

if candidate uses dotted line / might have used dotted line(bod) in (a)(i) ***and*** *(a)(ii) no marks for (a)(i) but allow full ecf in (a)(ii) eg 140 x 88 = 12320 gains* ***2*** *marks*

2

(b) trained athlete has higher stroke volume / more blood per beat

1

same volume blood expelled with fewer beats

or for same heart rate more blood is expelled

1

(c) increased aerobic respiration

or

decreased anaerobic respiration

allow correct equation for aerobic respiration
accept don't have to respire anaerobically

1

increased energy supply / need

1

less lactic acid formed

or to breakdown lactic acid **or** less O_2-debt

1

can do more work **or** can work harder / faster / longer

accept muscle contraction for work

or less fatigue / cramp / pain

1

[9]

Q19.

(a) (i) 19 800

for correct answer ignore working or lack of working
*165 × 120 but no answer / wrong answer = **1** mark (ignore extras)*

2

(ii) any **two** from:

- for respiration
  ignore oxygen debt
- energy released
  allow energy produced
- prevents anaerobic respiration
- prevents build-up of lactic acid

2

(b) any **two** from:

- increased breathing rate(*)
- increased depth of breathing **or** deep breathing(*)
  *(*)more breathing is max **1** mark*
  ignore increase in heart rate
  allow heavier breathing
  *do **not** allow harder breathing*
- dilation of arteries / vasodilation
  allow blood vessels dilate
  *do **not** allow veins / capillaries dilate*
- blood diverted from elsewhere
  ignore name of organ

2

[6]

Q20.

(a) any **two** from:

- age
- gender
- mass
- number in group
- time

2

(b) any **two** from:

- highest (mean) mass loss on Rosemary Conley **or** Rosemary Conley most effective
- least (mean) mass loss in control group **or** <u>mean</u>

2

(c) (Atkins)

costs least

1

mass loss very similar to other diets **or** second highest mass loss **or** as effective as other diets

1

(d) any **two** from:

- (exercise) increases metabolic rate / respiration
  ignore sweating

- (exercise) needs / uses energy / calories

  allow burns fat / calories
  *do **not** accept energy <u>for</u> respiration*

- (this) energy comes from food / fat

- less food / energy/ calories converted to fat

2

[8]

Q21.

(a) A

1

(b) (i) diffusion

1

(ii) respiration

1

(iii) mitochondria

1

(iv) photosynthesis

1

[5]

Q22.

(a) A

no mark – can be specified in reason part
if B given = no marks throughout
if unspecified plus two good reasons = 1 mark

high(er) pressure in A

allow opposite for B
do not accept 'zero pressure' for B

1

pulse / described in A

accept fluctuates / 'changes'
allow reference to beats / beating
ignore reference to artery pumping

1

(b) (i) 17

1

(ii) 68

accept correct answer from candidate's (b)(i) × 4

1

(c) (i) oxygen / oxygenated blood

allow adrenaline

ignore air

1

glucose / sugar

extra wrong answer cancels eg
sucrose / starch / glycogen / glucagons / water

allow fructose as an alternative to glucose

ignore energy

ignore food

1

(ii) carbon dioxide / CO_2 / lactic acid

allow CO2 / CO^2

ignore water

1

[7]

Q23.

(a) No

no mark
if yes max 1 for correct statement

diffusion is down the concentration gradient

accept by diffusion ions would leave the root

1

to enter must go up / against the concentration gradient
or concentration higher in the root
or concentration lower in the soil

1

(b) (i) 0.9 **or** 3.25

for correct answer with or without working

*if answer incorrect 1.3 **or** their rate – 0.4 gains 1 mark*

***or** 130 – 40 **or** 90 gains 1 mark*

2

(ii) (uptake) by active transport

1

requires energy

more energy from aerobic respiration

1

or

more energy when oxygen is present

1

[7]

Q24.

(a) 4000

*award **both** marks for correct answer, irrespective of working*
*1500 + 2000 + 500 gains **1** mark*

2

(b) day 2 (no mark)

any **two** from:

*max **1** mark if correct day not identified or if no day given*

- more (water in) breath / breathing
- more (water in) sweat / sweating
  accept a lot of sweating
- less (water in) urine
  *if no other marks awarded allow **1** mark for more water lost on day 2*

2

(c) (i) respiration

1

(ii) cools / removes heat owtte
ignore 'maintains body temperature' unqualified

1

(iii) osmosis

1

[7]

Q25.

(a) B = rib

1

C = diaphragm

1

(b) (i) D
allow lower case

1

(ii) carbon dioxide

1

[4]

Q26.

(a) (i) A **or** C
allow lower case

1

(ii) B **or** D

allow lower case

1

(b) (i) 60

1

(ii) 4

1

(c) red blood cells

1

[5]

Q27.

(a) any **three** from:

- rose <u>rapidly</u> (during exercise) / use of approximate figures
- then more slowly (during exercise)

  accept rate (of increase) slows down
- to max 126 / at 5 minutes / end of exercise
- <u>rapid</u> fall (during recovery) **or** use of approximate numbers
- then less rapid fall / use of approximate numbers
- returned to resting rate (60 bpm) by 11 minutes

3

(b) arteries dilate / widen

accept muscle in wall relaxes

1

(c)

any **four** from:

- muscles using more energy **or** more energy released
- muscles <u>respire</u> faster
- supply more oxygen
- supply more glucose / sugar
- remove more CO_2
- remove lactic acid
- remove heat / to cool

do **not** accept energy produced

allow for aerobic respiration **or** to prevent anaerobic respiration

'more' needed ONCE only for full marks

4

[8]

Q28.

(a) increased speed
or harder exercise / running
→increased need / use / loss of energy

1

allow further you run / walk the more energy you need

increased mass / bigger → increased use of energy

1

(b) any **three** from:

- supply / using (more / enough) oxygen
  or get (more) oxygen in blood(*)
- remove (more) CO_2(*)
- doing (more) work
  or
  using (more) energy allow produce energy(*)
  (*)need reference to 'more' ONCE only for full marks
- for <u>respiration</u>
- prevent build up of lactic acid
  or prevent oxygen debt
  or prevent anaerobic (respiration)
  or allow aerobic (respiration)

3

[5]

Q29.

(a) circulation / mixing / described

1

or

temperature maintenance

supply <u>oxygen</u>

*do **not** allow oxygen for anaerobic respiration*

or

for <u>aerobic</u> conditions

or

for <u>faster</u> respiration

1

(b) any **one** from:

- energy supply / fuel
  or use in respiration

*do **not** allow just food / growth*
ignore reference to aerobic / anaerobic

- material for growth
  or to make mycoprotein

1

(c) (heat / energy) from respiration
allow exothermic reactions
allow description eg breakdown of glucose / catabolism
ignore metabolism
ignore aerobic / anaerobic

1

(d) (i) any **one** from:

- compete (with Fusarium) for food / oxygen
  or reduce yield of Fusarium
- make toxic waste products
  or they might cause disease / pathogenic
  or harmful to people / Fusarium
  *do **not** allow harmful unqualified*

1

(ii) any **two** from:

- steam / heat treat / sterilise fermenter (before use)
  ***not** just clean*
  *allow sterilisation unqualified for **1** mark*
- steam / heat treat / sterilise glucose / minerals / nutrients / water (before use)
  ***not** just use pure glucose*
- filter / sterilise air intake
- check there are no leaks

2

(e) any **three** from:

- beef is best **or** beef is better than mycoprotein(*)
- mycoprotein mainly better than wheat(*)
- more phenylalanine in wheat than in mycoprotein(*)
  allow equivalent numerical statements(*)
- but no information given on other amino acids / costs / foods

3

overall conclusion:

statement is incorrect

or

it would be the best source for vegetarians

or

for given amino acids, beef is the best source

or

three foods provide insufficient data to draw a valid conclusion

1

[11]

Q30.

(a) 94.8

1

(b) (i) to cool (the body) / maintain (body) temperature

*do **not** accept let out heat*

1

(ii) water **and** ions

1

(iii) water ignore CO_2, and vapour

1

(c) any **two** from:

used in respiration

provides energy

(energy) needed for movement / running / muscle action

2

[6]

Q31.

<u>in correct sequence</u>:

breathing

1

diffusion

1

respiration

1

[3]

Q32.

(a) respire

1

oxygen / glucose
glucose / oxygen
} each once only

2

blood

1

carbon dioxide / heat
heat / carbon dioxide
} each once only

2

[6]

Q33.

(a) (before exercise) – 9 to 11 **and** (after exercise) – 12 **or** 13

both *correct*

1

(b) 0.75 to 0.90

ignore working or lack of working

eg. 2.35 – 1.55 ***or*** $\frac{(2.35-1.0)\times 60}{100}$ ***or*** *other suitable figures for* ***1*** *mark*

2

(c) any **four** from:

still need to remove extra carbon dioxide

still need to remove heat / to cool

(some) anaerobic respiration (in exercise)

lactic acid made (in exercise)

oxygen needed to break down lactic acid **or** suitable reference to oxygen debt

lactic acid broken down to CO_2 and water **or** lactic acid changed into glucose

4

[7]

Q34.

(a) (i) count the pulse **or** count beats in artery in wrist neck **or** feel the pulse **or** take the pulse **or** find the pulse

accept use of heart monitor ***or*** *heart meter*

1

(ii) 80

2 marks for correct answer

1f answer incorrect allow ***1*** *mark for showing 8000 divided by 100* ***or*** *indicating cardiac output divided by stroke volume*

2

(iii) Increased activity stroke volume
falls / gets less / should get higher / reach a peak

*accept does not increase **or** changes from 134 cm^3 to 127 cm^3*

1

(iv) 1ncreased / more ventricle contractions

*accept heart beat faster **or** it beats faster **or** more powerful contractions*

1

(b) (stronger heart muscle) increases cardiac output **or** increases stroke volume

*accept pumps more blood (per beat) **or** pumps blood faster*

ignore heart bigger

1

so more (oxygenated) blood can be sent <u>to muscles</u>

accept more oxygen sent to muscles

1

[7]

Q35.

any **four** from:

more energy / respiration required

*accept it prevents / reduces anaerobic respiration **or** less / no lactic acid*

reference to increase must be made, but only needed once, provided inference is clear for remainder of points.

accept 'delivered more quickly' for 'increase'

increase oxygen uptake into blood (in lungs)

increase oxygen delivery to muscles

increase glucose delivery to muscles

increase removal of heat from muscles **or** increase delivery of heat to skin

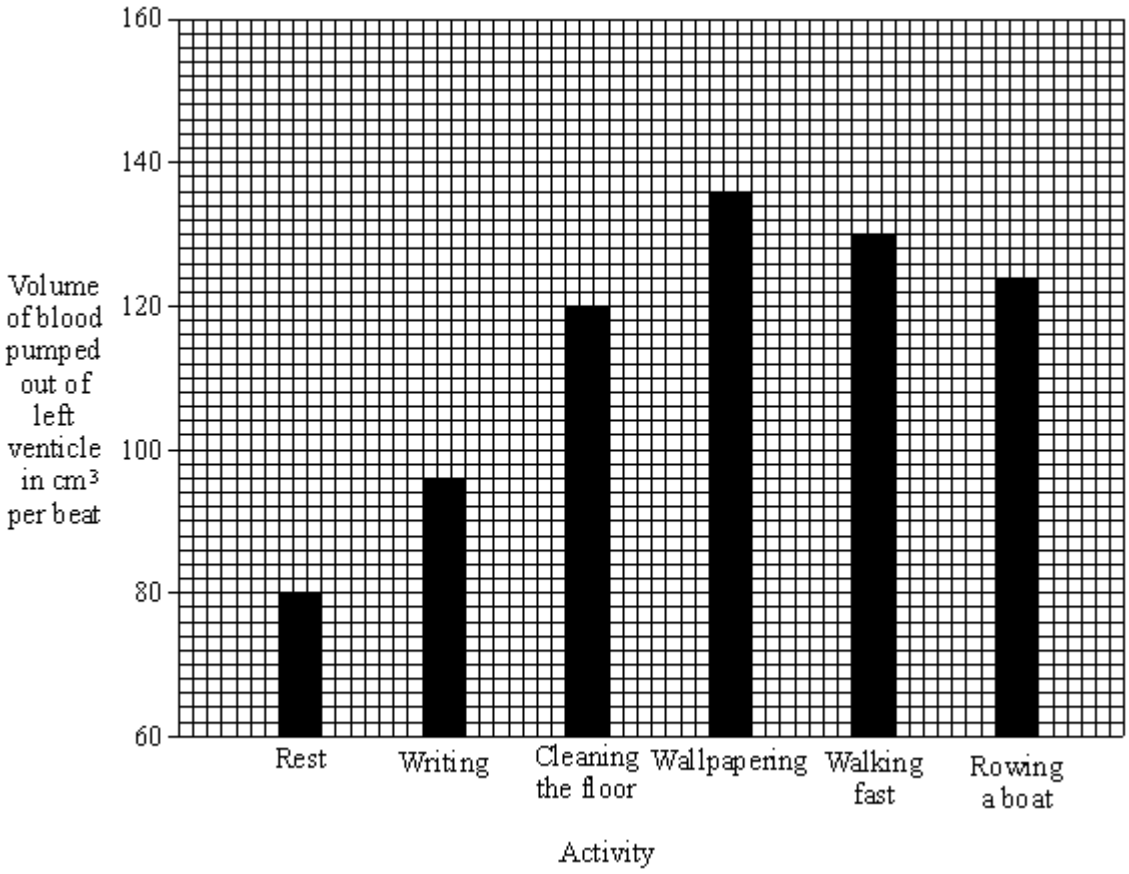
increase removal of carbon dioxide from muscles

increase removal of carbon dioxide from blood (in lungs)

[4]

Q1.

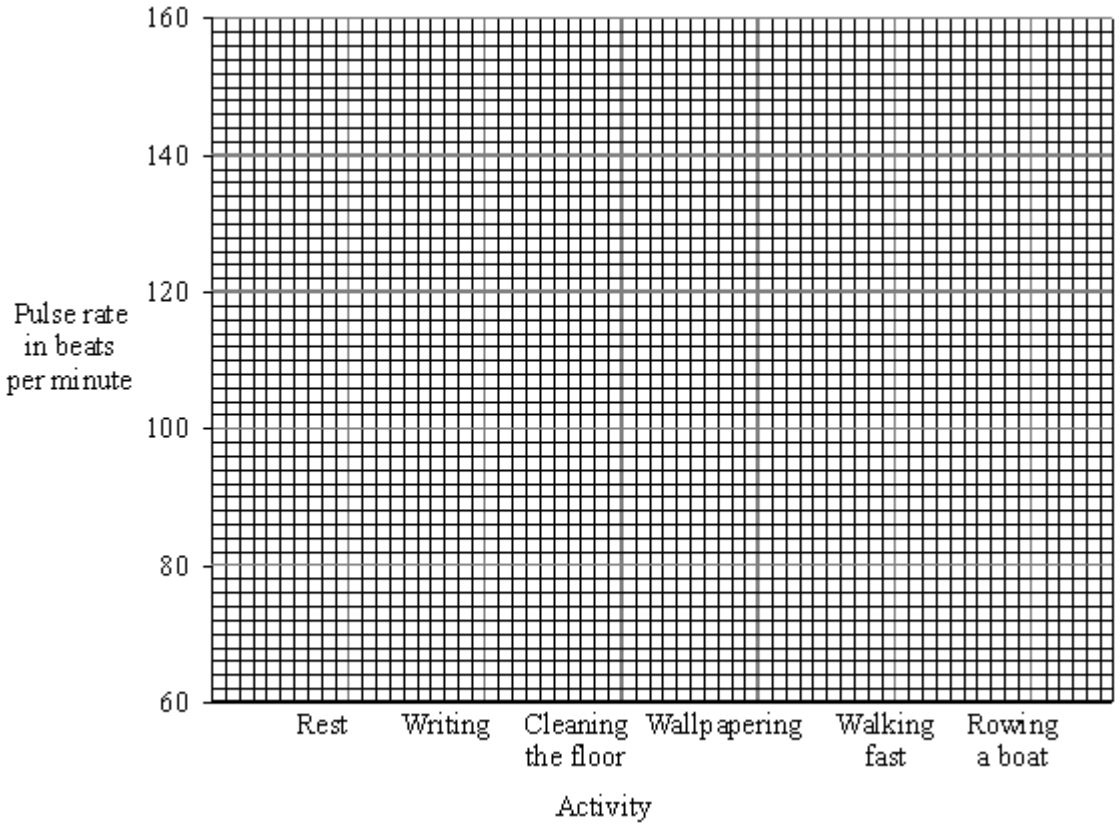
(a) The volume of blood pumped out of the left ventricle at each beat was measured for a person during six different activities. These activities showed an increasing energy demand, with rest requiring the least energy and rowing a boat the most. The results of these measurements are shown on the bar chart.



(i) The pulse rate was also measured for the person during the same activities. The table shows the results that were obtained.

Activity	Pulse rate in beats per minute
Rest	70
Writing	85
Cleaning the floor	100
Wallpapering	120
Walking fast	132
Rowing a boat	153

On the graph paper below draw a bar chart of the results obtained for the measurements of the pulse rate.



(2)

(ii) Undertaking activities with increasing energy demand has an effect on the volume of blood pumped from the left ventricle (per beat) and on the pulse rate. What do the bar charts show these effects to be? Use only information shown in the bar charts in your answer.

_____

_____

_____

(2)

(b) The pulse rate changed when the activity changed. Explain the reason for this.

_____

_____

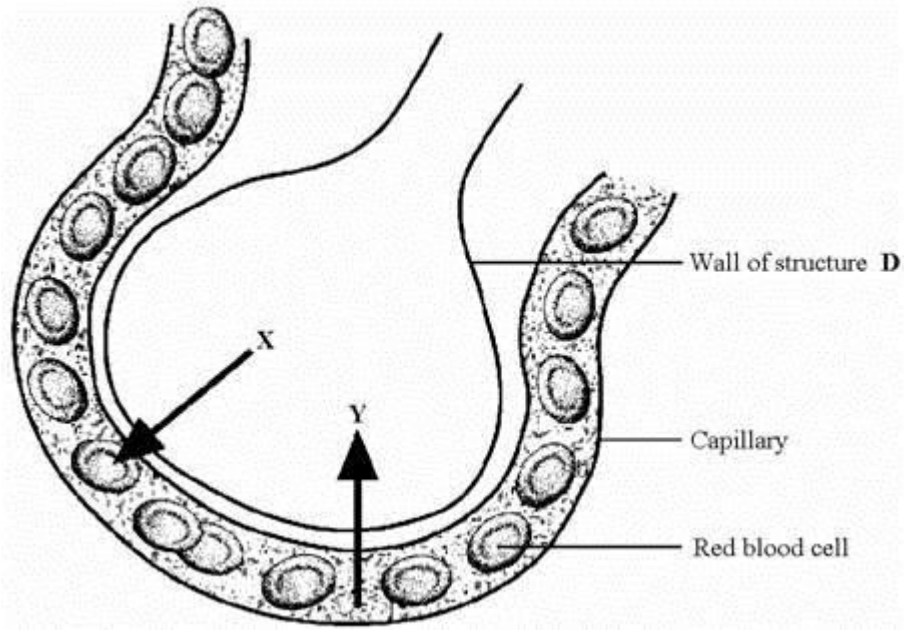
_____

(2)

(Total 6 marks)

Q2.

The diagram shows an enlargement of structure **D**.



The arrows show the direction of the gases exchanged in this structure. Name gas **X** and gas **Y**.

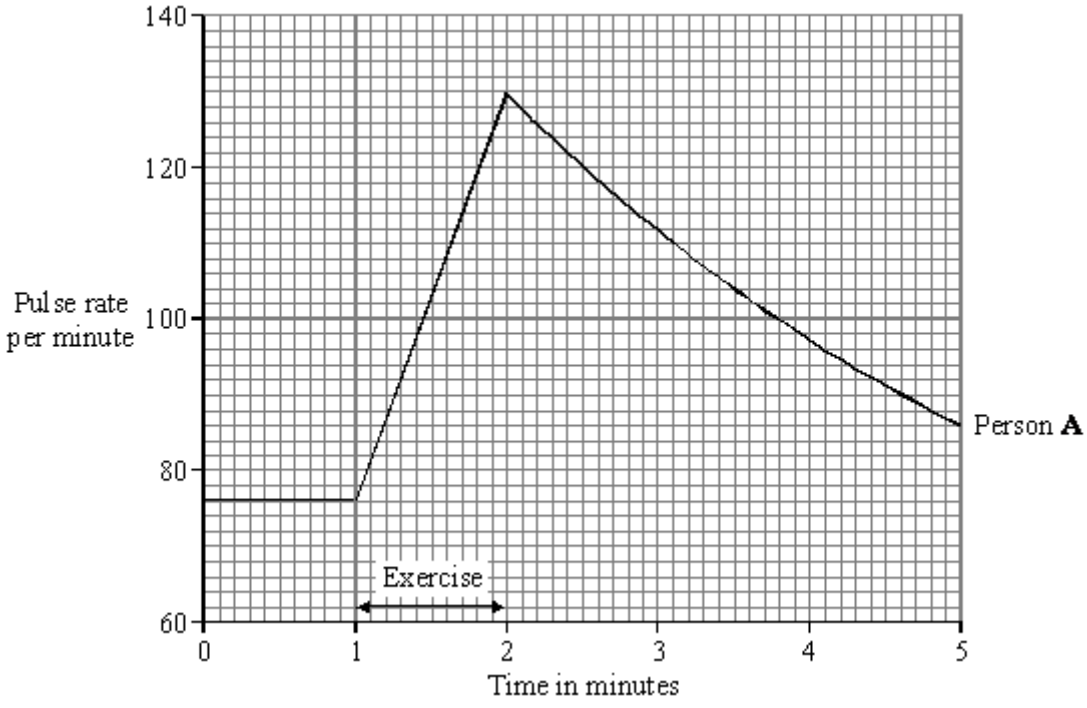
X _____

Y _____

(Total 2 marks)

Q3.

Person A and **Person B** measured their pulse rates over a period of five minutes. For one minute of this time they exercised by stepping on and off a box. At other times they sat still. The graph shows the results for **Person A**.



(i) What does the graph tell you about the changes in the pulse rate of **Person A** within the five minute period?

_____

_____

_____

_____

_____

(3)

(ii) What was the pulse rate of **Person A** at the end of the five minute period?

_____

(1)

(iii) The table shows the results obtained for **Person B**.

Time in minutes	Pulse rate per minute
0	68
1	68
2	110
3	96
4	80
5	68

Plot these results on the graph.

(2)

(Total 6 marks)

Q4.

(a) During respiration, sugar is oxidised to release energy. Complete the equation for respiration.

Sugar + _____ = _____ + _____ + energy

(3)

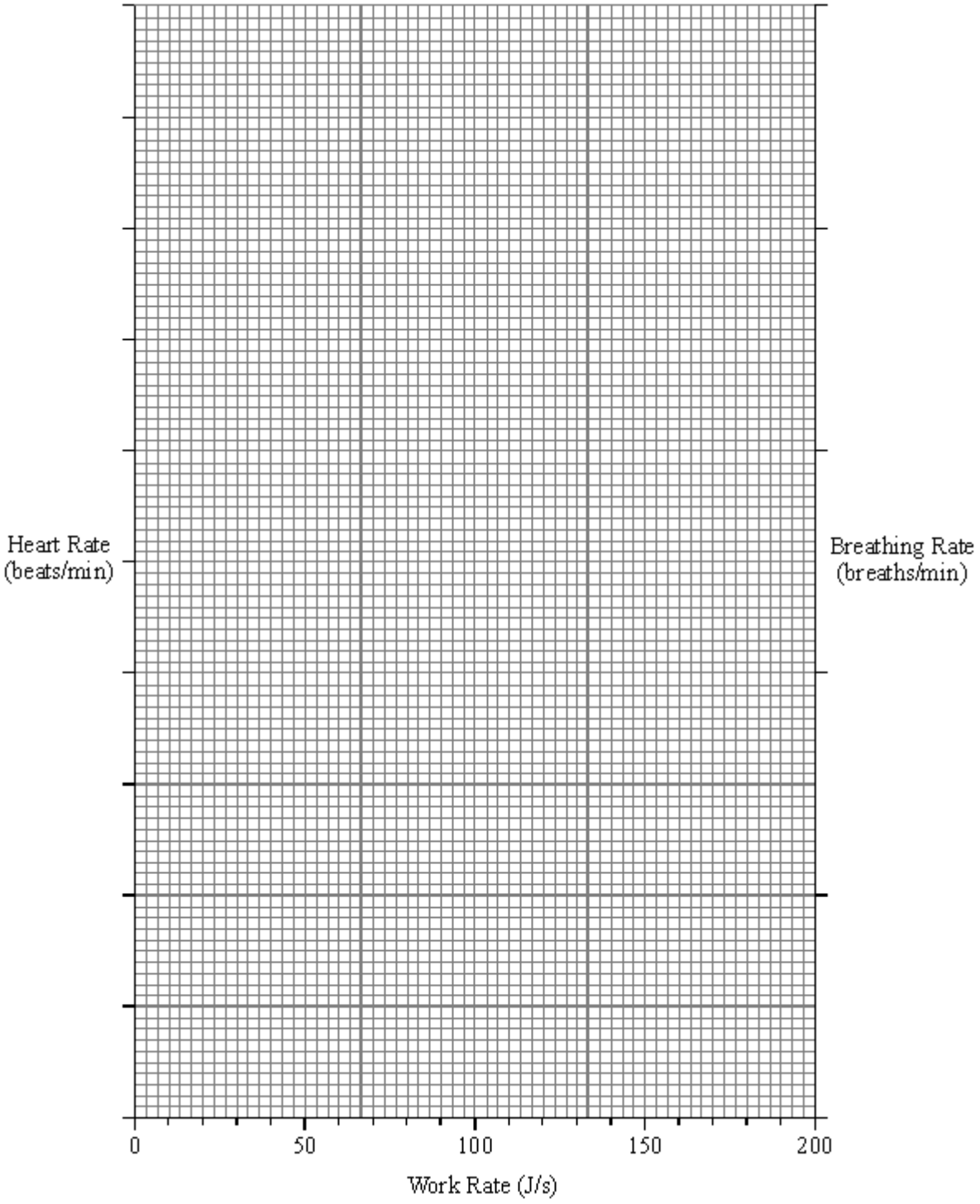
(b) The photograph below shows an athlete using an exercise machine. The machine can be adjusted to vary the rate at which the athlete is required to work.

The athlete's heart rate and breathing rate were measured at different work rates.

The table below shows the results which were obtained.

WORK RATE (J/s)	HEART RATE (beats/min.)	BREATHING RATE (breaths/min.)
0	86	9.6
60	106	10.0
80	112	10.4
100	122	10.4
120	135	11.4
140	143	14.5
160	156	15.8
200	174	30.5

Plot the data on the graph paper below.



(3)

(c) Explain, as fully as you can, the advantages to the body in the change in breathing and heart rates.

(6)

(d) This increase in the rate of heart-beat is a response to a stimulus. For this response suggest:

(i) the stimulus; _____

(ii) the co-ordinator; _____

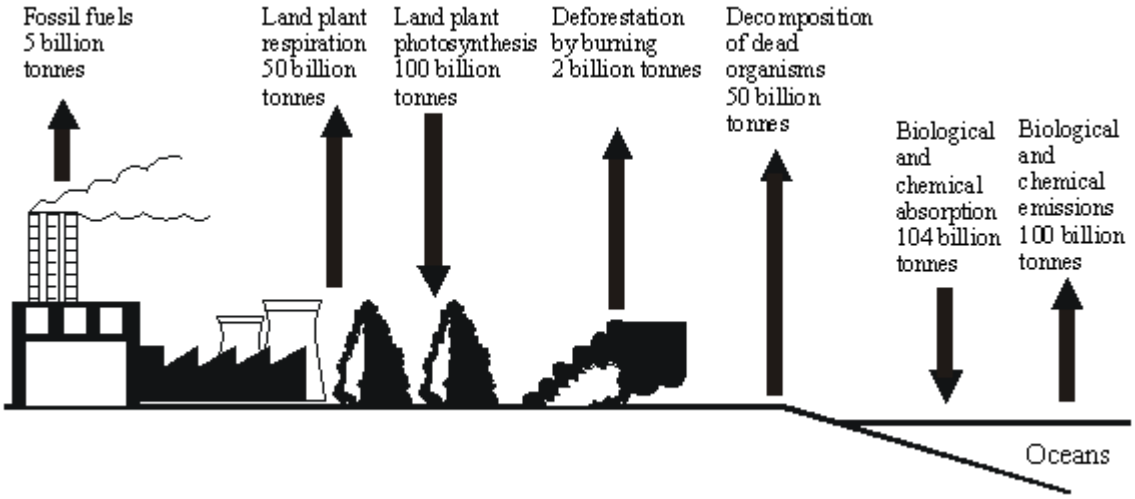
(iii) the effector. _____

(3)

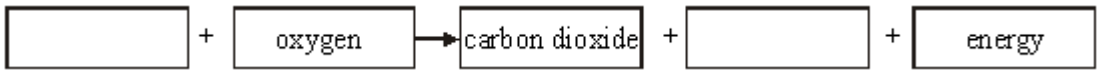
(Total 15 marks)

Q5.

The diagram below shows the mass of carbon involved each year in some of the processes in the carbon cycle.



(a) Complete the equation for plant respiration.



(2)

(b) (i) Calculate the mass of carbon removed from the atmosphere each year. *(Show your working.)*

Answer _____ billion tonnes

(1)

(ii) Calculate the percentage of this total which is removed by the photosynthesis of land plants. (*Show your working*.)

Answer _____ %

(2)

(iii) Calculate the net gain of carbon by the atmosphere in one year. *(Show your working.)*

Answer _____ billion tonnes

(2)

(Total 7 marks)

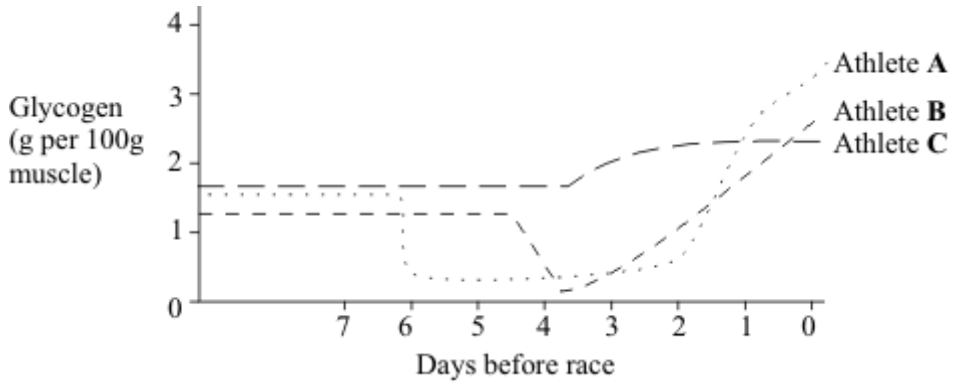
Q6.

Marathon runners are recommended to have a high carbohydrate diet prior to a race. Three athletes tried out three dietary regimes prior to a marathon race.

These three dietry regimes were as follows.

Athlete A	Up to 7 days before the race	-	Normal mixed diet
	7 days before the race	-	Prolonged extreme physical activity
	6-3 days before the race	-	Protein and fat diet; no carbohydrate
	2 and 1 days before the race	-	Large carbohydrate intake
Athlete B	Up to 5 days before race	-	Normal mixed diet
	5 days before the race	-	Prolonged extreme physical activity
	4-1 days before the race	-	Large carbohydrate intake
Athlete C	Up to 4 days before the race	-	Normal mixed diet
	4-1 days before the race	-	Large carbohydrate intake

The graph below shows the effect of each of these dietary regimes on glycogen levels in the athletes' muscles



(a) (i) What is the immediate effect of extreme physical activity on the glycogen content of muscles?

_____

_____

(1)

(ii) Describe how this effect occurs.

_____

_____

_____

_____

(3)

(b) (i) Evaluate the three regimes as preparation for a marathon race.

(3)

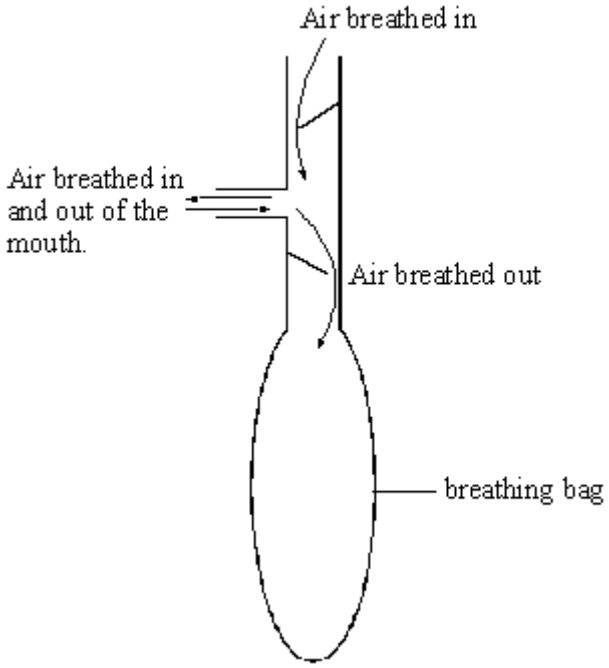
(ii) Suggest a possible explanation for the different effects of the three regimes.

(2)

(Total 9 marks)

Q7.

A student breathed out into an empty breathing bag five times.



After breathing out five times the volume of air in the bag was measured. The volume was 3000 cm^3.

(a) Complete the following sentences.

The air the student breathed in would contain more _____ than the air the student breathed out.

The air the student breathed out would contain more _____ than the air the student breathed in.

(2)

(b) The student then did some exercise for two minutes. The volume breathed out in five breaths was again measured. This time there was 9000 cm^3 of air in the bag.

What does this tell you about the effect of exercise on breathing?

_____

_____

(1)

(c) (i) Name the chemical process that releases energy when it takes place in the cells of the body.

_____

(1)

(ii) Name the substances produced by this process.

_____ and _____

(2)

(iii) Explain as fully as you can why this process has to take place more rapidly during exercise.

(2)

(Total 8 marks)

Q8.

(a) Explain, as fully as you can, why respiration has to take place more rapidly during exercise.

(2)

(b) During exercise the process of respiration produces excess heat. Explain how the body prevents this heat from causing a rise in the core (deep) body temperature.

(4)

(Total 6 marks)

Q9.

In an investigation four groups of athletes were studied. The maximum rate of oxygen consumption for each athlete was measured and the mean for each group was calculated. The athletes then ran 10 mile races and the mean of the best times was calculated for each group. The results are shown in the table below.

GROUP OF ATHLETES	MAXIMUM RATE OF OXYGEN CONSUMPTION (cm^3 per kg per min)	BEST TIME IN 10 MILE RACE (minutes)
A	78.6	48.9
B	67.5	55.1
C	63.0	58.7
D	57.4	64.6

(i) What is the relationship between maximum rate of oxygen consumption and time for a 10 mile race?

_____

_____

(1)

(ii) Suggest an explanation for this relationship.

_____

_____

_____

_____

_____

_____

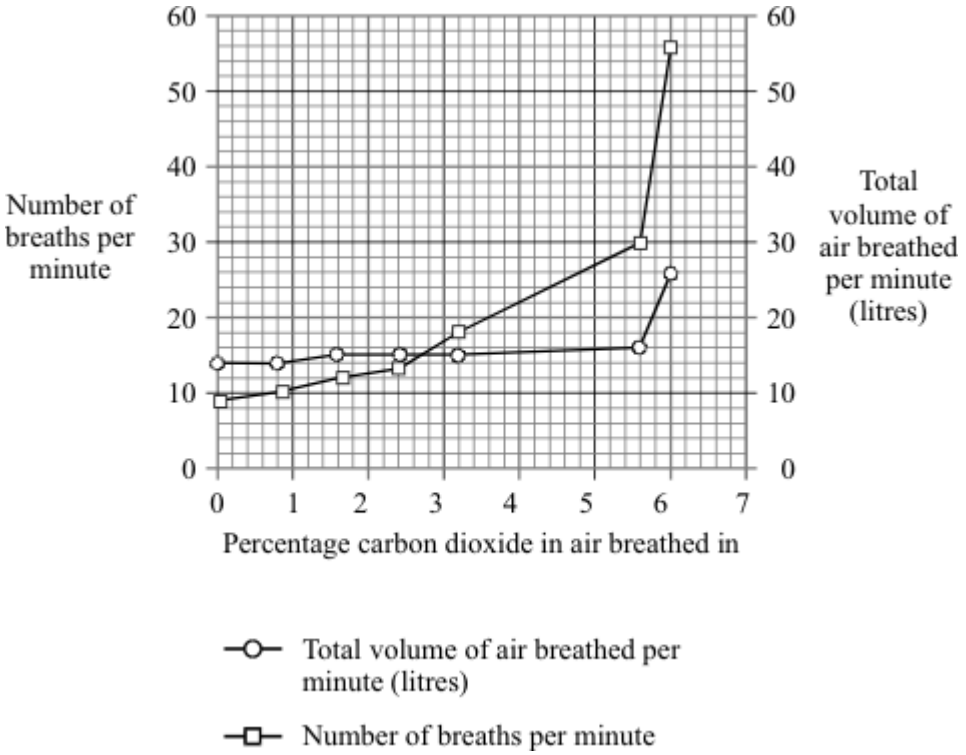
(3)

(Total 4 marks)

Q10.

The graph shows the effect of increasing the carbon dioxide content of the inhaled air on:

- the number of breaths per minute;
- the total volume of air breathed per minute.



(i) Describe the effect of increasing the percentage of carbon dioxide in the inhaled air on the total volume of air breathed.

_____

_____

_____

_____

(2)

(ii) Suggest why the total volume of inhaled air is **not** directly proportional to the number of breaths per minute.

_____

_____

_____

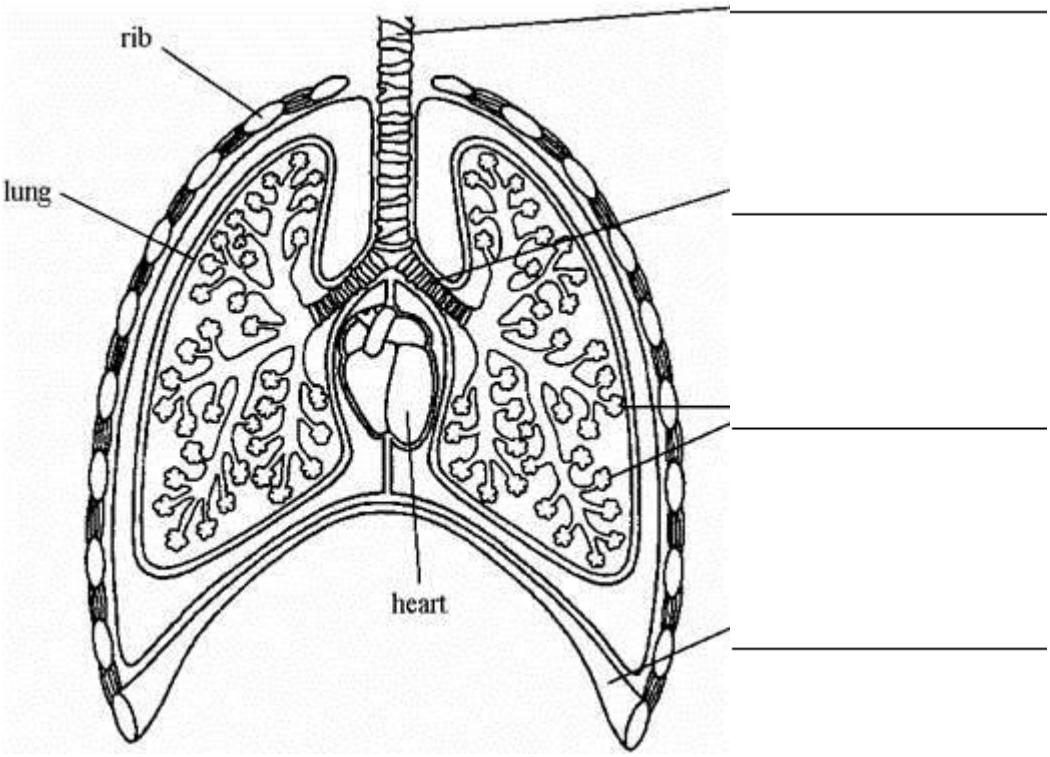
_____

(2)

(Total 4 marks)

Q11.

The diagram shows part of the breathing system in a human.



(a) Use words from the list to label the parts on the drawing.

alveoli **bronchiole** **bronchus** **diaphragm** **trachea (windpipe)**

(4)

(b) Where in the lungs does oxygen enter the blood?

_____

(1)

(c) Which process in cells produces carbon dioxide?

_____

(1)

(Total 6 marks)

Q12.

Read the passage.

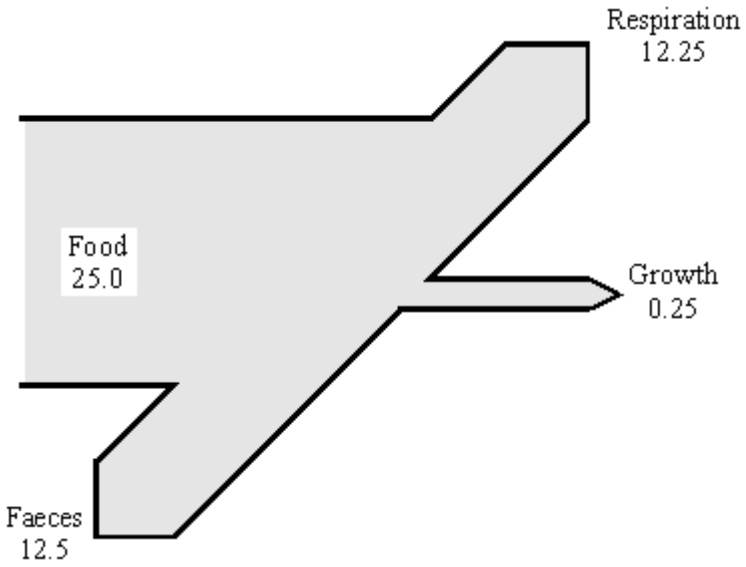
Glutton up a gum tree

Along the banks of the Cygnet River on Kangaroo Island, the branches of the dying gum trees stretch out like accusing fingers. They have no leaves. Birds search in vain for nectar-bearing flowers.

The scene, repeated mile upon mile, is an ecological nightmare. But, for once, the culprit is not human. Instead, it is one of the most appealing mammals on the planet – the koala. If the trees are to survive and provide a food source for the wildlife such as koalas that depend on them, more than 2000 koalas must die. If they are not removed the island's entire koala population will vanish.

Illegal killing has already started. Worried about soil erosion on the island, some farmers have gone for their guns. Why not catch 2000 koalas and take them to the mainland? "Almost impossible," says farmer Andrew Kelly. "Four rangers tried to catch some and in two days they got just six, and these fought, bit and scratched like fury."

The diagram shows the flow of energy through a koala.
The numbers show units of energy.



(i) Calculate the percentage of the food intake which is converted into new tissues for growth. Show your working.

_____ %

(2)

(ii) Give **three** different ways in which the koala uses the energy released in respiration.

1. _____

_____

2. _____

_____

3. _____

_____

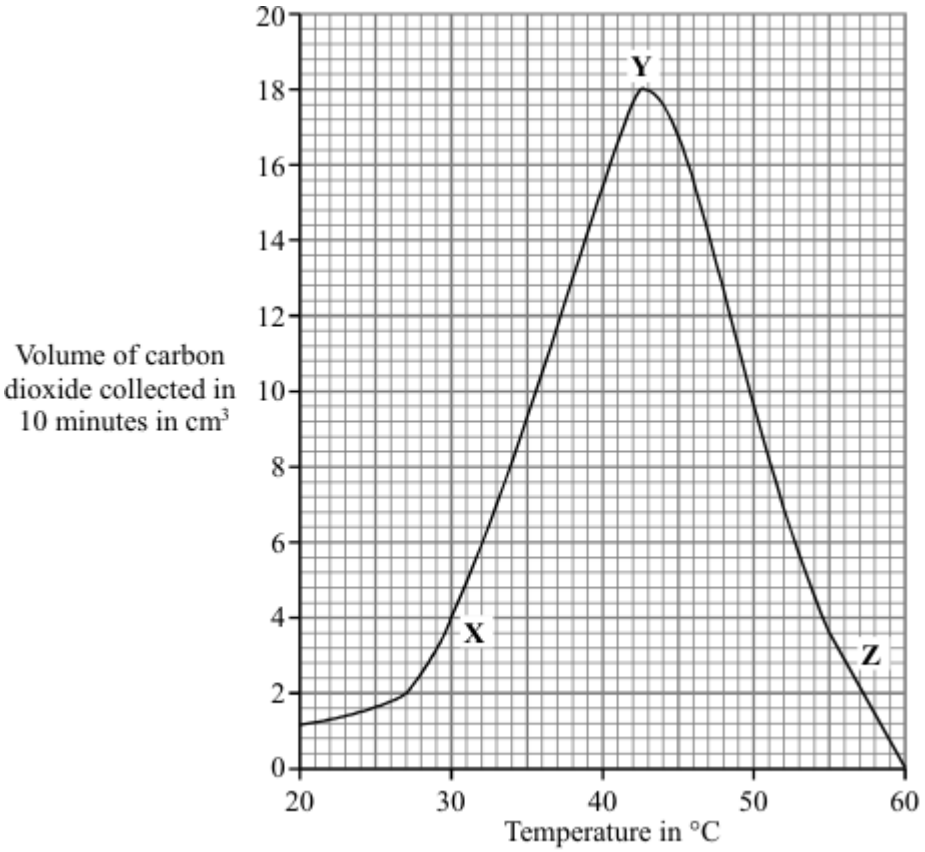
(3)

(Total 5 marks)

Q13.

Fermentation of sugar by yeast produces carbon dioxide.

The graph shows the effect of temperature on the production of carbon dioxide by fermentation.



(a) By how much did the volume of carbon dioxide collected change when the temperature was raised from 30°C to 40°C?

_____ cm^3

(1)

(b) Complete the sentences to explain the shape of the curve between **X** and **Y**.

Raising the temperature _____ the speed of the reacting particles.

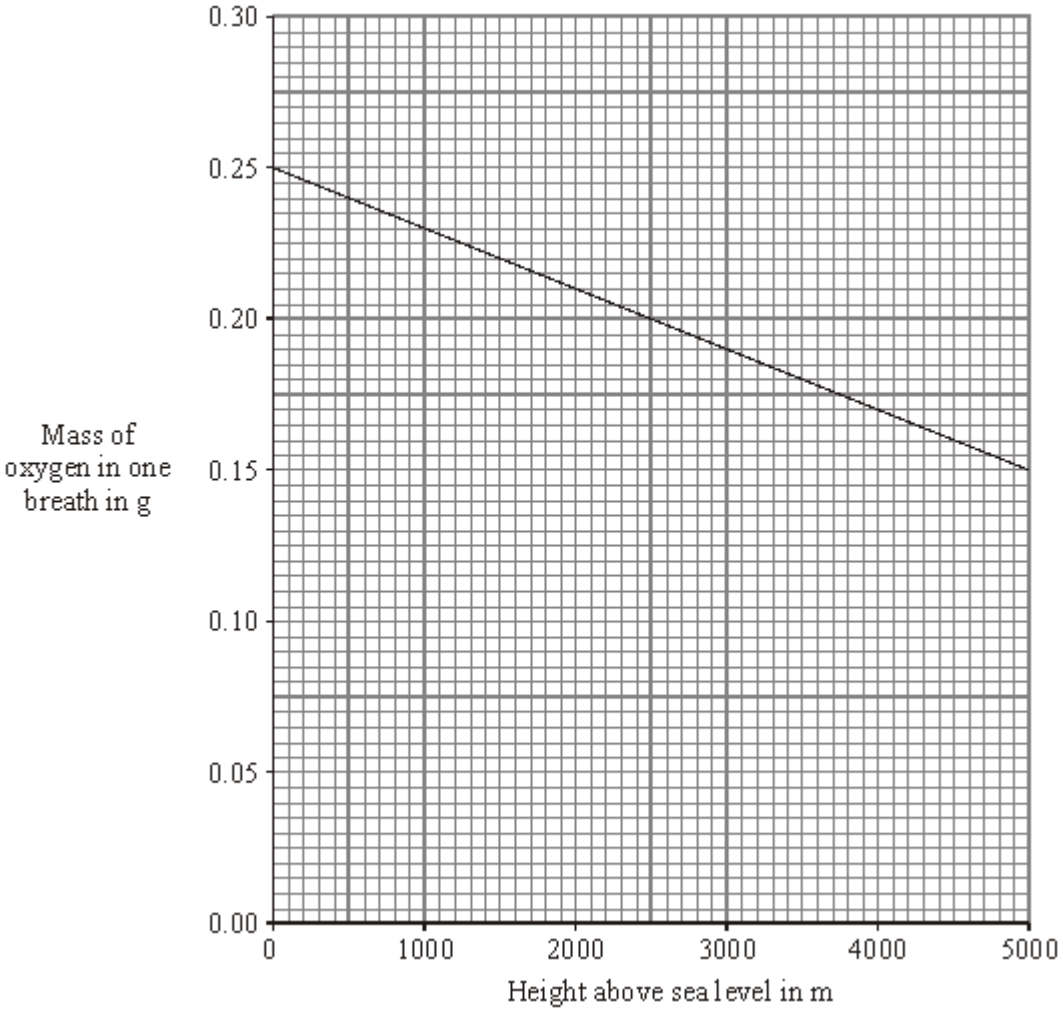
These particles collide more _____ and more _____ .

(3)

(Total 4 marks)

Q14.

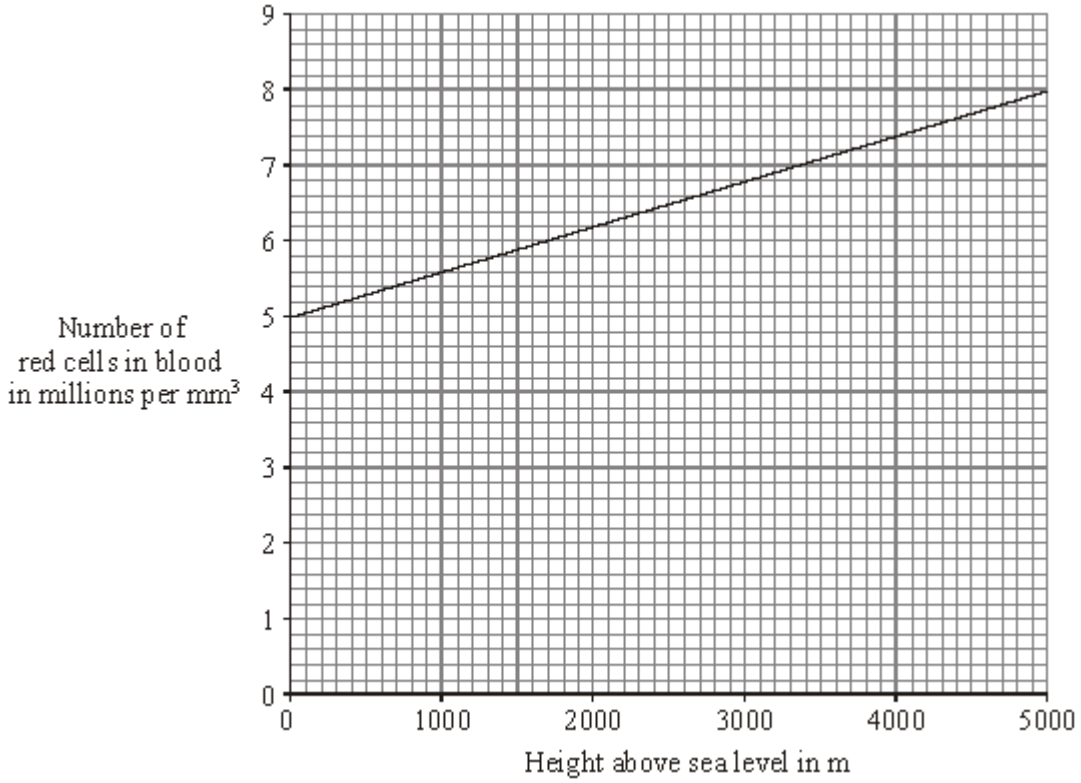
(a) The graph shows how the mass of oxygen you breathe in changes as you climb up a mountain.



Describe, in as much detail as you can, how the mass of oxygen in one breath changes as you climb from sea level to 3000 m.

(3)

(b) People who live high up in mountainous areas have more red blood cells than people who live at sea level. The graph below shows how the number of red blood cells changes with height above sea level.



(i) How many more red blood cells does a person living at 3000 m above sea level have than someone living at sea level? Show clearly how you work out your answer.

_____

_____

Increase in number of red blood cells = _____ millions per m^3

(2)

(ii) What is the advantage of having more red blood cells?

_____

_____

(1)

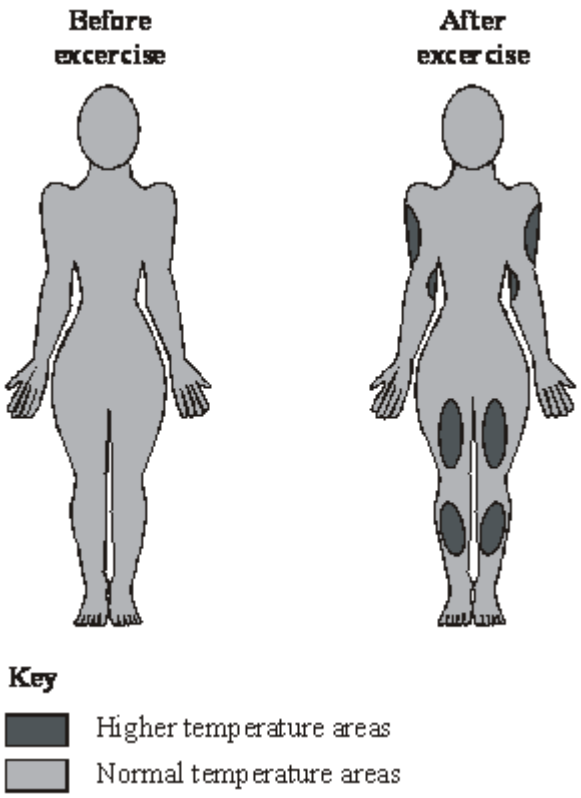
(Total 6 marks)

Q15.

The temperature at the surface of the skin can be measured by using a technique called thermography.

In this technique, areas with higher temperature appear as a different colour on the thermographs.

The drawings below show the results of an investigation in which thermographs were taken from a person before and after exercise.

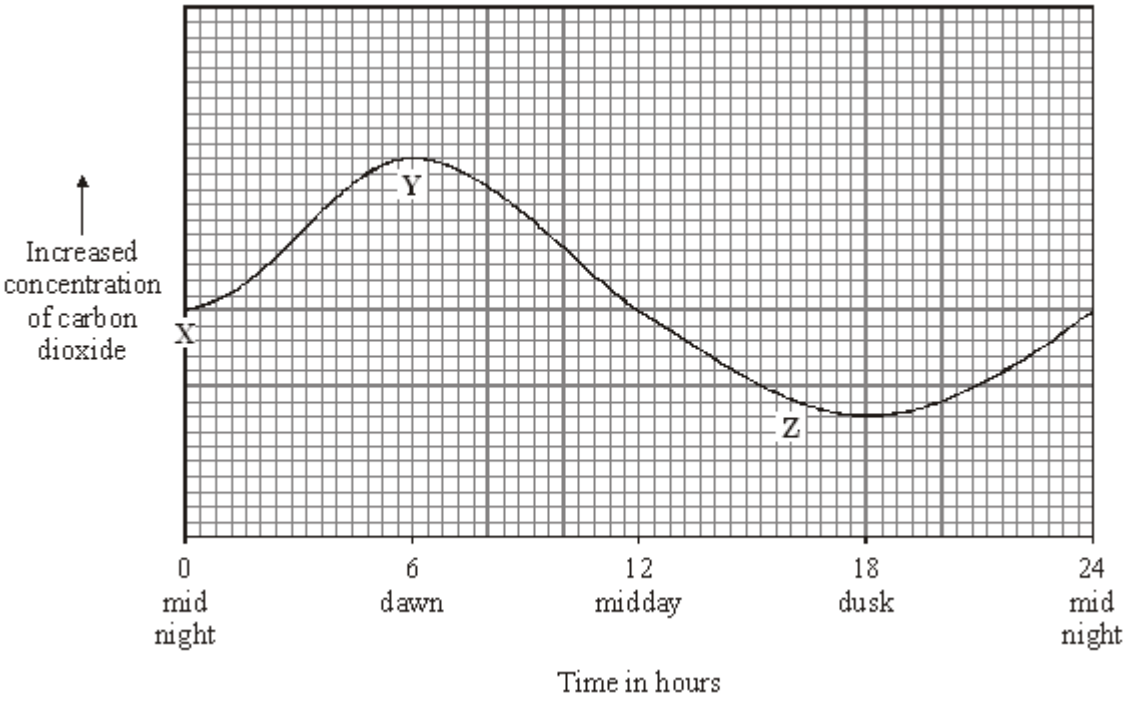


Describe and explain, as fully as you can, the effects of exercise on skin temperature.

(Total 3 marks)

Q16.

The graph shows the concentration of carbon dioxide in the air in a greenhouse full of tomato plants, measured over a period of 24 hours.



(a) Explain why the concentration of carbon dioxide in the air in the greenhouse increased between **X** and **Y**.

_____

_____

_____

_____

(2)

(b) Explain why the concentration of carbon dioxide in the air in the greenhouse decreased between **Y** and **Z**.

_____

_____

_____

_____

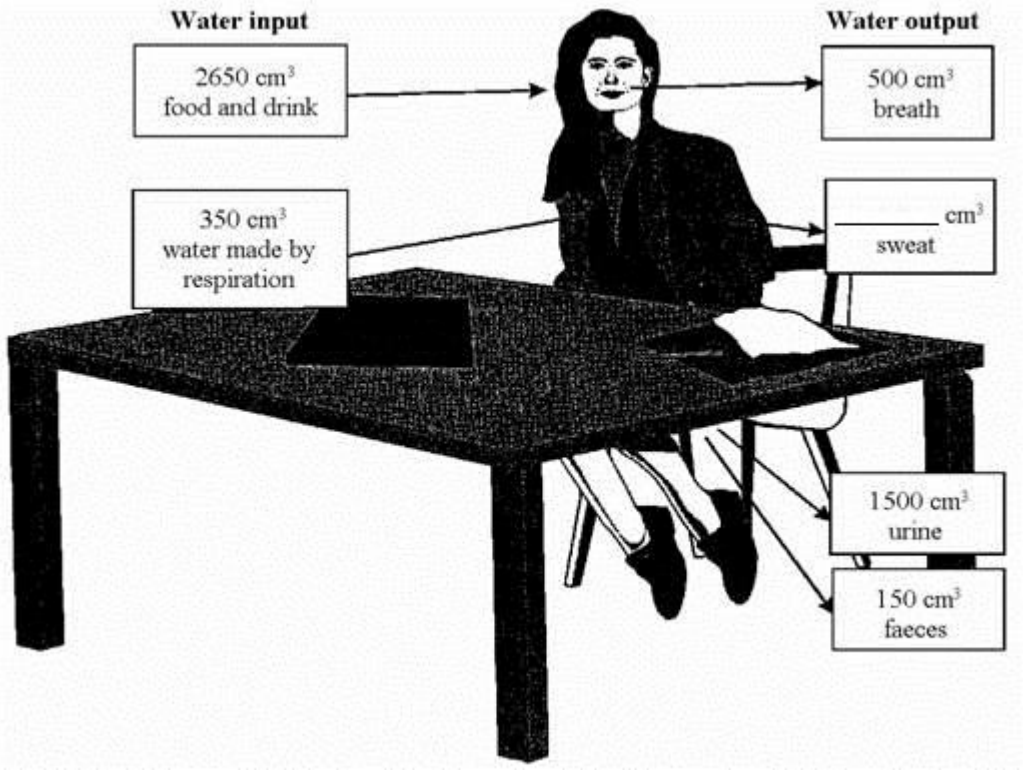
(2)

(Total 4 marks)

Q17.

The diagram shows a water balance for a girl who spends most of the day working at a desk. It is not complete.

(a) Complete the diagram by writing in the volume of sweat produced.



(1)

(b) The next day she spent much of the day training, doing many different types of exercise.

State how **each** of the following would change and why it would be different from the previous day.

(i) The amount of water given off as sweat.

_____

_____

_____

(2)

(ii) The amount of water breathed out.

_____

_____

_____

(2)

(iii) The amount of urine passed, if she had the same water intake as on the previous day.

_____

_____

_____

(2)

(c) Which organ controls the amount of water in the body?

_____

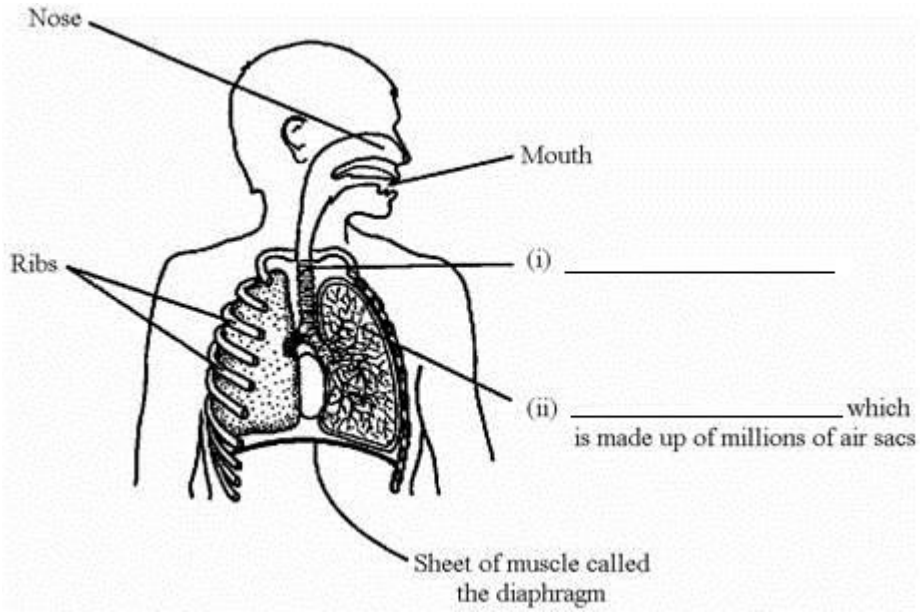
(1)

(Total 8 marks)

Q18.

The diagram shows the human breathing system.

(a) Complete the labels (i) and (ii).



(2)

(b) Complete the following sentence.

When we breathe out, the mixture of gases which leaves the air sacs contains **more** _____ and **less** _____ than the mixture of gases which enters the air sacs.

(2)

(Total 4 marks)

Q19.

(i) What is the name of the process which takes place in living cells in your body and which releases energy from oxygen and glucose?

_____

(1)

(ii) Name the **two** products of the process in part (i).

_____ and _____

(1)

(Total 2 marks)

Q20.

(a) (i) Complete the word equation for the process of aerobic respiration.

Glucose + _____ → carbon dioxide + water

(1)

(ii) Which organ removes carbon dioxide from your body?

_____

(1)

(b) Use names from the box to complete the **two** spaces in the passage.

carbon dioxide	lactic acid	nitrogen	oxygen	water

Anaerobic respiration can occur when an athlete does vigorous exercise.

This is because there is not enough _____ in the body.

The product of anaerobic respiration is _____ .

(2)

(Total 4 marks)

Q21.

Oxygen from our lungs is carried, by our blood, to cells in our body where aerobic respiration takes place.

(i) Complete the **two** spaces to balance the chemical reaction for aerobic respiration.

$$C_6H_{12}O_6 + 6O_2 \rightarrow \_\_\_\_ CO_2 + \_\_\_\_ H_2O$$

(1)

(ii) Name the substance with the formula $C_6H_{12}O_6$.

_____

(1)

(iii) Name the structures in the cytoplasm of our cells where aerobic respiration takes place.

_____

(1)

(Total 3 marks)

Q22.

A young athlete trains and this makes her heart work harder. The table shows part of her

training record.

Time measured in weeks from the start of training	0	8	16	24	32	40
Resting pulse rate measured in pulses per minute	75	69	66	63	61	60

(i) Give **two** changes to her heart resulting from this training.

1. _____

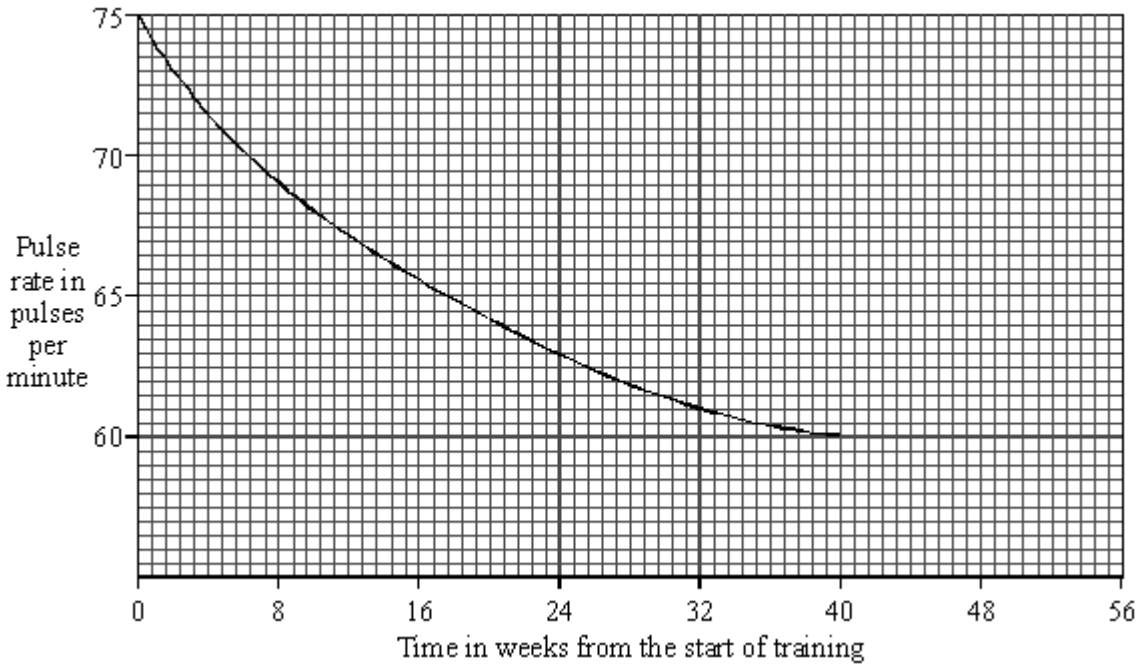
_____

2. _____

_____

(2)

(ii) The graph shows a smooth curve drawn to match the data from her training record.



Use the graph:

(A) to estimate her resting pulse rate, in pulses per minute, after 18 weeks of training;

_____

(1)

(B) to predict her resting pulse rate, in pulses per minute, if she continues her training until the end of the year.

_____

(1)

(Total 4 marks)

Q23.

(a) The air you breathe in and the air you breathe out are different.

Use the names of gases from this box to complete the **three** spaces.

argon	carbon dioxide	nitrogen	oxygen	water vapour

Compared to the air you breathe in, the air you breathe out contains:

- **more** _____
- **more** _____
- **less** _____

(3)

(b) The process of aerobic respiration takes place in your cells.

(i) Complete the space in the word equation for this process.

_____ + oxygen → carbon dioxide + water

(1)

(ii) Complete the space to give the main energy transfer which takes place in this process.

chemical energy → _____ energy

(1)

(iii) What is the name of the organ where oxygen from the air passes to your blood?

_____

(1)

(c) The athlete is taking part in vigorous exercise.

Complete the **two** spaces in the passage.

The cells in our muscles respire anaerobically during vigorous exercise. This results in _____ debt and the production of _____ acid.

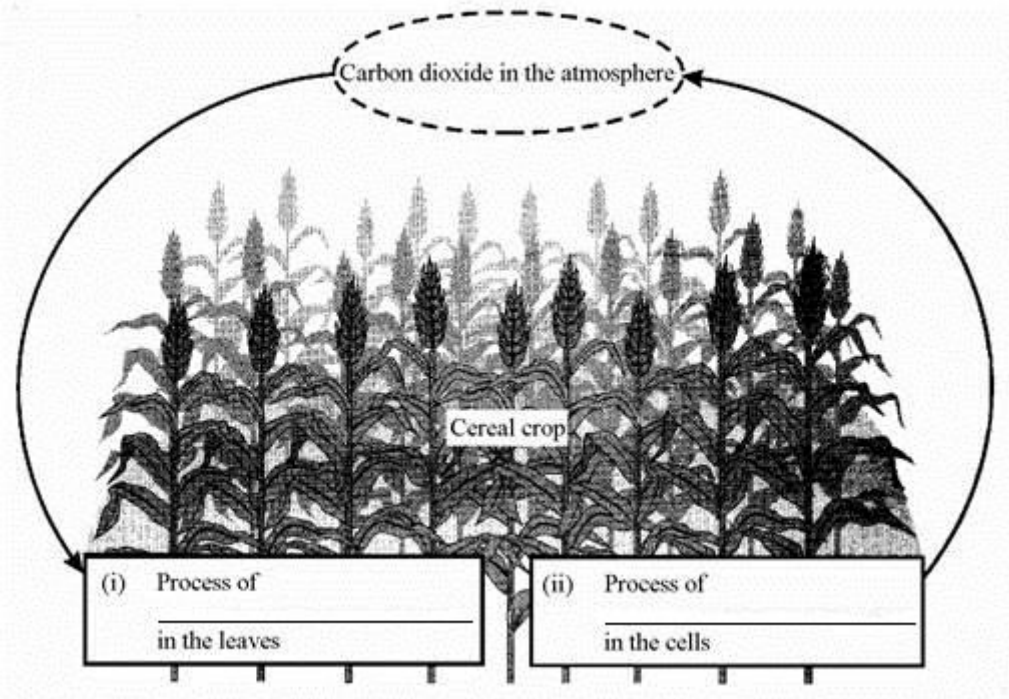
(2)

(Total 8 marks)

Q24.

(a) The diagram shows a cereal crop.

Complete spaces (i) and (ii).



(2)

(iii) What sort of weather may cause the cereal crop to wilt?

_____

(1)

(b) Describe the process of transpiration in plants.

_____

_____

_____

_____

_____

_____

(3)

(Total 6 marks)

Q25.

The man uses energy as he walks along. Energy is released in the cells in his body.

(i) What name is given to this process which occurs in his cells?

Circle the correct name.

circulation **reproduction** **respiration** **transpiration**

(1)

(ii) What gas is brought to his cells by the blood?

_____

(1)

(iii) What gas is released by his cells and carried away by the blood?

_____

(1)

(Total 3 marks)

Q26.

(a) Respiration is a process which takes place in living cells. What is the purpose of *respiration*?

_____

_____

(1)

(b) (i) Balance the equation for the process of respiration when oxygen is available.

$C_6H_{12}O_6$ + O_2 → CO_2 + H_2O

(1)

(ii) What is the name of the substance in the equation with the formula $C_6H_{12}O_6$?

_____

(1)

(c) Oxygen is absorbed through the alveoli in the lungs.

(i) How are the alveoli adapted for this function?

_____

_____

_____

(2)

(ii) Name the gas which is excreted through the alveoli.

_____

(1)

(d) (i) What is the name of the process of respiration when oxygen is **not** available?

_____

(1)

(ii) Describe the process of respiration which takes place in human beings when oxygen is **not** available and give an effect.

_____

_____

_____

_____

_____

_____

(3)

(Total 10 marks)

Q27.

Plants need chemical energy for respiration and for active transport.

(i) Write a balanced chemical equation which represents the process of respiration in plants.

(2)

(ii) Describe the process of active transport in the root hair cells of plants.

(3)

(Total 5 marks)

Q28.

The table shows the percentage of some gases in the air a boy breathed in and out.

Gases	Air breathed in	Air breathed out
carbon dioxide	0.04%	4.0%
oxigen	20.0%	16.0%
water vapour	1.0%	6.0%

(a) What happens in the lungs to change the levels of oxygen and carbon dioxide in this way?

Oxygen _____

Carbon dioxide _____

(4)

(b) Compare the percentage of water vapour in the air breathed out with the percentage in air breathed in.

_____

(2)

(Total 6 marks)

Q29.

Diagram 1 shows the main features of human blood circulation.

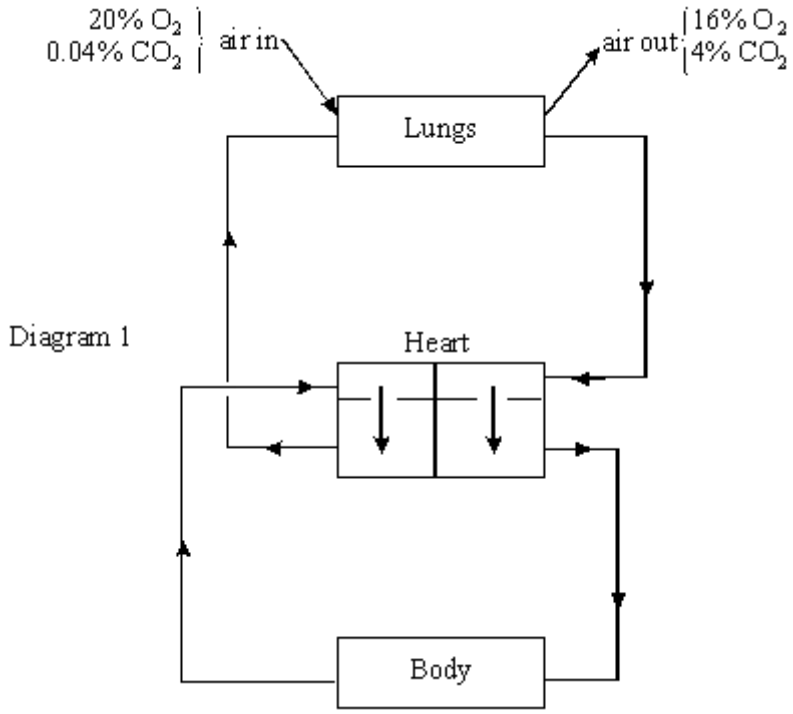


Diagram 1

(a) What changes in the composition of **blood** occur in the lungs?

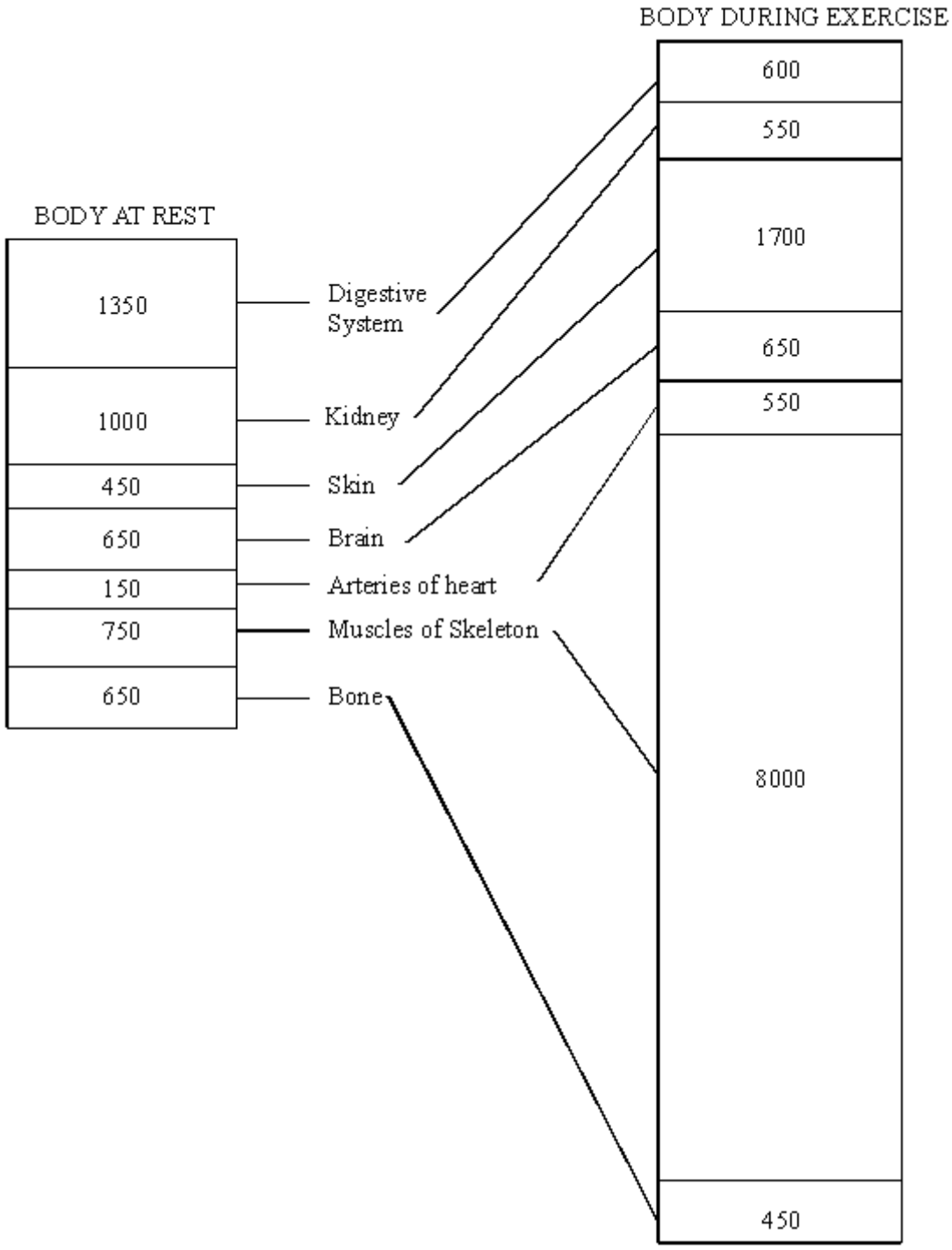
_____

_____

_____

(2)

Diagram 2 shows how the circulation of blood changes between rest and exercise.



Rate of supply of blood to parts of the body (cm^3/min) when at rest and during exercise.

(b) (i) Use the information from Diagram 2 to complete the table below.

Parts of the body to be included:

Digestive System

Skin

Brain

Arteries of Heart

Muscles of Skeleton

Bone

HOW BLOOD SUPPLY CHANGES DURING EXERCISE		
reduced	unchanged	increased
Kidney		

(4)

(ii) What happens to the rate of supply of blood to the whole body with exercise?

(You should make full use of the information provided.)

_____

_____

_____

(3)

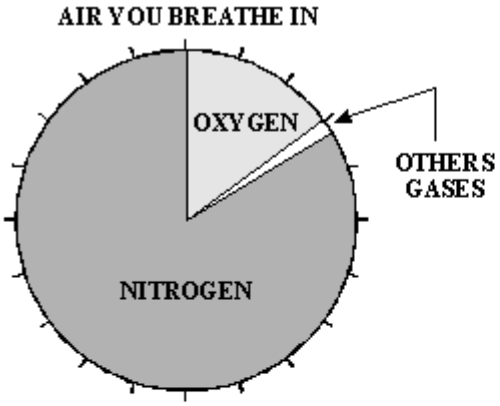
(Total 9 marks)

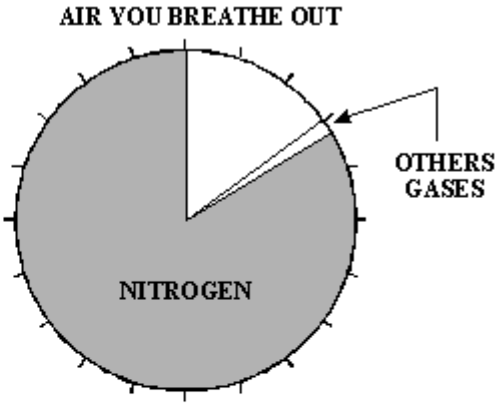
Q30.

(a) Breathed-out air is different from breathed-in air.

The two pie-charts show the percentages of different gases in each.

Complete the second pie-chart, using the information from the table.





This air contains less than 1% carbon dioxide. (Too little to show)

Gases in breathed–out air	
nitrogen	79%
oxygen	16%
carbon dioxide	4%
other gases	1%

(3)

(b) Use the information above to complete the following sentences.

The air you breathe out contains more _____ than the air you breathe in.

The air you breathe out contains less _____ than the air you breathe in.

(2)

(Total 5 marks)

Q31.

As they go higher up a mountain, mountaineers take less oxygen into their bodies with each breath.

This is shown in the table below.

	MILLIGRAMS OF OXYGEN TAKEN INTO **LUNGS** WITH	MILLIGRAMS OF OXYGEN TAKEN INTO **BLOOD** WITH

	EACH NORMAL BREATH	EACH NORMAL BREATH
At bottom of mountain	300	60
At top of mountain	150	30

(a) At the top of the mountain, they only take half as much oxygen into their lungs with each breath as they did at the bottom.

How does this affect the amount of oxygen that gets into their blood with each breath?

_____

_____

(2)

(b) Why do the cells in the mountaineers' bodies need oxygen?

_____

_____

(1)

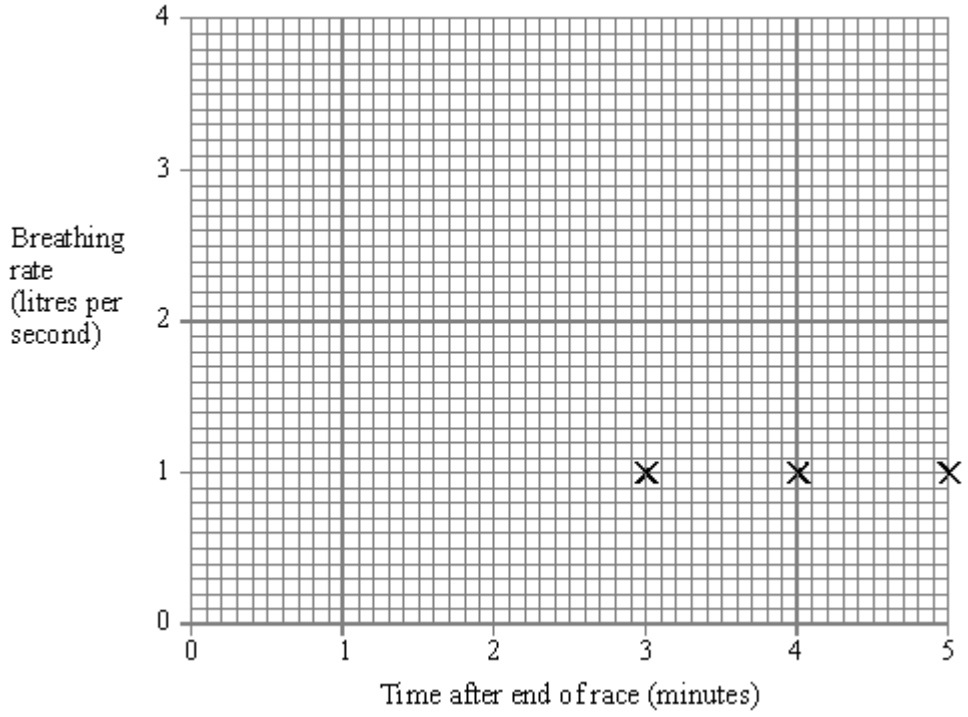
(Total 3 marks)

Q32.

(a) (i) The table shows an athlete's breathing rate after the end of a race.

The results can be put onto a graph.
Three of the points are already plotted.
Plot the other points shown in the table.
Then draw the graph.

Time after end of race (minutes)	Breathing rate (litres per second)
0	4
1	2
2	1
3	1
4	1
5	1



(4)

(ii) What is the athlete's breathing rate ½ (half) a minute after the end of the race?

_____

(2)

(b) One of the reasons for breathing is to get rid of carbon dioxide from your body. Choose words from the list to complete the sentences below about how your body does this.

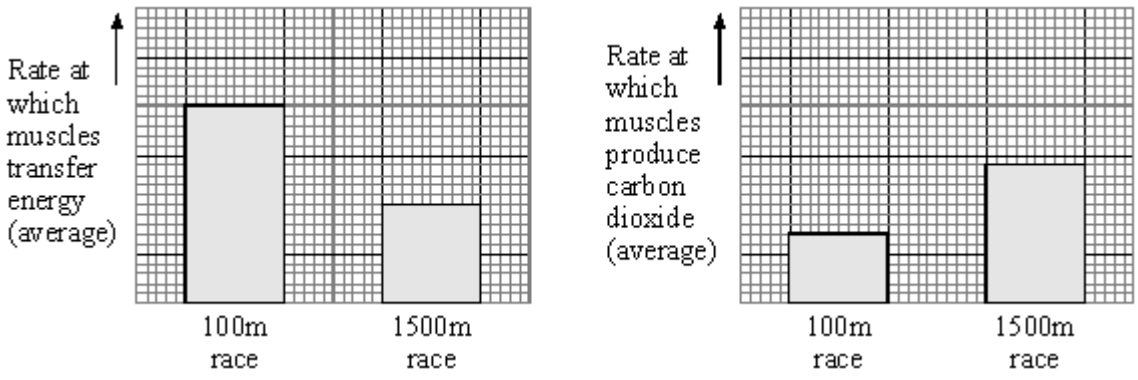
blood **heart** **kidneys** **lungs** **urine**

Carbon dioxide gets out of your body from your _____

The carbon dioxide is carried to this part of your body by your _____

(2)

(c) The bar charts show what happens in an athlete's muscles when running in two races of different distances.



(i) Compare what happens in the athlete's muscles when running in the two

races.

(3)

(ii) Use the information in the box to explain your answer to (i).

aerobic respiration	glucose + oxygen ⟶	carbon dioxide + water
anaerobic respiration	glucose ⟶	lactic acid

(2)

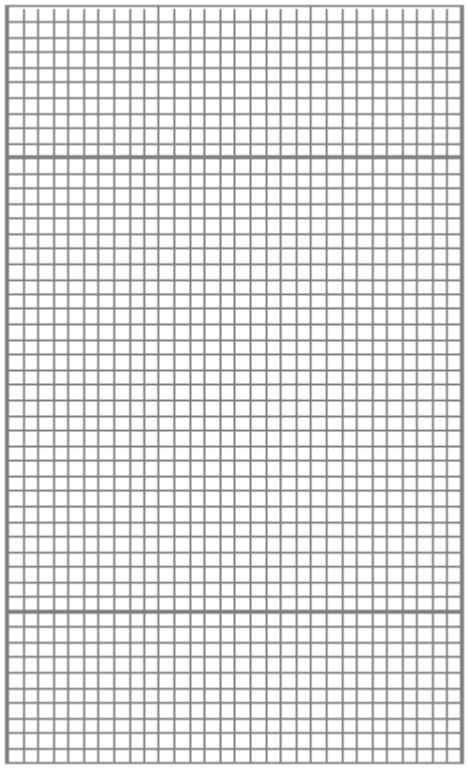
(Total 13 marks)

Q33.

(a) The table shows an athlete's breathing rate after the end of a race.

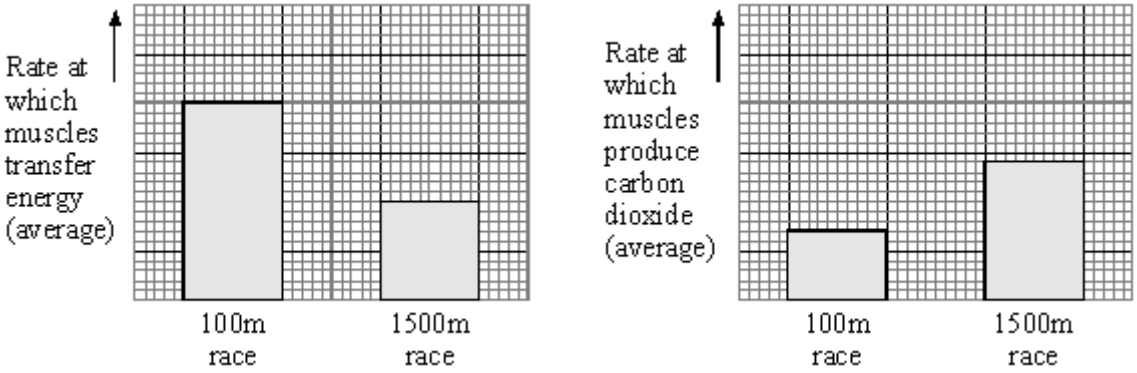
Use the information shown in the table to draw a line graph.

Time after end of race (minutes)	Breathing rate (litres per second)
0	4
1	2
2	1
3	1
4	1
5	1



(3)

(b) The bar charts show what happens in an athlete's muscles when running in two races of different distances.



(i) Compare what happens in the athlete's muscles when running in the two races.

_____

_____

(3)

(ii) Use the information in the box to explain your answer to (i).

aerobic respiration	glucose + oxygen ⟶	carbon dioxide + water
anaerobic respiration	glucose ⟶	lactic acid

_____

_____

(2)

(c) Explain why the athlete breathes at a faster rate than normal for two minutes after finishing a 100 metres race.

_____

_____

_____

(2)

(Total 10 marks)

Mark schemes

Q1.

(a) (i) plotting values for pulse rates;

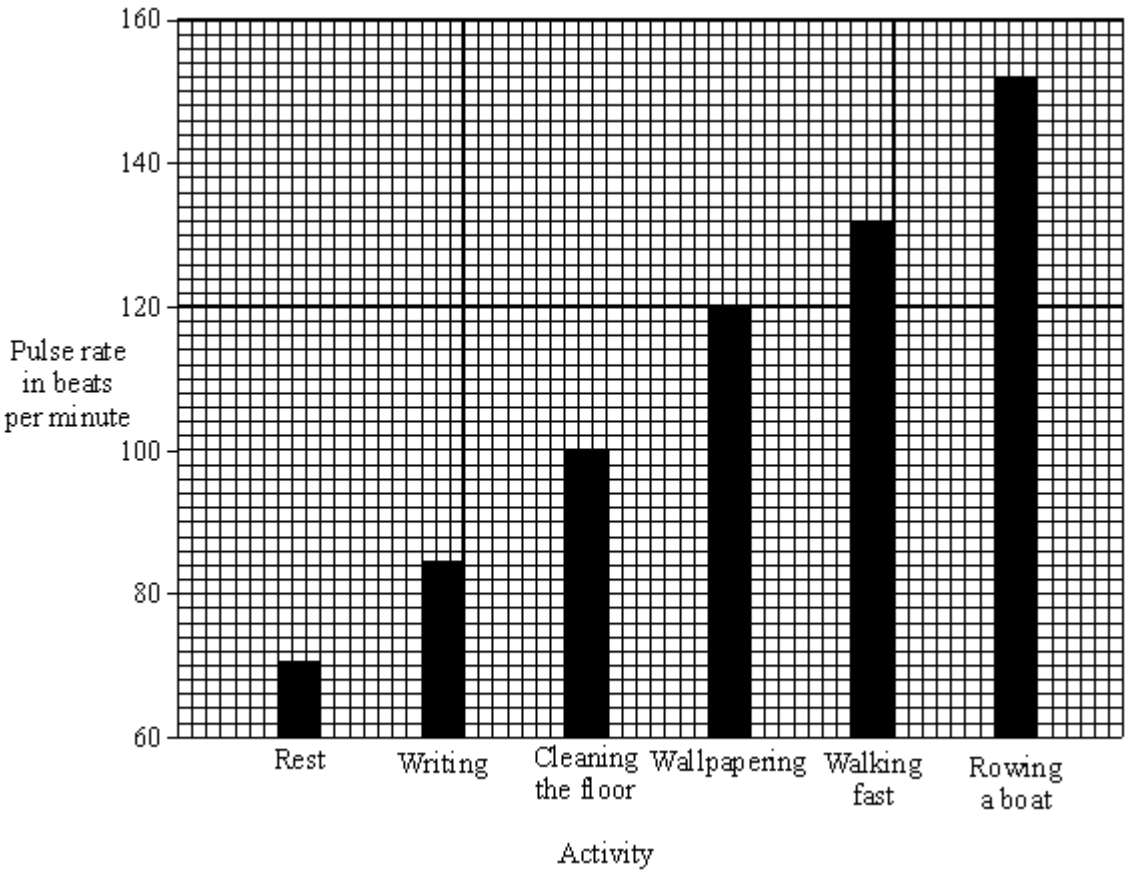
2 marks- minus 1 mark for each error to a maximum of 2

Accept values if plotted on blood volume bar chart

Non-horizontal tops to bars producing variable values = 1 error

If drawn as a line graph =1 mark maximum

2



(ii) **Either**

volume of blood went up then fell;

Accept went to a maximum then fell

pulse rate increased (steadily);

*Accept went up steadily **or** kept going up*

2

Or

at first **or** with low activity **or** with moderate activity both pulse and volume increased;

Accept activity up to wall- papering

with more activity pulse continued to increase but volume fell;

(b) Any **two** of

with increased activity greater muscle use **or** greater respiration;

need more glucose **or** oxygen;

Accept more sugar

heart beat faster;

Do not accept more air

*Accept more blood needed **or** blood flows faster*

*If 'more' **or** equivalent stated once it can be accepted elsewhere by implication*

2

[6]

Q2.

X – oxygen

accept O_2

Y – carbon dioxide

accept CO_2

[2]

Q3.

(i) <u>with exercise</u> rate rises;

accept between 1 – 2 minutes rate rises

1

(when exercise stops) rate falls slowly;

*accept gentle fall **or** steady fall*

for answers which <u>just describe a rise then a fall allow one mark only</u> as an alternative to the first two points

1

rate does not return to normal **or** to starting **or** to resting rate

*accept rate returns to normal after five minutes **or** three minutes of rest **or** after recording ended*

1

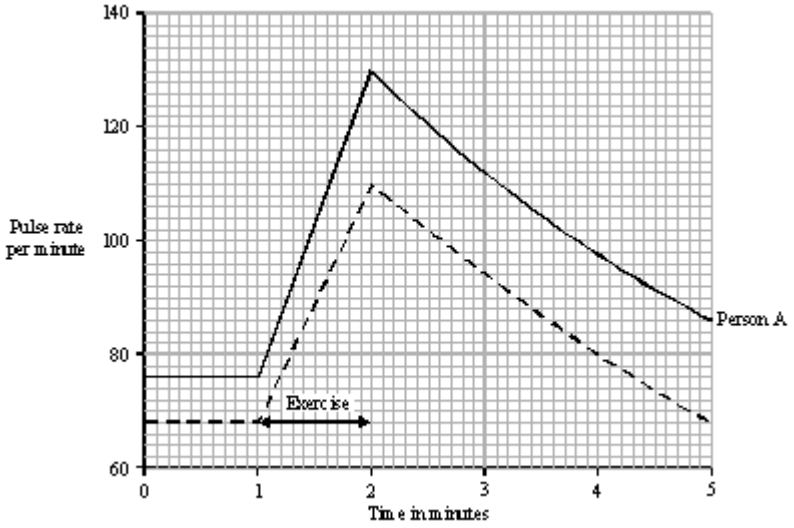
(ii) 86 (per minute);

1

(iii) plotting points;

deduct one mark for each error to max of two

if 68 wrongly plotted count as one error (ignore the quality of the line)



2

[6]

Q4.

(a) oxygen;)
carbon dioxide;) *allow symbols*
water)

each for 1 mark

3

(b) graph with reasonable vertical scales;
accurate plotting of all points (ignore lines) and labelling lines
histogram – must be coded

gains 3 marks

3

(c) 6 of:
during exercise the level of CO_2 (in the blood) rises;
increased breathing to remove excess CO_2;
increased oxygen supply to muscles;
or increased breathing takes in more O_2
or increased heart rate takes more O_2 to muscles;
increased supply of sugar to muscles;
increased respiration rate;
enable faster rate of energy release;
reference to lactic acid (allow even though not on syllabus)/O_2 debt;
to avoid cramp;
anaerobic reference;
reference to removal of 'heat';

6

(d) high carbon dioxide concentration;
brain/central nervous system;
heart muscles (both)

3

[15]

Q5.

(a) glucose/sugar water

for 1 mark each

2

(b) (i) 204

for 1 mark

1

(ii) 49 **gains 2 marks**

(incorrect answer, but correct method gains 1)

2

(iii) 3 **gains 2 marks**
(incorrect answer, but correct method gains 1)

2

[7]

Q6.

(a) (i) reduced sharply

for 1 mark

1

(ii) converted to glucose which is respired to produce energy

(allow answers in terms of glucagon)

gains 3 marks

3

(b) (i) athlete A's was most effective
since resulted in highest muscle glycogen level on day of race
for energy release during race

for 1 mark each

3

(ii) e.g. excess carbohydrate stored as glycogen rather than fat in short term
particularly if glycogen stores depleted

for 1 mark each

2

[9]

Q7.

(a) oxygen,
carbon dioxide or water (vapour)

for 1 mark each

2

(b) idea of more air per breath/deeper breaths

for 1 mark

1

(c) (i) respiration

for 1 mark

1

(ii) carbon dioxide,
water
for 1 mark each

2

(iii) more energy required,
for increased muscular activity
for 1 mark each

2

[8]

Q8.

(a) more energy needed,
for increased muscular activity
for 1 mark each

2

(b) increased sweat production,
evaporation of sweat cools body,
vasodilation OWTTE,
more heat loss (by radiation)
for 1 mark each

4

[6]

Q9.

(i) the higher the rate of oxygen consumption, the shorter the time taken to complete
for 1 mark

1

(ii) the faster oxygen is taken into the blood,
the faster energy can be released in the muscles,
and the faster the athlete can run
for 1 mark each

3

[4]

Q10.

(i) increase in CO_2 concentration leads to increase in volume of air inhaled
increase of % carbon dioxide has little effect over most of range / large increase when % carbon dioxide > 5.6 %
each for 1 mark

2

(ii) *idea that*
depth of breathing changes at low % carbon dioxide, in crease in % CO_2 results in volume of each breath increasing without increase / little increase in number of breaths
each for 1 mark

2

[4]

Q11.

(a) trachea / windpipe
bronchus
alveoli
diaphragm

for 1 mark each

4

(b) alveoli / air sacs (*reject* capillaries)

for one mark

1

(c) respiration

for one mark

1

[6]

Q12.

(i) 0.25 × 100 / 25

gains 1 mark

but
1%

gains 2 marks

2

(ii) muscle contraction / limb movement / moving around / chewing
heartbeat / breathing / internal muscle activity
maintaining body temperature / keeps body warm
active uptake synthesising substances (*reject* growth)

any three for 1 mark each

3

[5]

Q13.

(a) 11

accept 10.5 – 11.5

1

(b) ideas of

increase / rises

1

frequently / often

1

energetically / violently

1

[4]

Q14.

(a) falls

1

from 0.25

1

to 0.19

but by 0.06 gains two marks

if neither figure given, accept steadily / at constant rate for one mark
accept mass of oxygen inversely related / negative correlation to height above sea level for 2 marks

1

(b) (i) 1.8

accept correct readings from graph for (5 and 6.8) if subtraction incorrect for one mark

allow one mark for correct subtraction from incorrect readings

2

(ii) (blood can carry) more oxygen

1

[6]

Q15.

any **three** from:

heat produced by muscles

during exercise

accept when working

by respiration

(skin) temperature over muscles rises / more blood to skin over muscles

*allow vasodilation **or** arterioles dilate over muscles*
reject capillaries dilate
sweating neutral

[3]

Q16.

(a) respiration

reject start respiring / respire only at night

1

no photosynthesis because no light

1

(b) photosynthesis rate greater than respiration rate

1

reject no respiration / photosynthesis only

photosynthesis since light

1

[4]

Q17.

(a) 850

1

(b) (i) more

because exercise makes us sweat **or** work harder

accept to cool the body

do not credit body hotter or giving off more heat

2

(ii) more

because she respires more

*accept she breathes (in and out) more **or** heavier **or** faster*

2

(iii) less

because (more) water has been lost by sweating **or** breathing out **or** other methods

accept arguments about conservation of water

2

(c) kidney

1

[8]

Q18.

(a) (i) trachea

accept windpipe

1

(ii) (left) lung **or** lungs

do not credit right lung

1

(b) carbon dioxide **or** water <u>vapour</u>

do not credit just 'water'

1

oxygen

answers in terms of used air or fresh air or of temperature differences are not acceptable

1

[4]

Q19.

(i) (aerobic) respiration

do not credit anaerobic respiration

accept cellular respiration

1

(ii) carbon dioxide and water (vapour)

both required

do not credit heat

1

[2]

Q20.

(a) (i) oxygen

do not credit air

1

(ii) lung(s)

*do not credit blood **or** nose or windpipe alone but accept as a neutral answer if included with lungs*

1

(b) oxygen

1

lactic acid

both words required

1

[4]

Q21.

(i) 6 in both spaces

do not credit if any formula has been altered

1

(ii) glucose

*allow fructose **or** dextrose*

1

(iii) mitochondria

accept organelles

1

[3]

Q22.

(i) any **two** from

* (heart) more muscular

accept bigger

* (heart) more powerful

accept more efficient

accept stronger

2

(ii) * pauses longer between (heart) beats

accepts beats more slowly

accept heart rate decreases

* less fast around the heart

recovers more quickly not just 'heart healthier'

do not credit pulse rate slower

2

[4]

Q23.

(a) more water vapour

accept more water

1

more carbon dioxide

1

less oxygen

1

(b) (i) glucose

accept carbohydrate(s)

accept sugar(s)

1

(ii) heat

***or** thermal*

***or** <u>internal</u> kinetic*

1

(iii) lungs

accept alveoli / alveolus

do not credit air sacs

do not credit capillaries

both neutral if included with lungs

1

(c) oxygen

accept O_2

1

lactic

1

[8]

Q24.

(a) (i) photosynthesis

1

(ii) respiration

do not credit combustion

do not credit decay

1

(iii) dry

*accept hot **or** windy **or** drought*

1

(b) any **three** from

* evaporation (of water)

***or** loss of water vapour*

* (mostly) from the leaf / leaves

do not credit incorrect reference to leaves

* through the stomata

accept through each stoma

accept through the stomas(sic)

* causing a pull

***or** causing an increase in osmotic potential (at the top of the plant)*
***or** causing an increase in water potential (at the top of the plant) **or** causing a decrease in osmotic pressure (at the top of the plant)*

* (so that) water moves up (through the plant)

do not credit water vapour moves up through the plant

* as the transpiration stream

* water enters through roots (and goes up plants)

3

[6]

Q25.

(i) respiration

1

(ii) oxygen **or** O_2

*do not accept O **or** O^2*

1

(iii) carbon dioxide **or** CO_2

do not accept CO^2

1

[3]

Q26.

(a) to transfer / provide / give release energy

or *production of ATP / adenosine triphosphate (molecules)*

accept to give heat

1

(b) (i) $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

accept any other

n : 6n : 6n : 6n ratio

do not credit if any other changes have been made

1

(ii) glucose

do not credit sugar / sucrose

1

(c) (i) any **two** from

large surface

thin (surface)

moist (surface)

(with a good) blood supply

2

(ii) carbon dioxide

accept water vapour

do not credit just water

1

(d) (i) anaerobic (respiration)

1

(ii) any **three** from

in mitochondria

glucose decomposes / breaks down / reacts

or *glucose → lactic acid for (2) marks*

to give lactic acid

or *breathing hard*

or *lactic acid → CO2 + water*

causing pain

(leaving an) oxygen debt

(quick) source of energy

(but) less efficient than aerobic respiration

accept less efficient than with oxygen

3

[10]

Q27.

(i) $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

energy is neutral

1

formulae all correct

with no omissions / deletions

correctly balanced

credit 1 mark if the answer is the exact reverse of an incorrect answer for (a)

1

(ii) and **three** from

take up of (soluble) substances / ions against the concentration gradient

or *when the concentration (of the substance / ions) is greater inside the cell / cytoplasm than outside it*

through the (semi-permeable) (cell) membrane energy from mitochondria

or *energy from respiration*
not just energy

3

[5]

Q28.

(a) oxygen passes from the air/lungs into the body

gains 1 mark

but
oxygen passes from the air/lungs into the blood

gains 2 marks

carbon dioxide passes from the body into the air/lungs

gains 1 mark

but
carbon dioxide passes from the blood into the air/lungs

gains 2 marks

4

(b) increased/5% more

gains 1 mark

but
6 times more (in air breathed out)

gains 2 marks

2

[6]

Q29.

(a) *idea*
O_2 increases
CO_2 decreases

for 1 mark each

2

(b) (i)

<u>reduced</u>	<u>unchanged</u>	<u>increased</u>
digestive system	brain	skin
bone		muscles
		heart and arteries

All (6) correct gains 4
5 correct gains 3
4 correct gains 2
2/3 correct gains 1

Correct wording not needed if unambiguous. No mark if organ repeated.

4

(ii) more/higher/quicker/faster

gains 1 mark

but
7500 more/from 5,000 to 12,500 more

gains 2 marks

but
7500 cm^3/min more

gains 3 marks

or 2½ times more

3

[9]

Q30.

(a) carbon dioxide in range 2.5-5%

gains 1 mark

but
carbon dioxide closer to 4% than to 3% or 5%

gains 2 marks

OR
oxygen in range 15-17.5%

gains 1 mark

but
If 3 sectors drawn and two correctly labelled,
award marks and ignore remaining sector
Oxygen and carbon dioxide sectors labelled

for 1 mark

3

(b) carbon dioxide
oxygen

for 1 mark each

Do not allow water vapour.
(Allow correct symbols/formulae)

2

[5]

Q31.

(a) less / low

gains 1 mark

but
(also) half as much ***or*** still one fifth of what's breathed in

gains 2 marks

2

(b) for energy / respiration [credit for movement / to keep warm]

[Do not allow "to live"]
for 1 mark

1

[3]

Q32.

(a) (i) points correctly plotted

all correct gains 2 marks
2 correct gains 1 mark

each part of line correctly drawn (i.e. curve + straight line)

for 1 mark each part of line

4

(ii) 3 (or according to plotted graph)
litres per second

for 1 mark each

2

(b) lungs
blood

for 1 mark each

2

(c) (i) *ideas that*

- energy transferred faster in 100m race
- carbon dioxide produced faster during 1500m race / more
- carbon dioxide produced

for 1 mark each

3

correct reference to twice / half as fast in either / both cases

for a further mark

1

(ii)
- respiration during 100m race (mainly) anaerobic
- respiration during 1500m race (mainly) aerobic
- aerobic respiration produced carbon dioxide
- anaerobic respiration produced / lactic acid

for 1 mark each

1

[13]

Q33.

(a)
- appropriate scales (> halfway along each axis)
- all points correctly plotted to better than ½ a square
- lines carefully drawn

(*allow* point to point in this case)

N.B.

- no mark available for labelling axes
- *allow* either orientation

for 1 mark each

3

(b) (i) *ideas that*

- energy transferred faster in 100m race

(*not* more energy transferred)

- carbon dioxide produced faster during 1500m race

for 1 mark each

(*allow* more carbon dioxide produced)

correct reference to twice / half as fast in either / both cases

for 1 further mark

3

(ii)
- respiration during 100m race (mainly) anaerobic
- respiration during 1500m race aerobic
- aerobic respiration produces carbon dioxide
- anaerobic respiration doesn't produce carbon dioxide / produces lactic acid

any two for 1 mark each

2

(c) *ideas that*

- there is an oxygen debt / more than normal oxygen needed
- lactic acid needs to be oxidised / combined with oxygen

for 1 mark each

2

[10]