AQA GCSE BIOLOGY (HIGHER) · 8461

BIOLOGY



EXAM QUESTION PACK

4.4.2 RESPIRATION (PACK 1)

SCORE	PERCENTAGE
/336	%

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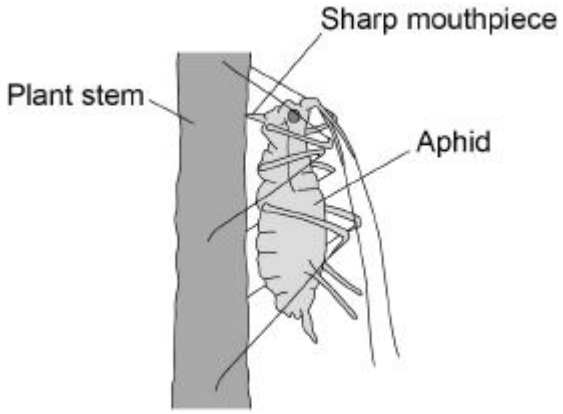
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Q1.

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 ☐

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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.

_____

_____

_____

_____

_____

(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.

_____

_____

_____

_____

_____

(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.

_____

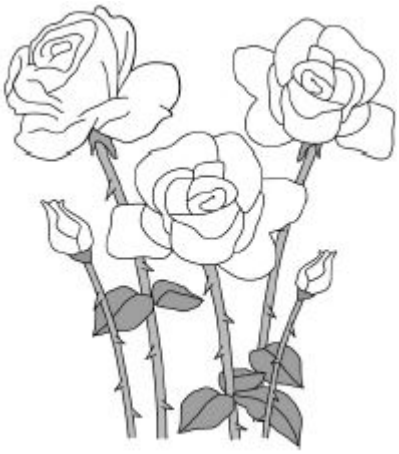
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(1)

Figure 2 shows part of a rose plant.

Figure 2

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

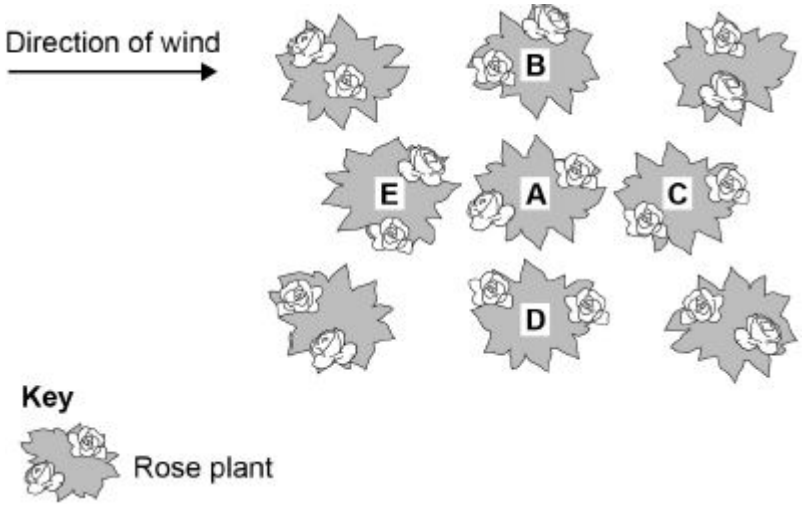
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(1)

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)

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(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?

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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.

_____

_____

_____

_____

_____

_____

(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.

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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. ☐

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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. _____

_____

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2. _____

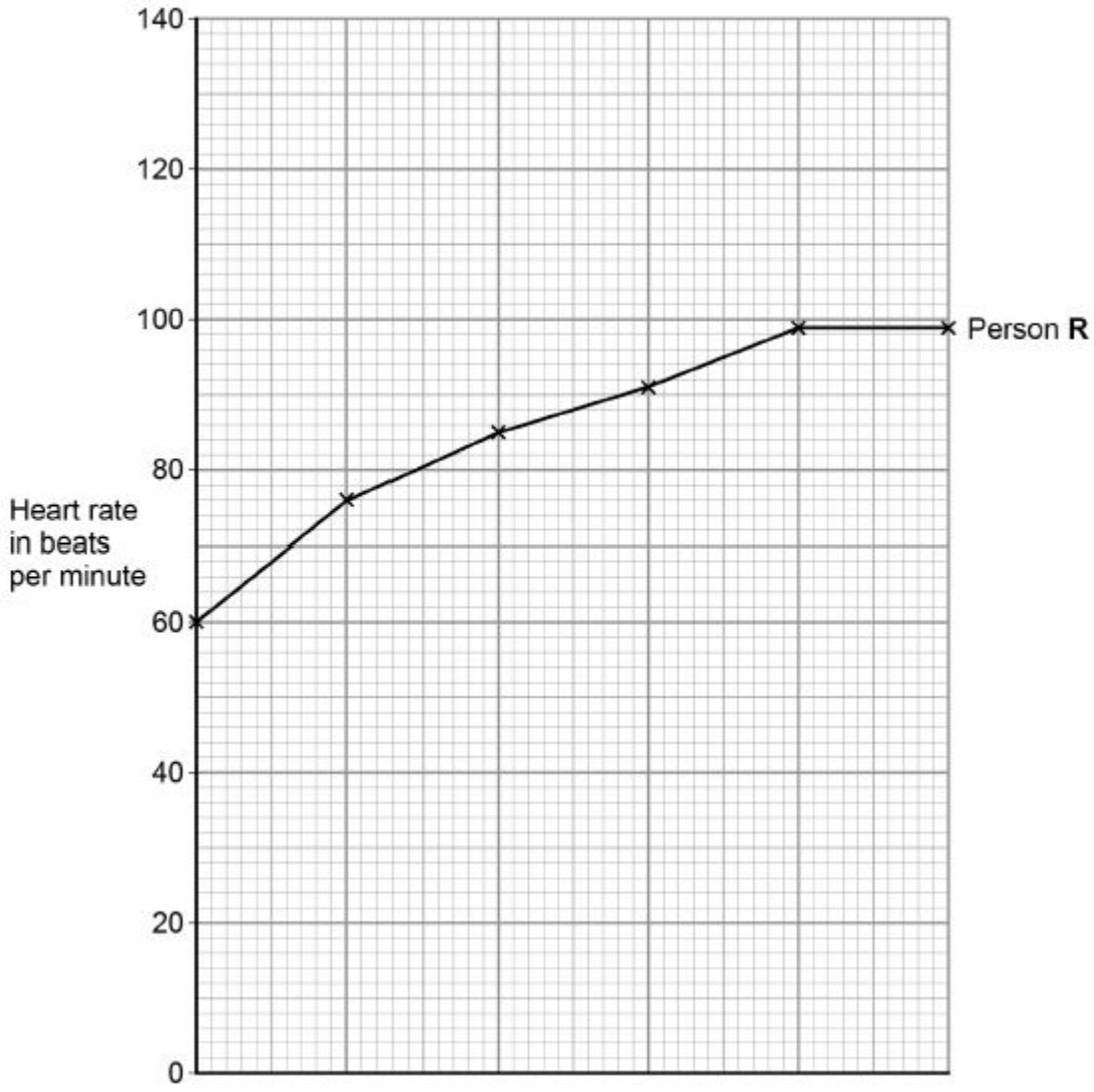
_____

(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.

_____

_____

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_____

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.

_____

_____

_____

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(6)

(Total 20 marks)

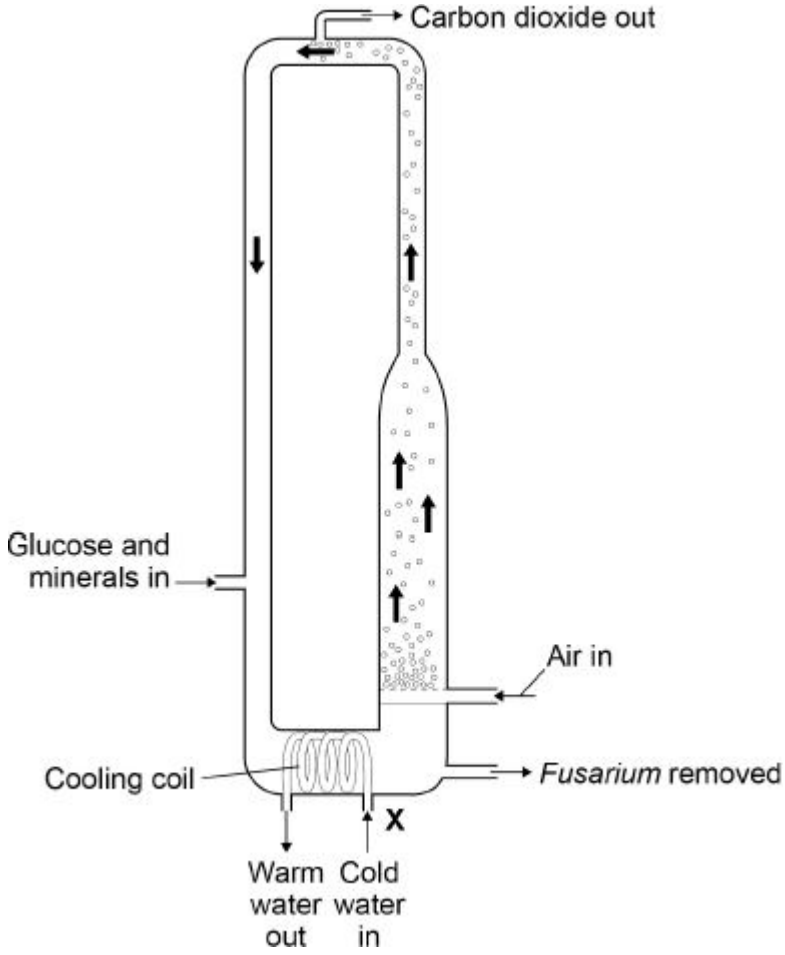
Q4.

Mycoprotein is a protein-rich food.

Mycoprotein is made from the fungus *Fusarium*.

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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 ☐

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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.

_____

_____

_____

_____

(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 ☐

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220 grams ☐

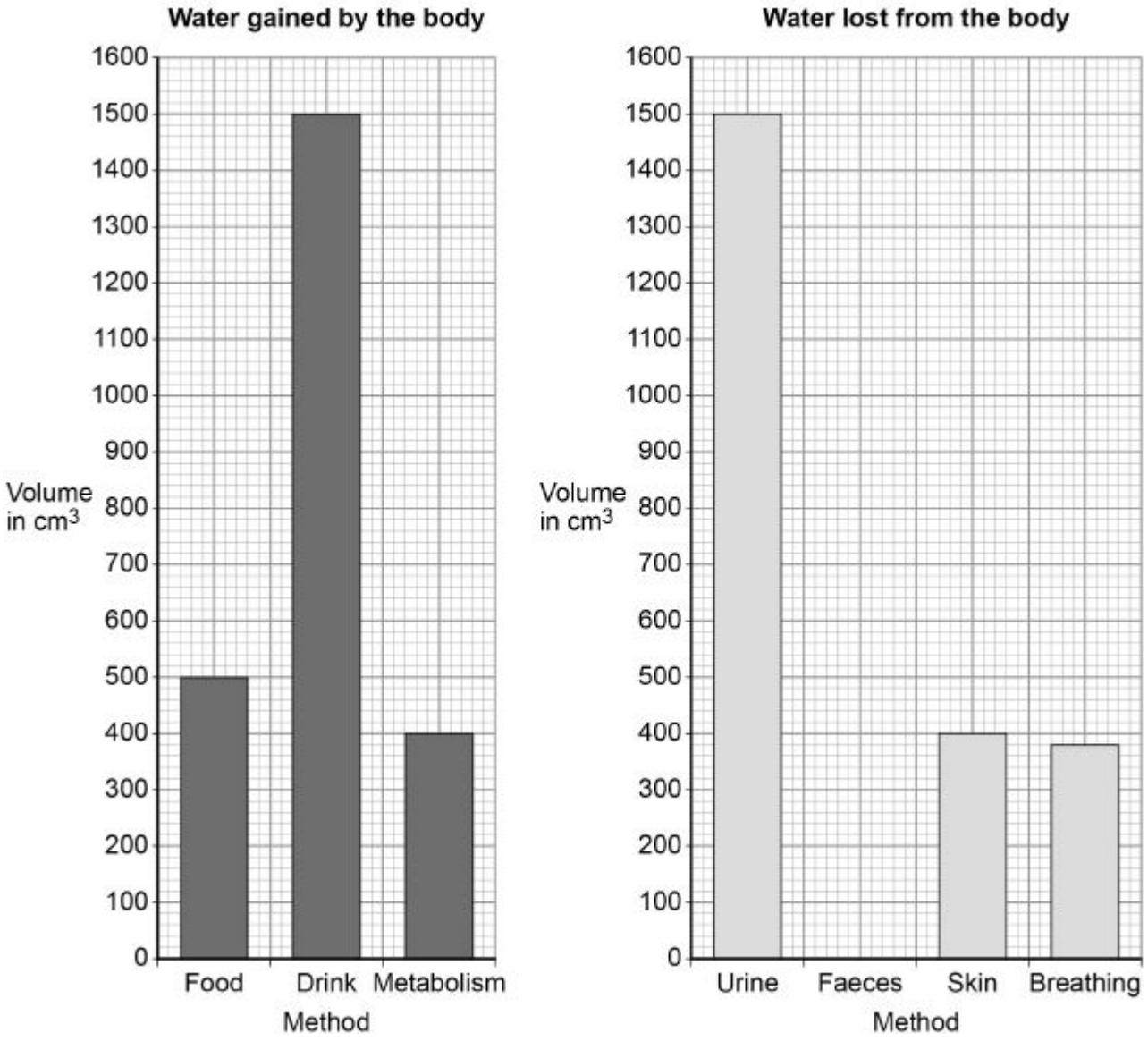
(1)

(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.

_____

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_____

_____

_____

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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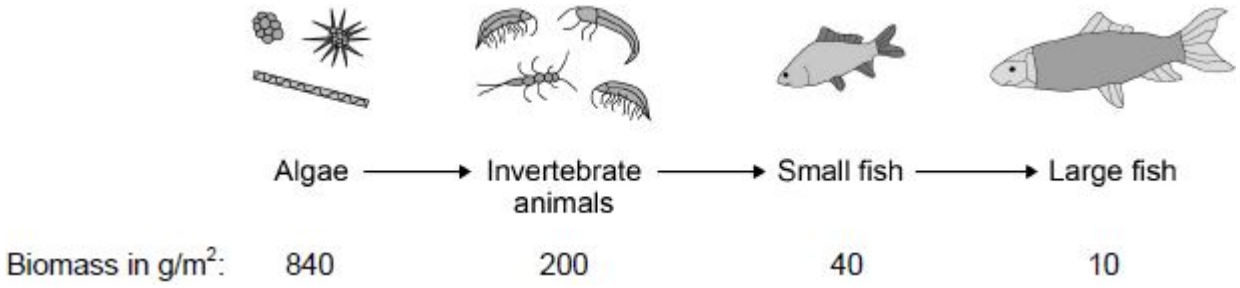
(3)
(Total 8 marks)

Q6.

Figure 1 shows:

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

Figure 1

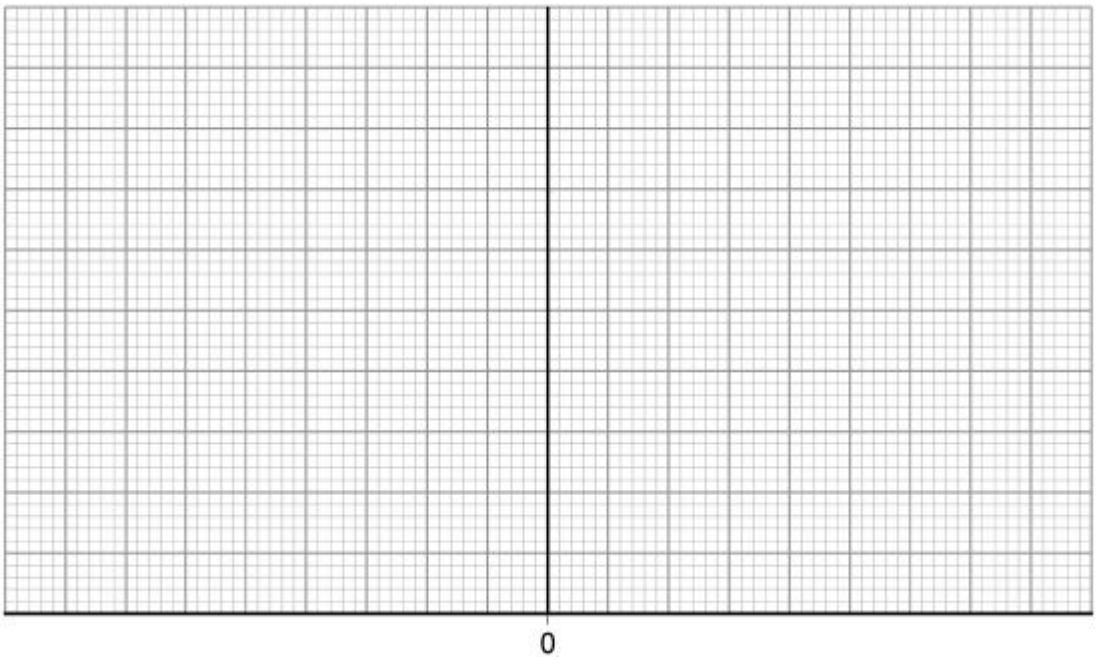


(a) Draw a pyramid of biomass for the food chain in **Figure 1** on **Figure 2**.

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.

_____

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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.

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_____

(5)

(Total 13 marks)

Q7.

Glucose is broken down in respiration.

(a) What is the chemical formula for glucose?

Tick **one** box.

$C_6H_6O_6$ ☐

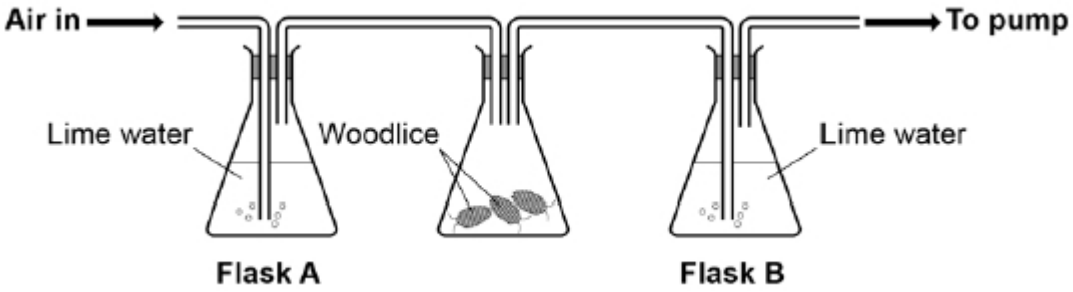
$C_3H_6O_3$ ☐

$C_6H_{12}O_6$ ☐

$C_6H_{10}O_6$ ☐

(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.

_____

_____

_____

_____

(2)

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

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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 + _____

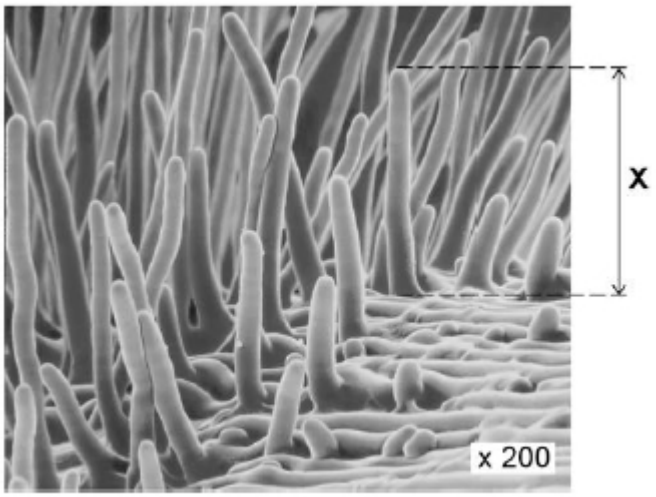
(1)

(Total 8 marks)

Q8.

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

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(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

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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.

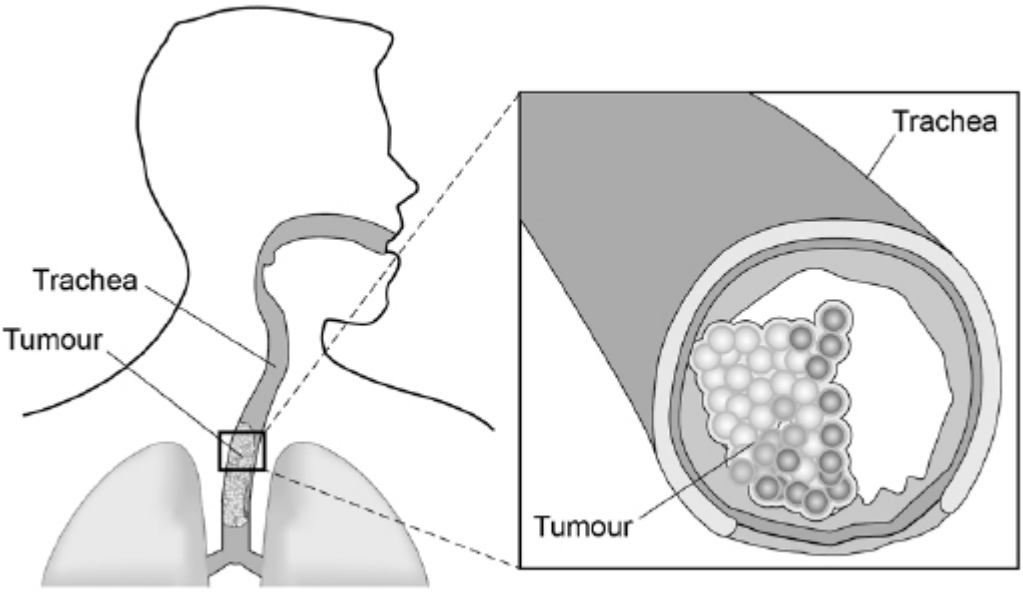
(a) What is a stem cell?

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(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)

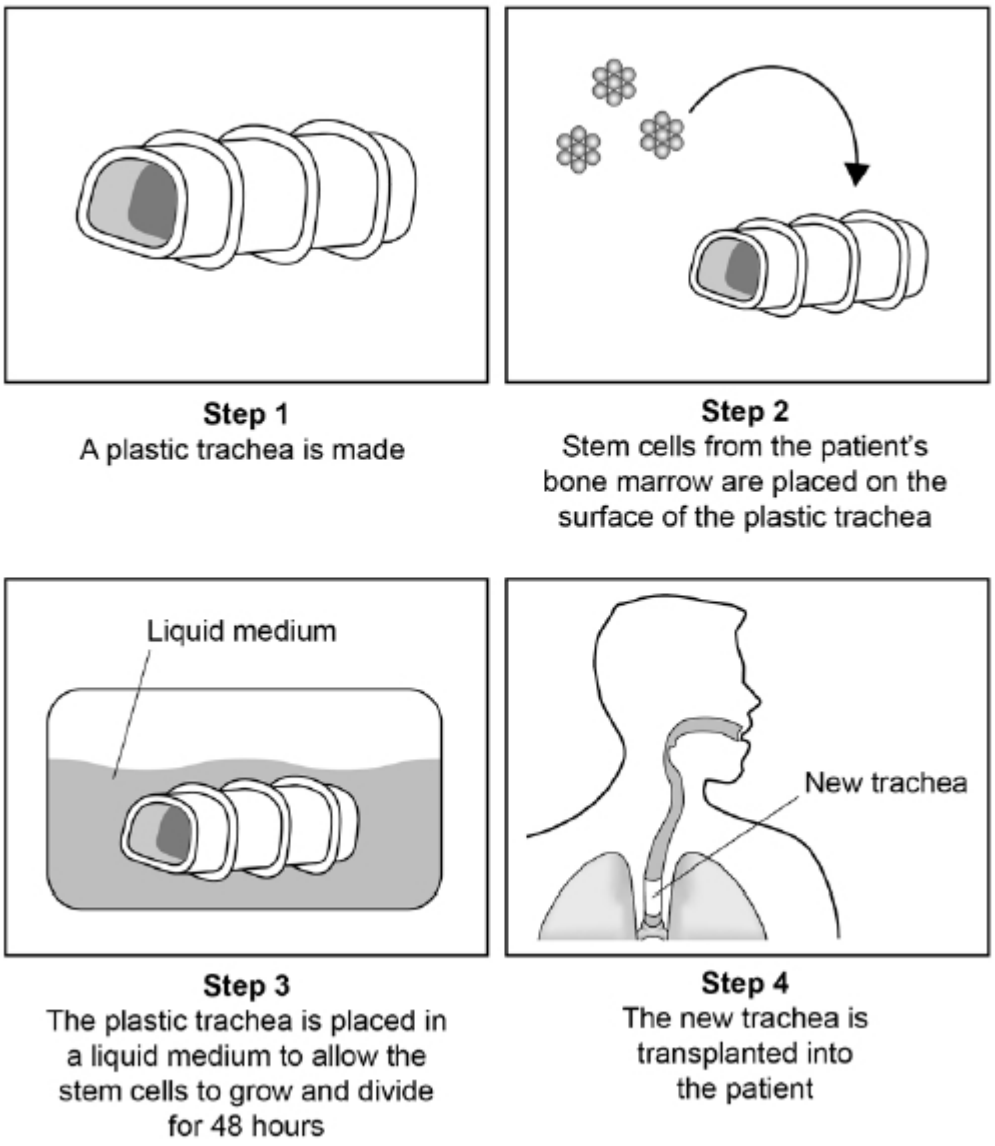
Scientists can treat the patient's tumour by replacing the trachea with a plastic trachea.

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

Figure 2 shows the procedure.

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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.

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1. _____

_____

2. _____

_____

(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.

_____

_____

_____

_____

(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.

_____

_____

_____

_____

_____

_____

_____

_____

(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?

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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

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

_____

_____

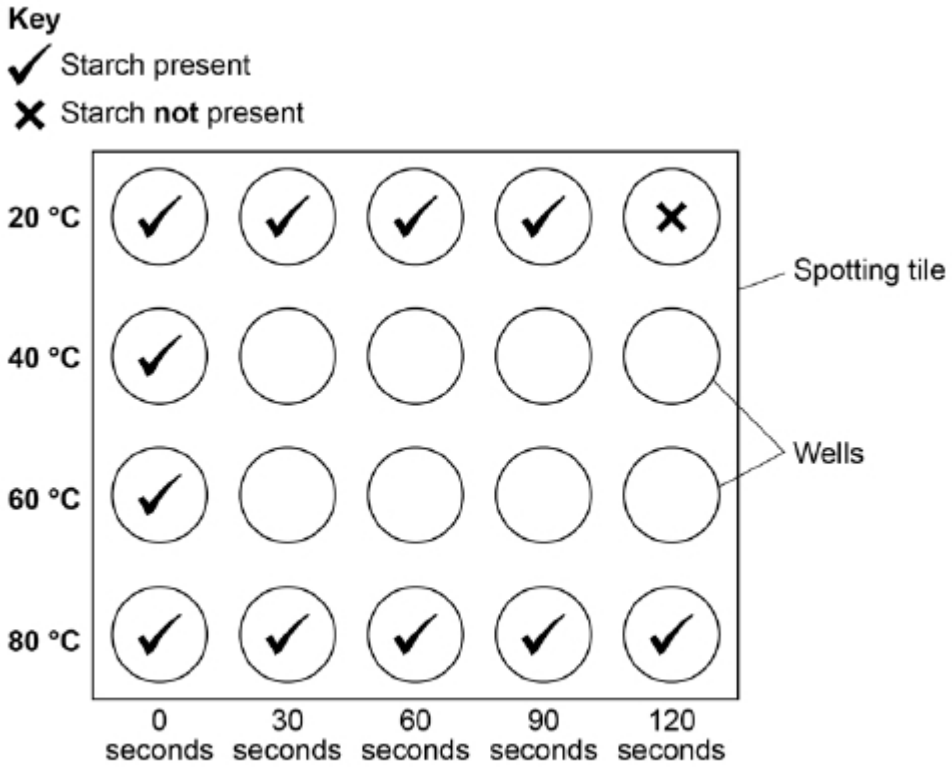
(1)

(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?

_____

_____

_____

_____

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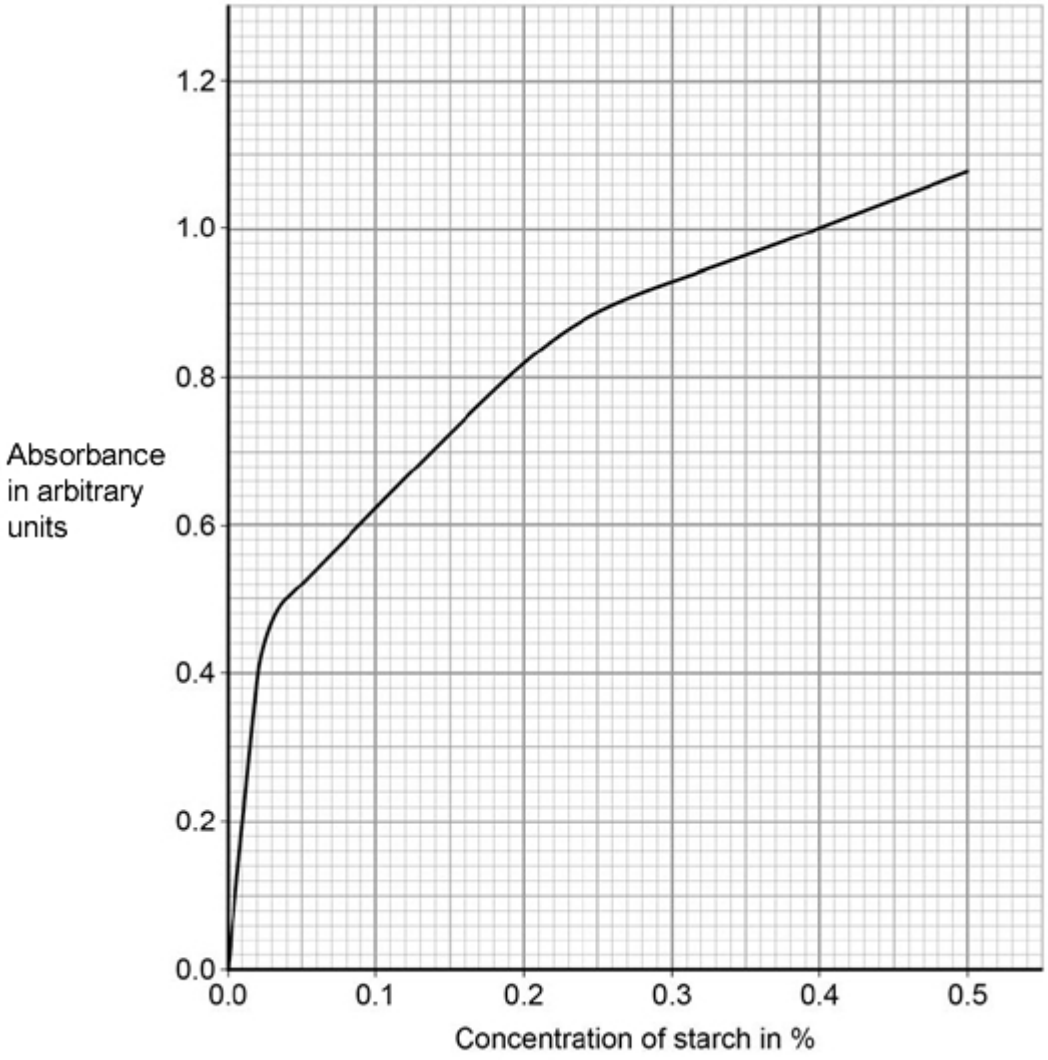
(2)

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 _____

_____

_____

_____

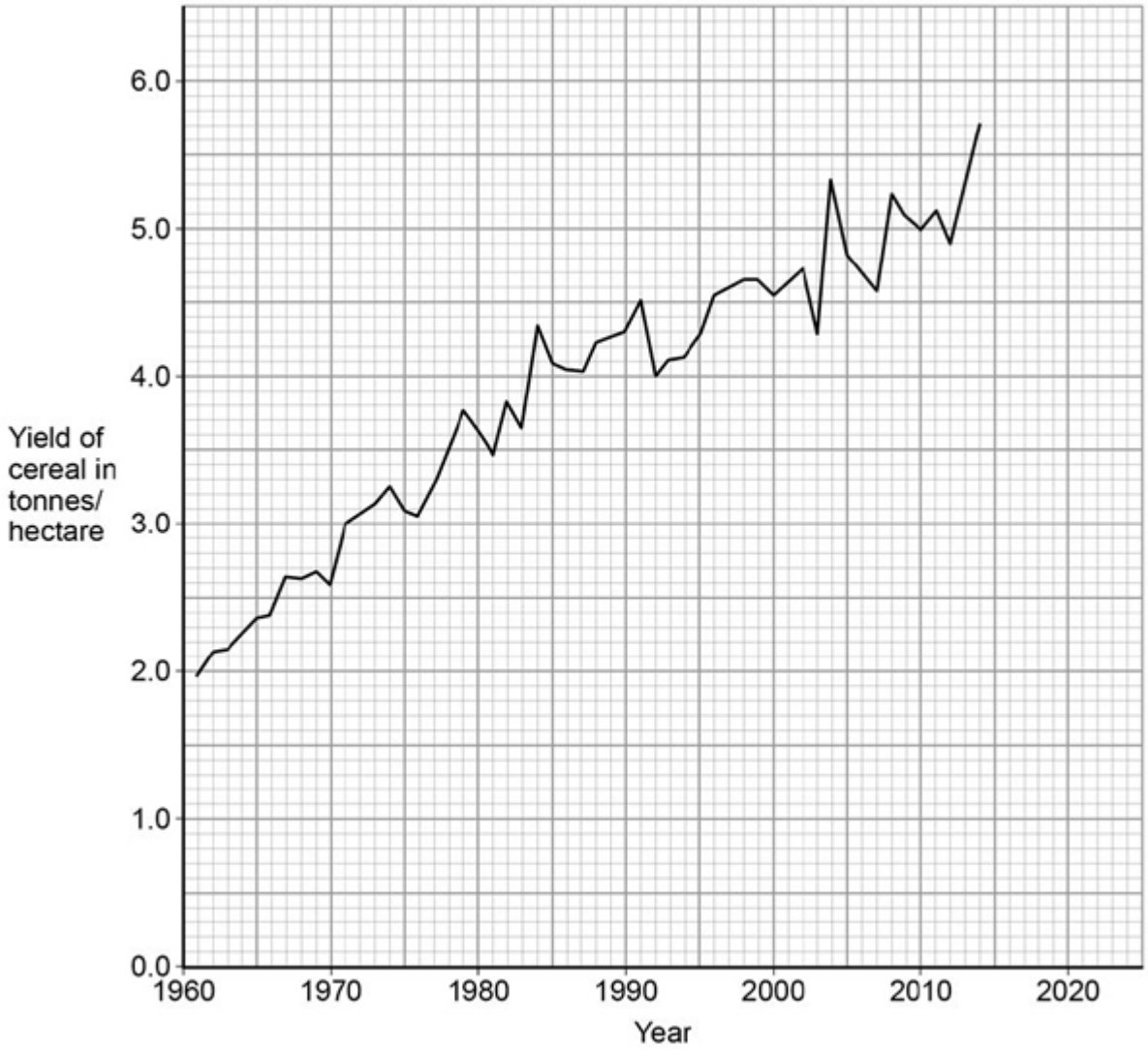
(3)

(Total 16 marks)

Q11.

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

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(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.

$\frac{1}{10}$ ☐ $\frac{1}{5}$ ☐ $\frac{1}{2}$ ☐ $\frac{3}{4}$ ☐

(1)

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

Which substance do plants make using nitrate ions?

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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.

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Figure 1

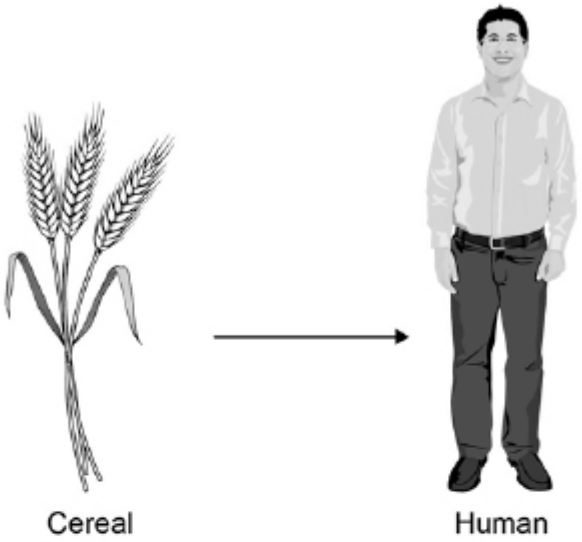
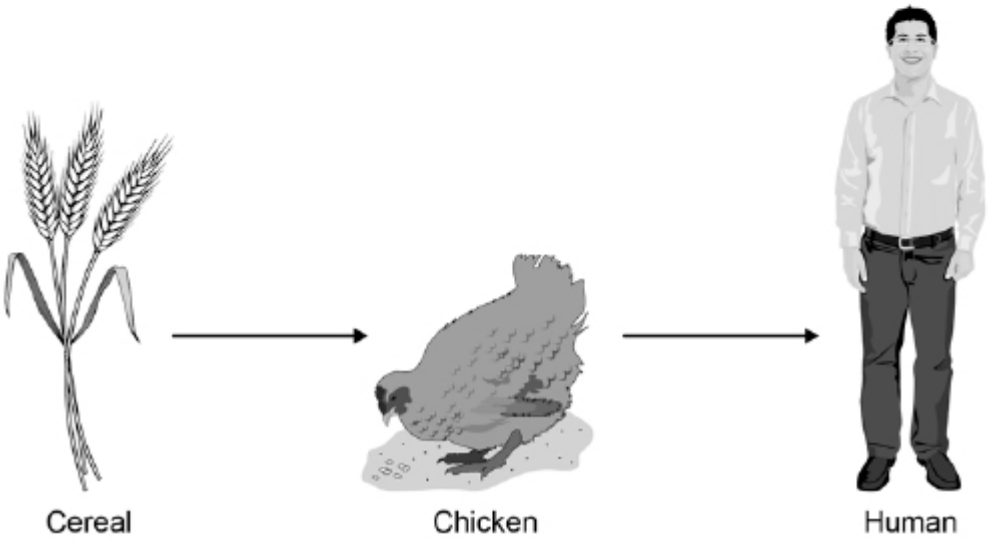
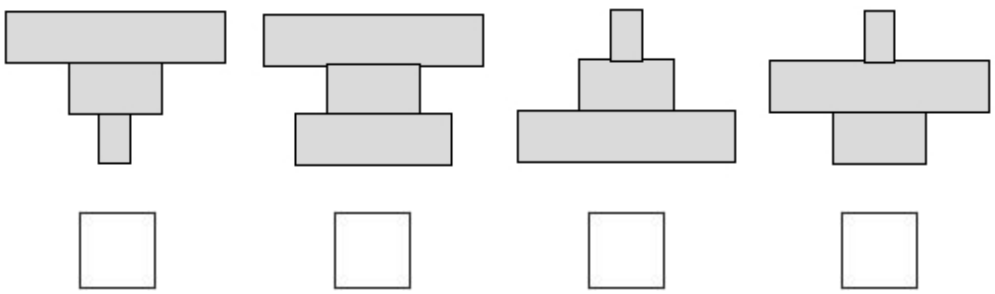


Figure 2



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

Tick **one** box.



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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.

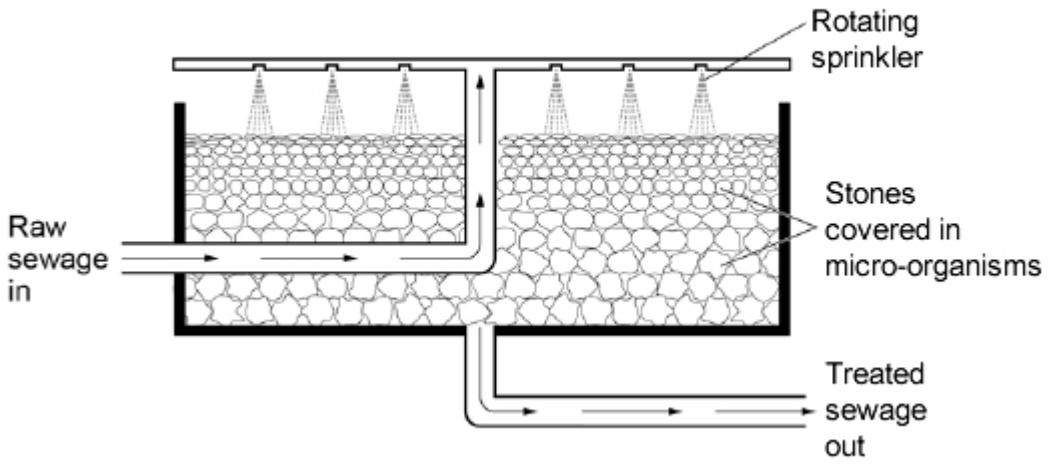
Pollution of rivers with untreated sewage can kill plants and animals.

Figure 1 shows a sprinkler bed at a sewage works.

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

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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. _____

_____

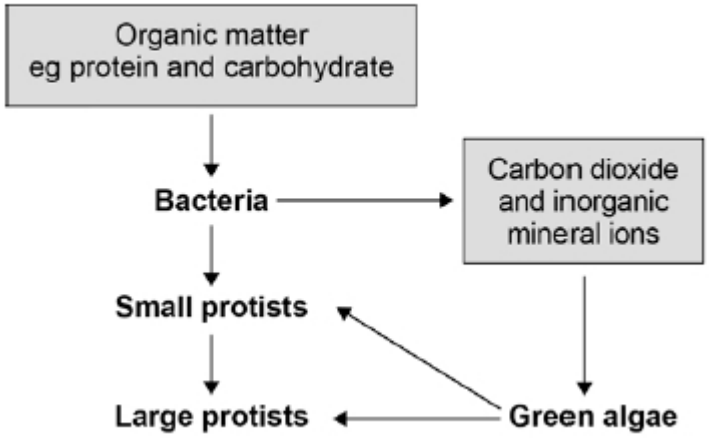
2. _____

_____

(2)

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

Figure 2



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(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**

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(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.

_____

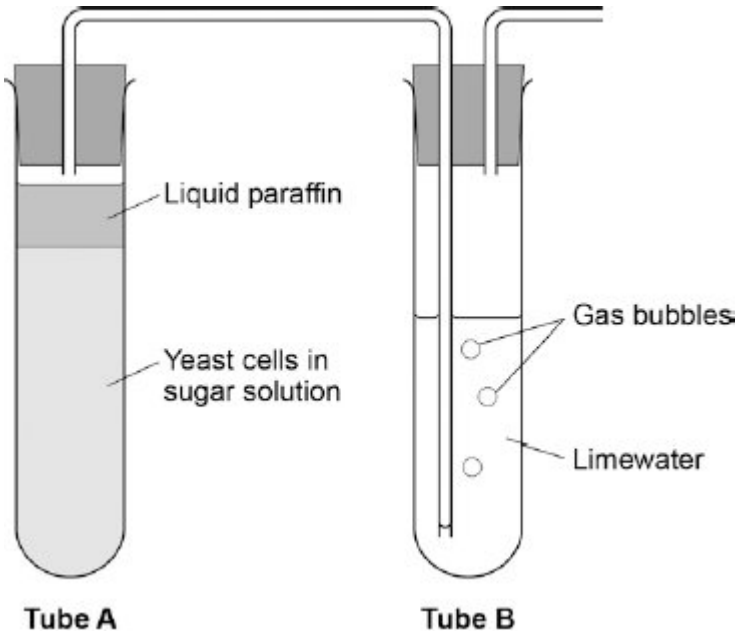
_____

_____

_____

(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 ☐

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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.

_____

_____

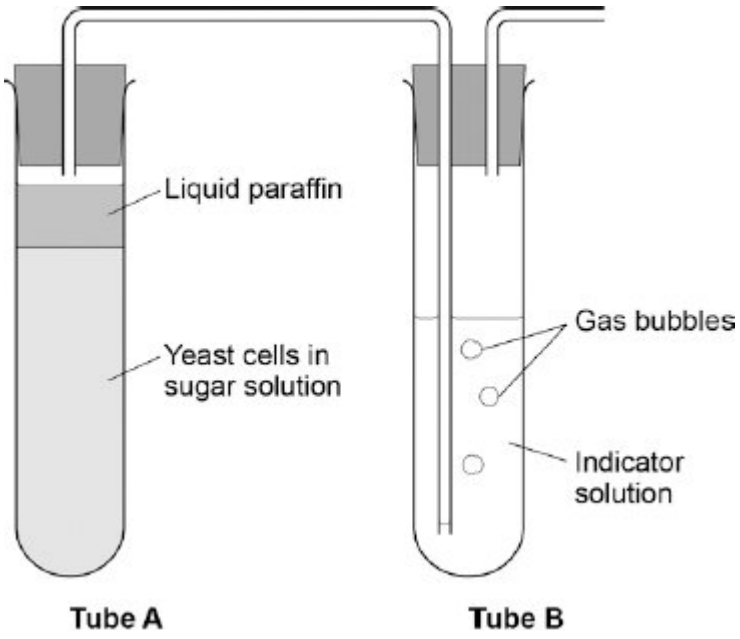
_____

_____

(2)

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

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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 ☐

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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.

_____

_____

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_____

_____

(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.

_____

_____

_____

_____

_____

_____

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_____

_____

_____

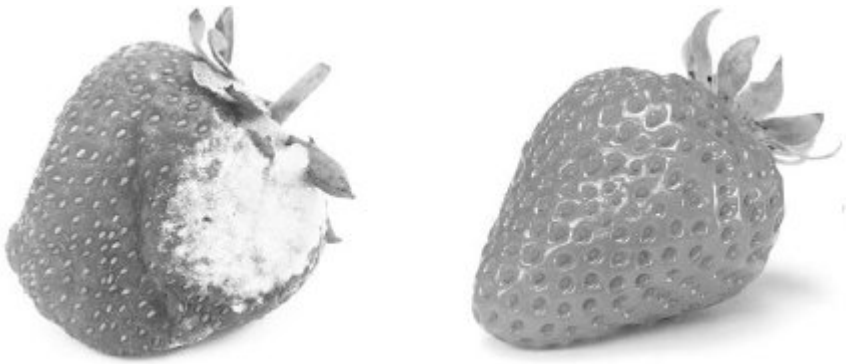
_____

(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:

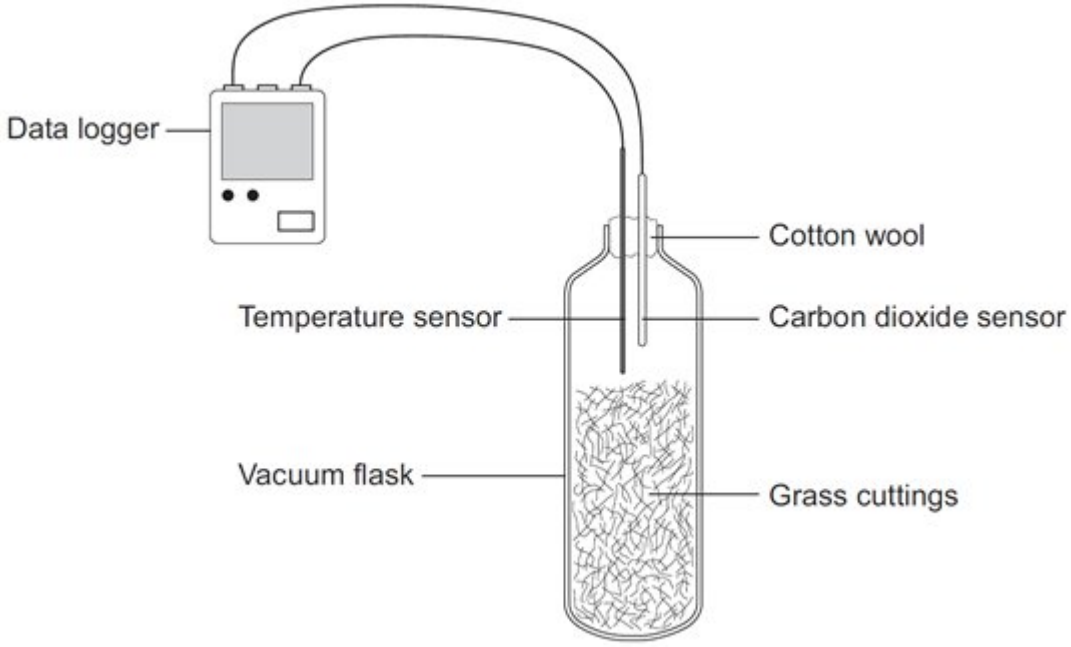
- put some decaying grass cuttings into a vacuum flask
- put a carbon dioxide sensor and a temperature sensor in the flask
- attached the sensors to a data logger
- closed the flask with cotton wool.

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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.

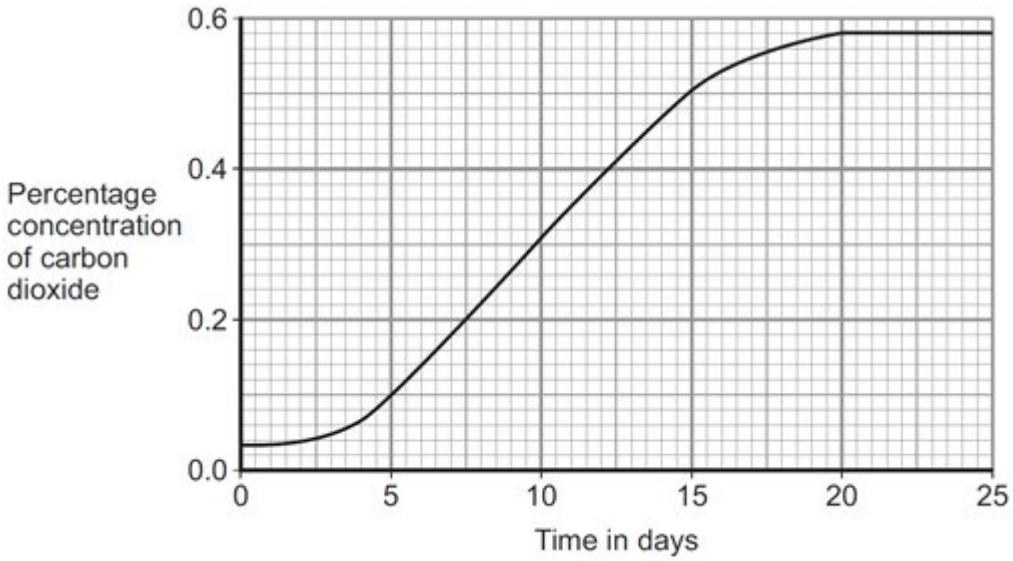
_____

_____

(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



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(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)

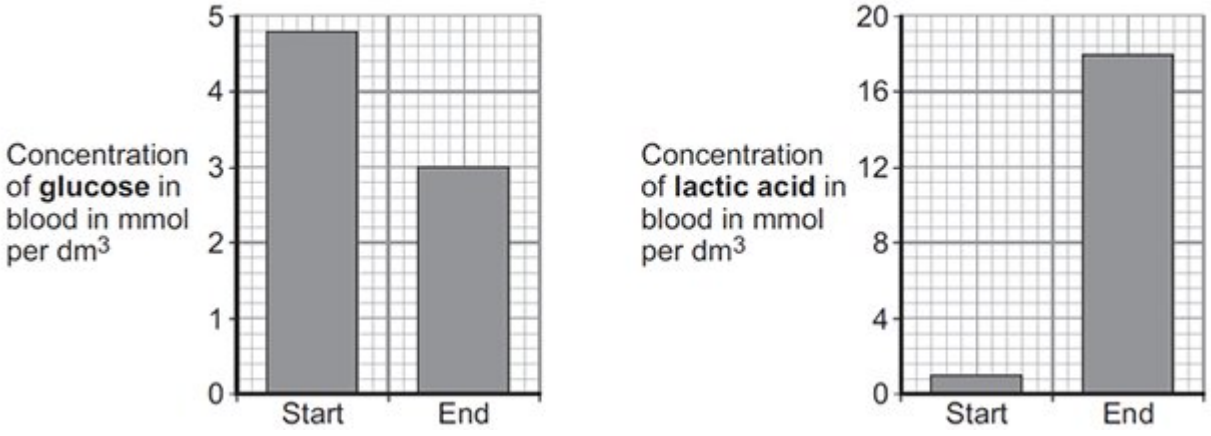
(Total 5 marks)

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)

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

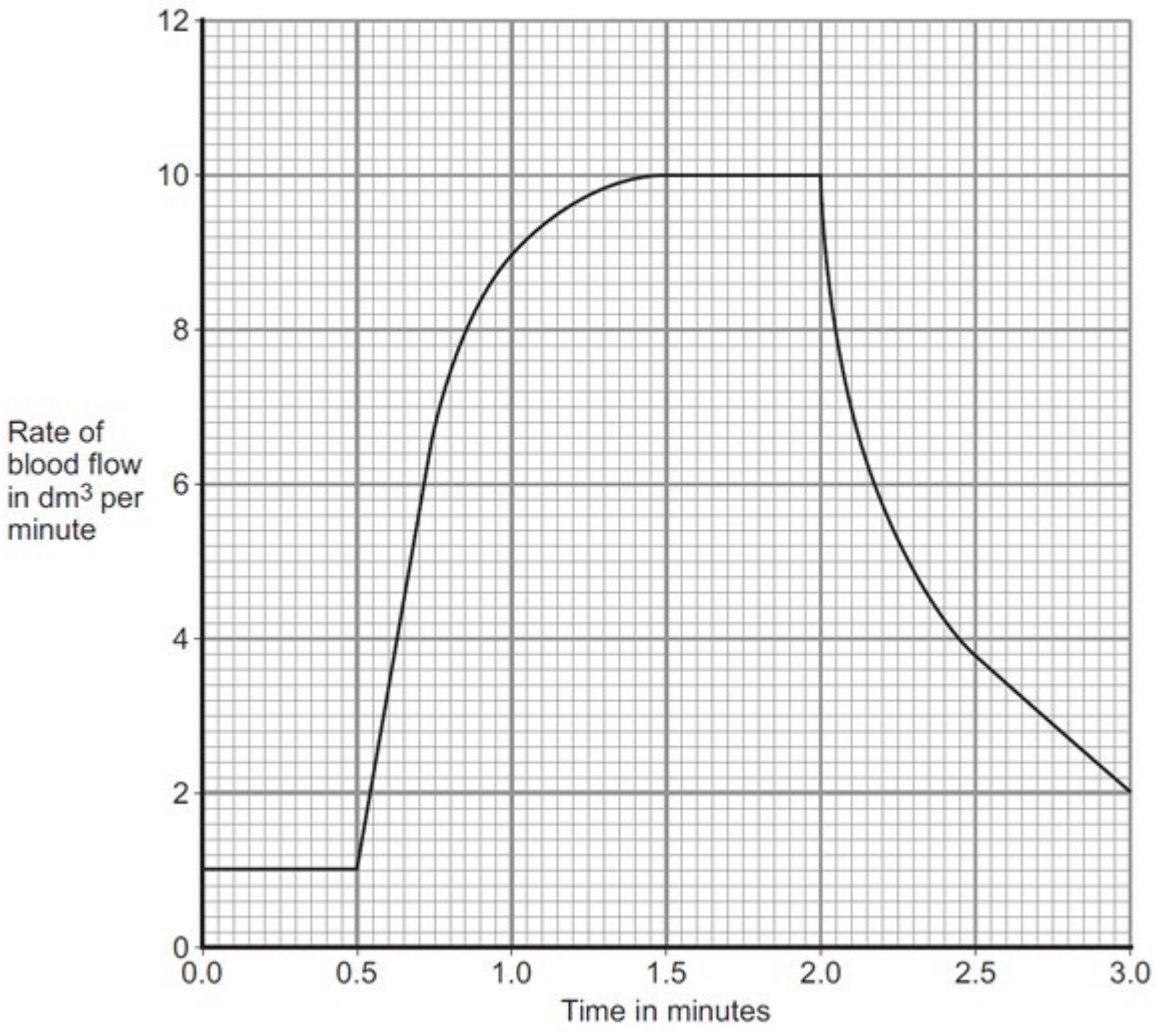
_____

_____

(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.

_____

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_____

_____

_____

(2)

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

_____

_____

_____

_____

_____

_____

_____

_____

_____

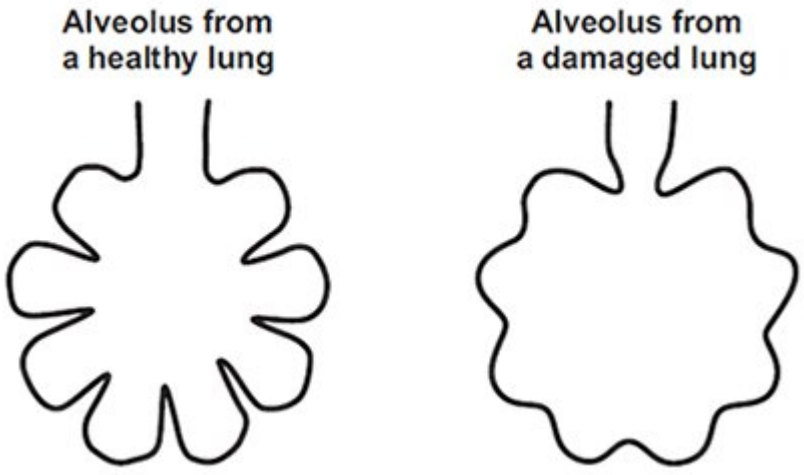
_____

(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?

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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?

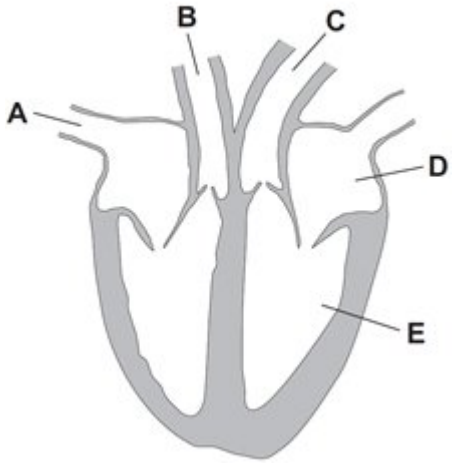
_____

(1)

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

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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**.

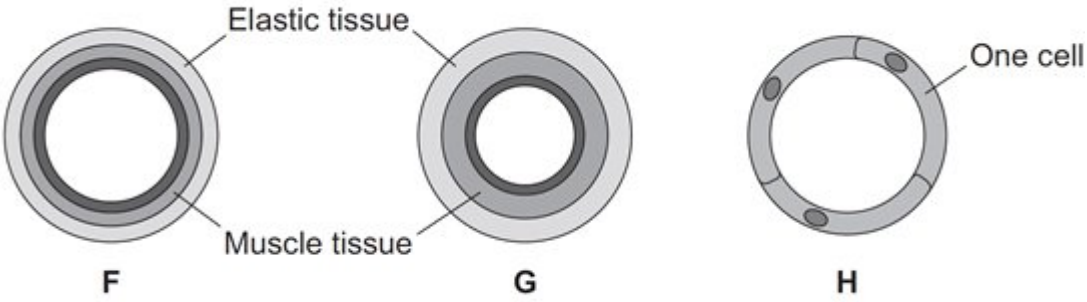
D _____

E _____

(2)

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

Figure 2



Not to scale

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

Tick (✔) **one** box.

an artery ☐

a capillary ☐

a vein ☐

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(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.

$6CO_2$ + _____ $\xrightarrow{\text{light}}$ _____ + $6O_2$

(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.

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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 _____

_____

_____

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_____

(3)

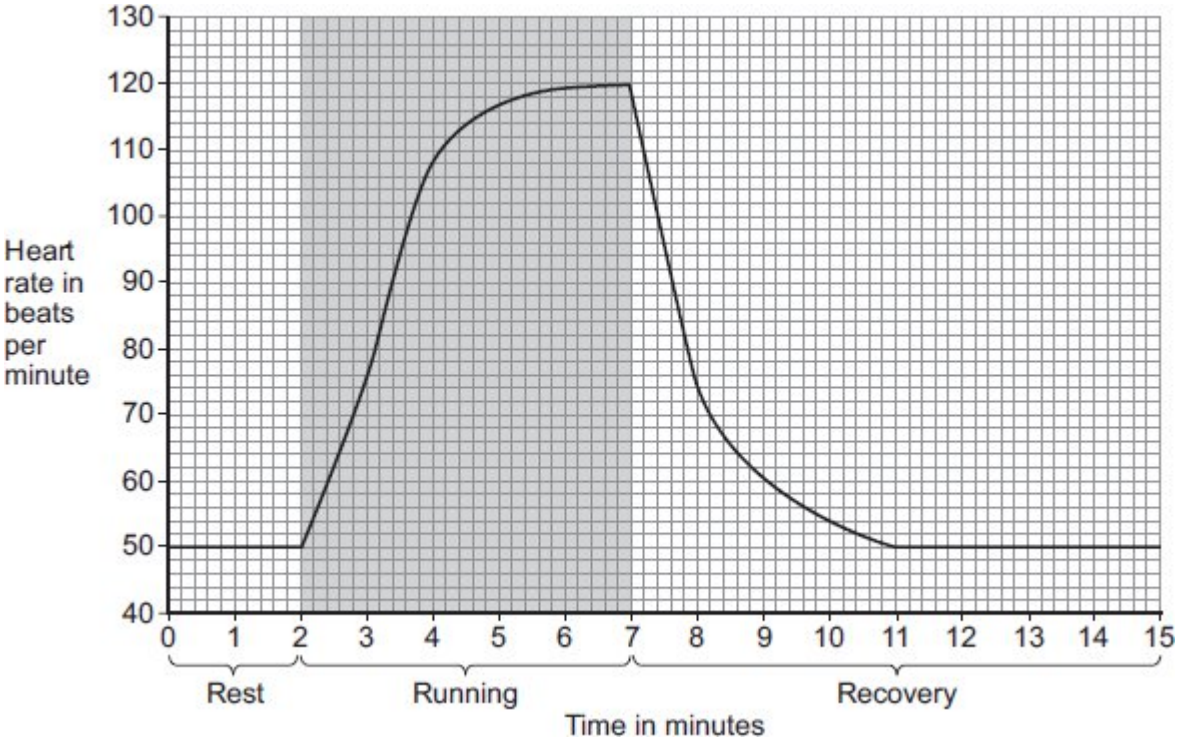
(Total 8 marks)

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.

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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

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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)

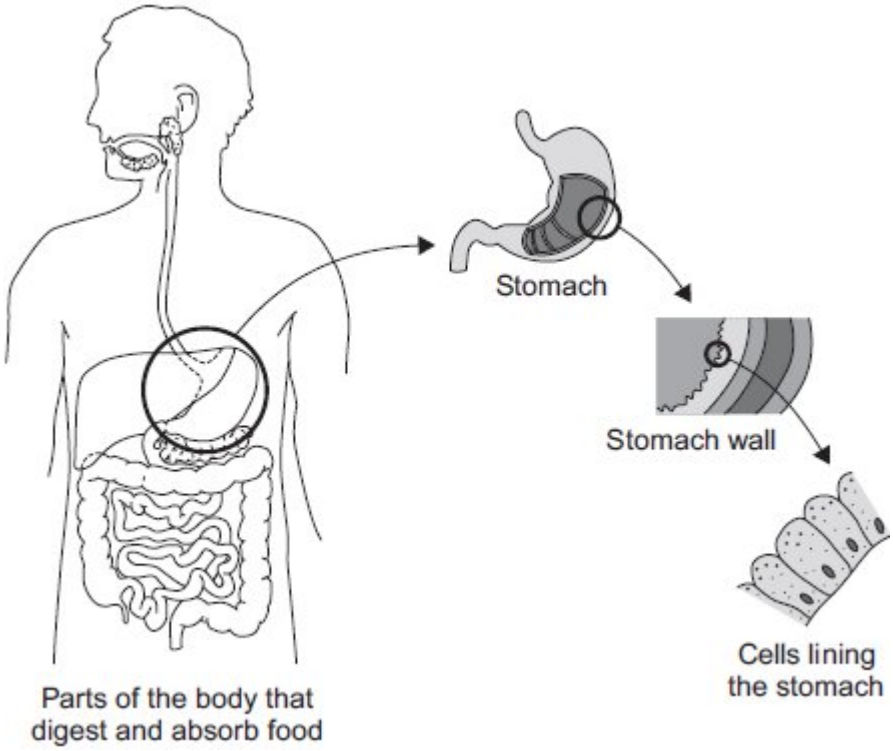
(Total 12 marks)

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.

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(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**

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(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)

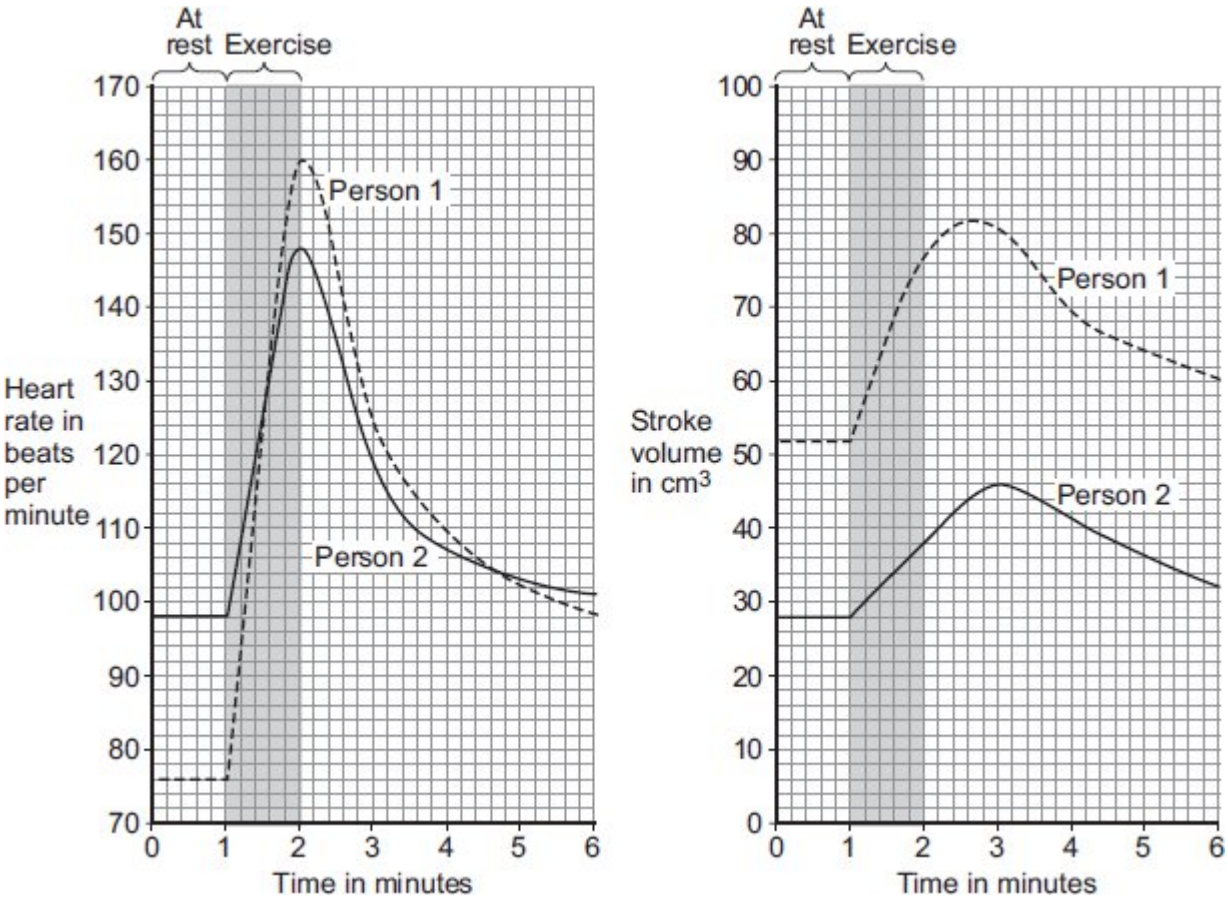
Q23.

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

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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.

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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.

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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

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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

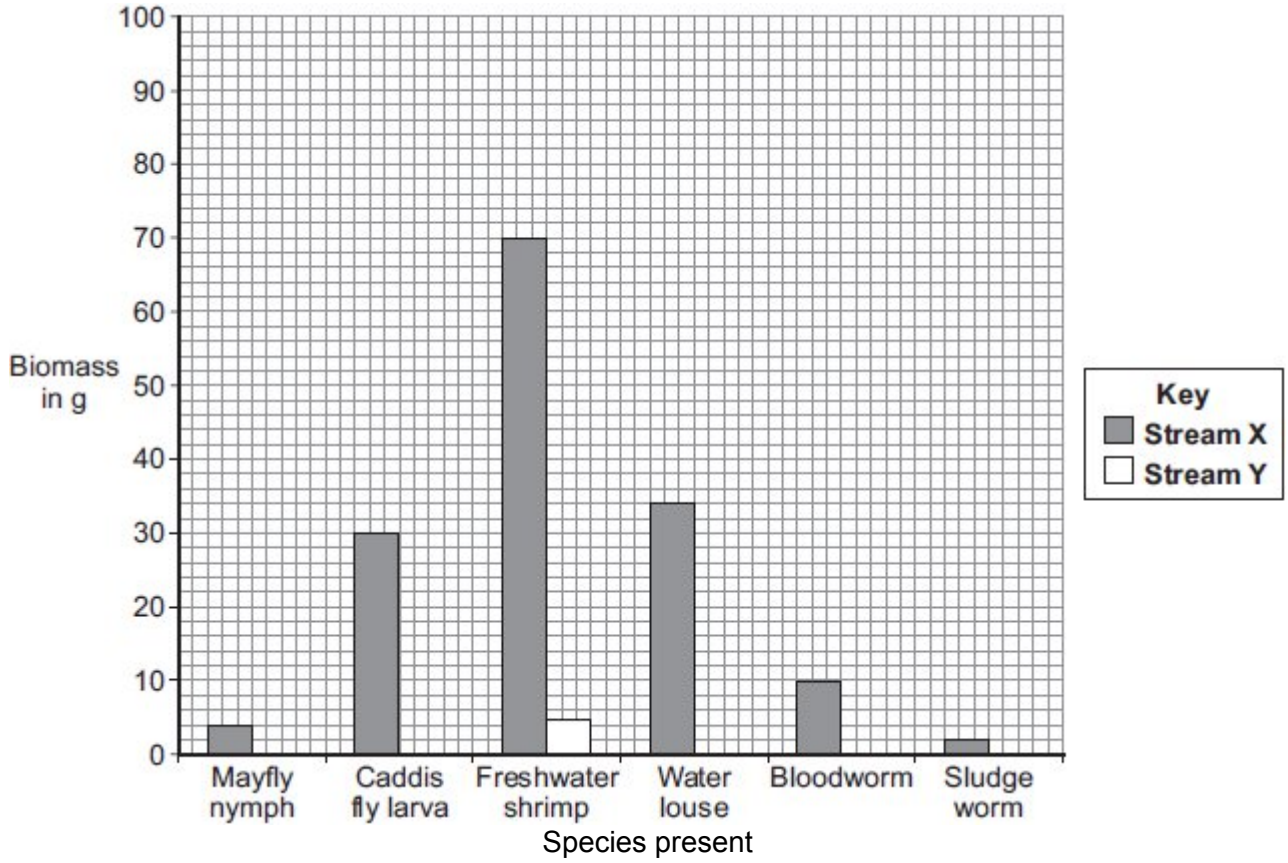
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Sludge worm	2	90
Total	**150**	**150**

(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.

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_____

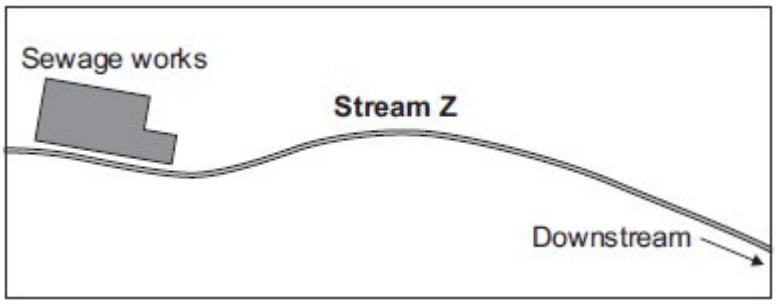
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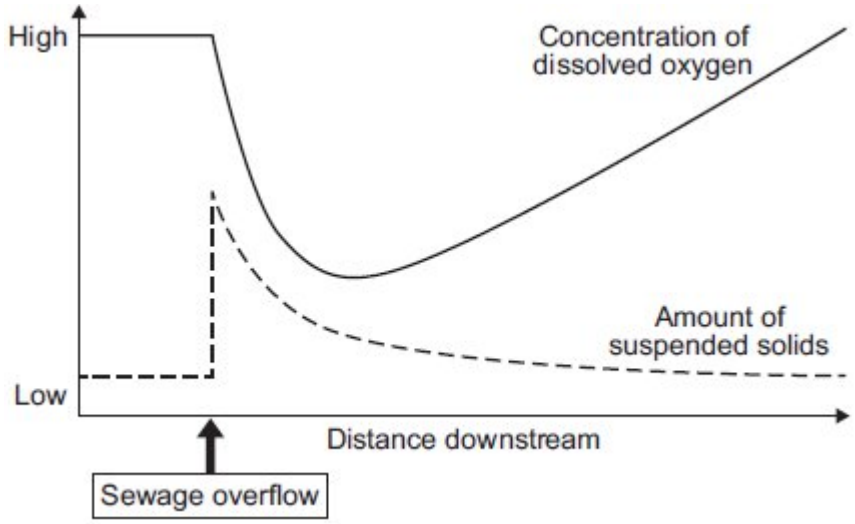
(2)

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



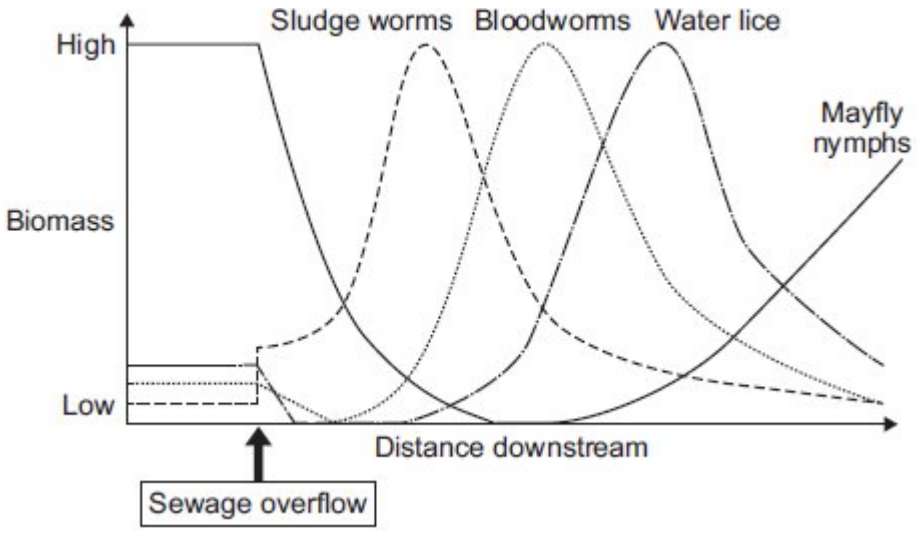
An accident caused sewage to overflow into **Stream Z**.
Two weeks later scientists took samples of water and invertebrates from the stream.
They took samples at different distances downstream from where the sewage overflowed.
The scientists plotted the results shown in **Graphs P** and **Q**.

Graph P: change in water quality downstream of sewage overflow



Graph Q: change in invertebrates found downstream of sewage overflow

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(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.

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_____

_____

_____

_____

(2)

(Total 13 marks)

Q26.

Figure 1 shows an athlete running on a treadmill.

Figure 1



© Starush/istock/Thinkstock

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:

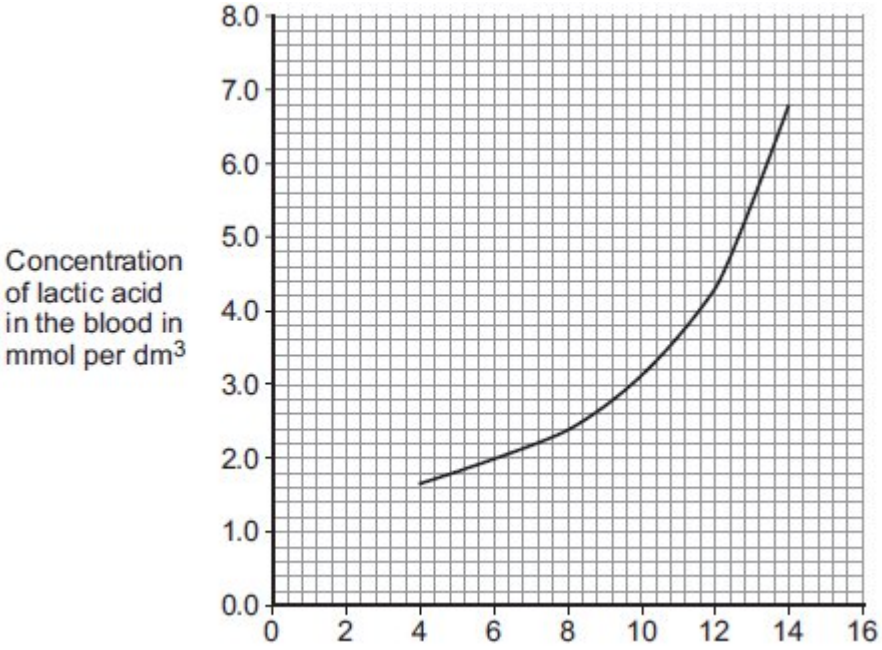
- the athlete ran on the treadmill at 4 km per hour
- the scientists measured the concentration of lactic acid in the athlete's blood after 2 minutes of running.

The investigation was repeated for different running speeds.

Figure 2 shows the scientists' results.

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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:

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- 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?

_____

_____

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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.

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_____

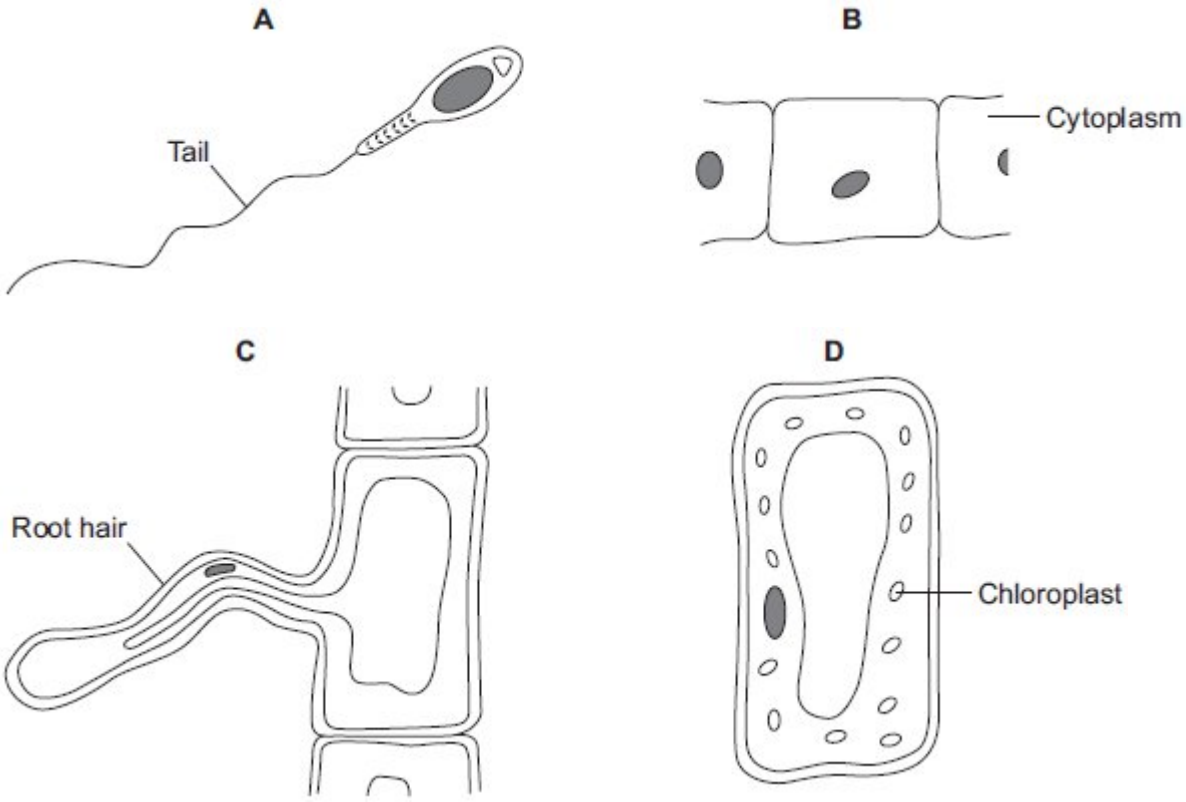
_____

(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.

_____

_____

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(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?

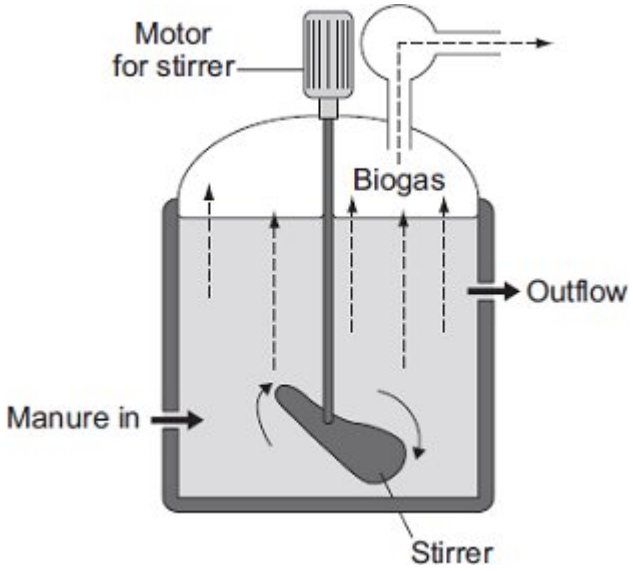
Draw a ring around **one** answer.

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. ☐

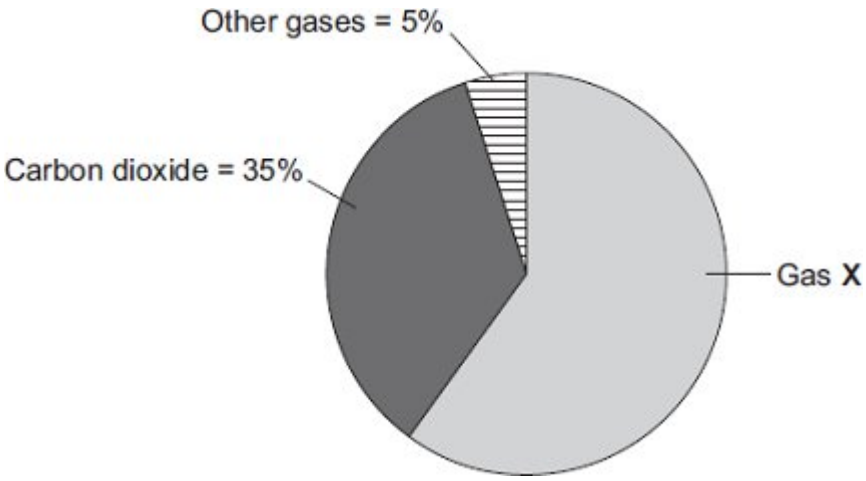
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A higher concentration would be difficult to stir. ☐

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.

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fermentation.

(1)

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

ammonia.

nitrogen.

oxygen.

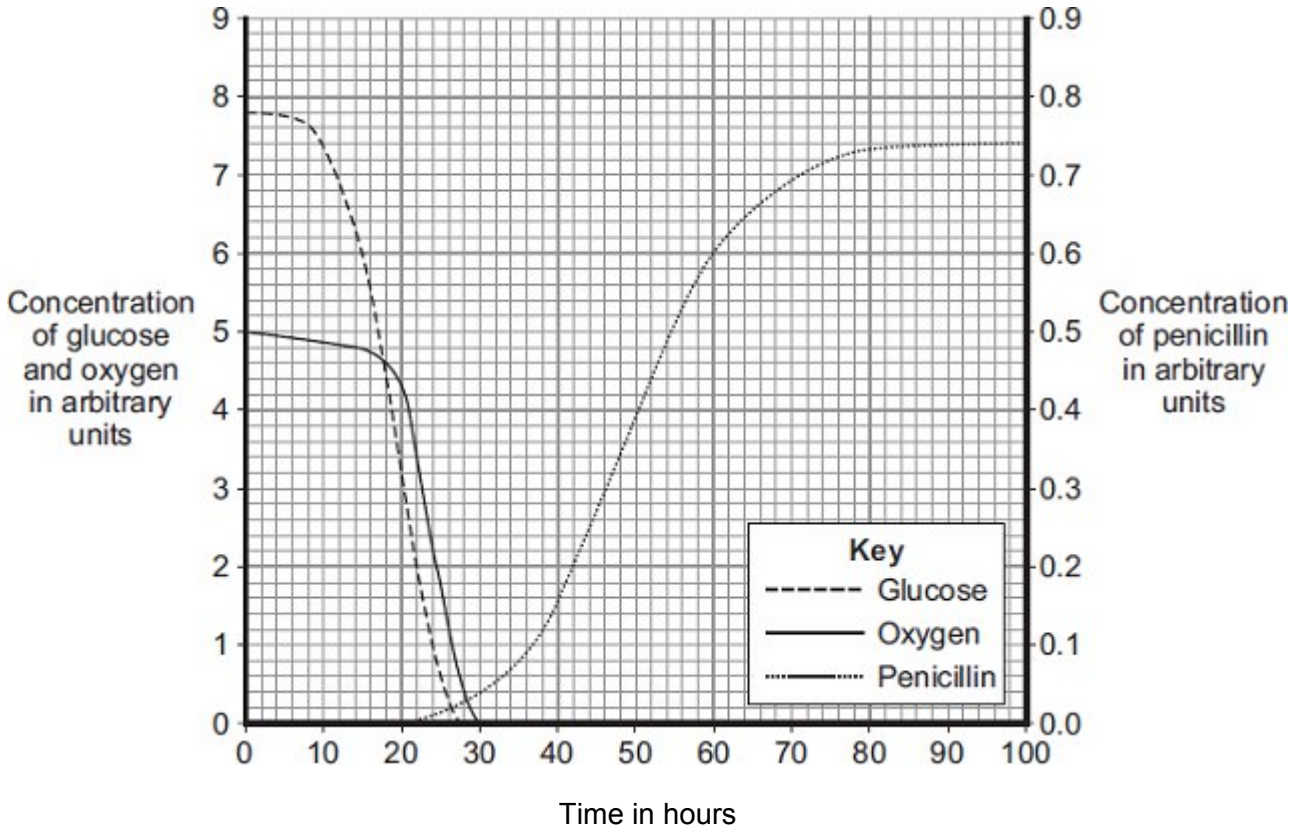
(1)

(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.

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_____

_____

_____

_____

(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)

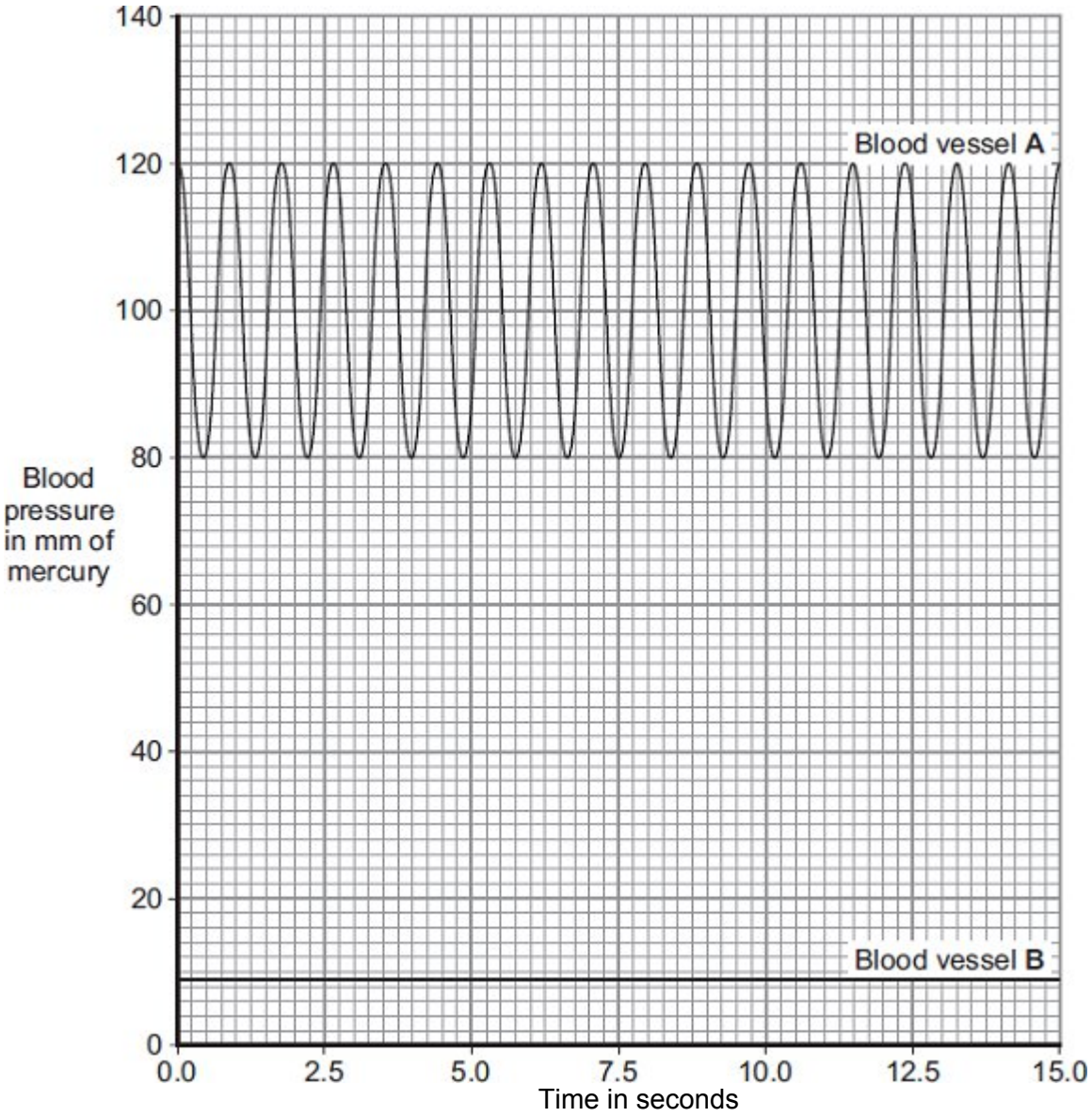
(Total 6 marks)

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.

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(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)

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(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. _____

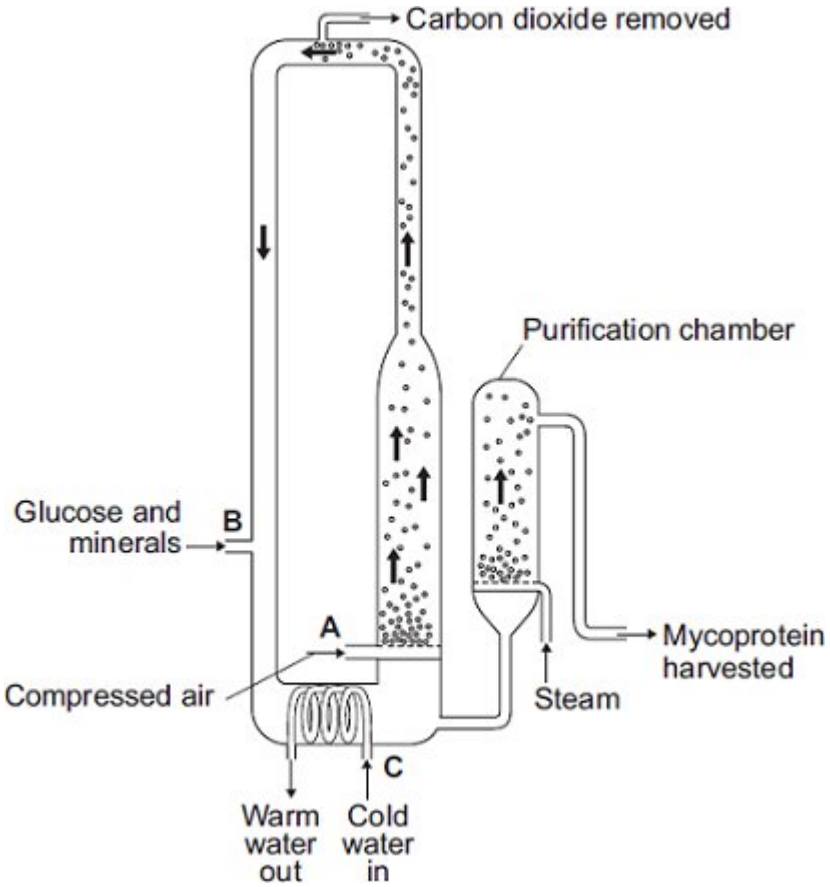
(2)

(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**.

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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

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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.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

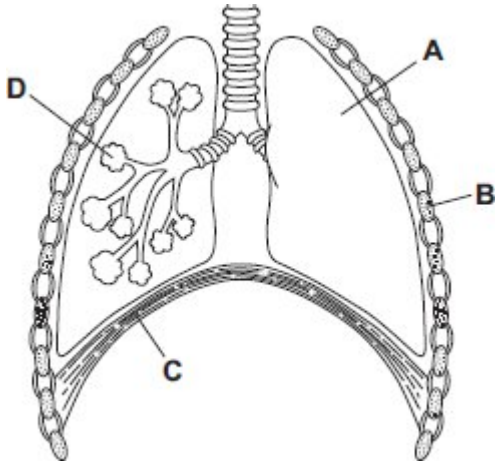
(4)

(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**.

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alveolus	diaphragm	lung	rib	trachea

A _____

B _____

C _____

D _____

(4)

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

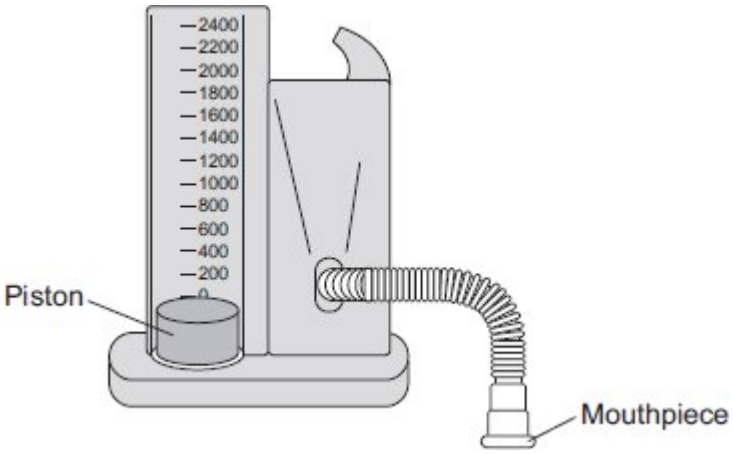
Part **B** moves _____

Part **C** moves _____

(2)

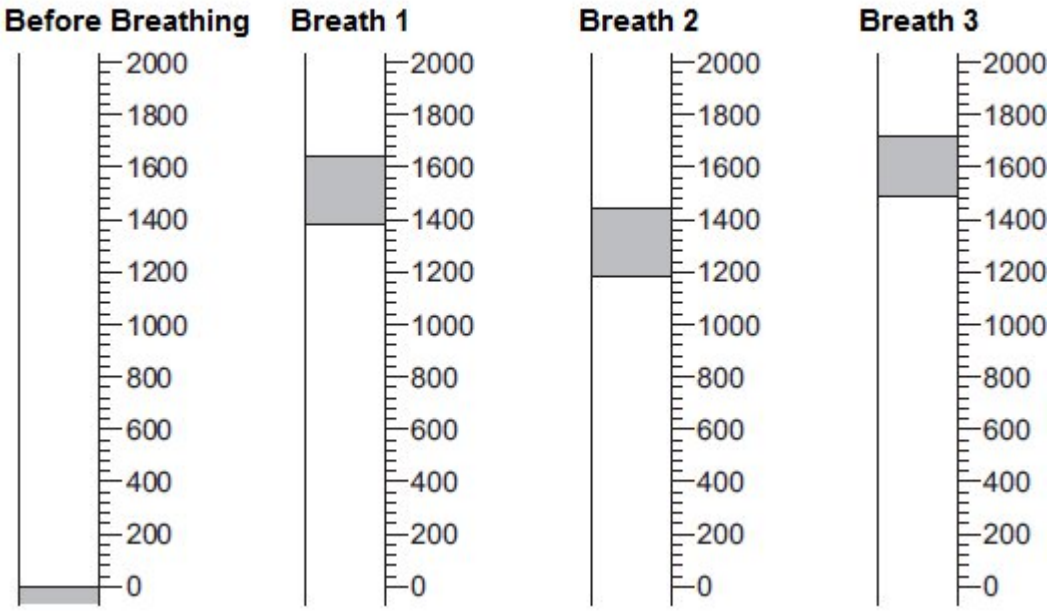
(b) A student used the apparatus shown in **Diagram 2** to measure the maximum volume of air that he could breathe in one breath.
When the student breathes in, the piston moves upwards.
The piston moves back down after the student has breathed out.

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.

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(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.

_____

_____

_____

_____

_____

_____

_____

_____

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(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



© Digital Vision/Photodisc

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

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© Emine Donmaz/iStock

(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.

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© 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**
	Ear
Sight of the finishing line	
	Nose
Sound of the starting gun	
	Eye
Pressure of the ground on the fingers	
	Skin

(3)

(ii) Which cells detect changes in the environment?

Tick (✓) **one** box.

Gland cells ☐

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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. _____

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_____

2. _____

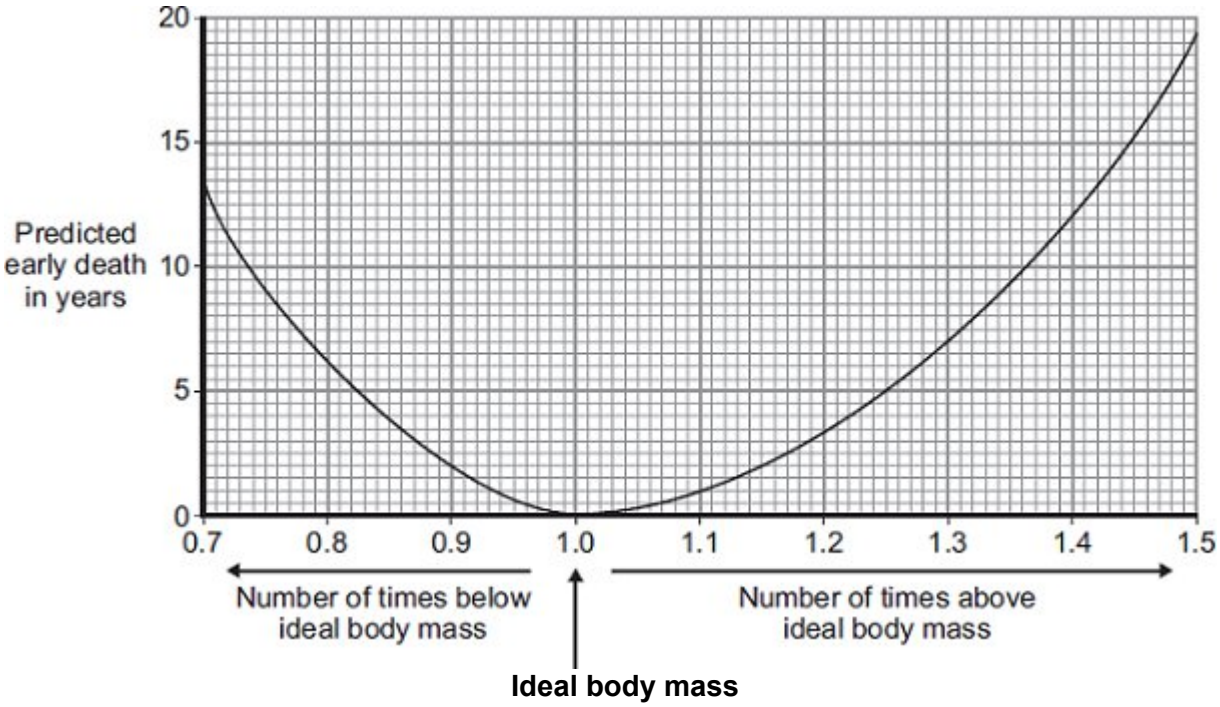
_____

(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)

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

Give **two** changes she should make.

1. _____

_____

2. _____

_____

(2)

(Total 7 marks)

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