Respiration

Question Paper 1

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Biology
Exam Board	AQA
Topic	4.4 Bioenergetics
Sub-Topic	Respiration
Difficulty Level	Silver Level
Booklet	Question Paper 1

Time Allowed: **60 minutes**

Score: **/60**

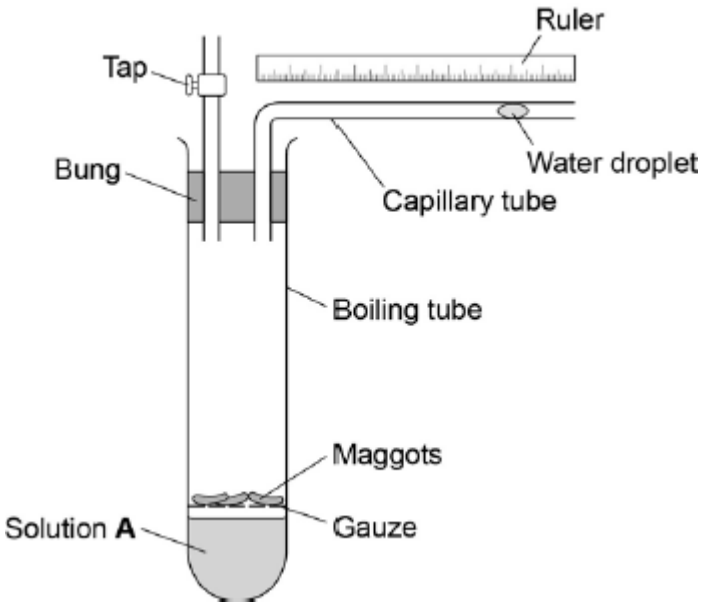
Percentage: **/100**

Grade Boundaries:

Q1.A student investigates the rate of respiration in maggots.

Figure 1 shows the equipment he uses.

Figure 1



(a) Why does the student put the maggots on gauze?

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(1)

(b) When maggots respire they take in a gas from the air and release a different gas.

Solution **A** absorbs the gas released.

At the start of the investigation the student records the distance of the water droplet from the bend in the capillary tube.

Explain what happens to the water droplet as the maggots respire.

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(4)

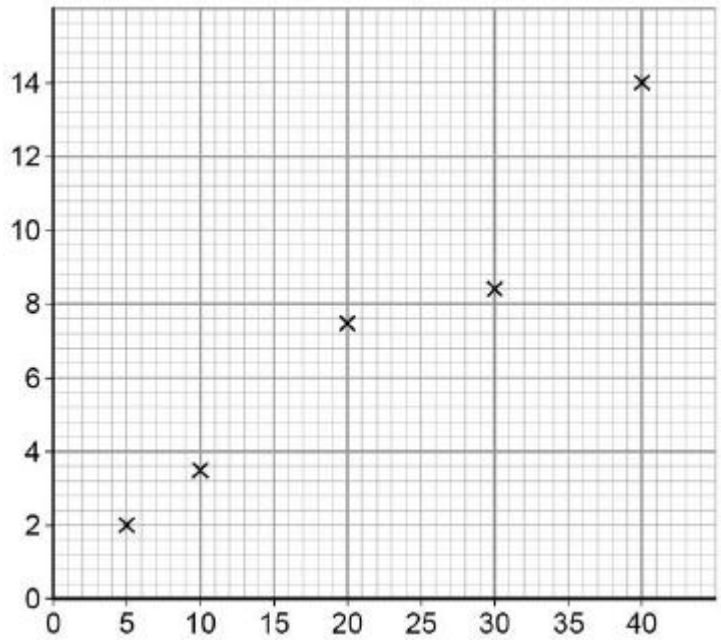
(c) The table below shows the results the student calculated.

Temperature in °C	Rate of respiration in units
5	2.2
10	3.5
20	7.5
30	8.4
40	14.0

The student uses his results to plot the graph in **Figure 2**.

Label the *x* and *y* axis.

Figure 2



(1)

(d) How could the student find out if the result at 30 °C is anomalous?

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(1)

(e) Suggest what the value at 30 °C should be to fit the pattern of the graph.

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(1)
(Total 8 marks)

Q2. 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.

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**?

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(1)

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

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(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.....

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Explanation.....

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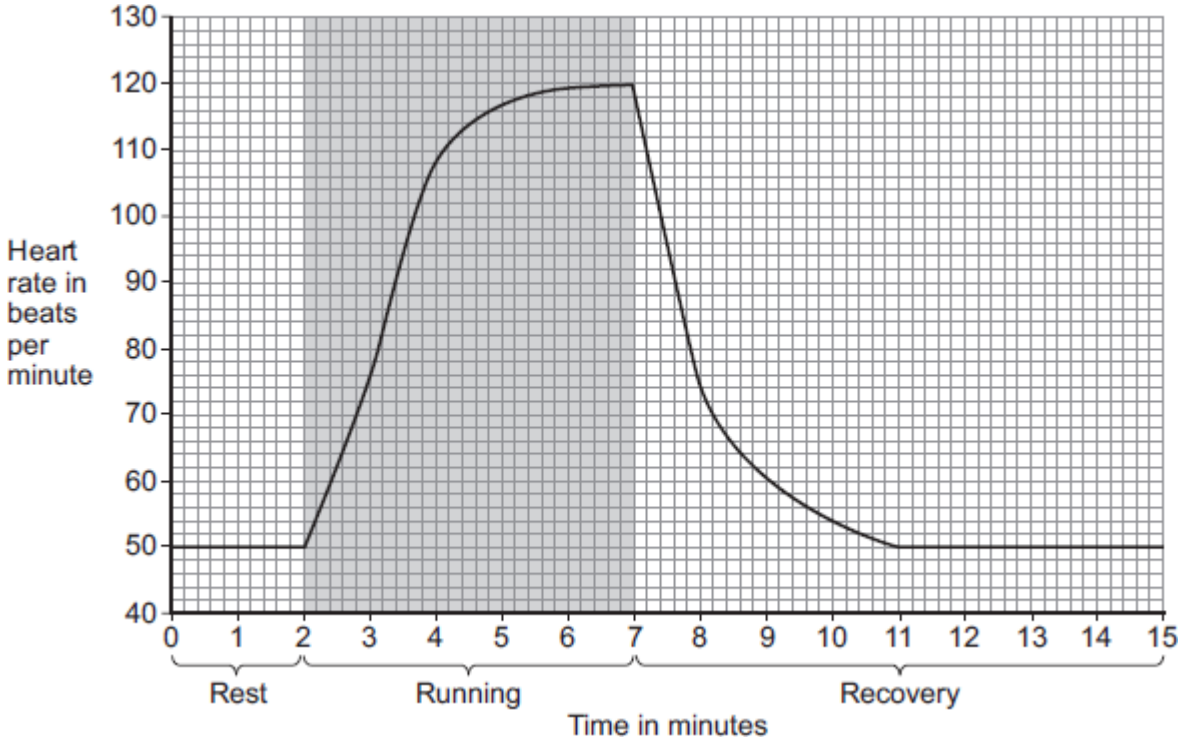
(3)
(Total 8 marks)

Q3.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.

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(4)
(Total 12 marks)

Q4. 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**.

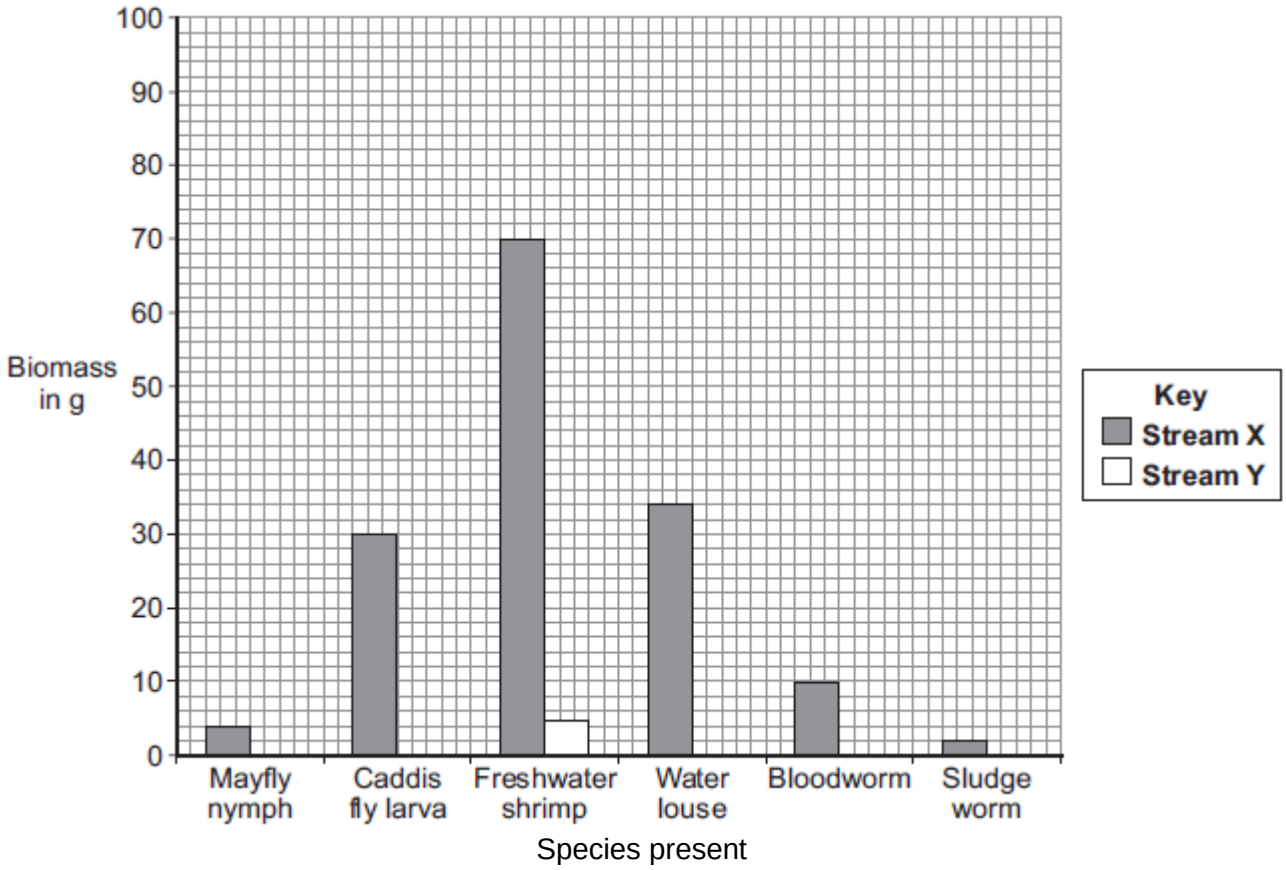
Table 1

	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.

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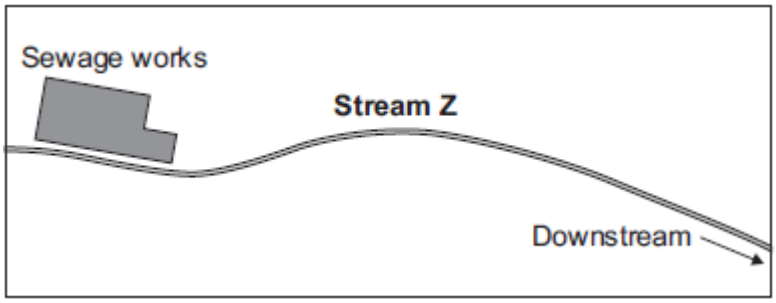
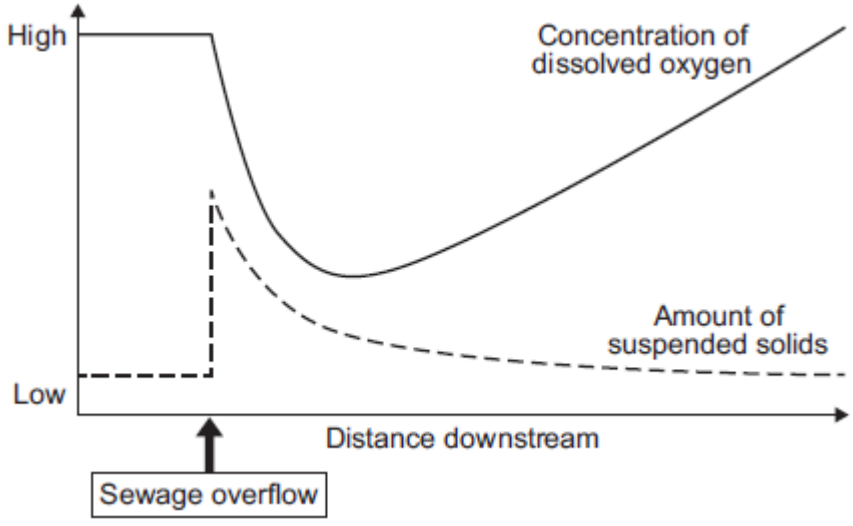
(2)

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

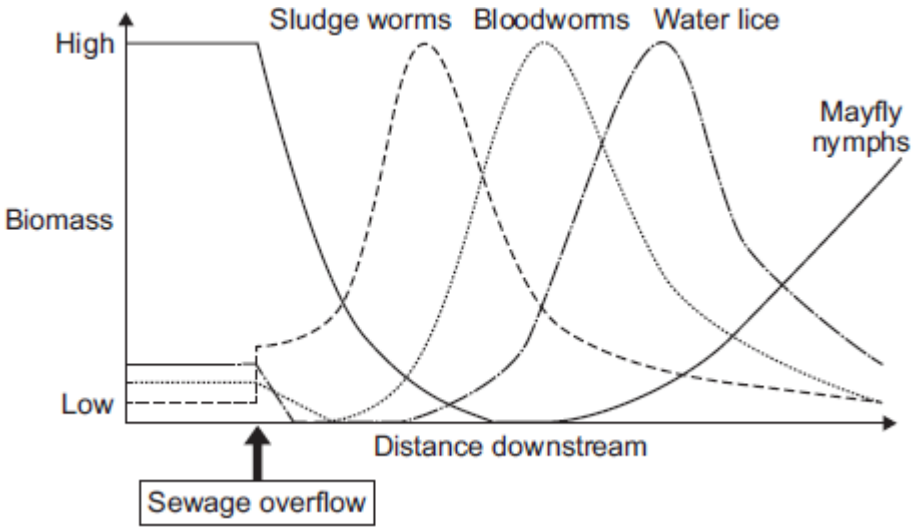


An accident caused sewage to overflow into **Stream Z**.
Two weeks later scientists took samples of water and invertebrates from the stream.
They took samples at different distances downstream from where the sewage overflowed.
The scientists plotted the results shown in **Graphs P** and **Q**.

Graph P: change in water quality downstream of sewage overflow



Graph Q: change in invertebrates found downstream of sewage overflow



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

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(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.

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(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)

Q5.Figure 1 shows an athlete running on a treadmill.

Figure 1

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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.

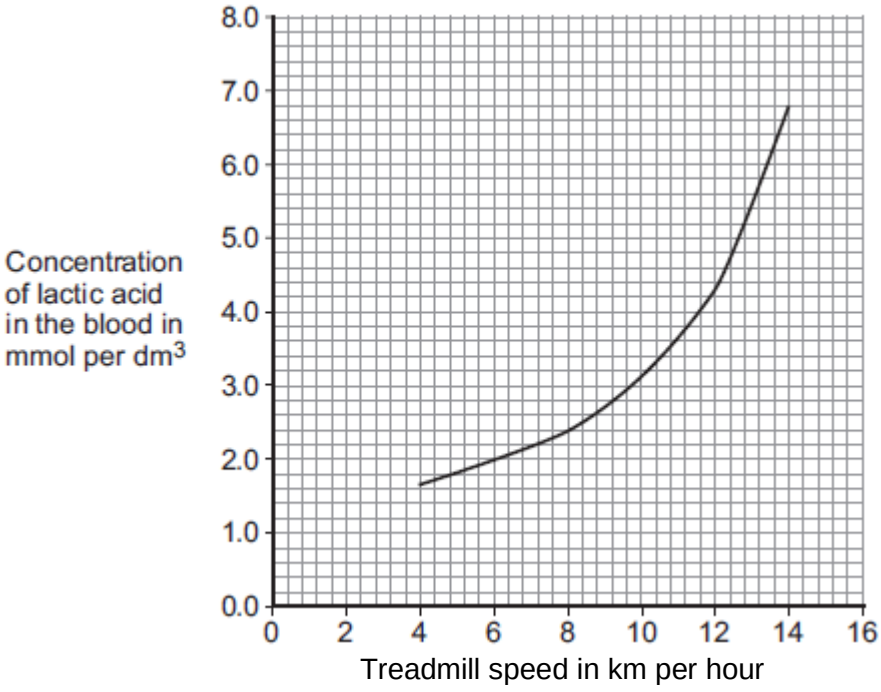
In the investigation:

- 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?

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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?

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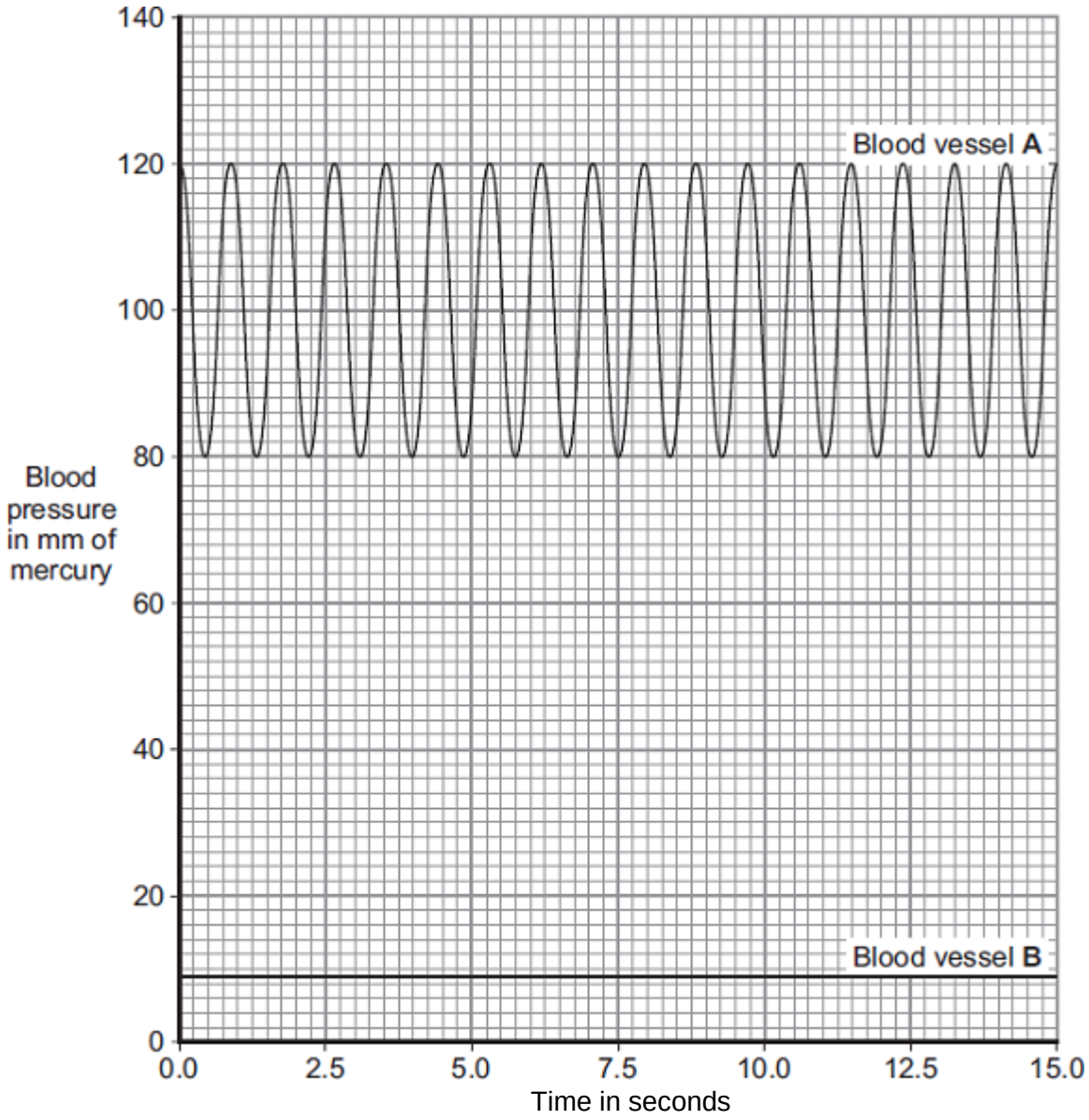
(3)
(Total 6 marks)

Q6. 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.

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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)

Q7. One factor that may affect body mass is *metabolic rate*.

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

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(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.....

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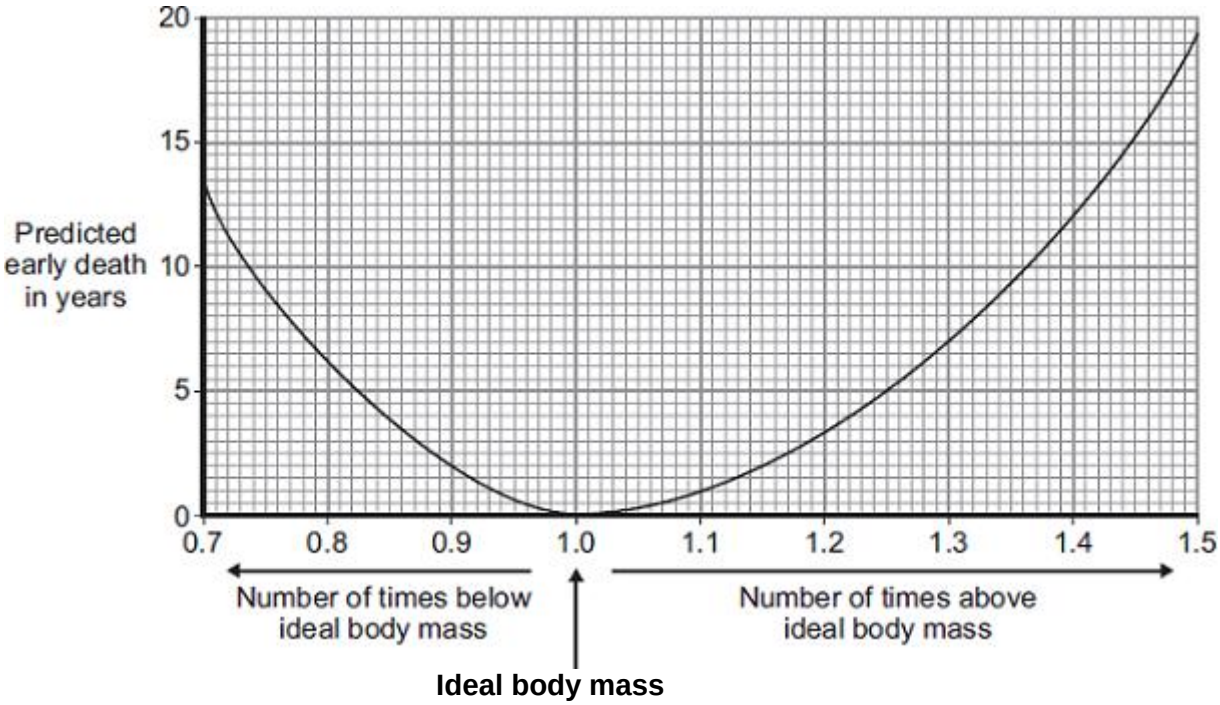
(2)

(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.

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Age at death = ... years

(2)

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

Give **two** changes she should make.

1.....

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2.....

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(2)

(Total 7 marks)