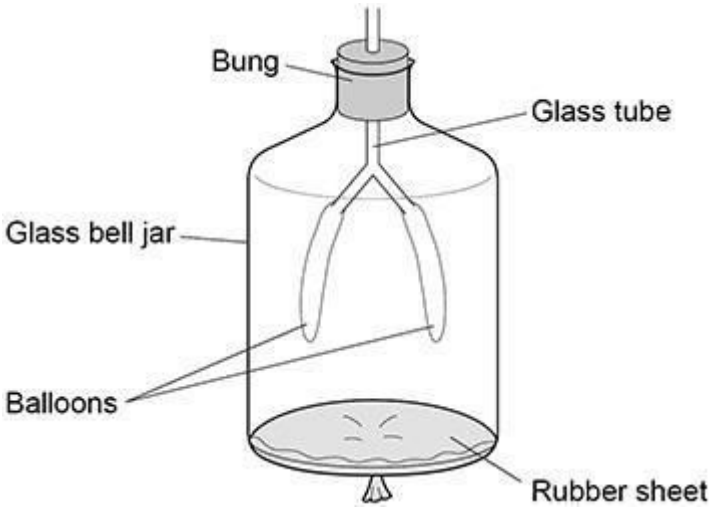
All questions are for both separate science and combined science students

Q1.

Figure 1 shows a model used to demonstrate human breathing.

Figure 1




(a) Which part of the breathing system is represented by the glass tube? Tick (✓) one box.

| | |
|---|---|
| Alveoli | ☐ |
| Capillaries | ☐ |
| Lung | ☐ |
| Trachea | ☐ |

(1)

The model in Figure 1 represents the human breathing system.

A teacher said:

"The model does not represent the human breathing system very well."

(b) Give two reasons why the teacher is correct.

1 _____

_____

2 _____

_____

(2)

A scientist investigated the effect of exercise on breathing rate.

This is the method used.

1. Record the breathing rates of 10 male non-smokers at rest.
2. Tell each man to run on a treadmill at the same speed for 8 minutes.
3. Record the breathing rate of each man every 2 minutes.
4. Continue to record the breathing rate of each man for 4 minutes after he stops running.

(c) Give two variables the scientist controlled in the investigation.

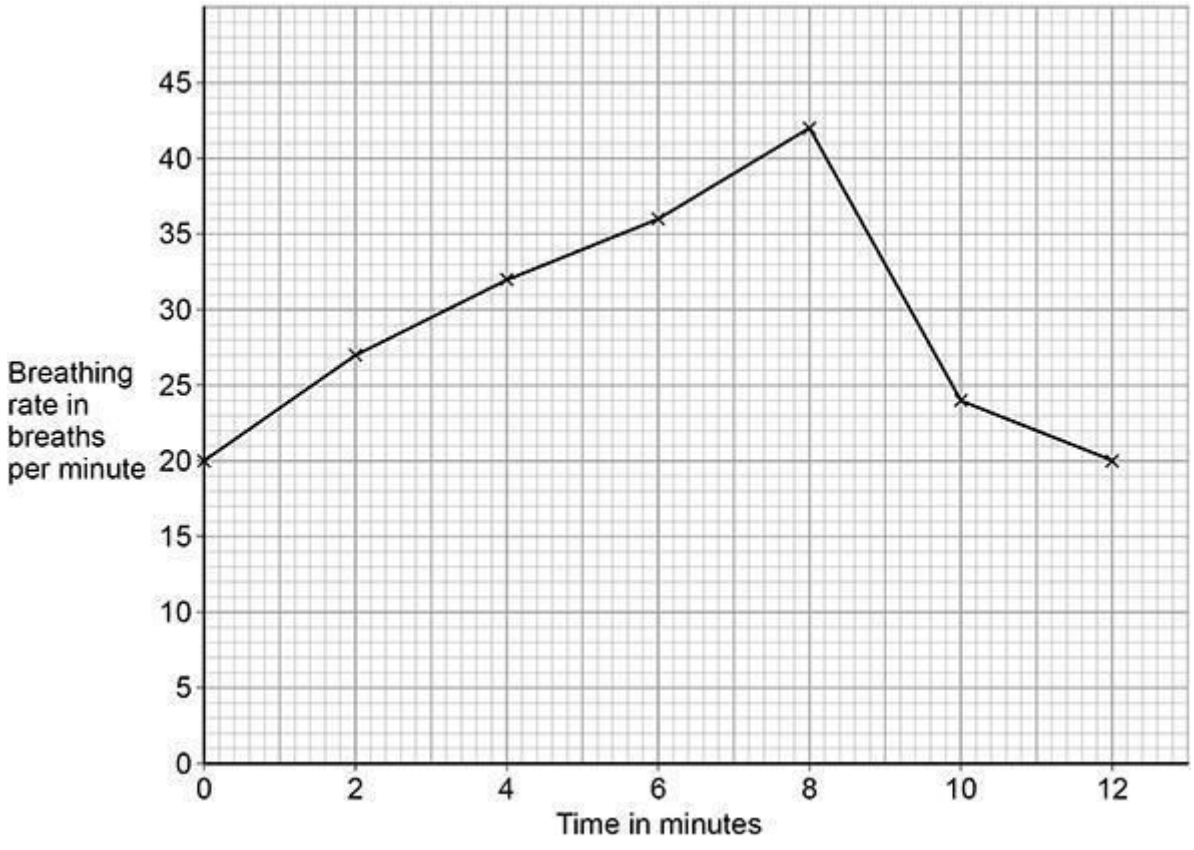
1 _____

2 _____

(2)

Figure 2 shows the data collected from one of the men.

Figure 2




(d) Calculate the percentage increase in the man's breathing rate between 0 minutes and 8 minutes.

Use the equation:

$$\text{percentage increase} = \frac{(\text{breathing rate at 8 minutes} - \text{breathing rate at 0 minutes})}{\text{breathing rate at 0 minutes}} \times 100$$

_____

_____

_____

_____

_____

_____

Percentage increase = _____ %

(3)

(e) Explain why the man's breathing rate increased when he was running.

_____

_____

_____

_____

(2)

(f) Give one measurement that could be taken to show a different effect of exercise on the body.

Do not refer to breathing rate in your answer.

_____

(1)

(g) The men in the investigation were all non-smokers. Give

one effect that smoking can have on the body.

_____

_____

(1)

(Total 12 marks)

Q2.

All living organisms respire.

(a) What is the chemical equation for aerobic respiration? Tick

(✓) one box.

$6\ O_2 + 6\ CO_2 \rightarrow 6\ H_2O + C_6H_{12}O_6$ ☐

$6\ H_2O + C_6H_{12}O_6 \rightarrow 6\ H_2O + 6\ CO_2$ ☐

$6\ H_2O + 6\ CO_2 \rightarrow 6\ O_2 + C_6H_{12}O_6$ ☐

$6\ O_2 + C_6H_{12}O_6 \rightarrow 6\ H_2O + 6\ CO_2$ ☐

(1)

(b) Name the sub-cellular structures where aerobic respiration takes place.

_____

(1)

(c) Energy is released in respiration.

Give two uses of the energy released in respiration.

1 _____

_____

2 _____

_____

(2)

(d) Describe two differences between aerobic and anaerobic respiration in humans.

Do not refer to oxygen in your answer.

1 _____

_____

2 _____

_____

(2)

(e) What are the two products of anaerobic respiration in plant cells? Tick

(✓) two boxes.

Carbon dioxide ☐

Ethanol ☐

Glucose ☐

Lactic acid ☐

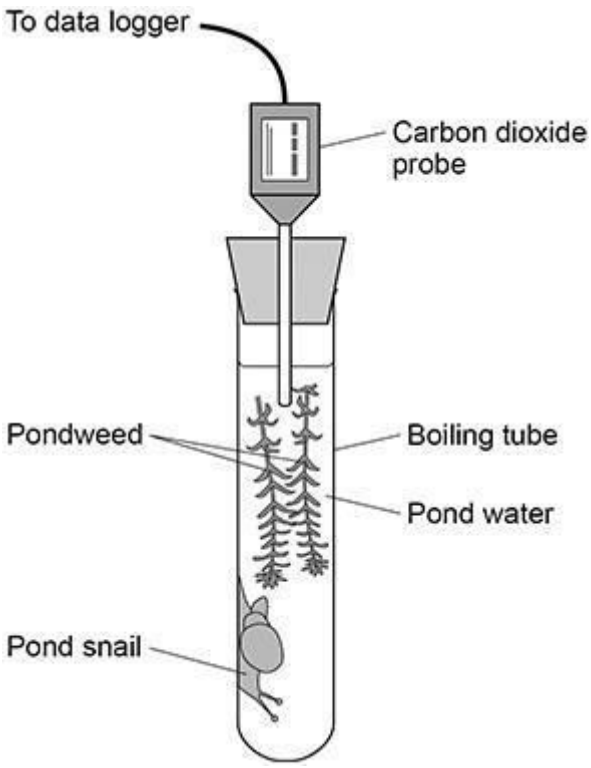
Water ☐

(2)

A scientist investigated respiration and photosynthesis using some pondweed and a pond snail.

Figure 1 shows the apparatus used.

Figure 1




The apparatus was left in a well-lit room for 5 days.

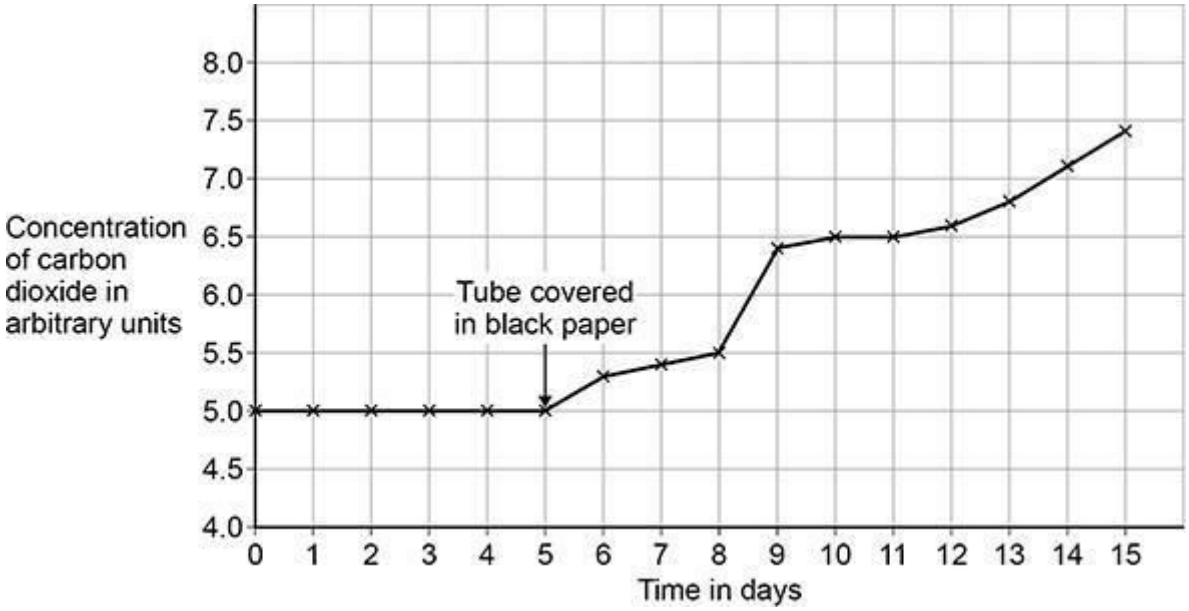
The data logger recorded the concentration of carbon dioxide continuously.

After 5 days, the scientist completely covered the boiling tube with black paper.

The data logger continued to record the concentration of carbon dioxide.

Figure 2 shows the concentration of carbon dioxide inside the boiling tube over 15 days.

Figure 2




(f) Explain why the concentration of carbon dioxide in the tube stayed the same between day 0 and day 5.

_____

_____

_____

_____

(2)

(g) Suggest why the concentration of carbon dioxide increased between day 5 and day 10.

_____

_____

_____

_____

(1)

(h) On day 10, the pond snail died.

Explain why the death of the pond snail caused the concentration of carbon dioxide to increase after day 10.

_____

_____

_____

_____

_____

_____

(3)

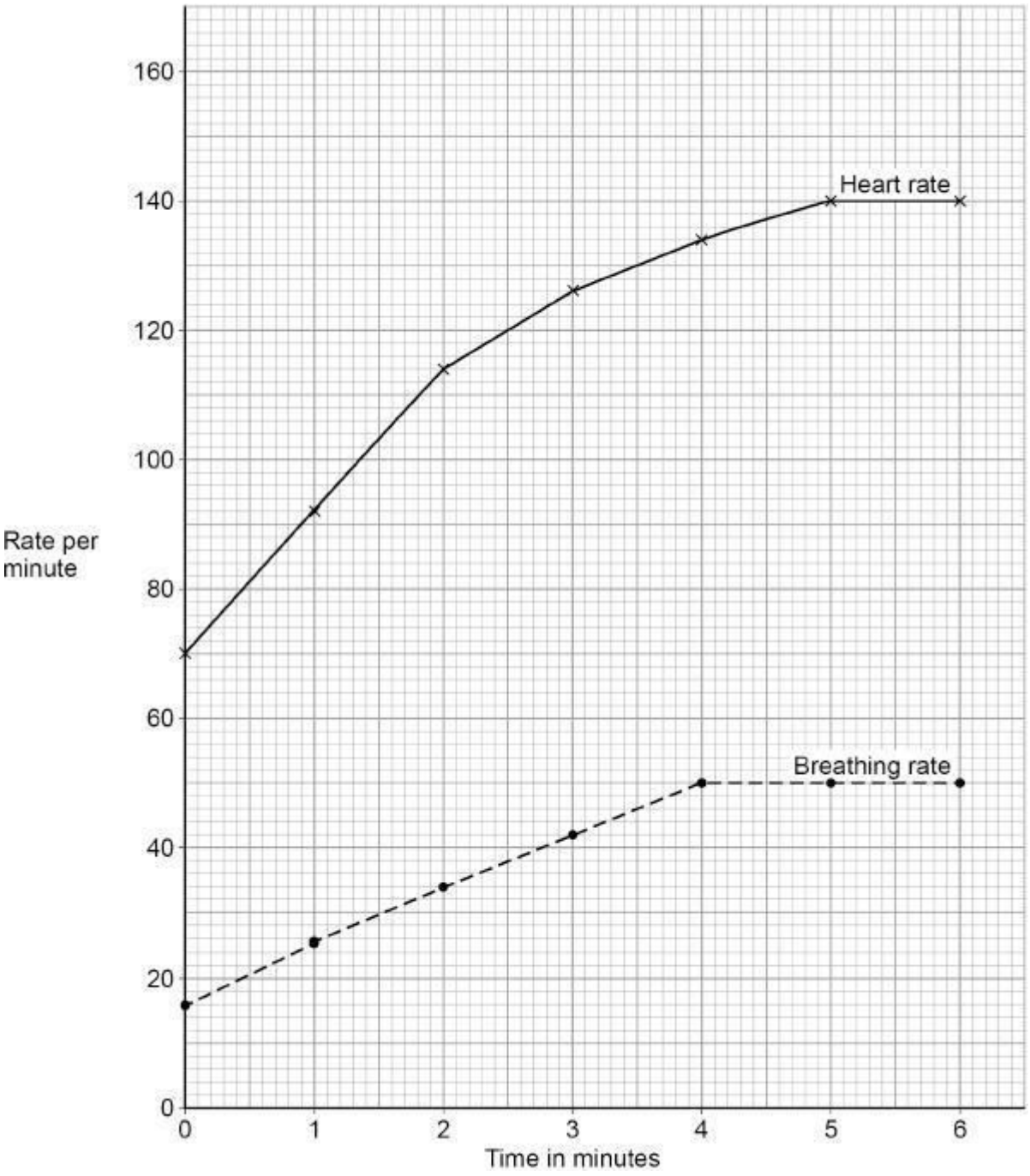
(Total 14 marks)

Q3.

A 45-year-old man exercised on a rowing machine for six minutes.

A fitness monitor recorded his heart rate and breathing rate every minute.

The graph below shows the results.




(a) Describe the trend for breathing rate shown in graph. Use data from the graph in your answer.

_____

_____

_____

_____

_____

_____

(3)

(b) The safe maximum heart rate for a person exercising can be calculated using the equation:

safe maximum heart rate = 220 – age in years

Calculate the safe maximum heart rate for the man.

_____

Safe maximum heart rate = _____ beats per minute

(1)

(c) What is the man's maximum heart rate?

Use the graph above.

Man's maximum heart rate = _____ beats per minute

(1)

(d) The man concluded that he was exercising at a safe heart rate. Give the reason for his conclusion.

Use your answers from part (b) and part (c)

_____

_____

(1)

(e) Explain the ways the man's body has responded to the exercise. Use information from the graph above.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(6)

(Total 12 marks)

Q4.

A student investigated respiration in yeast.

This is the method used.

1. Add 5 cm3 of a yeast and water mixture to each measuring cylinder.

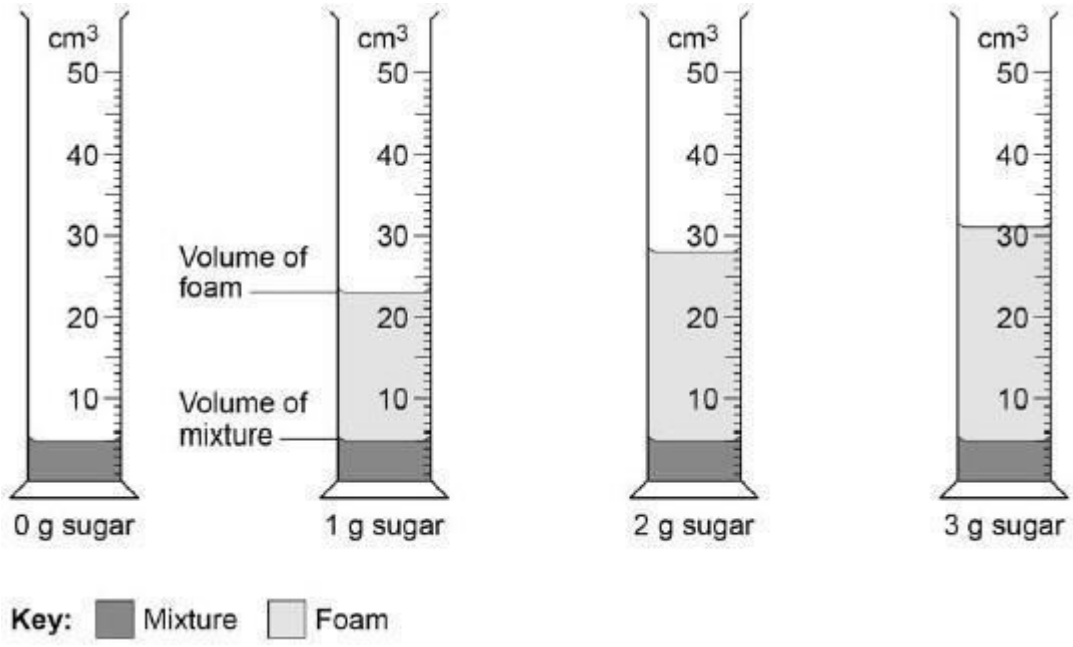
2. Add different masses of sugar to each measuring cylinder.

3. Mix the contents of each measuring cylinder gently for 5 seconds.

4. Put the measuring cylinders in a water bath at 25 °C

5. Over the next 20 minutes, record the maximum volume the foam reaches in each measuring cylinder.

The figure below shows the student's results.




(a) Which two variables did the student control in the method? Tick

(✓) two boxes.

Mass of sugar ☐

pH of the mixture ☐

Temperature ☐

Volume of foam ☐

Volume of yeast and water ☐

(2)

The following table shows the results.

| Mass of sugar in g | Maximum volume in cm3 |
|---|---|
| 0 | 5 |
| 1 | 23 |
| 2 | X |
| 3 | 31 |

(b) What is value X in the table?

Use the figure above.

X = _____ cm3

(1)

In the investigation, the yeast respires and releases a gas which causes the foam to rise.

(c) Which gas causes the foam to rise?

Tick (✓) one box.

Carbon dioxide ☐

Hydrogen ☐

Nitrogen ☐

Oxygen ☐

(1)

(d) What conclusion can you make about the relationship between the mass of sugar used and the volume of gas produced?

_____

_____

_____

_____

(1)

(e) Why was no foam produced in the mixture with 0 g of sugar?

_____

_____

(1)

(f) Why was the measuring cylinder with 0 g of sugar included in the investigation?

_____

_____

(1)

(g) The top of the mixture can be covered with a layer of oil after step 3 in the method.

Suggest why the layer of oil stops the yeast respiring aerobically.

_____

_____

(1)

(h) What other substance is produced during anaerobic respiration in yeast? Tick

(✓) one box.

| | |
|---|---|
| Ethanol | ☐ |
| Hydrochloric acid | ☐ |
| Lactic acid | ☐ |
| Water | ☐ |

(1)

(Total 9 marks)

Q5.

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.

_____

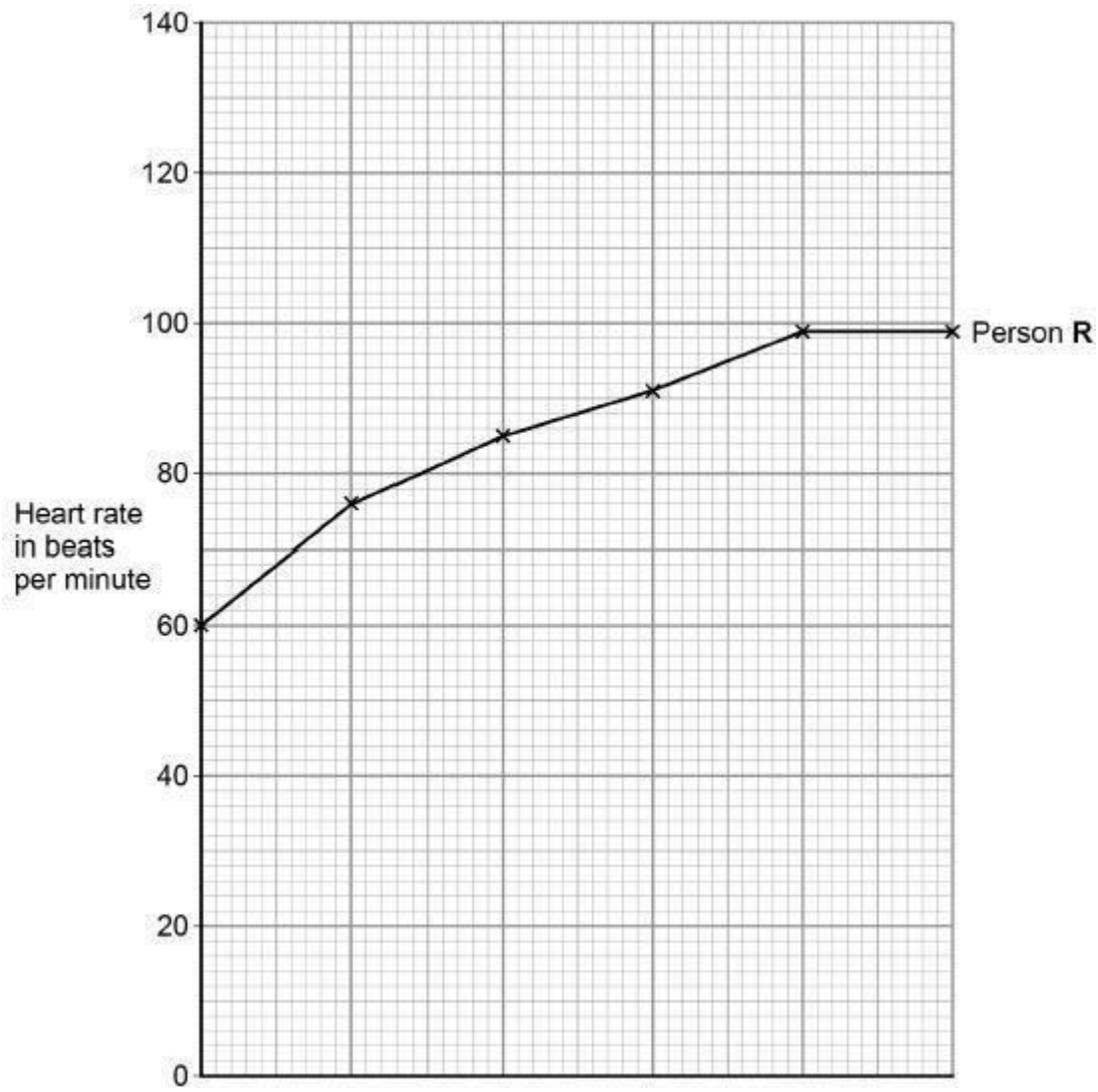
_____

(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.

_____

_____

_____

_____

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_____

_____

_____

(6)

(Total 20 marks)

Q6.

Glucose is broken down in respiration.

(a) What is the chemical formula for glucose?

Tick one box.

C6H6O6 ☐

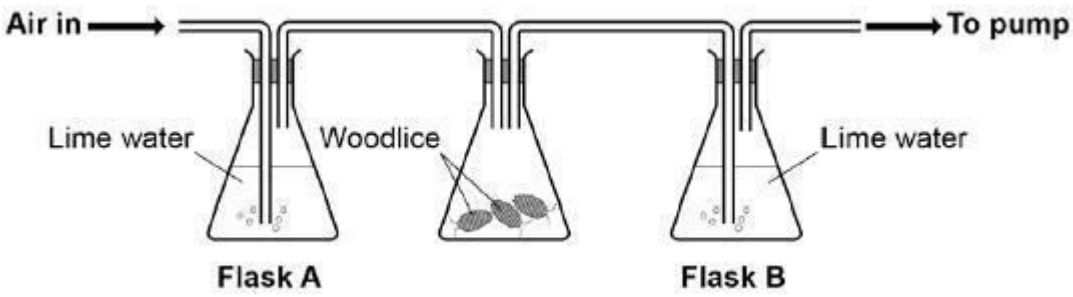
C3H6O3 ☐

C6H12O6 ☐

C6H10O6 ☐

(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.

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)

Q7.

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.

_____

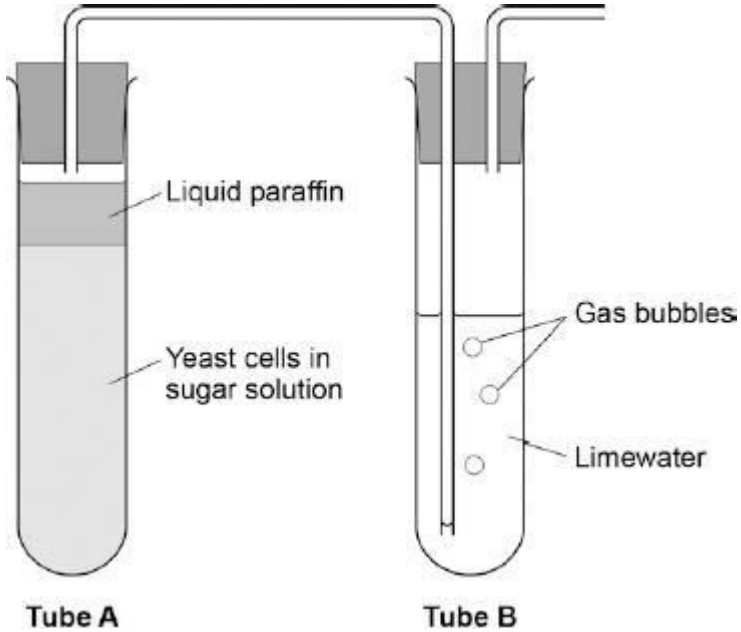
_____

_____

_____

(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)

Q8.

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.

_____

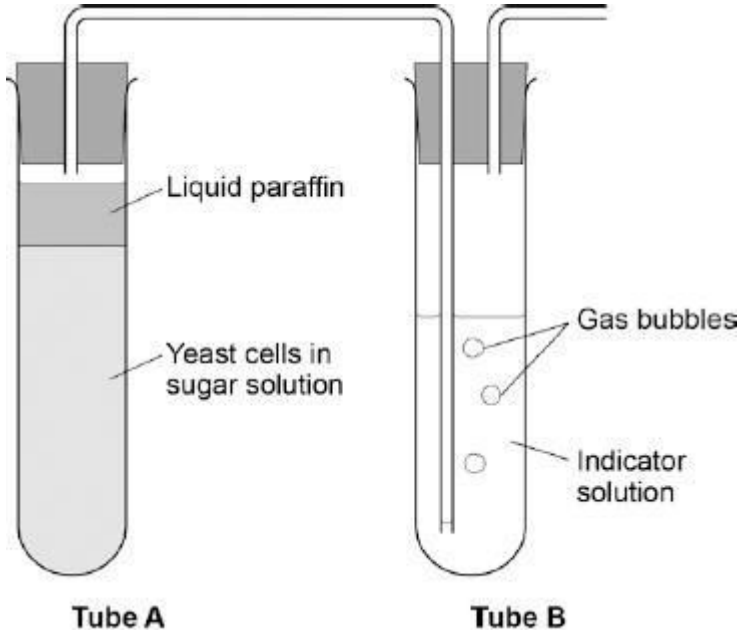
_____

_____

_____

(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)

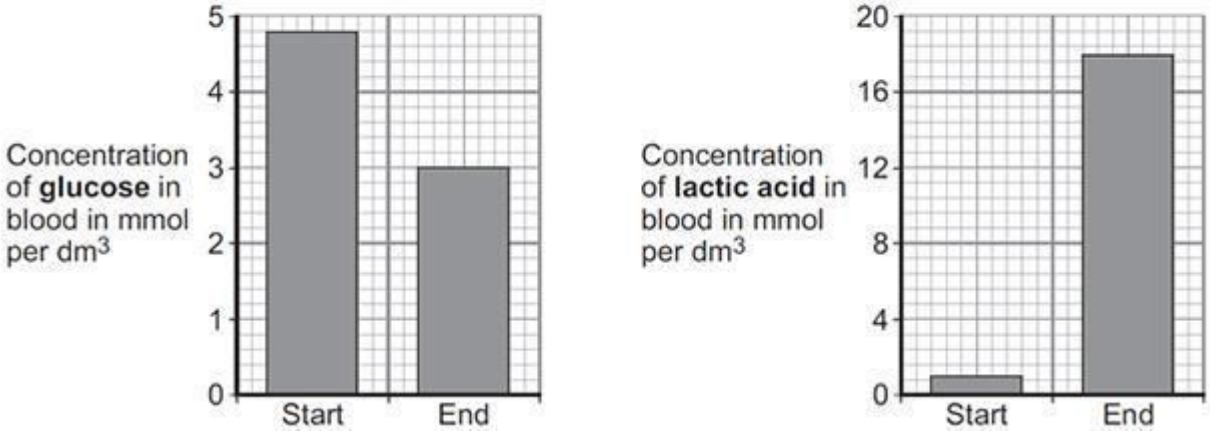
(Total 9 marks)

Q9.

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.

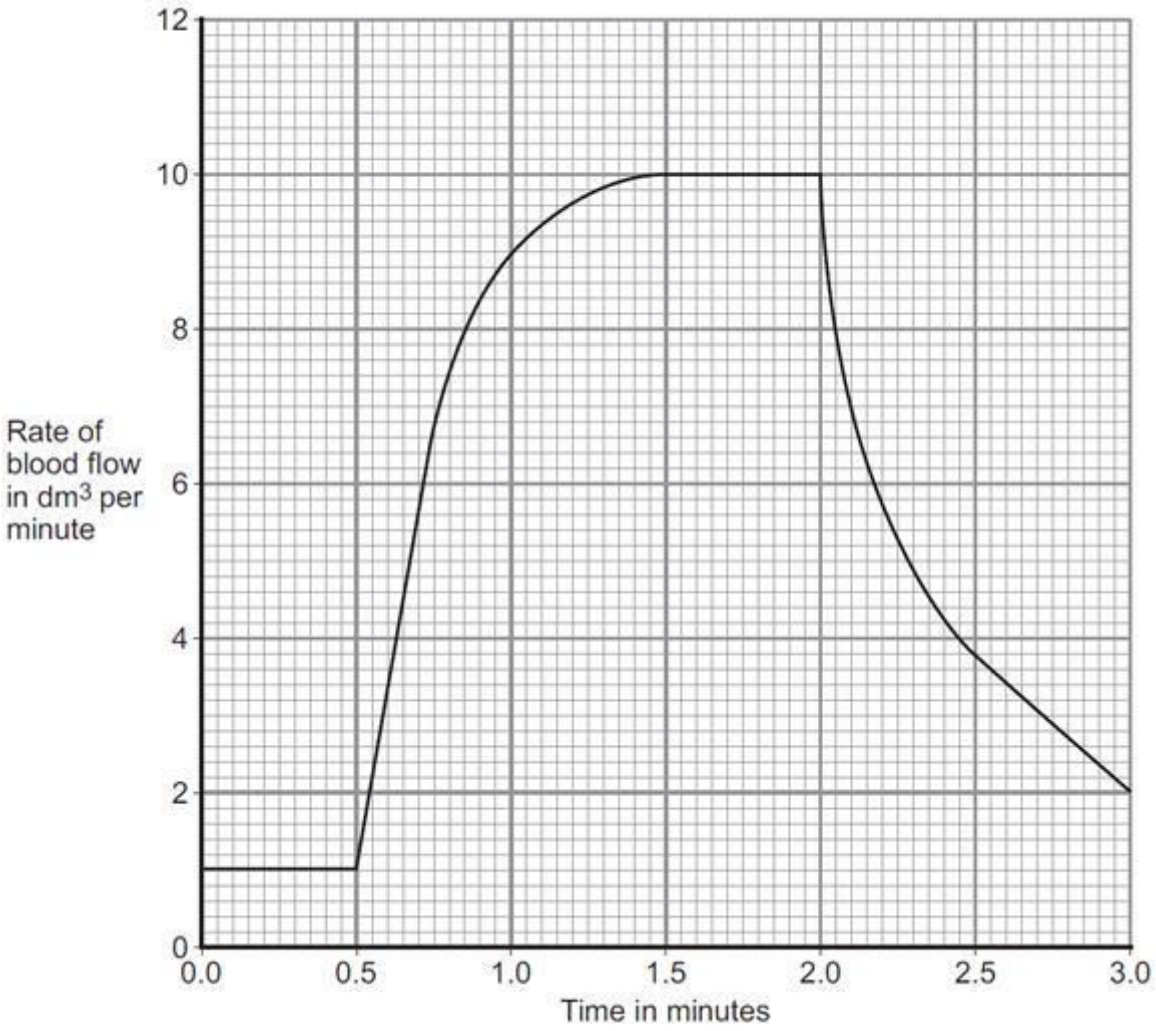
_____

_____

(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)

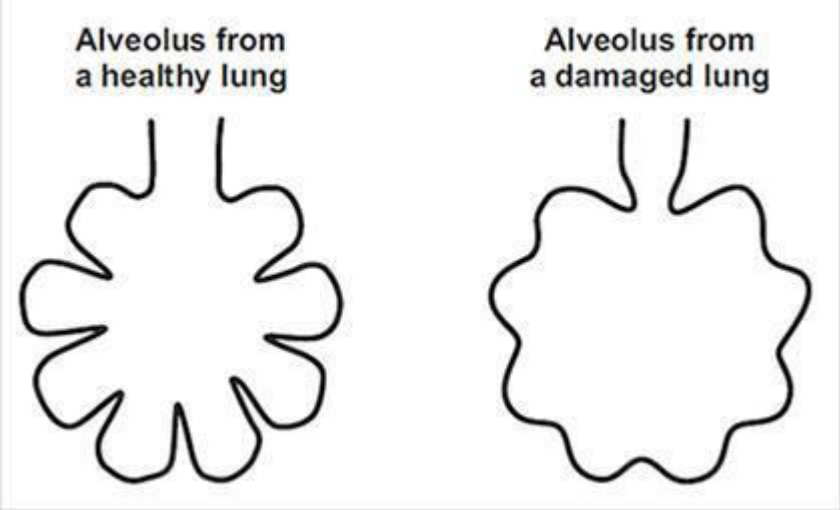
(iii) Explain how the change in blood flow to the athlete's muscles helps him to run.

(4)

(Total 9 marks)

Q10.

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)