



EPSOM
COLLEGE

Science

13+ Scholarship

Sample Paper

Name: _____

School: _____

Marks _____ / 45 (45 minutes)

This paper has three sections: Biology, Chemistry and Physics. You should answer **all** questions in the spaces provided. As a guide, you should look to spend no more than 15 minutes on each section.

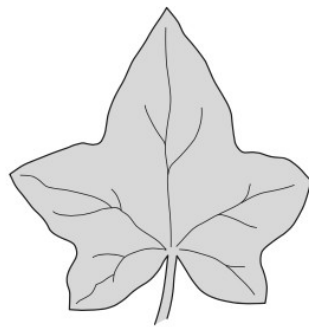
Biology	Chemistry	Physics
/15	/15	/15

Section 1: Biology

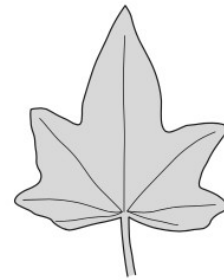
1. Ivy plants can grow up trees and walls.

Figure 1 shows two ivy leaves. One leaf is from an ivy plant growing up a tree in the centre of a shady woodland area. The other leaf is from an ivy plant growing up a tree in a sunny area at the edge of the woodland.

Figure 1



Ivy leaf from shady woodland area
(centre of woodland)



Ivy leaf from sunny area
(edge of woodland)

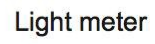
A student makes the following hypothesis.

“The size of ivy leaves decreases as light intensity increases.”

How would you use the apparatus shown in **Figure 2** to test this hypothesis? You should include details of how you would make sure the results are valid.

[6 marks]

The image displays three different measuring tools. On the left is a coiled 100 m tape measure with a metal hook and a plastic clip. In the center is a long, thin ruler with a scale from 0 to 30 cm. On the right is a light meter, which is a rectangular device with a circular dial and a lens.

This image shows a full page of white paper with horizontal dashed lines, typical of primary school writing paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

2. Read the information below and use it to answer the following questions. In 2012 approximately 32 million tonnes of waste plastic was discarded in the UK. Most went to landfill but 25% was recycled.



Plastic waste dumped at a landfill site

Waste plastics at landfill sites produce chemicals called phthalates which are toxic. Scientists have discovered bacteria which can break phthalates down into useful substances.

- (a) Calculate the mass of waste plastic which was **not** recycled in the UK in 2012.
[2 marks]

Mass of plastic =tonnes

- (b) Scientists investigated how quickly bacteria broke down samples of phthalates at 15°C and 25°C. The results for 25°C are shown in the table below and the results for 15°C are on the graph opposite.

Results for 25°C

time (hours)	phthalates remaining in sample (a.u.)
0	100
10	96
20	92
30	60
40	33
50	5

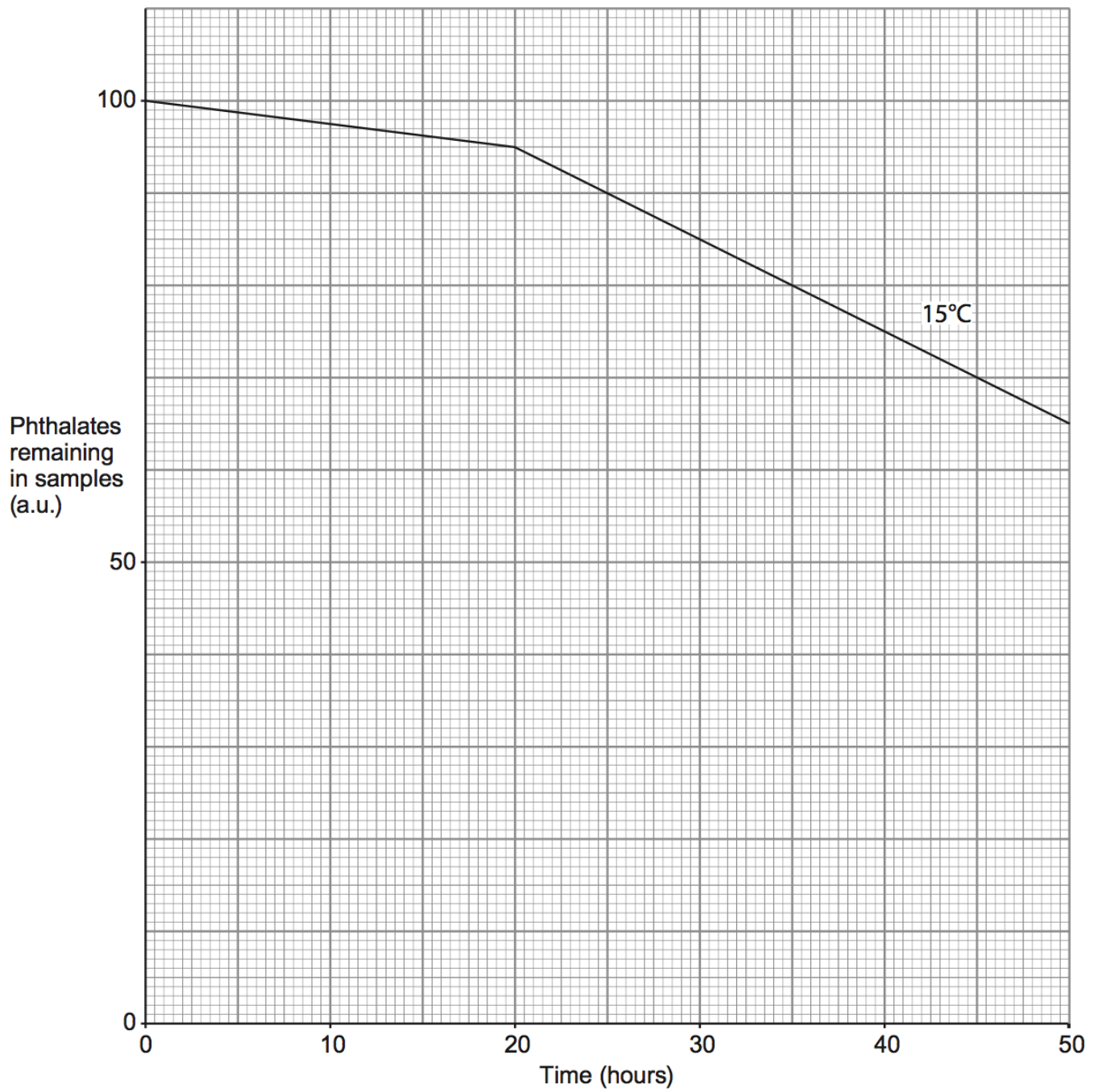
(i) Complete the graph opposite by

- plotting the results for 25°C,

[2 marks]

- drawing a line using a ruler to join your plots.

[1 mark]



(ii) From this graph, describe how temperature affects the breakdown of phthalates by bacteria and suggest a reason for the difference in the results seen at 15°C and 25°C.

[2 marks]

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3. About 1 in 10000 people has a condition called situs inversus.

People with this condition have **their organs reversed** so they are a '**mirror image**' of the usual arrangement.

For most people with situs inversus, there are no harmful effects on their health.

However, doctors need to know if someone has the condition if they are going to successfully treat them if they are ill or injured.

(a) The diagram (**Figure 3**) shows the heart from someone with situs inversus, viewed from the front.

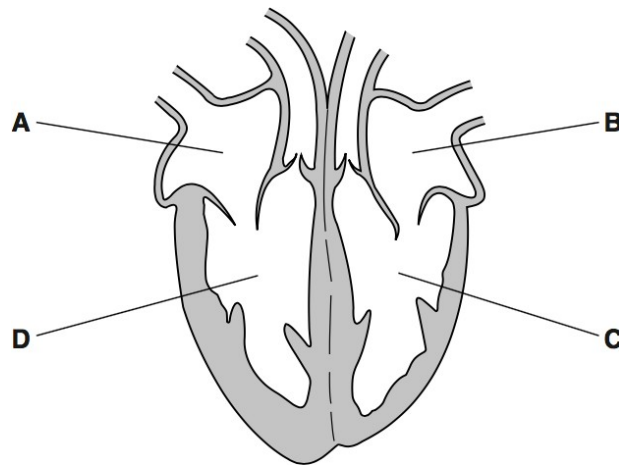


Figure 3

(i) Look at the diagram of the heart. Which part pumps blood **around the body**? Choose from **A, B, C** or **D**, and explain your choice.

[2 marks]

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Section 2: Chemistry

Q1.

Many everyday items are made of metal.

The picture shows four objects made of metals or alloys.



electrical wire



aeroplane



jewellery



knife

Explain why gold is a suitable metal to make jewellery.

(2)

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Q2.

Overhead power cables supported on pylons are used to carry electricity.



The table shows information about three metallic substances.

metallic substance	density / kg m ⁻³	cost per tonne / £	relative strength	relative ability to conduct electricity	relative resistance to corrosion
copper	8920	5279	high	very good	good
aluminium	2700	1425	high	good	good
steel	7820	505	very high	good	poor

(i) The pylons are made of steel.

Use information from the table to explain which properties of steel make it the most suitable of these three metals for the pylons.

(2)

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(ii) Use information from the table to explain which properties of aluminium make it more suitable than copper for making overhead power cables.

(2)

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Q3.

Indigestion is caused by excess hydrochloric acid in the stomach.

Calcium carbonate neutralises the excess hydrochloric acid, producing calcium chloride, a gas and water.

Use words from the box to complete the word equation for this reaction.

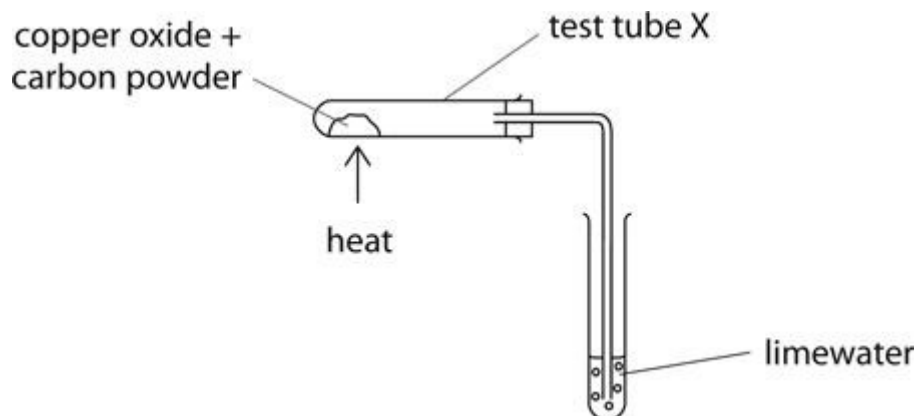
(2)

calcium hydroxide	calcium oxide	carbon dioxide
chlorine	hydrochloric acid	hydrogen

Calcium carbonate + \rightarrow calcium chloride + + water

Q4.

A mixture of copper oxide and carbon powder was heated. Carbon dioxide was produced. It was bubbled into limewater.



The word equation for the reaction is

copper oxide + carbon \rightarrow copper + carbon dioxide

(i) Complete the sentence by underlining your answer. When carbon dioxide is bubbled into limewater, the limewater

(1)

- a. changes from orange to colourless
- b. remains colourless
- c. becomes milky
- d. becomes blue

(ii) The mass of test tube X and its contents was measured before heating and after heating.

There was a change in mass.

Explain why the total mass of the test tube and contents changes during the reaction.

(1)

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Q5.

Problems caused by acids

(a) Hydrochloric acid is produced in the stomach.
When too much acid is produced it can cause indigestion.

(i) Give a reason why hydrochloric acid is present in the stomach.

(1)

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(ii) Complete the sentence by underlining your answer. The formula of hydrochloric acid is

(1)

- A HCl
- B H₂Cl
- C HCl₂
- D HCl²

(iii) Which of these hazard symbols should be used on a container of dilute hydrochloric acid to show that it is an irritant?

Put a cross (☒) in the box next to your answer.

(1)



☐ A



☐ B



☐ C



☐ D

(b) Indigestion can cause pain in the chest. Indigestion tablets can be taken to relieve this pain.



(2)

(i) Explain how indigestion tablets relieve this pain.

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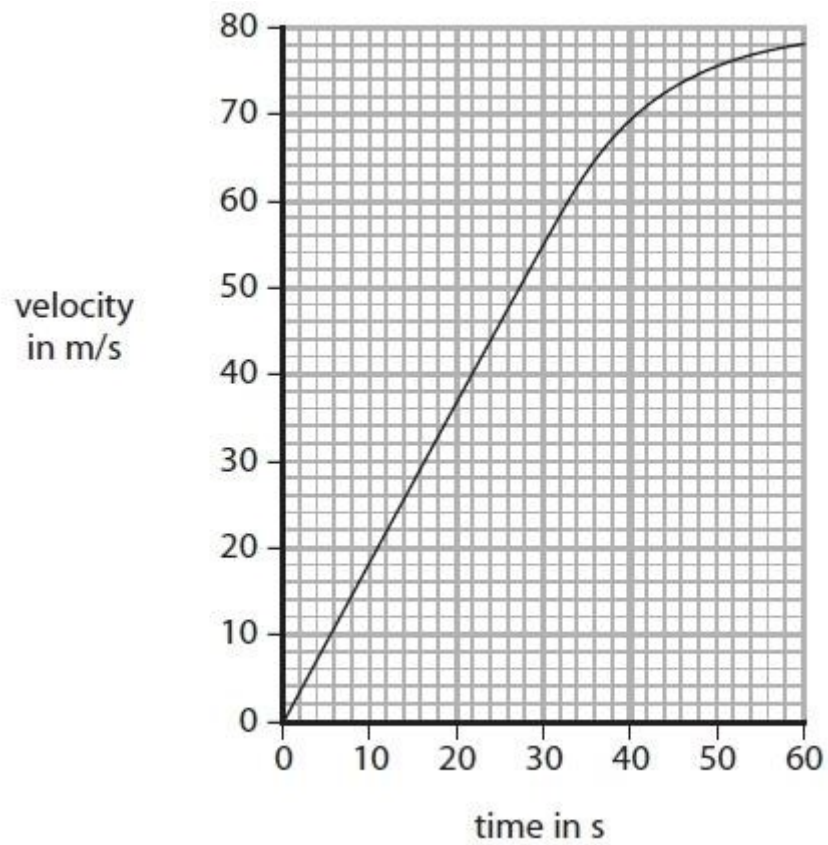
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Section 3: Physics

Q1.

The graph shows how the velocity of an aircraft changes as it accelerates along a runway.



(a) Use the graph to find the average acceleration of the aircraft.

(3)

Acceleration = m/s^2

(b) Explain why the acceleration is not constant, even though the engines produce a constant force.

(3)

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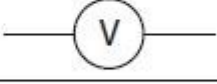
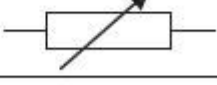

(Total for question = 6 marks)

Q2.

This question is about electrical components.

(a) Draw a straight line from each electrical component to its correct symbol. One has been done for you.

(3)

electrical component		symbol
ammeter	●—————●	
battery	●—————●	
lamp	●—————●	
variable resistor	●—————●	
voltmeter	●—————●	

(b) (i) Name an electrical component whose resistance decreases when it is moved into brighter light.

(1)

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(ii) Name an electrical component whose resistance decreases as its temperature increases.

(1)

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(Total for question = 5 marks)

Q3.

Builders work on a new house.



scaffolding

A builder carries a concrete block from the ground up to the top of the scaffolding.



(a) (i) State the equation linking gravitational potential energy, mass, g and height.

(1)

(ii) The concrete block has a mass of 18 kg.

Calculate the gravitational potential energy gained by the concrete block if the scaffolding is 5 m high.

(2)

Gravitational potential energy = J

(iii) What is the link between the gravitational potential energy gained by the concrete block and the work done by the builder to lift it?

(1)

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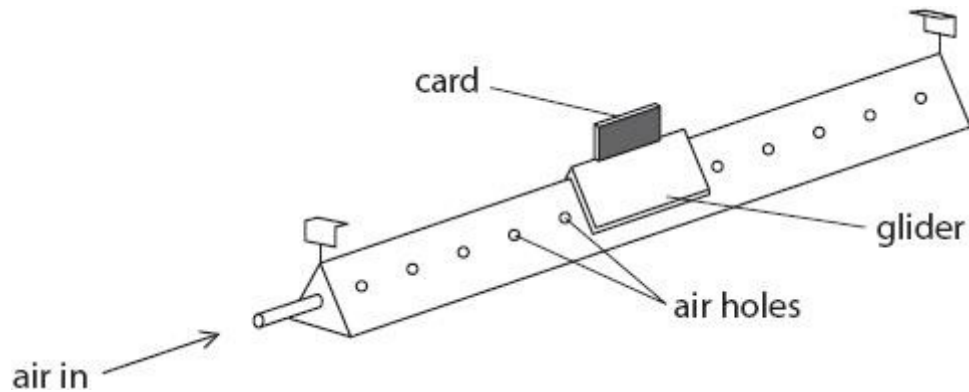
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Q4.

The diagram shows an air track that can be used to investigate motion. Air comes out through a series of small holes in the air track.

A small glider floats on a cushion of air.

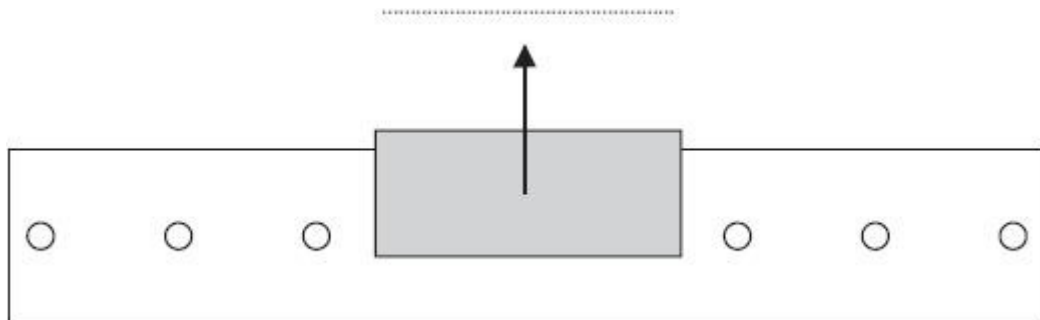


(a) (i) The diagram below shows the glider at rest on the air track.

Complete the diagram to show the forces acting on the glider. Label the forces.

One force arrow has been drawn for you.

(3)



(ii) Explain what effect the cushion of air has on the movement of the glider.

(2)

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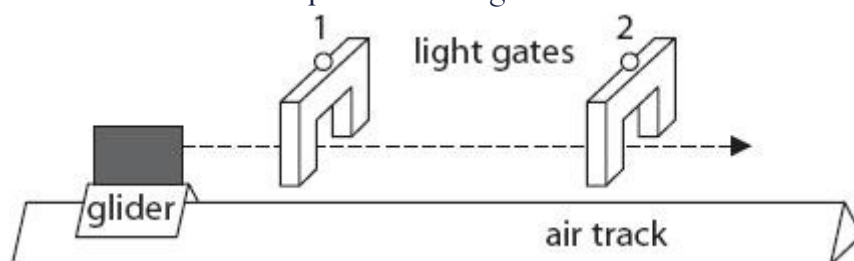
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(b) Two light gates connected to a data logger are placed above the air track so that the card will pass through them.

The glider moves at a constant speed to the right.



The length of the card is 8.3 cm.

The card takes 314 ms to pass through the first light gate.

(i) State the relationship between average speed, distance moved and time taken. (1)

(ii) Calculate the average speed of the card as it passes through the first light gate. (2)

average speed = cm/s

(iii) State the time taken for the card to pass through the second light gate. (1)

time taken = ms

(Total for question = 9 marks)

Q5.

A skydiver jumps from an aircraft.

(a) The mass of the skydiver is 70 kg.

(i) State the equation linking weight, mass and g .

(1)

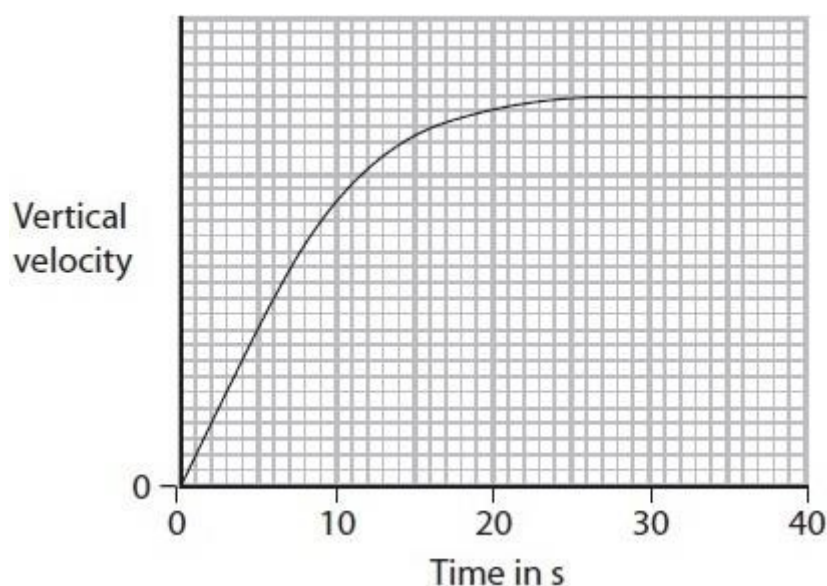
(ii) Calculate the weight of the skydiver and state the unit.

(2)

weight = unit =
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(b) The graph shows the vertical velocity of the skydiver during the first 40 s of the fall.

His parachute is not open during this time.



Explain the shape of the graph.

(4)

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Q6.

Mains electricity is used in circuits at home.

(a) Double insulation is needed for safety when there is **(1)**

☐ **A** no circuit breaker

☐ **B** no earth

connection ☐ **C** no

fuse

☐ **D** no switch

(b) A fuse is used so that **(1)**

☐ **A** an earth connection is not needed

☐ **B** the appliances are more efficient

☐ **C** the circuit cannot overheat if there is a fault

☐ **D** the user cannot touch a live wire

(c) Most lamps at home have their own switch. This is because the lamps are connected **(1)**

☐ **A** in parallel

☐ **B** in series

☐ **C** to a fuse

☐ **D** to an earth wire

(Total for question = 3 marks)