AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

Level 3 Certificate
MATHEMATICAL STUDIES

Paper 2C Graphical techniques

Wednesday 25 May 2016 Morning Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:
- a clean copy of the Preliminary Material and formulae sheet (enclosed)
- a scientific calculator or graphics calculator
- a ruler.

Instructions
- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer questions in the space provided. Do not write outside the box around each page or on blank pages.
- Show all necessary working; otherwise, marks for method may be lost.
- Do all rough work in this book. Cross through any work that you do not want to be marked.
- The **final** answer to questions should be given to an appropriate degree of accuracy.
- You may **not** refer to the Preliminary Material that was available prior to this examination. A clean copy is enclosed for your use.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60.
- You may ask for more answer or graph paper, which must be tagged securely to this answer booklet.
- The paper reference for this paper is 1350/2C.

Answer **all** questions in the spaces provided.

1 Use **Facebook Facts** on page 2 of the Preliminary Material.

1 (a) According to the article, Facebook had 1230 million monthly active users worldwide by the end of 2013

Circle 1230 million written in standard form.

[1 mark]

1230×10^6 1.23×10^7 1.23×10^8 1.23×10^9

1 (b) Suggest **two** improvements that could be made to the presentation of the bar chart in the article.

[2 marks]

Improvement 1

Improvement 2

1 (c) Joe has just started working for Survey Hunt, a social media research company.

Joe calculates the mean increase in the number of active Facebook users per year from the beginning of 2008 to the end of 2013

His calculation is as follows.

$$\frac{(145 - 58) + (360 - 145) + (680 - 360) + (845 - 608) + (1056 - 845) + (1230 - 1056)}{5}$$

Critically analyse Joe's calculation, stating any corrections or improvements that could be made.

[3 marks]

1 (d) Just before Facebook bought Instagram, Facebook had 900 million users.

As part of the purchase, each Instagram user was automatically given a Facebook account.

On 10 April 2012, Survey Hunt carried out a survey about the public's opinion of social media.

A sample of 350 people with Facebook accounts took part in this survey.

Of these 350 people, 25 were Instagram users who had just been given a Facebook account.

Survey Hunt claimed that its survey fairly represented the Instagram users who had just been given a Facebook account.

Does the data support the claim?
You **must** show your working.

[4 marks]

1 (e) On 4 February 2014, Lena had 50 shares in Facebook.

The exchange rate that day was £1 = $1.60

She said,

"My shares in Facebook are worth more than £2000"

Was she correct?
You **must** show your working.

[2 marks]

Turn over for the next question

2 Use **Global Adult Literacy** on page 3 of the Preliminary Material.

2 (a) Some members of UNESCO suggested that the data had not been presented well.

2 (a) (i) Give one reason why they might suggest this with regard to **Figure 1**

[1 mark]

2 (a) (ii) Give one reason why they might suggest this with regard to **Table 1**

[1 mark]

2 (b) The two statements below were made on an online forum discussing adult literacy rates.

'The number of literate adults in the world in 2012 reached nearly 4.2 billion.'

(Paul)

'Central Asia has made the greatest progress in improving adult literacy over the past two decades.'

(Rena)

Critically analyse these two statements.
Show working to justify your comments.

[6 marks]

Paul's statement

Rena's statement

3 Consumers of electricity have to decide which payment plan, or tariff, to follow each year.

Tariffs usually consist of a charge per kilowatt hour (kWh) of electricity used and an annual standing charge (a fixed fee that is payable no matter how much electricity is used).

The table below shows three tariffs that are offered to consumers.

	Charge per kWh	**Annual standing charge**
Tariff A	16p	£0
Tariff B	14p	£40
Tariff C	12p	£100

3 (a) Show that using 1000 kWh in one year with tariff B would cost £180

[1 mark]

3 (b) Ava is employed to advise consumers about the cheapest tariff for them.

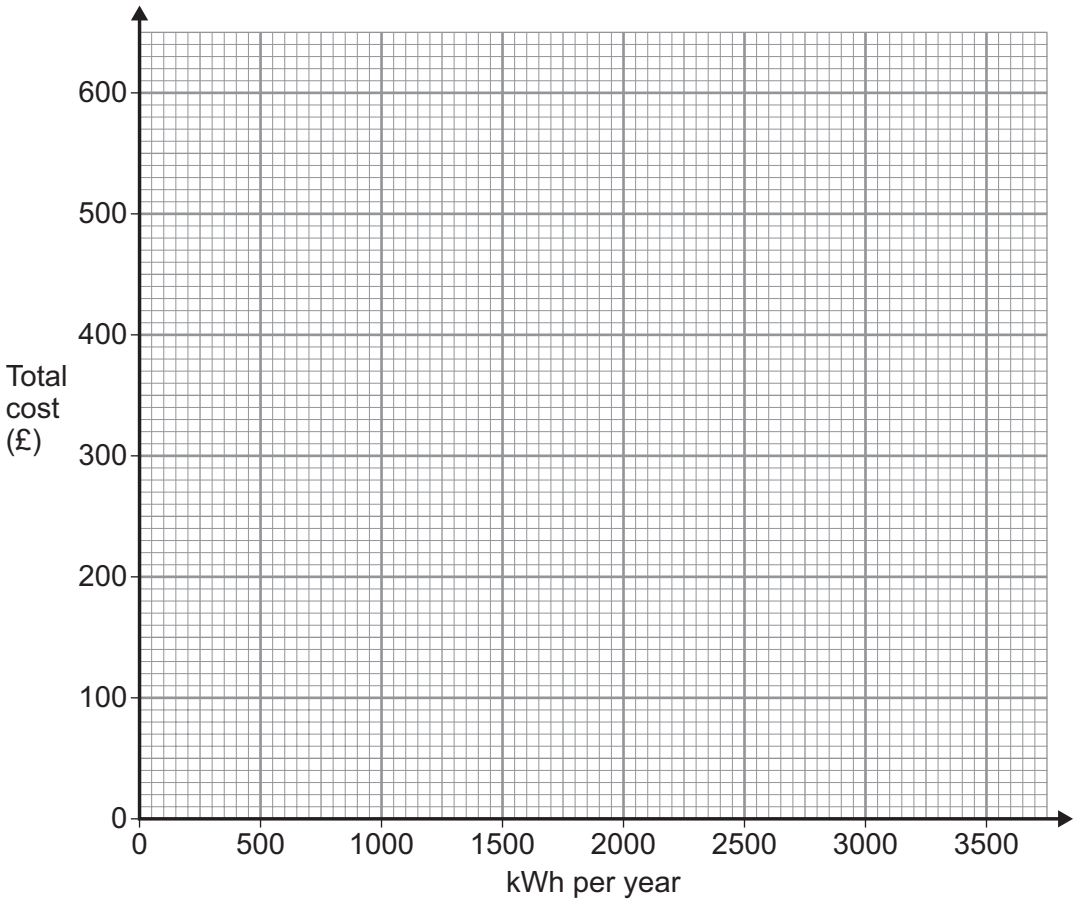
The consumers she advises use between 1500 kWh and 3500 kWh per year.

She needs to know which tariff will be cheapest for different amounts of electricity used.

Advise Ava on which tariff to suggest to consumers, depending on how many kWh of electricity they expect to use in the next year.

You may use the grid on the opposite page to help you if you wish.

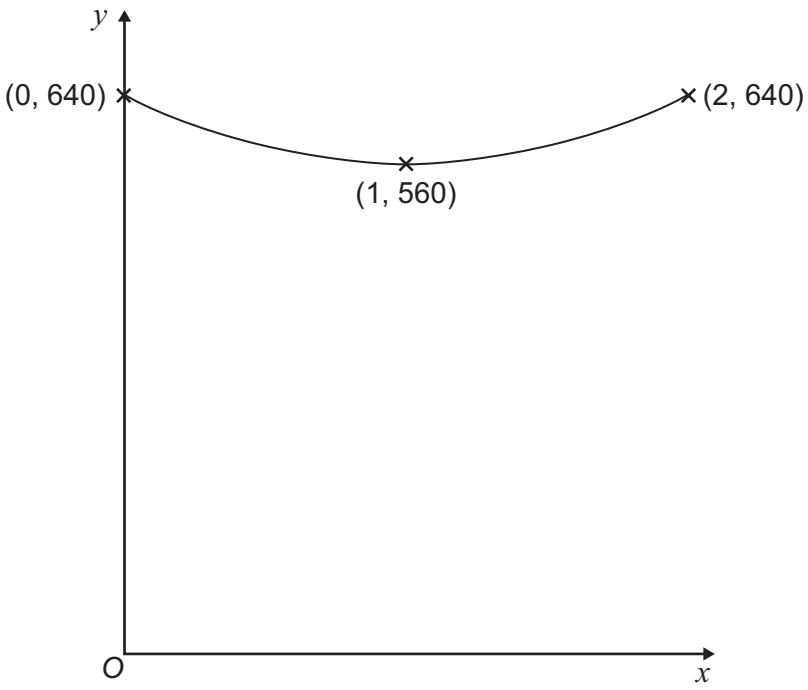
[9 marks]



4 (a) The graph below shows the average annual cost of gas per household in the UK from 1 January 2006 to 1 January 2008, calculated daily.

y is the average annual cost of gas, in pounds, per household in the UK.

x is the number of years after 1 January 2006



For example, on 1 January 2007 the average annual cost of gas per household in the UK was £560

Sam believes that the average annual cost of gas for this period can be modelled by the quadratic function

$$y = a(x^2 - 2x) + c$$

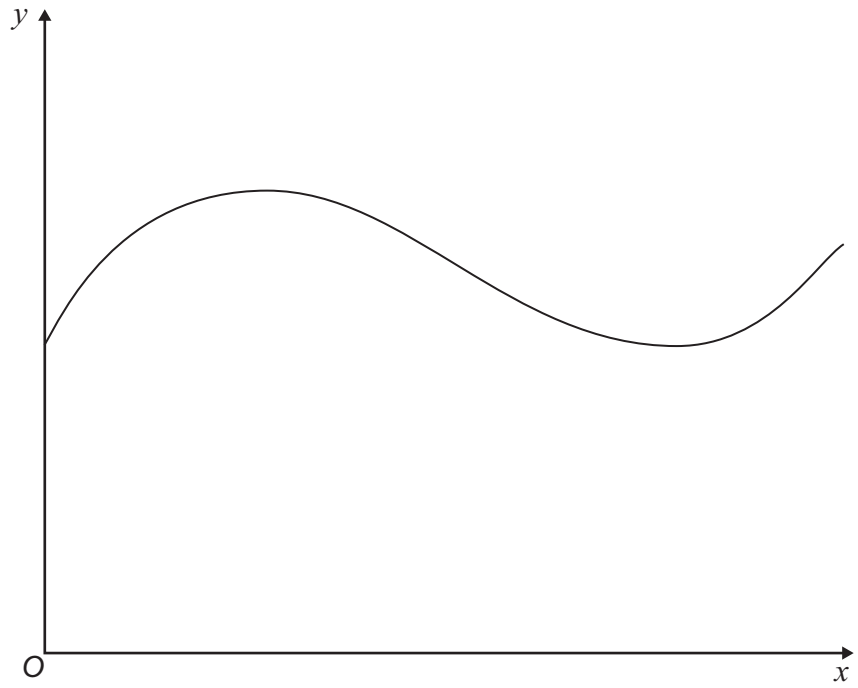
where a and c are constants.

Calculate the values of a and c

[4 marks]

Answer a = _____ c = _____

4 (b) The graph below shows the average annual cost of gas per household in the UK for a different time period from the one shown in part **(a)**.



Sam wants to use a mathematical function to model the average annual cost of gas as shown by the graph.

Which type of function would be suitable for this?
Circle your answer.

[1 mark]

Linear Quadratic Cubic Exponential

5 A scientist is studying a colony of bacteria.

At time t minutes there are N thousand bacteria in the colony.

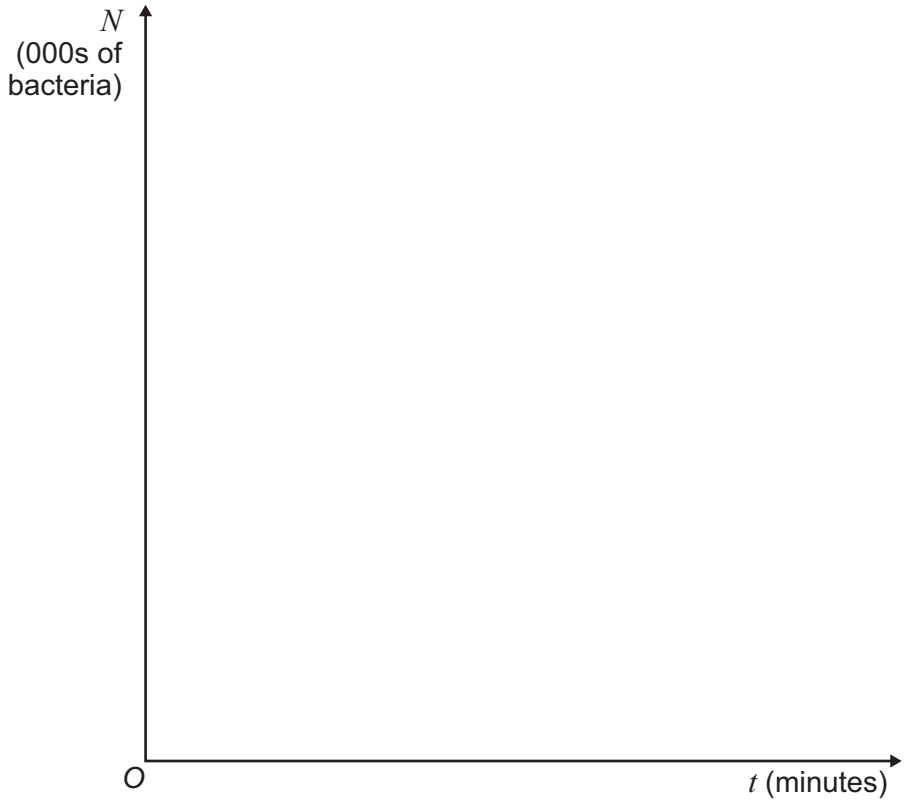
The scientist models N using the exponential function

$$N = e^t$$

5 (a) On the axes below, sketch the graph of N against t

Give the coordinates of any points where the graph intersects the axes.

[2 marks]



5 (b) Work out how many minutes it will take for the number of bacteria to grow to 90 000

[2 marks]

Answer _____ minutes

5 (c) At what rate per minute is the number of bacteria growing when there are 90 000 bacteria in the colony?

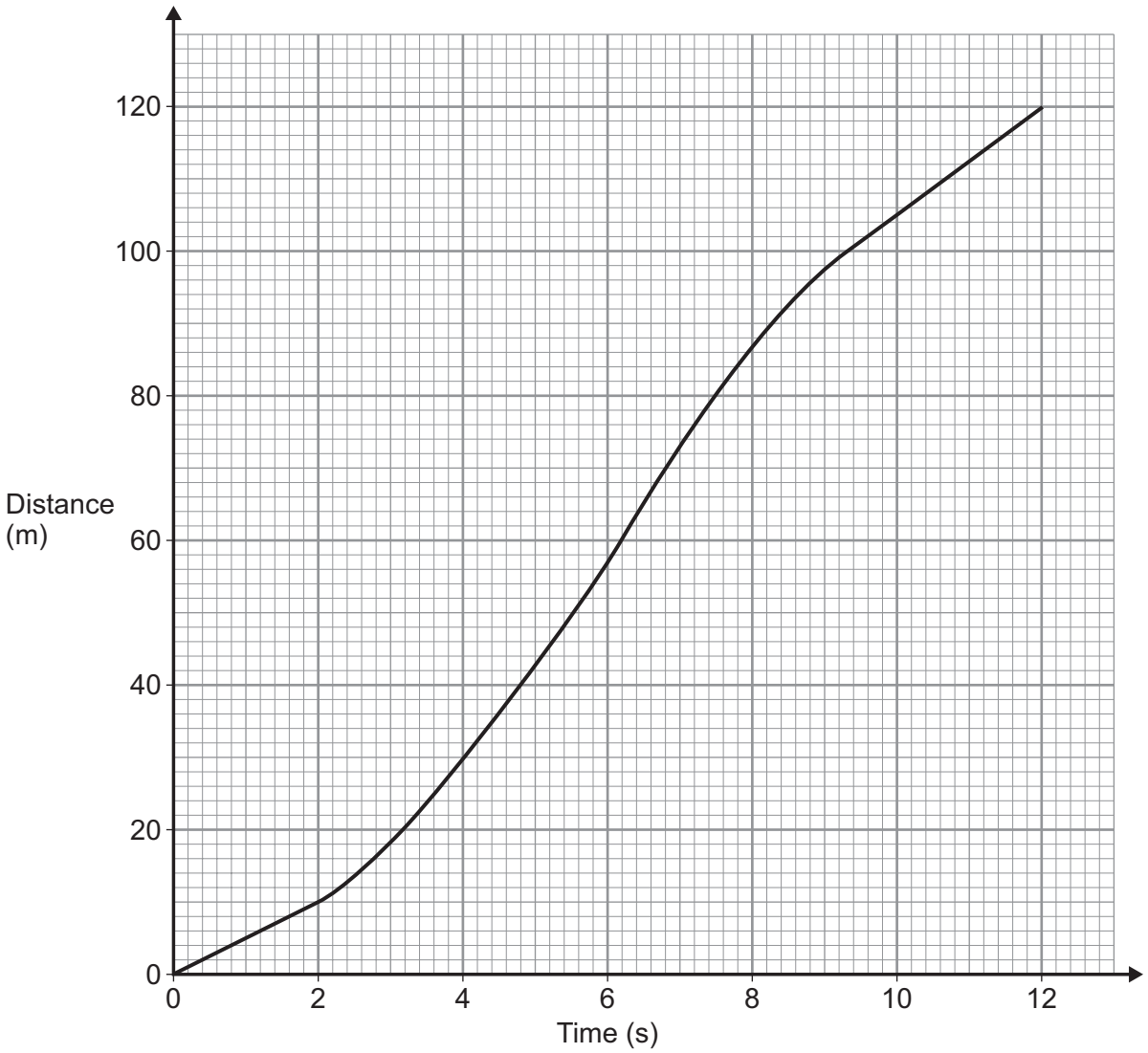
[1 mark]

Answer _____ per minute

Turn over for the next question

6 The distance-time graph below represents a car that is overtaking a lorry on a straight road.

The speed of the car is constant during the first 2 seconds and the final 2 seconds.



6 (a) Work out the average speed of the car during the 12 seconds.

[2 marks]

Answer _____ $m\,s^{-1}$

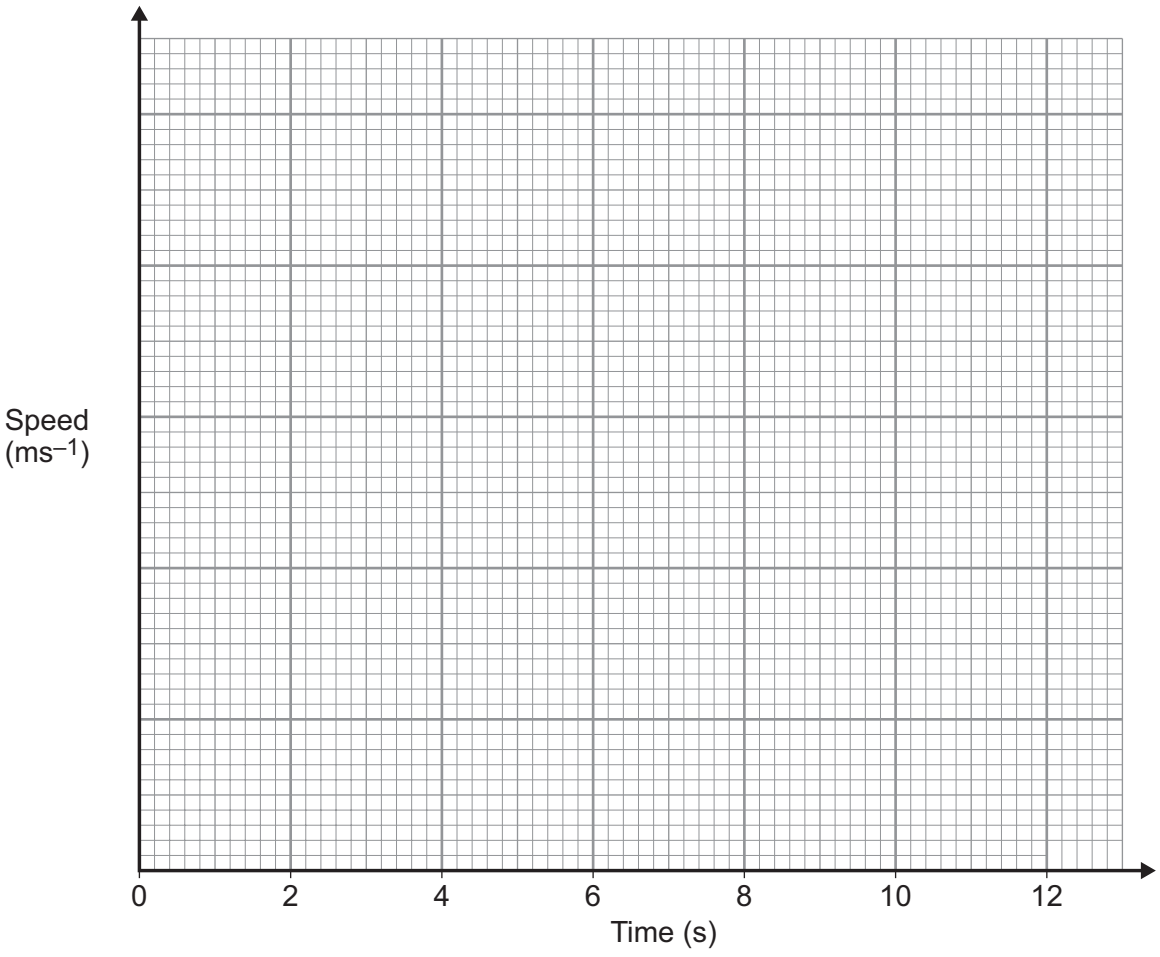
6 (b) Use the graph to estimate the maximum speed of the car as it overtakes the lorry.

[3 marks]

Answer _____ $m\,s^{-1}$

6 (c) Sketch a graph to show the speed of the car as it overtakes the lorry.

[3 marks]



7 Lily is a parachutist.

She jumps from a static balloon and falls vertically through the air.

Before her parachute is opened, Lily's speed, v m s^{-1}, at time t seconds after leaving the balloon, is modelled by the equation

$$v = 54(1 - e^{-0.2t})$$

Lily opens her parachute after 3 seconds.

7 (a) Work out Lily's speed as she opens her parachute.

[2 marks]

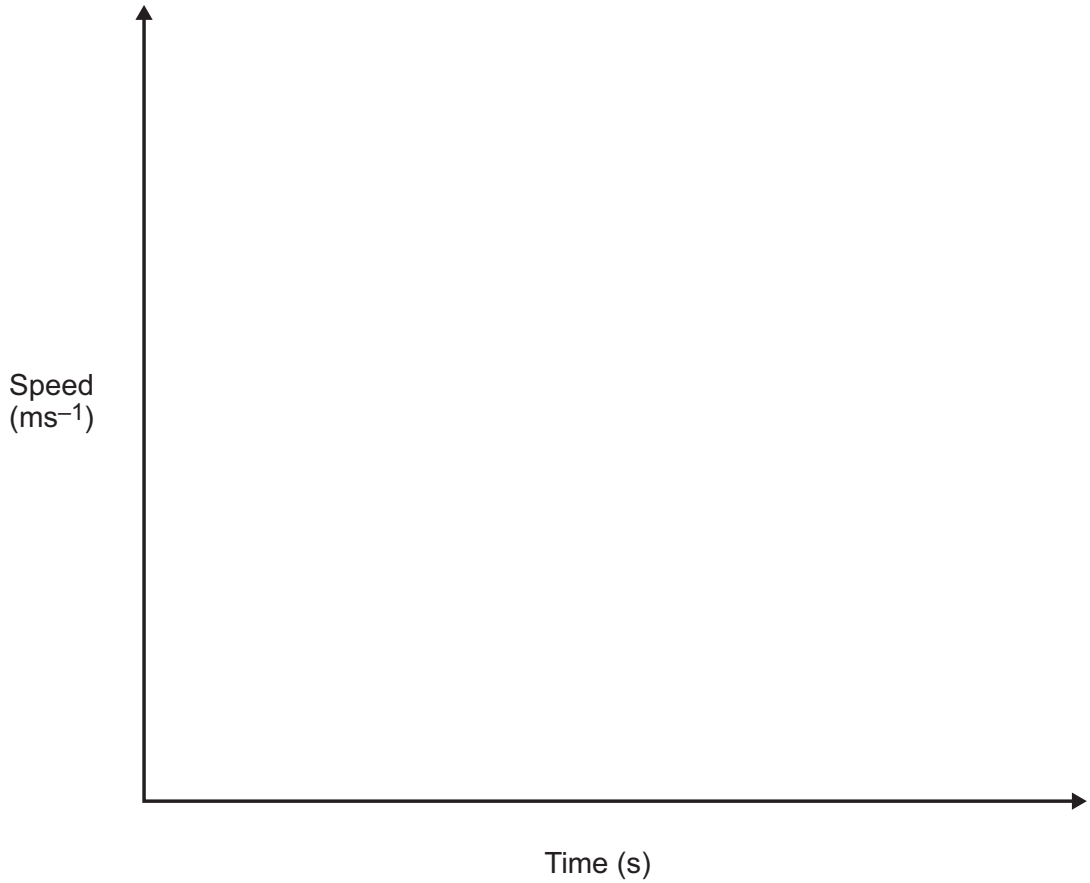
Answer _____ m s^{-1}

7 (b) After the parachute has opened, Lily's speed reduces rapidly and can be modelled by an exponential function.

Eventually Lily's speed approaches 8 m s^{-1}

Sketch a graph to show Lily's speed after she leaves the balloon.

[3 marks]



7 (c) When the parachute has been open for 2 seconds Lily's speed is 10 $m\,s^{-1}$

Her speed, V $m\,s^{-1}$, at time T seconds **after the parachute is opened**, is modelled by the equation

$$V = 8 + Be^{-kT}$$

where B and k are constants.

Work out Lily's speed 2.5 seconds after the parachute is opened.
Give your answer to two decimal places.

[7 marks]

Answer _____ $m\,s^{-1}$

END OF QUESTIONS

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