



1(a). A toy car is placed on the floor of a sports hall.

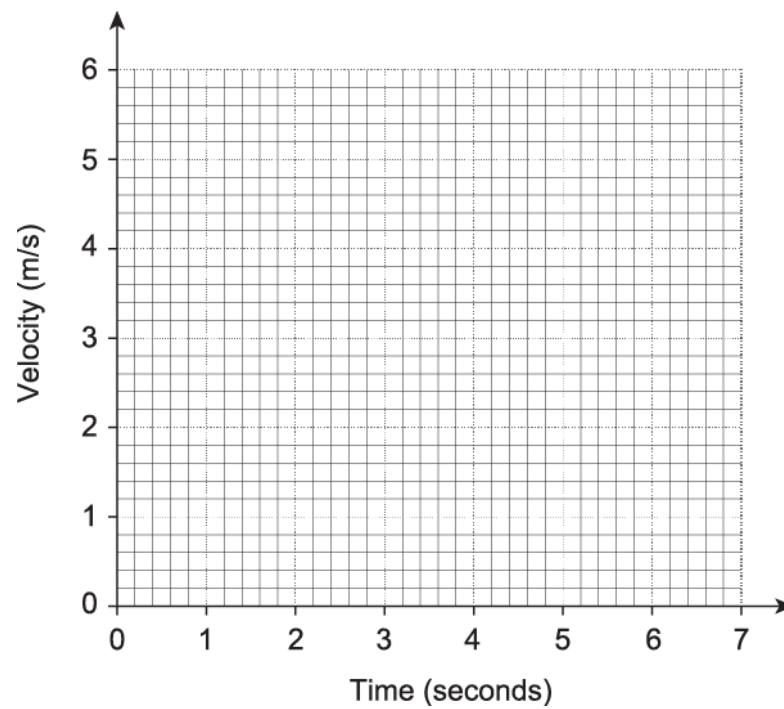
It moves in a straight line starting from rest.

It travels with constant acceleration for 4 seconds reaching a velocity of 5 m/s.

It then slows down with constant deceleration of  $1 \text{ m/s}^2$  for 2 seconds.

It then hits a wall and stops.

Draw a velocity-time graph for the toy car.



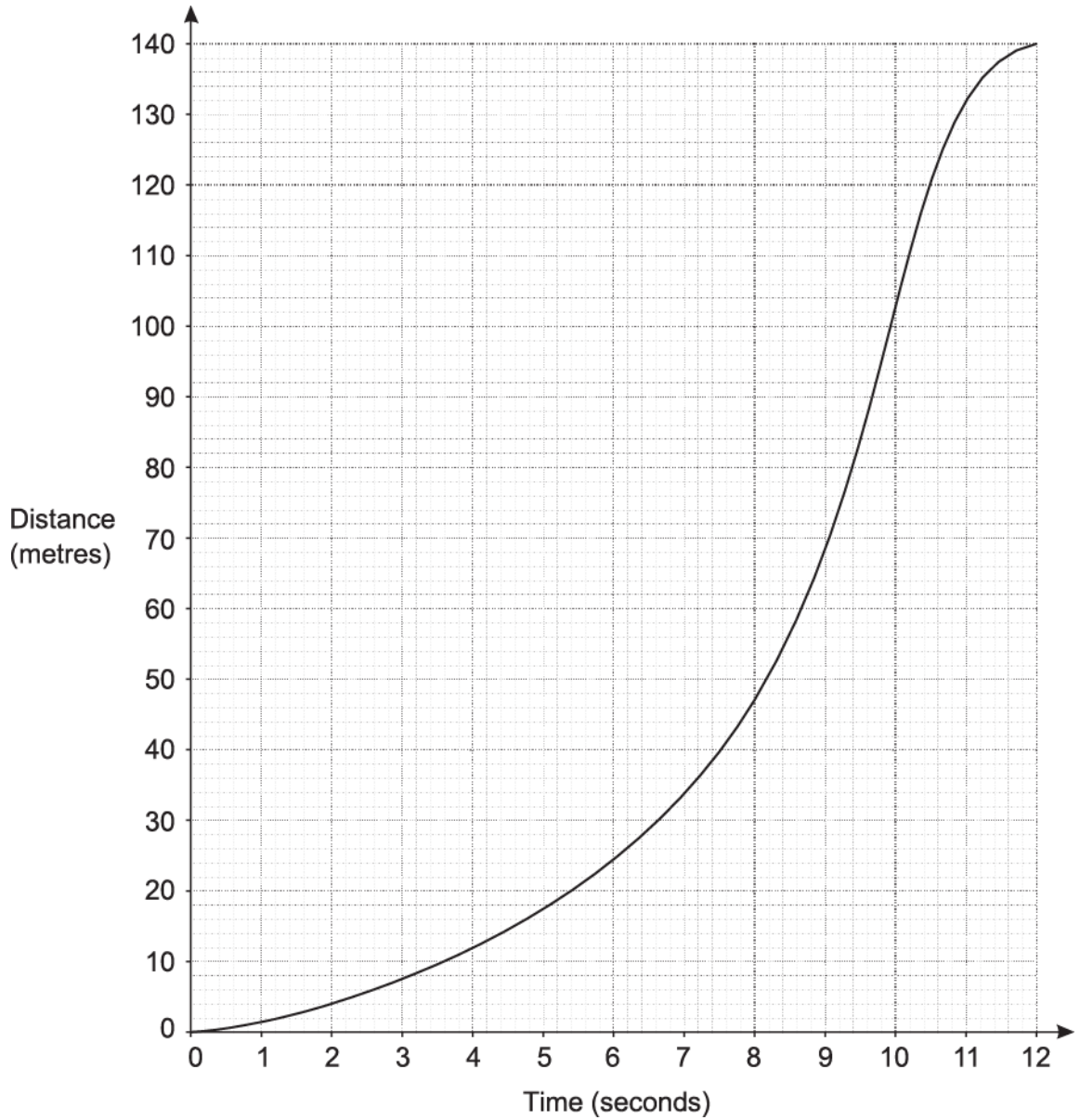
[3]



(b). Work out the total distance travelled by the toy car.

(b) ..... m [3]

2(a). The graph shows the distance travelled by an animal over 12 seconds.



Work out the average speed between 2 and 8 seconds.

----- m/s [2]

(b). Estimate the speed of the animal at 6 seconds.

----- m/s [4]

(c). Nuri says

I think this animal must be able to move at over 20 m/s!

Do you agree with Nuri?

Explain your decision.

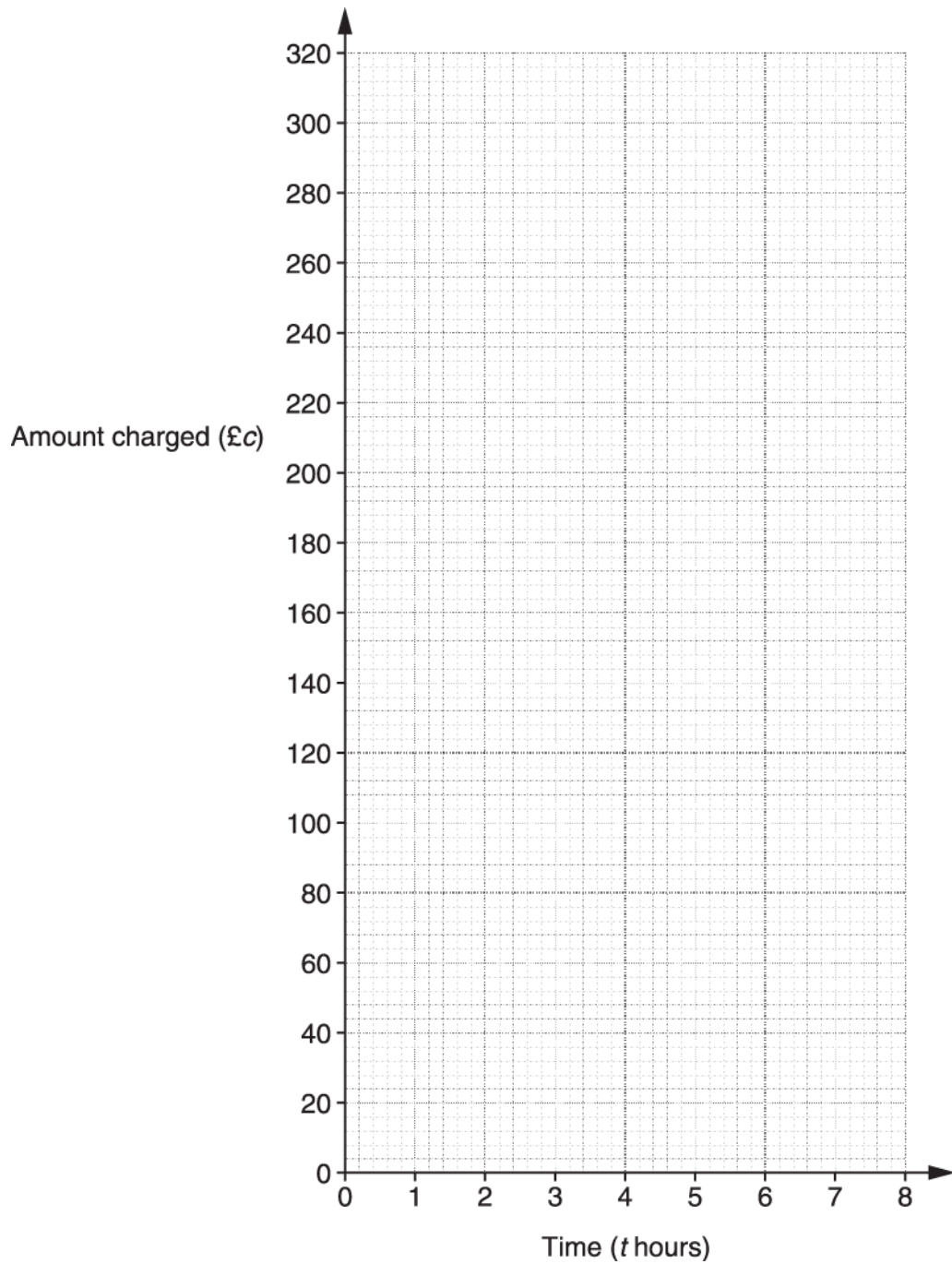
-----  
----- [2]



3. A plumber does three different tasks.  
She records the time each task takes and the amount she charges.

Task	A	B	C
Time taken ( $t$ hours)	1	3	7
Amount charged (£ $c$ )	60	140	300

- (i) Plot these values on the grid and draw a straight line through them.



(ii) The plumber charges a fixed call-out fee and an amount for each hour the task takes.

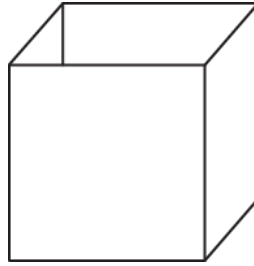
Complete the following.

The fixed call-out fee is £ \_\_\_\_\_ .

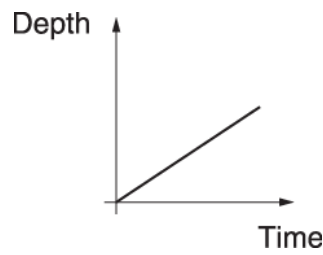
The amount for each hour is £ \_\_\_\_\_ .



4(a). This empty container is filled with water at a constant rate.

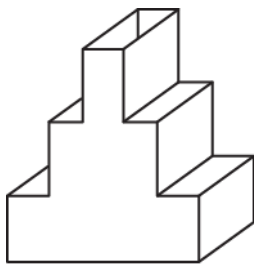


The graph of depth of water against time looks like this.

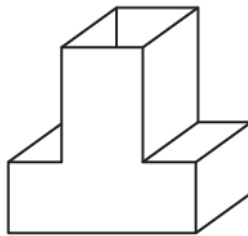


Four more empty containers are shown below.

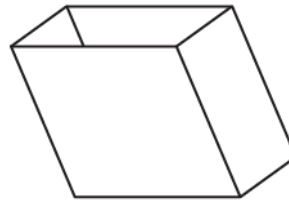
Each of these containers is filled with water at a constant rate.



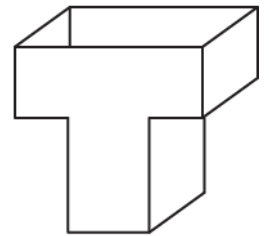
A



B

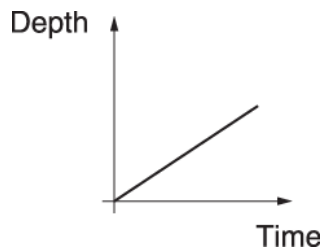


C



D

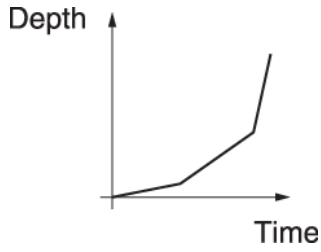
Choose which of these containers matches each of the graphs.



Container..... [1]



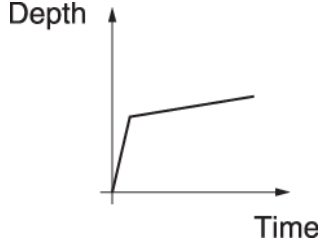
(b).



Container..... [1]



(c).

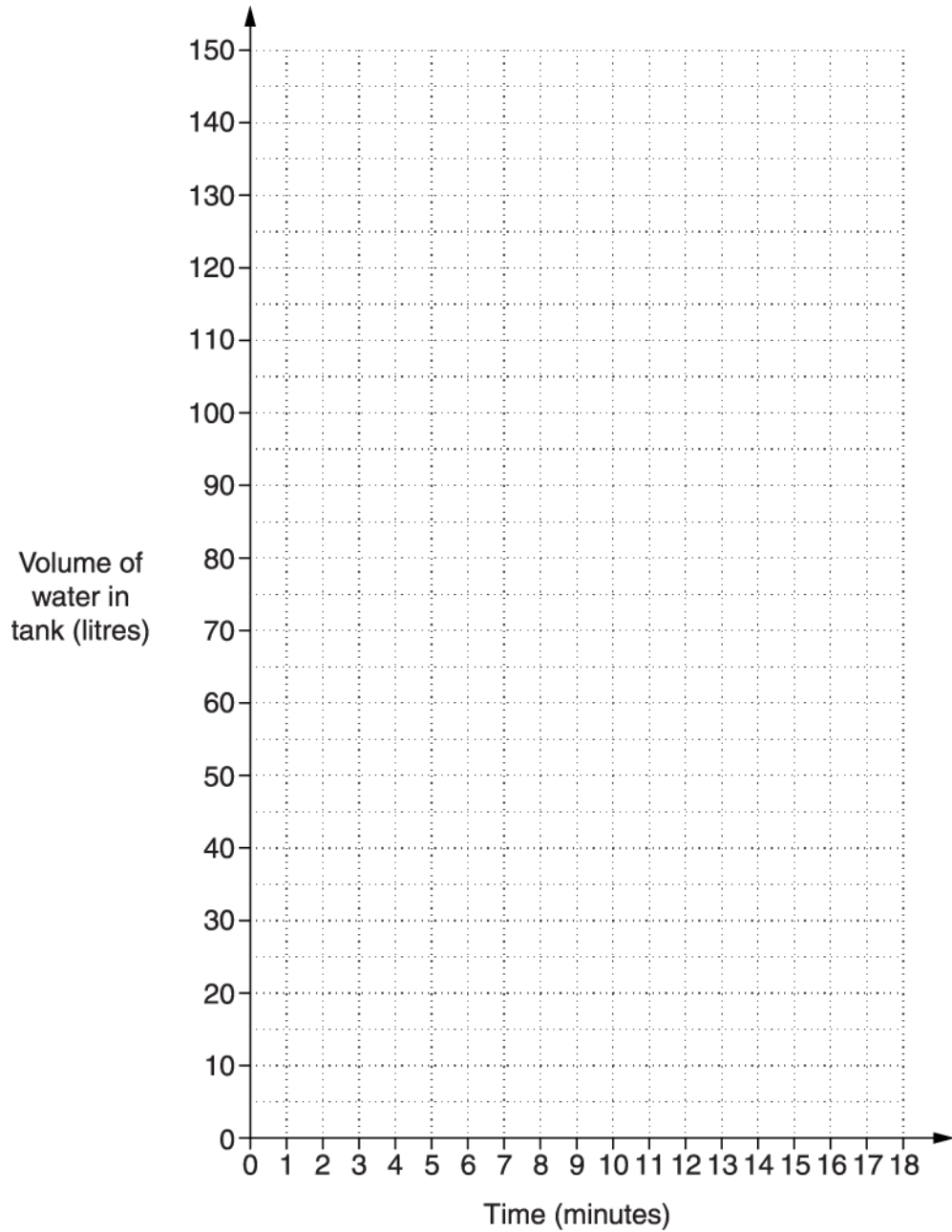


Container..... [1]



5. An empty water tank is to be filled with water and then emptied.  
For the first 4 minutes it is filled at a constant rate of 20 litres per minute.  
For the next 3 minutes it is filled at a constant rate of 15 litres per minute.  
It is then left for 2 minutes.  
It is then emptied at a constant rate of 25 litres per minute.

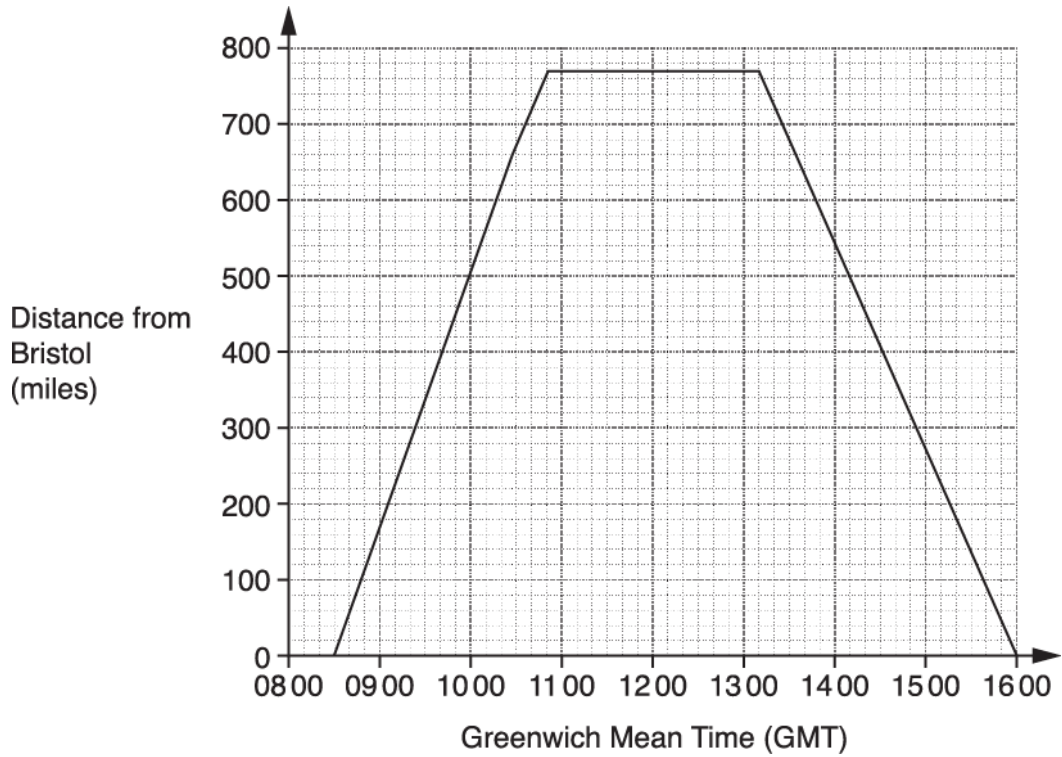
Show this information on the grid below.



[4]



6(a). The graph shows the journey of a plane from Bristol to Barcelona and back.



(i) Use the graph to complete this table.

Time (GMT)	08 30	10 30
Distance from Bristol (miles)	0	

[1]

(ii) Use the table to work out the average speed of the plane on the outward journey from Bristol to Barcelona. Give the units of your answer.

(ii) ..... [3]



(b). The local time in Barcelona is one hour **ahead** of GMT.

What was the **local time** when the plane landed at Barcelona?

----- [1]

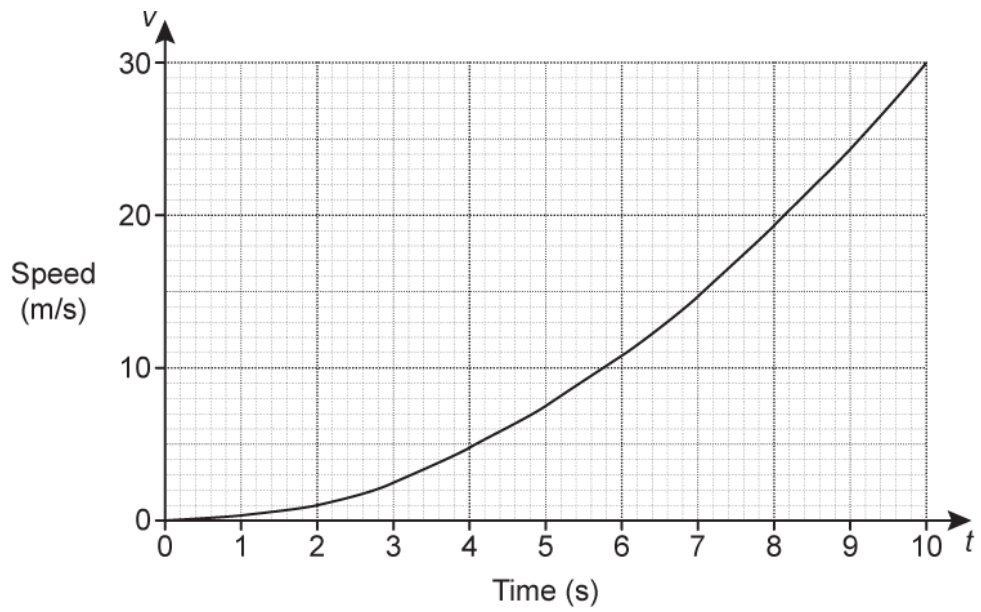


(c). The plane flew over a beacon which is 280 miles from Bristol.

Write down the GMT times when the plane flew over the beacon.

----- and ----- [2]

7(a). The graph shows the speed,  $v$  metres per second (m/s), of a car at time  $t$  seconds.



Find the speed of the car at  $t = 7$ .

----- m/s [1]

(b). It is claimed that the car has accelerated from 0 to 60 miles per hour in the first 10 seconds.

Does the graph support this claim? Show your reasoning.

Use 1 mile = 1.6 kilometres.

[5]

(c). Use the graph to estimate the acceleration at  $t = 7$ .

----- m/s<sup>2</sup>[3]

(d). Georgina says that the graph shows that the speed of the car will continue to increase after 10 seconds.

Make one comment to show that this statement is incorrect.

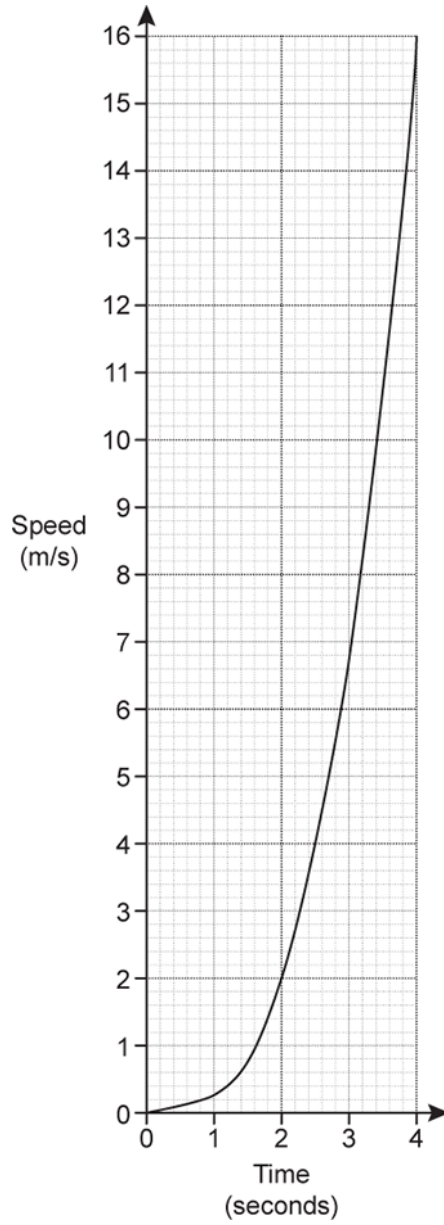
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----- [1]

8. The graph shows the speed, in metres per second, of a particle over the first four seconds of motion.

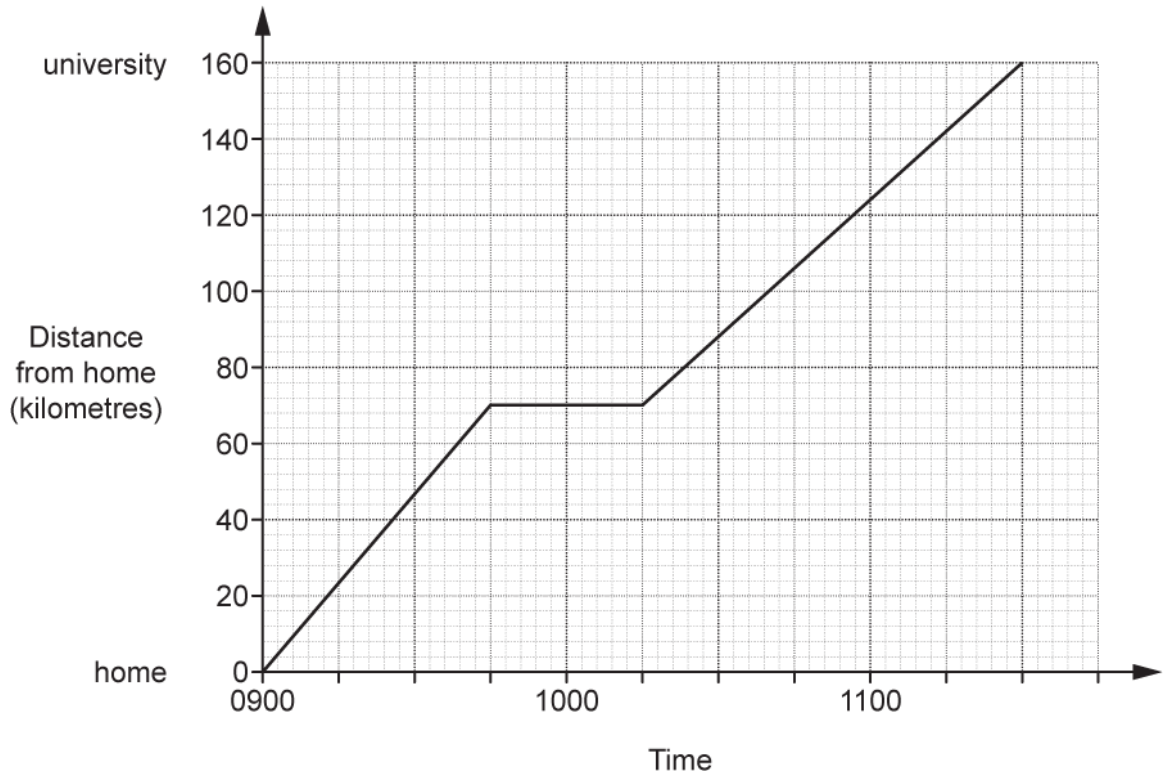


Use the graph to estimate the distance travelled by the particle in the four seconds.

----- metres [2]



9. The graph shows Mia's journey from her home to university.



Calculate Mia's average speed for the whole journey.

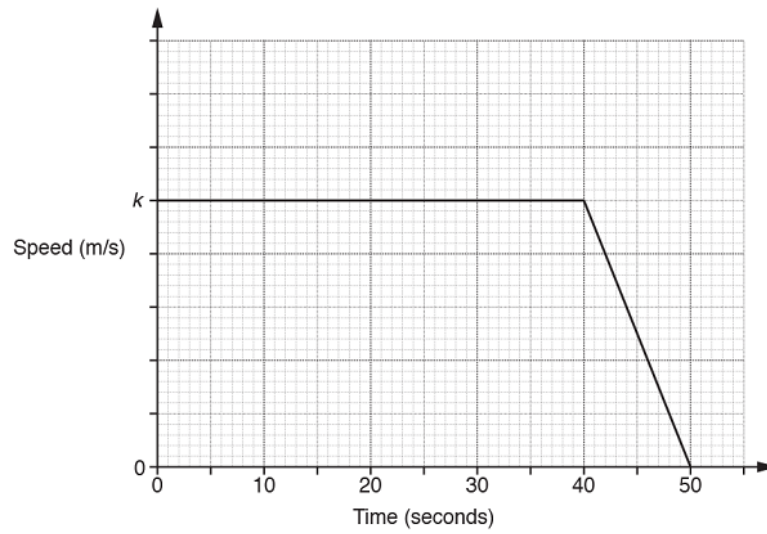
----- km/h [3]



10(a) The graph shows information about the speed of a vehicle during the final 50 seconds of a journey.

At the start of the 50 seconds the speed is  $k$  metres per second.

The distance travelled during the 50 seconds is 1.35 kilometres.



Work out the value of  $k$ .

$k =$  ----- [5]





(b).

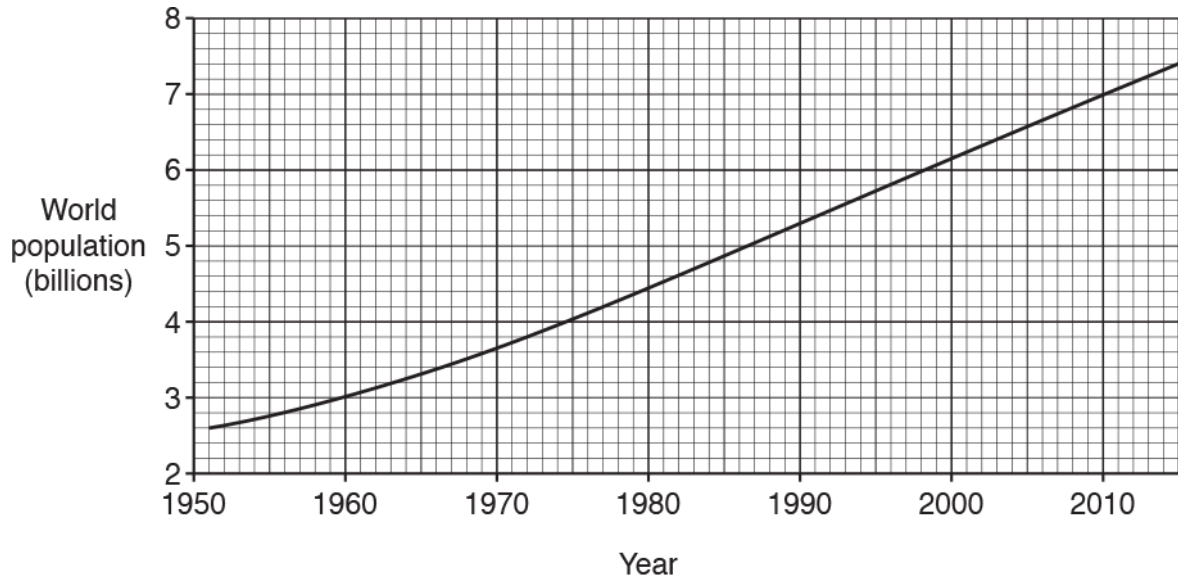
(i) Calculate the gradient of the graph in the final 10 seconds of the journey.

(i) ----- [1]

(ii) Describe what this gradient represents.

-----  
----- [2]

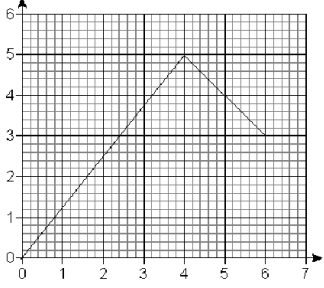
11. This graph shows the world population, in billions, between 1951 and 2015.



Use the graph to estimate the average rate of growth of the world population between 1951 and 2015.  
Give suitable units for your answer.

----- ° [3]

**END OF QUESTION PAPER**

Question			Answer/Indicative content	Marks	Part marks and guidance	
1	a		Both sections of graph correct 	3	B1 for plotting a line segment from the origin to (4, 5)  B1 for plotting a line segment from <i>their</i> '(4, 5)' to <i>their</i> ('4' + 2, '5' - 2)	
	b		18	3	M2 for $\frac{1}{2}(5 \times 4) + \frac{1}{2}(5 + 3) \times 2$ or M1 for attempt to find area under graph	Accept all ways to split area FT <i>their</i> graph
			<b>Total</b>	<b>6</b>		
2	a		7.1 to 7.2	2	M1 for $(47 - 4) \div (8 - 2)$ , allow one error	
	b		7.5 to 8.5	4	M1 for an attempt to draw a tangent drawn at 6 and M2 for <i>their</i> distance $\div$ <i>their</i> time e.g. $(40 - 2) \div (8 - 3)$ with a time gap of at least two seconds or M1 for an inaccurate attempt at distance $\div$ time (FT <i>their</i> tangent)	Accuracy $\pm 1$ mm
	c		Agreement, with correct reasoning	2	B1 for agreement, with partial reasoning	
			<b>Total</b>	<b>8</b>		
3		i	Correct ruled line from (1, 60) to (7, 300)	2	B1 for 3 points correct	$\pm 1$ small square Condone freehand line for max 1 mark  <b>Examiner's Comments</b>  Virtually all candidates were able to plot the points and join them with a ruled line.

Question			Answer/Indicative content	Marks	Part marks and guidance	
		ii	20	1		<b>Examiner's Comments</b>  Many did not continue the line back to the vertical axis making it harder to answer which required the value of the intercept. Despite this most candidates were able to extract the necessary information to find the call-out fee and hourly rate.
		ii	40	1		
			<b>Total</b>	<b>4</b>		
4	a		C	1		
	b		A	1		
	c		D	1	<b>Examiner's Comments</b>  This question was answered correctly by the vast majority of candidates.	
			<b>Total</b>	<b>3</b>		

Question		Answer/Indicative content	Marks	Part marks and guidance	
5		Line from (0, 0) to (4, 80) Line from (4, 80) to (7, 125) Line from (7, 125) to (9, 125) Line from (9, 125) to (14, 0)	1 1FT 1FT 1FT	Ruled straight lines $(n, m)$ to $(n + 3, m + 45)$ $(x, y)$ to $(x + 2, y)$ Correct gradient down to $(p, 0)$ <u>After 0</u> SC2 for 4 correct vertices Or SC1 for 2 correct vertices  <u>Examiner's Comments</u>  This question was well answered by most. The information was correctly interpreted and diagrams were accurate and neat. A few candidates drew a bar chart and others plotted a series of points, not always connected. A small number did not start and/or finish their graph on the horizontal axis.	Condone freehand straight Points correct 'by eye'  Correct gradient 'by eye'
		<b>Total</b>	<b>4</b>		

Question			Answer/Indicative content	Marks	Part marks and guidance	
6	a	i	660 to 680	1		

Question		Answer/Indicative content	Marks	Part marks and guidance	
	ii	330 – 340 mph or 5.5 – 5.7 mpm or [0].0916 – [0].095 mps	3	<p><b>B2</b> for answer of 330 – 340 or 5.5 – 5.7 or [0].0916 – [0].095 or FT <i>their (a)(i) ÷ 2</i> correctly calculated  or  <b>M1</b> for ‘a distance’ ÷ ‘a corresponding time taken’ e.g. <i>their(a)(i) ÷ 2</i> or 770 ÷ (2h 20m or 220 or 140 or 2 <math>\frac{1}{3}</math>oe)  and  <b>B1</b> for the correct units for their answer</p> <p>If <b>0</b> scored award <b>B1</b> for units of mph with no working</p> <p><b>Examiner's Comments</b></p> <p>Part (i) was answered well except those who went for 770. However in part (ii) the intention was that candidates simply had to use their answer to (i) and divide by 2, the majority however went back to the graph and read the distance and time from it. The majority used 770 and the time taken 2 hrs 20 mins. Many candidates were understandably unsure how to deal with 2 hrs 20 mins, with common incorrect attempts including 220 minutes and 2.2 hours. The demand does clearly state “use your table” which few did. To ease the numeric demand some converted to minutes or even seconds and the units mark was dependent on the units used by each candidate.</p>	<p>We look at their number to indicate the units they are using</p> <p>They must use the outward journey</p> <p>Allow m/h, m/m or m/s</p>

Question		Answer/Indicative content	Marks	Part marks and guidance	
	b	11 50 [am] cao	1	<p><u>Examiner's Comments</u></p> <p>Many did get the correct answer, but some gave 09 50 by subtracting one hour whilst others gave 15 00 taken from the final time.</p>	
	c	[0]9 20[am] [and] 15 00	1,1	<p>condone 14 55 – 15 00 or 2 55 – 3[ 00] pm for second time</p> <p><u>Examiner's Comments</u></p> <p>This was answered better still however some looked up 200 miles instead of 280 miles. There is a small number of candidates who still confuse the 24 hour clock with the 12 hour clock showing times such as 15 00 pm.</p>	15 00 pm scores 0
		<b>Total</b>	<b>7</b>		



Question		Answer/Indicative content	Marks	Part marks and guidance	
7	a	14 – 15	1	<p style="text-align: center;"> </p> <p><b>Examiner's Comments</b></p> <p>Most candidates answered this part correctly.</p>	

Question		Answer/Indicative content	Marks	Part marks and guidance		
	b	<p>30 from graph</p> <p>Starting with <i>their</i> 30 (using mph) <i>These method marks could be awarded in any order</i></p> <p><math>\times 60^2</math> soi <math>\div 1000</math> soi</p> <p><math>\div 1.6</math> soi</p> <p>67.5 so yes</p>	<p><b>B1</b></p> <p><b>M1</b></p> <p><b>M1</b></p> <p><b>M1</b></p> <p><b>A1</b></p>	<p>Starting with 60 (using m/s) <i>These method marks could be awarded in any order</i></p> <p><math>M1 \times 1.6</math> soi by 96 <math>M1 \times 1000</math> soi</p> <p><math>M1 \div 60^2</math> soi <b>B1</b> for 30 from graph <b>A1</b> for 26.6 to 26.7 and 30 so yes</p>	<p>accept any correct method e.g.</p> <p>(using km/hr) <b>M1</b> for <math>60 \times 1.6</math> soi by 96 <b>B1</b> for 30 from graph Starting with <i>their</i> 30 <i>These method marks could be awarded in any order</i></p> <p><math>M1 \times 60^2</math> soi <math>M1 \div 1000</math> soi</p> <p><b>A1</b> for 96 and 108 so yes</p>	
				<b>Examiner's Comments</b>		
				<p>In this part, they had to compare two values. The most successful candidates were those who started from 30 and worked towards the speed (67.5 mph). Some converted 60 mph to 96 km/h and compared with 108 km/hour. A few started with 60 and changed that to m/s. Many did not show their working clearly and often included a number of calculations in one step, which was difficult to follow.</p>		

Question		Answer/Indicative content	Marks	Part marks and guidance	
	c	<p>Attempt at a tangent drawn at <math>t = 7</math></p> <p>4.0 to 4.5 oe</p>	<p>B1</p> <p>B2</p>	<p>M1 for an attempt at speed <math>\div</math> time, could be on the graph e.g. <math>30 \div 10</math> or <i>their</i> (a) <math>\div 7</math> so 2.07... or 2.14..</p>	<p>Accept answer as a fraction and tolerance on reading from graph <math>\pm \frac{1}{2}</math> small square</p> <p>Gradient for M1 could be from a chord.</p> <p>Ignore any negative sign</p> <p><b>Examiner's Comments</b></p> <p>In this part, some candidates realised that they needed to draw a tangent to estimate the acceleration, but a few of them then went on to make errors with the scales, particularly the time scale. The majority of candidates however did not use a tangent and simply took their reading of speed in part (a) and divided it by 7.</p>

Question		Answer/Indicative content	Marks	Part marks and guidance	
	d	any correct comment e.g. graph only valid / information only available up to 10 secs or car will eventually reach max. speed	1	See appendix	
				<b>Examiner's Comments</b>	
				The majority of candidates in this part responded along the lines that "the graph only had valid information up to 10 seconds" or that "the car will eventually reach a maximum speed". There were some predictions based on what (they incorrectly thought) the graph showed up to 10 seconds, for example "the line is starting to straighten out" or "the acceleration has stopped increasing at the end".	
		<b>Total</b>	<b>10</b>		

Question		Answer/Indicative content	Marks	Part marks and guidance	
8		evidence of finding the area under the graph  15 to 22	M1  B1	M1 for evidence of any correct method to find the area under the graph e.g. counting squares (numbers or dots in squares) or use of triangles, trapeziums or rectangles  accept answer as a fraction	
<b>Total</b>			<b>2</b>		

**Examiner's Comments**

The majority of responses showed just  $4 \times 16 = 64$  or  $16 \div 4 = 4$ . There were only few that realised they had to find the area under the graph and the most common attempts to do this used triangles and rectangles.

Question		Answer/Indicative content	Marks	Part marks and guidance		
9		64	3	<p>M2 for <math>160 \div 2.5</math> oe isw</p> <p>Or M1 for 160 and 2.5 oe seen or for attempt at 160 divided by <i>their time interval</i> isw or for clear attempt to find gradient of line joining (09 00, 0) to (11 30, 160)</p> <p>or <i>their dist</i> divided by 2.5 oe isw</p>	<p>For M1, <i>their time interval</i> is in range 2 to 3 or 2h 30m or 1.5 or 3.5 accept 150 mins used</p>	
				<p><b>Examiner's Comments</b></p> <p>Many candidates struggled with this question and were seemingly unsure of how to find average speed. Of those that divided 160 by 2.5, a number made arithmetic errors. Many others were unable to use the correct time interval, with 2 hours, 3 hours and 11 hours 30 mins sometimes used. Many candidates tried a 3-stage calculation for each stage of the journey, which was often left incomplete. A few found the area under the graph. Working in this question was often very random with candidates trying a variety of different and often conflicting</p>		

Question			Answer/Indicative content	Marks	Part marks and guidance	
					methods.	
			Total	3		

Question			Answer/Indicative content	Marks	Part marks and guidance	
10	a		30	5	<p><b>B1</b> for 1350  <b>M3</b> for <math>1350 = 40k + \frac{1}{2} \times 10 \times k</math>  <b>oe</b>  or <b>M2</b> for <math>40k + \frac{1}{2} \times 10 \times k</math> <b>oe</b>  or <b>M1</b> for any attempt to find any relevant area under the graph</p>	<p>Condone figs 135 for M3 and variable other than <math>k</math></p>
					<p><u>Examiner's Comments</u></p> <p>This question was also poorly answered by most candidates.</p> <p>In part (b), those that knew that the area under the graph gave the distance on a speed-time graph were successful. Most candidates, however, were unfamiliar with this concept.</p>	
	b	i	-3	1FT	<p>FT (<i>-their</i> (b) <math>\div 10</math>)</p>	<p><u>Examiner's Comments</u></p> <p>This question was also poorly answered by most candidates.</p> <p>In part (c), candidates could follow through from their <math>k</math> value in part (b). A few scored this mark but many overlooked the fact that the gradient was negative.</p> <p>Very few could describe what the gradient represented in terms of a deceleration in <math>\text{m/s}^2</math>.</p>



Question			Answer/Indicative content	Marks	Part marks and guidance	
		ii	[Constant] deceleration oe  m/s <sup>2</sup>	1  1		Condone acceleration The rate at which the speed changes
			<b>Total</b>	<b>8</b>		
11			71 000 000 to 89 000 000 in figs or words          people/year	2     <b>and</b>  1	<p><b>M1</b> for attempt to find 'gradient' using figures from the graph e.g. (7.4 – 2.6) ÷ (2015 – 1951)</p> <p><b>Examiner's Comments</b></p> <p>Most candidates identified the world populations in 1951 and 2015 but did not know how to proceed. Those attempting a gradient calculation were usually successful and able to state their answer in figures or words. Few mentioned 'people' when giving the units for their answer.</p>	<p>Could be in billions Eg. (7 400 000 000 – 2 600 000 000) ÷ (2015 – 1951)</p> <p>For M1, condone incorrect conversion used consistently for both population figures.</p>
			<b>Total</b>	<b>3</b>		