

Surname	Centre Number	Candidate Number
Other Names		0



GCSE LINKED PAIR PILOT

4361/02

APPLICATIONS OF MATHEMATICS

UNIT 1: Applications 1 HIGHER TIER

P.M. TUESDAY, 15 January 2013

2 hours

ADDITIONAL MATERIALS

A calculator will be required for this paper.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

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

Take π as 3.14 or use the π button on your calculator.

INFORMATION FOR CANDIDATES

You should give details of your method of solution when appropriate.

Unless stated, diagrams are not drawn to scale.

Scale drawing solutions will not be acceptable where you are asked to calculate.

The number of marks is given in brackets at the end of each question or part-question.

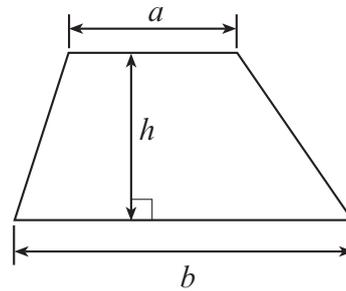
You are reminded that assessment will take into account the quality of written communication (including mathematical communication) used in your answer to question 8(b).

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1	7	
2	4	
3	6	
4	8	
5	8	
6	3	
7	10	
8	8	
9	6	
10	13	
11	13	
12	14	
TOTAL MARK		

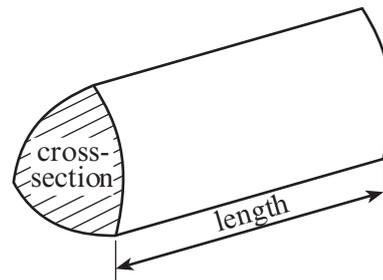
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Formula List

Area of trapezium = $\frac{1}{2}(a + b)h$

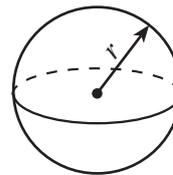


Volume of prism = area of cross-section \times length



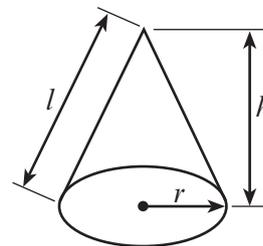
Volume of sphere = $\frac{4}{3}\pi r^3$

Surface area of sphere = $4\pi r^2$



Volume of cone = $\frac{1}{3}\pi r^2 h$

Curved surface area of cone = $\pi r l$

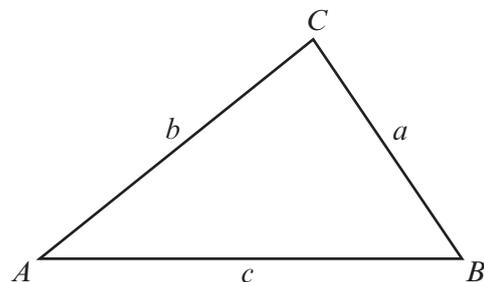


In any triangle ABC

Sine rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine rule $a^2 = b^2 + c^2 - 2bc \cos A$

Area of triangle = $\frac{1}{2}ab \sin C$



The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$

where $a \neq 0$ are given by

$$x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$$

1. (a) Write down expressions for each of the following.

- (i) The total cost, in pence, of 3 buttons at e pence each and 2 sewing needles at f pence each.

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[2]

- (ii) The total cost of these buttons and needles in pounds.

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[1]

(b) Write down an expression for the number of metres in t kilometres.

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[1]

(c) Write down an expression for the following.

The total amount of money donated to a charity by 5 people, given that the mean amount of money each gave was x pounds.

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[1]

(d) Write down an expression for the area of the right-angled triangle shown below written in its simplest form.

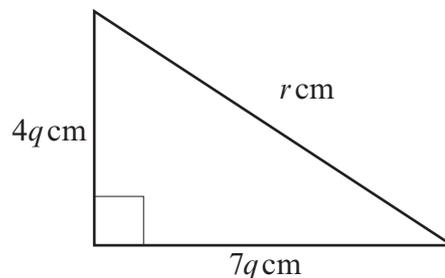


Diagram not drawn to scale

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[2]

2. Owen works in a DIY warehouse.
He is asked to sort some tiles.
He has the following shapes of tiles to sort.

Square Kite Rhombus Parallelogram

- (a) He is asked to sort the tiles using the table shown below.
Complete the table.

Tiles with equal diagonals	All other tiles

[2]

- (b) Owen is then asked to sort the tiles differently using the table shown below.
Complete the table.

Tiles with opposite sides parallel	All other tiles

[2]

3. (a) Abby is having difficulty deciding on a four-digit code for her debit card.



To generate a code, she decides to write down an expression in which she would substitute her age.

When an expression produces a four-digit number, she could then use it as her code.

Abby is 17 years old.

In each of the following expressions, y is Abby's age.

Evaluate the expressions to find which of them Abby could use to produce a four-digit code for her debit card.

You must show all your working and answers.

$$y^2 - 2y$$

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$$3y(2y^2 + 5)$$

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$$\frac{289y + 502}{5}$$

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Abby's four-digit code

[4]

- (b) Charlie is also having difficulty deciding on a four-digit code.
He decides to use the smallest four-digit number he gets by squaring a prime number.
Find Charlie's four-digit code.

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[2]

4. A survey is to be carried out to find out how popular MP3 players are across the various age groups of the general population. The survey is carried out by asking people questions as they come out of a cinema. Two questions from the survey questionnaire are shown below.

1. How old are you?		
Put a tick in the box	under 10	<input type="checkbox"/>
	10 to 20	<input type="checkbox"/>
	20 to 30	<input type="checkbox"/>
	older than 30	<input type="checkbox"/>
2. Do you own an MP3 player?		
Put a tick in the box	Yes	<input type="checkbox"/>
	No	<input type="checkbox"/>

- (a) Is this a biased survey? Give a reason for your answer.

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[1]

- (b) State a criticism about the design of question 1 in the survey.

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[1]

- (c) Write a question, with a selection of answer boxes, to find out how much people are prepared to pay for MP3 players.

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[2]

- (d) If you were to use your question to carry out a survey by asking 100 people today and again tomorrow, would you expect to get exactly the same results? Give a reason for your answer.

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- (e) A different survey was carried out to find the favourite colour of MP3 players. The results are shown in the table below.

Favourite colour of MP3 player	Number of people		
	The first 20 people asked	The second 20 people asked	The third 20 people asked
Red	2	5	8
Black	5	4	3
Silver	13	11	9

- (i) Did any person answering the survey have a favourite colour of MP3 player other than red, black or silver? Give a reason for your answer.

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- (ii) Calculate the best estimate for the probability that one of the people answering the survey, selected at random, says that their favourite colour of MP3 player is black.

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[2]

5. Danny is setting out a treasure hunt.
 The first clue is found 300 m from the start on a bearing of 120° .
 The second clue is found 360 m from the position of the first clue on a bearing of 040° .
 The third clue is found 100 m from the position of the second clue on a bearing of 280° .

- (a) Using a scale of 1 cm to represent 40 m, complete an accurate scale drawing of the treasure hunt route, showing the positions of the three clues.

[5]

North



Start

- (b) Write down the bearing of the start from the position of the first clue.

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- (c) Write down the distance and the bearing of the start from the position of the third clue.

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Distance m

Bearing $^\circ$

[2]

6. Natasha, Aled and Sara buy a computer between them.
They share the cost of the computer in the ratio 2:3:5.
Natasha pays the smallest share and Sara pays the largest share.
Aled pays £195 towards buying the computer.
Calculate how much the computer costs to buy.

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[3]

7. (a) (i) When visiting a hat shop, customers had the circumference of their head measured. The table shows the results for the customers who bought a hat during December.

Head circumference, c cm	Number of customers
$50 \leq c < 54$	12
$54 \leq c < 58$	32
$58 \leq c < 62$	14
$62 \leq c < 66$	2

Calculate an estimate for the mean head circumference.

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[4]

- (ii) The hat shop sells 4 different sizes of hats. The conversion table from head circumference to hat size is shown below.

Head circumference, c cm	Hat size
$50 \leq c < 54$	1
$54 \leq c < 58$	2
$58 \leq c < 62$	3
$62 \leq c < 66$	4

A salesman places an order for new stock for the hat shop. The salesman's order form shows that about half of the hats ordered are size 2. The owner of the shop says the order should show that about a quarter of the hats ordered are size 2. Who is more likely to be correct, the salesman or the owner of the shop? You must give a reason for your answer.

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[2]

(b) Sales of hats were recorded each season.

Season	Summer 2011	Autumn 2011	Winter 2012	Spring 2012	Summer 2012	Autumn 2012
Number of hats sold	348	184	266	170	320	160

(i) Calculate the 4-season moving averages and complete the table below.

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4-season time period ending:	Spring 2012	Summer 2012	Autumn 2012
4-season moving average:			

[3]

(ii) Explain why using the 4-season moving average is useful.

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8. Eliza makes this sketch of a pond.

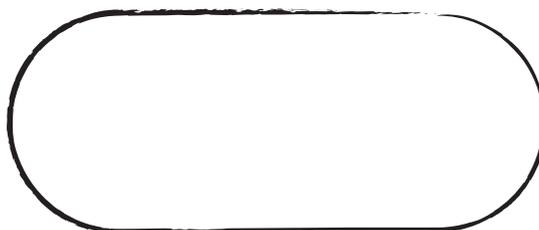


Diagram not drawn to scale

The shortest distance across the pond is 6 m.
The longest distance across the pond is 20 m.

Eliza estimates that the surface area of the pond is 120 m².

(a) Explain why the surface area of the pond is less than Eliza's estimate.

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[2]

(b) *You will be assessed on the quality of your written communication in this part of the question.*

Calculate an estimate for the surface area of the pond that would be more accurate than Eliza's estimate.
Show all of your working and explain how you have decided to calculate your estimate.

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[6]

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9. (a) In 2010 there were approximately 34 204 000 metres of railway track in the UK. Each section of railway track has **two rails**. The diagram shows a length of railway track.



Calculate an estimate for the total length, in metres, of **rails** in the UK in 2010. Give your answer in standard form.

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[2]

- (b) In some countries there are small gaps in the rails to allow them to expand in hot weather.



There is a 3 cm gap in every 19 metres of rail.
In one of these countries there is 5.43×10^6 metres of rail.
Calculate an estimate for the total length of the **gaps in the rail**, in metres.
Give your answer in standard form.

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[4]

10. A company is considering changes to its price list for delivering parcels in a local area. The company is considering a charge based on the distance between the warehouse and the destination of the parcel. The table gives the grouped frequency distribution for the distances, measured to the nearest km, for 60 parcels.

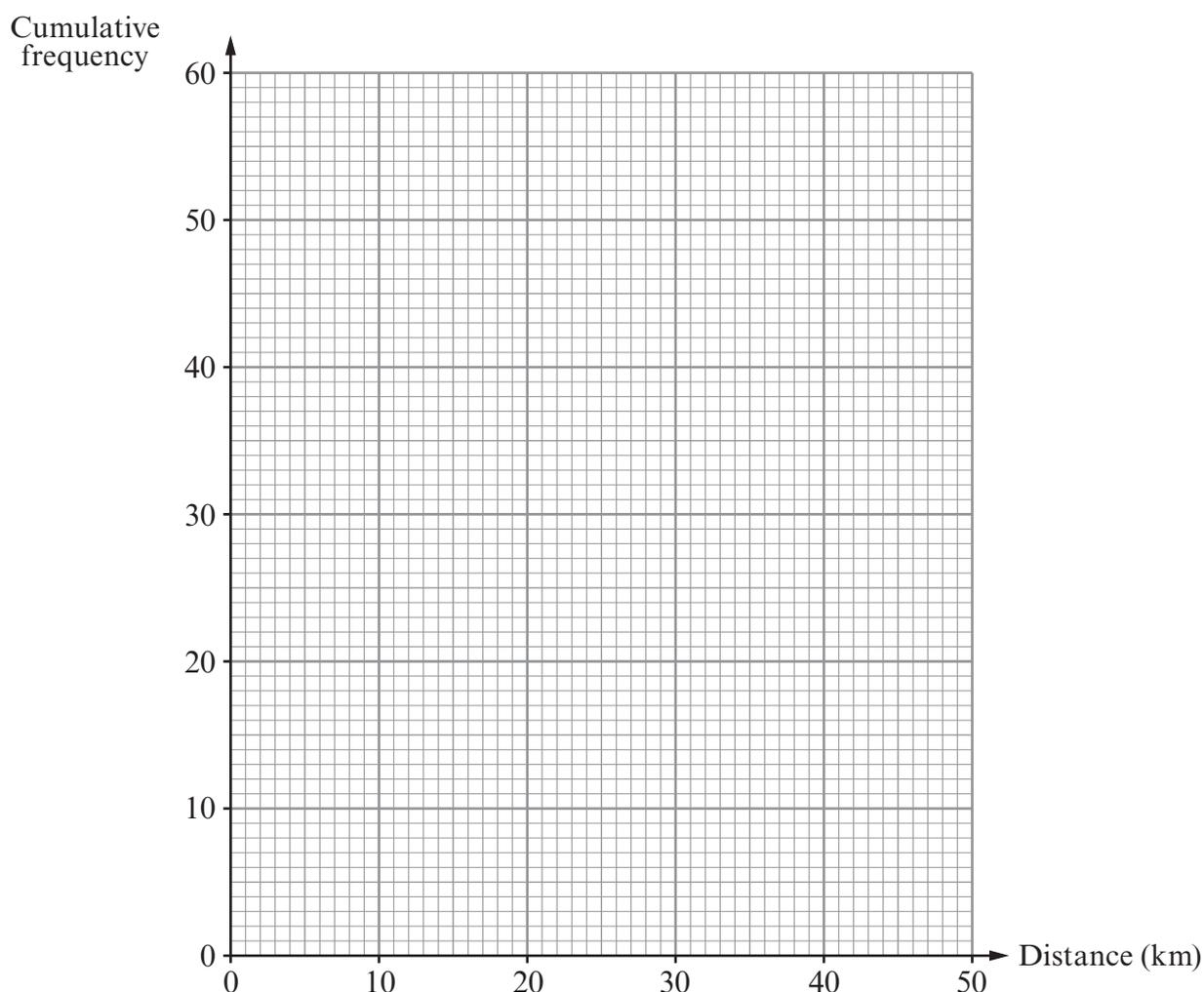
Distance, to the nearest km	1 - 10	11 - 20	21 - 30	31 - 40
Number of parcels	10	30	15	5

- (a) Complete the following cumulative frequency table.

Distance (km)	<0.5	<10.5	<20.5	<30.5	<40.5
Cumulative frequency	0	10			

[1]

- (b) On the graph paper below, draw a cumulative frequency diagram to show this information.



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- (c) Use your cumulative frequency diagram to find an estimate for the median and the interquartile range of the delivery distances.
You **must** show your working.

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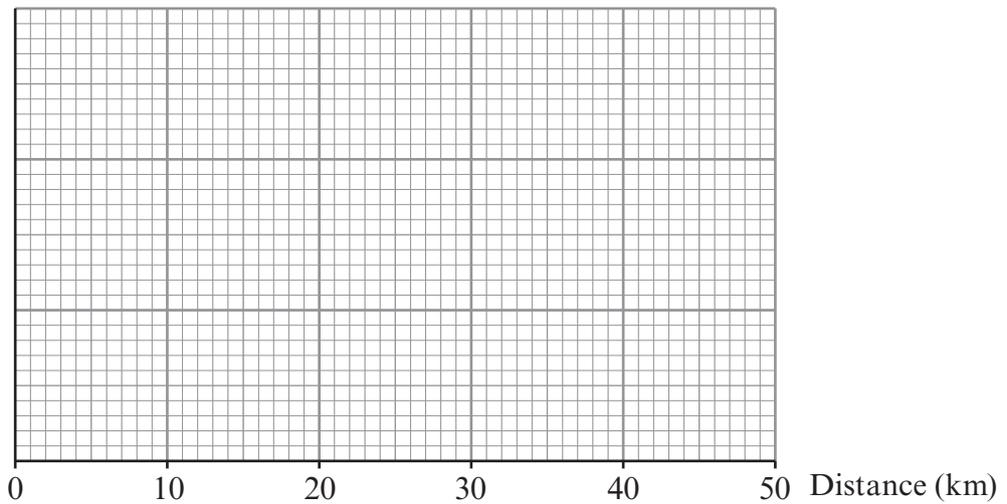
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Median Interquartile range

[3]

- (d) For these 60 parcels, the shortest delivery distance is 2km and the longest delivery distance is 37km.
Draw a box and whisker diagram to illustrate this information.



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- (e) Previously, the delivery charge was £2 for each parcel.
The new pricing plan being considered is:
- free delivery for all parcels up to the median delivery distance;
 - £4 per parcel for all other deliveries.

Would you expect the company to profit from the new pricing for parcel delivery?
Explain your answer.

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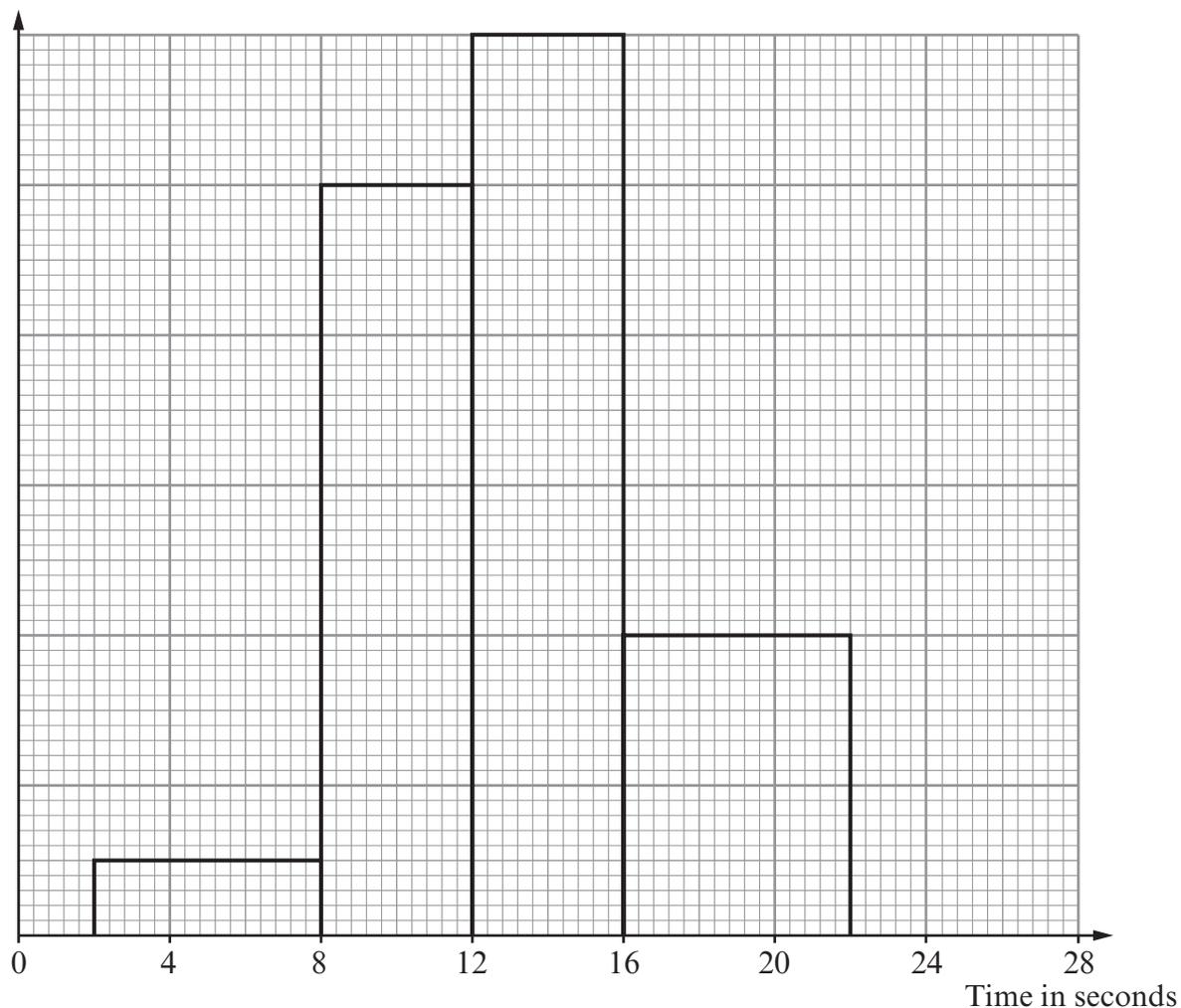
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11. (a) As part of a quality control exercise in a supermarket, the time taken to scan 20 items was measured for each worker under the age of 40. A printout of the histogram that illustrates the results obtained is shown below.

Frequency density



Unfortunately, the labelling of the frequency density axis was missing from the printout. It is known that there were 12 workers under the age of 40 that took more than 16 seconds to scan the 20 items.

- (i) Complete the labelling of the scale on the frequency density axis.

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- (ii) Calculate how many workers under the age of 40 took part in this quality control exercise.

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- (iii) Calculate an estimate of the median time taken by a worker under the age 40 to scan 20 items.

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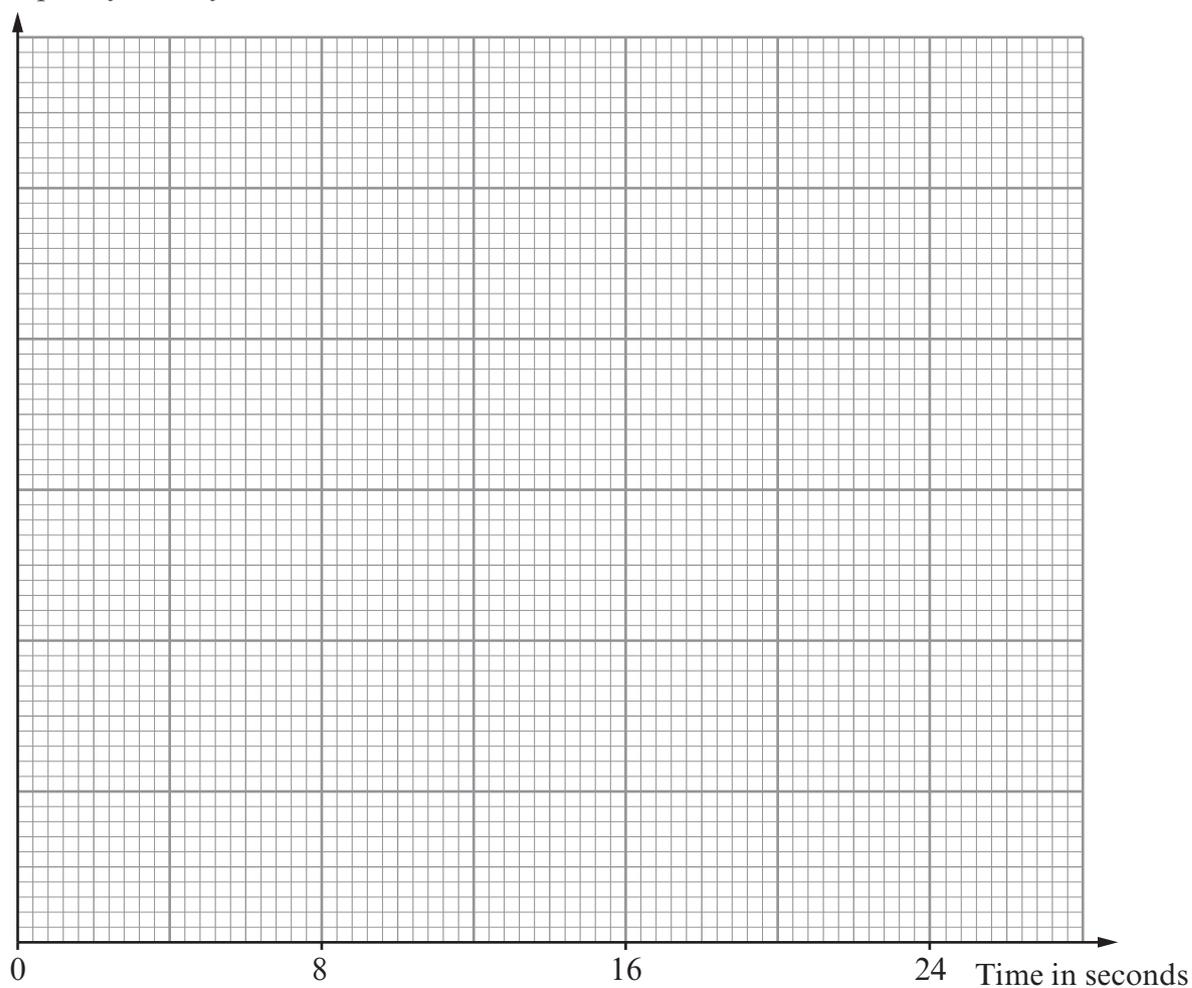
[4]

- (b) As part of the quality control exercise in a supermarket, the time taken to scan 20 items was measured for each worker aged 40 or over. The table below shows the results.

Time in seconds, t	$0 < t \leq 4$	$4 < t \leq 8$	$8 < t \leq 12$	$12 < t \leq 16$	$16 < t \leq 24$
Number of workers	0	2	36	24	8

Complete the scale on the frequency density axis and draw a histogram to illustrate the distribution on the graph paper below.

Frequency density



[3]

(c) Which of the two groups of workers is, on average, quicker at scanning 20 items in the supermarket? You must give a reason for your answer.

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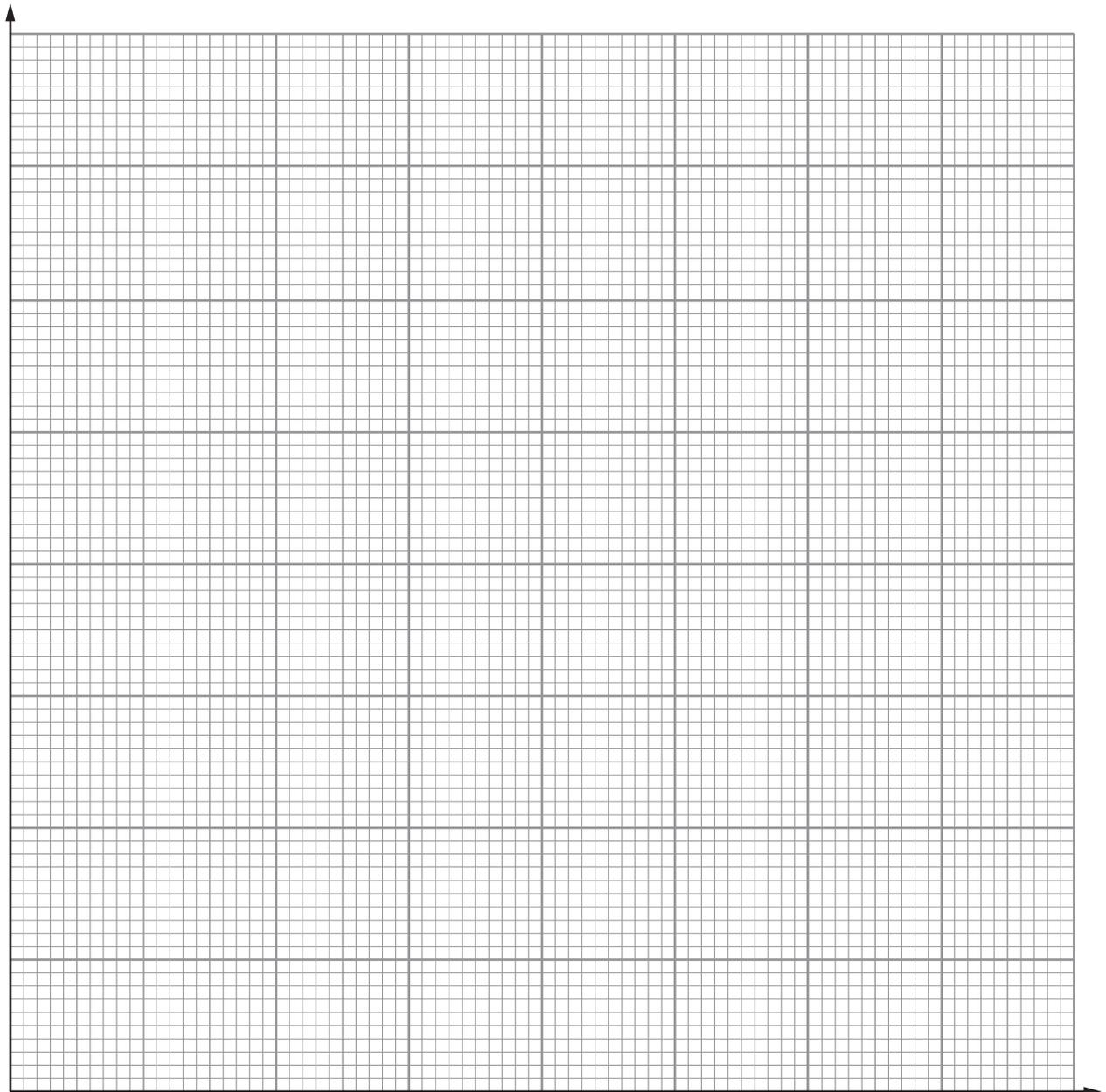
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Examiner
only

[1]

12. The formula $v = 8t - t^2$ is used to calculate the velocity v m/s of a particle at a time t seconds after the start of an experiment.

(a) Draw the graph of $v = 8t - t^2$ for values of t from 0 to 8.



[5]

(b) Find the time at which the acceleration of the particle is zero.

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(c) Find an approximation for the acceleration when $t = 7$.
State the units of your answer.

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(d) Find an approximation for the distance travelled by the particle by the time $t = 8$.

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