Surname	Centre Number	Candidate Number
Other Names		0

WJEC CBAC

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		

4361 020001

Examiner only

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.

Total Cost = $3e + 2f$

[2]

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

Total cost = $\frac{3e + 2f}{100}$ ($1p = \frac{1}{100}$ £)

[1]

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

$1000t$

[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.

$5x$

[1]

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

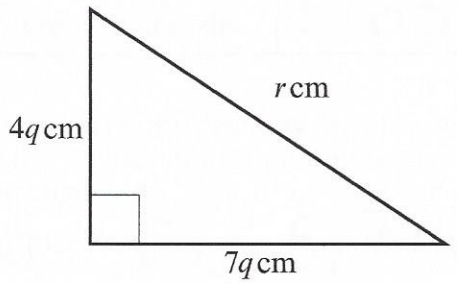


Diagram not drawn to scale

Area = $\frac{1}{2}(b \times h) = \frac{1}{2}(4q \times 7q) = \frac{1}{2}(28q^2)$

$\therefore$ Area = $14q^2$ (cm^2)

[2]

Examiner only

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
Square	Rhombus Parallelogram Kite

[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
Square Parallelogram Rhombus	Kite

[2]

Examiner only

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.

$y = 17$

$y^2 - 2y$

$y^2 - 2y = (17)^2 - 2(17) = 255$

1 2 3 Digits

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

$3y(2y^2 + 5) = 3(17)(2(17)^2 + 5)$
$= 29733$

1 2 3 4 5 digits

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

$\frac{289y + 502}{5} = \frac{289(17) + 502}{5} = 1083$

1 2 3 4 digits

Abby's four-digit code 1083

[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.

Prime Numbers : 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37
Prime Numbers Squared : 4, 9, 25, 49, 121, 169, 289, 361, 841, 961, 1369

$37^2 = 1369$

$\therefore$ 1369

Smallest 4-digit

[2]

Examiner only

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	☐
10 to 20	☐
20 to 30	☐
older than 30	☐

2. Do you own an MP3 player?

Put a tick in the box

Yes	☐
No	☐

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

No, as range of ages go to the cinema.

[1]

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

Age range option of 0→9, 10→20, 20→30, then sudden jump to older than 30, leaving large group of older people.

[1]

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

3. How much would you be willing to pay for an MP3?
Put a tick in Box

Under £20 ☐
£20 to £40 ☐
More than £40 ☐

[2]

Examiner only

(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.

No, as repeating a test can lead to different results.

[1]

(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
	= 20	= 20	= 20

(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.

No, as total of each column is 20.

[1]

(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.

$\frac{2+5+8}{20+20+20} \neq \frac{5+4+3}{20+20+20} = \frac{12}{60} = \frac{1}{5}$

Total People

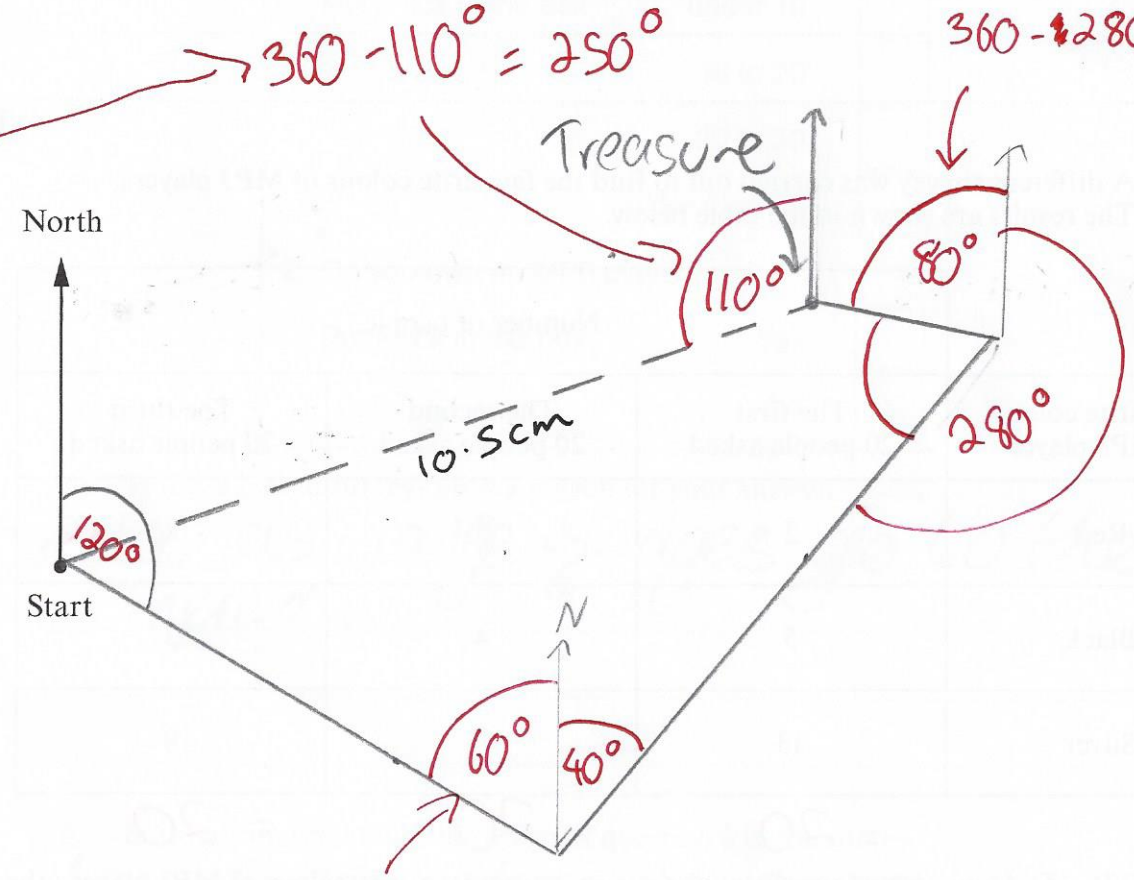
[2]

Examiner only

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]



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

300°

[1]

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

10·5cm => 10·5 x 40 = 420m

Distance 420 m

Bearing 250 °

[2]

Examiner only

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.

Total Parts = 2 + 3 + 5 = 10

Natasha : Aled : Sara

2 : 3 : 5

: 195 :

⇒ 3 parts = £195

⇒ 1 part = $\frac{195}{3}$ = £65

⇒ 10 parts = 65 × 10 = £650 [3]

∴ Cost of Computer = £650

Examiner only

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 (f)
$50 \leqslant c < 54$	52	12
$54 \leqslant c < 58$	56	32
$58 \leqslant c < 62$	60	14
$62 \leqslant c < 66$	64	2

Calculate an estimate for the mean head circumference.

Mid Points: 52, 56, 60, 64

$\Sigma fx = (52 \times 12) + (32 \times 56) + (60 \times 14) + (64 \times 2)$

$\therefore \Sigma fx = 3384$

$\text{Mean} = \frac{\Sigma fx}{12+32+14+2} = \frac{3384}{60} = 56.4 \text{ cm}$

[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
$50 \leqslant c < 54$	1
$54 \leqslant c < 58$	2
$58 \leqslant c < 62$	3
$62 \leqslant c < 66$	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.

32 hats of 60 Are Size 2

$\frac{32}{60} \approx \frac{1}{2}$ (Roughly half are size 2)

$\therefore$ Salesman statement is correct

[2]

Examiner only

(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.

1. $\frac{348+184+266+170}{4} = 242$

2. $\frac{184+266+170+320}{4} = 235$

3. $\frac{266+170+320+160}{4} = 229$

4-season time period ending:	Spring 2012	Summer 2012	Autumn 2012
4-season moving average:	242	235	229

[3]

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

Gives a picture of complete years sales by smoothing out data.

[1]

Examiner only

8. Eliza makes this sketch of a pond.

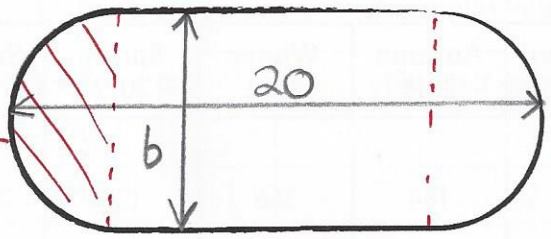


Diagram not drawn to scale

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 m^2.

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

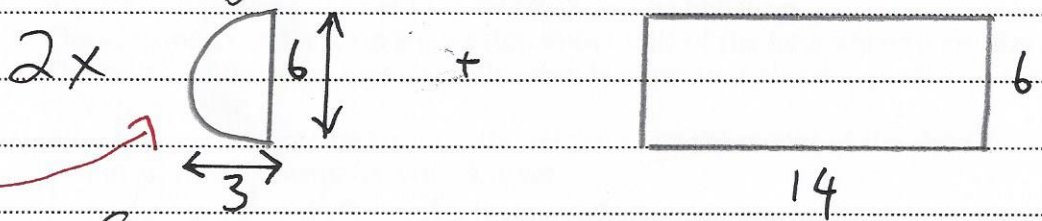
She has approximated the pond to be a rectangle, It is smaller than the stated rectangle. (Estimation = $6 \times 20 = 120 m^2$)

[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.

By splitting pond into 3 shapes.
E.g

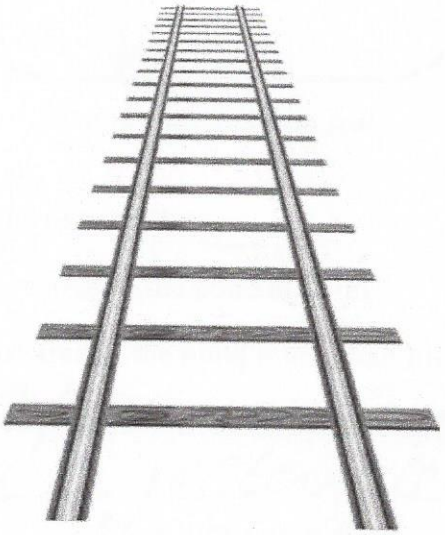


Area = 2x Semi Circle + Rectangle
$= 2 \times \frac{1}{2} \pi r^2 + (b \times h)$
$= \pi r^2 + (b \times h) = \pi (3)^2 + (14 \times 6)$
$= 112.27$

[6]

Examiner only

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.

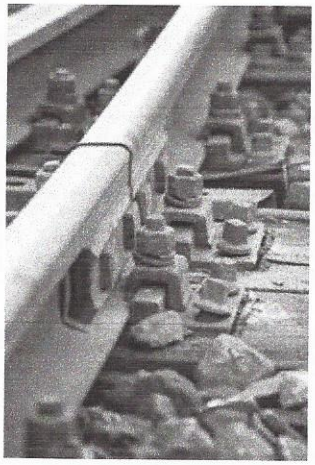
length = 2 × 34204000
= 68408000
= 6·8 × 10 7

Press ENG on
Calc.

[2]

Examiner only

(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 $5{\cdot}43 \times 10^6$ metres of rail.
Calculate an estimate for the total length of the **gaps in the rail**, in metres.
Give your answer in standard form.

Total Number of gaps $= \frac{5.43 \times 10^6}{19} = 286 \times 10^3$

$\therefore$ Total length of gaps $= 286 \times 10^3 \times \left(\frac{3}{100}\right)$

$= 8574$

$= 8.57 \times 10^3$

3cm in m

[4]

Examiner only

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.

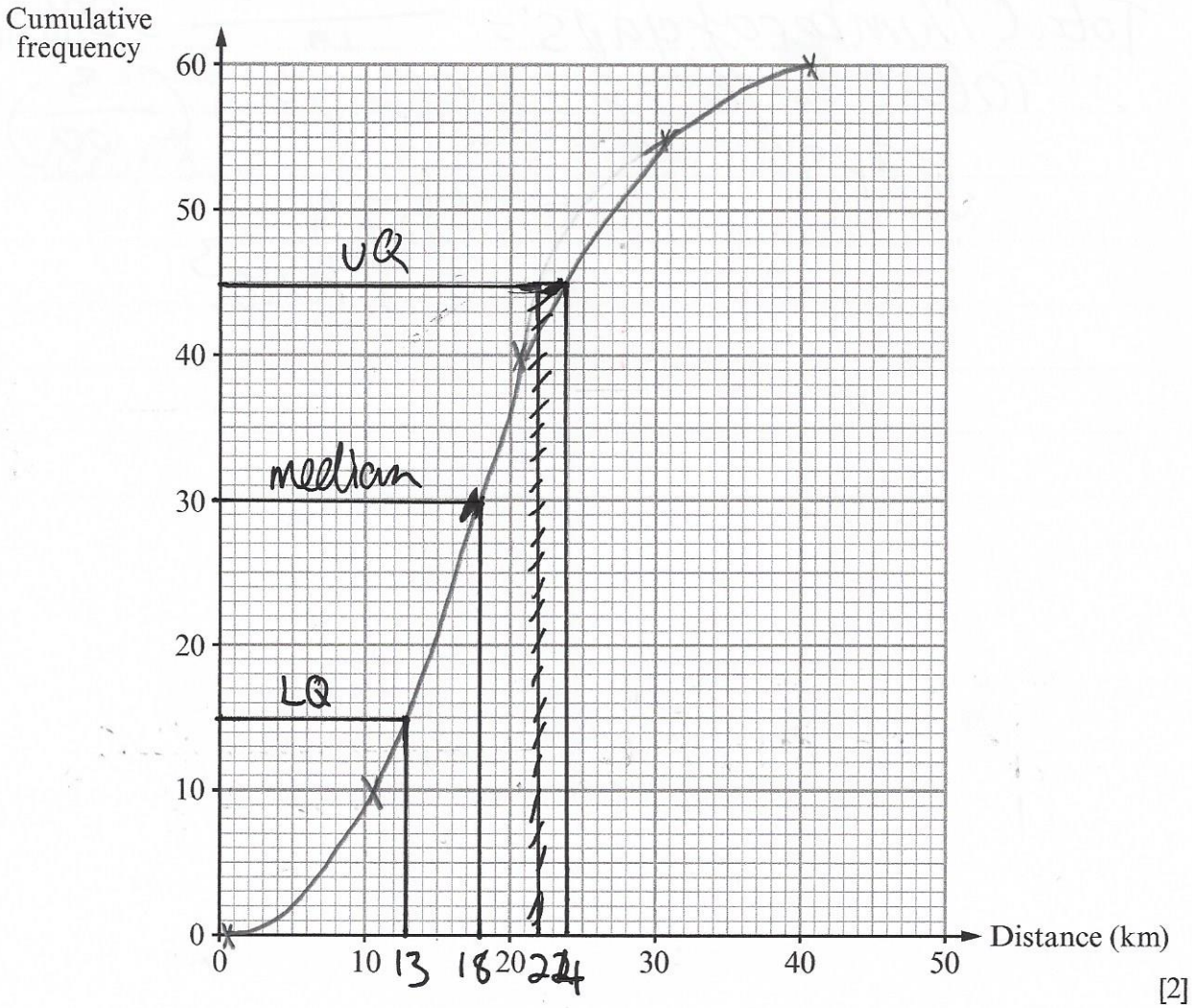
Distance, to the nearest km	1 - 10	11 - 20	21 - 30	31 - 40
Number of parcels	10	30	15	5

(a) Complete the following cumulative frequency table.

Distance (km)	<0·5	<10·5	<20·5	<30·5	<40·5
Cumulative frequency	0	10	40	55	60

30+10 40+15 55+5 [1]

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



[2]

Examiner only

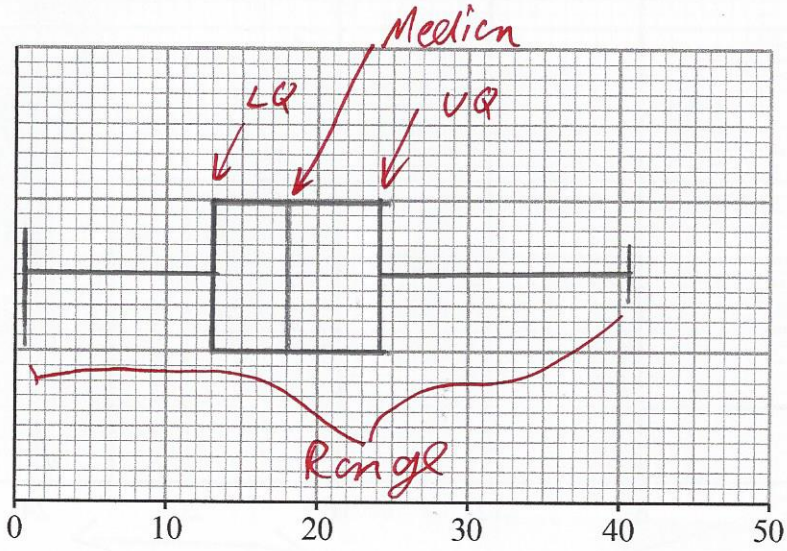
(c) Use your cumulative frequency diagram to find an estimate for the median and the interquartile range of the delivery distances.
You **must** show your working.

LQ At $60 \times \frac{1}{4} = 15$ is 13
UQ At $60 \times \frac{3}{4} = 45$ is ~~22~~ 24
Median is 18
IQR = UQ − LQ = 24 − 13 = 11

Median 18 Interquartile range 11

[3]

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



[4]

(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.

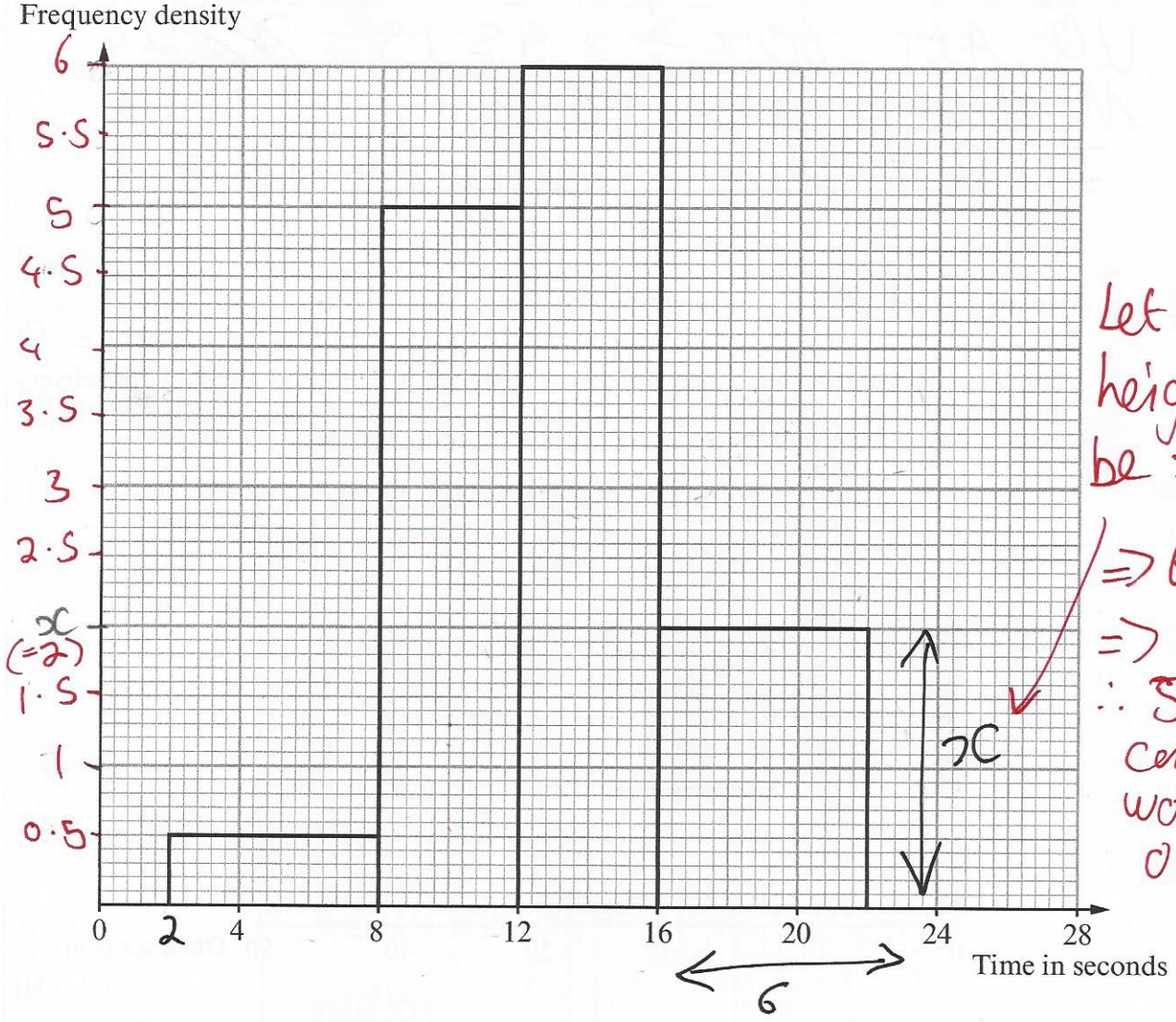
Would you expect the company to profit from the new pricing for parcel delivery?
Explain your answer.

Median is middle (same number above + below)
⇒ half free and half £4
⇒ Exactly the same profit as $2 \times £2 = 4$.

[3]

Examiner only

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.



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.

Area = 12 ⇒ 6x = 12 ⇒ x = 2

< 40

At 16

[3]

Examiner only

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

Area = (0.5 × 6) + (4 × 5) + (4 × 6) + (6 × 2)
= 59

use our scale

[2]

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

Median = middle worker

$\frac{59}{2}$ = 29.5 ⇒ 30th worker

Lies in range 12 → 16 (24 in group)

7th in group

30 − 23 = 7

$\frac{4}{24} \times 7 = 1.17$*

∴ Median = 1.17 + 12 = 13.17

start of group

[4]

0.5 × 6 = 3 } 23

4 × 5 = 20

4 × 6 = 24 } 44

In 12 → 16 range

* $\frac{4 \text{ (group width)}}{24} \times 7$

Num. People in group

7th person

Examiner only

(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	$0 < t \leqslant 4$	$4 < t \leqslant 8$	$8 < t \leqslant 12$	$12 < t \leqslant 16$	$16 < t \leqslant 24$
Number of workers	0	2	36	24	8

$4 \times x = 36$ $\quad 4x = 24$ $\quad 8x = 8$
$x = 9$ $\quad x = 6$ $\quad x = 1$

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

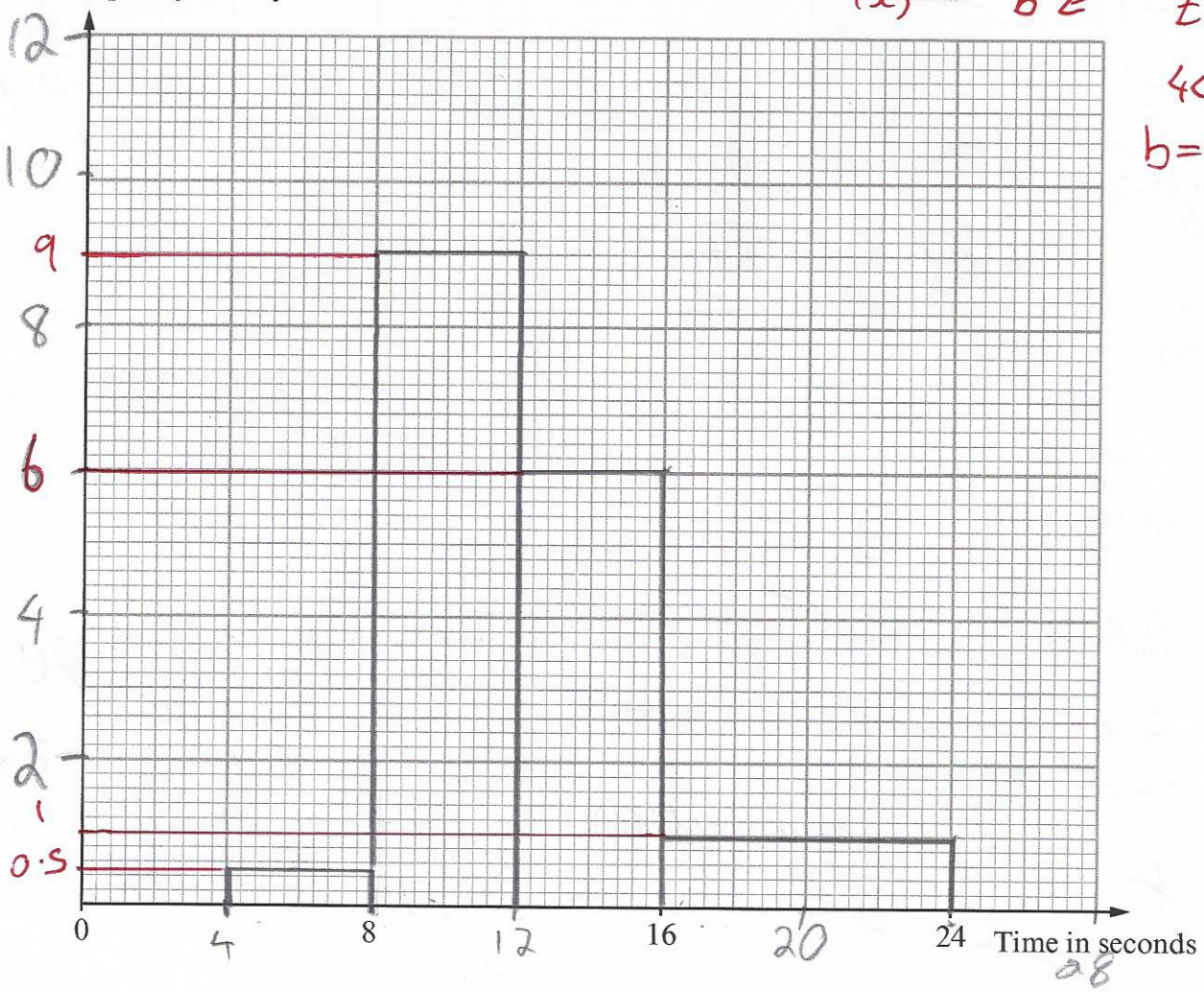
$4 \times x = 2$ $\quad 4x = 36$ $\quad 4x = 24$ $\quad 8x = 8$

$\Rightarrow x = 0.5$ $\quad x = 9$ $\quad x = 6$ $\quad x = 1$

AS $b \times h =$ People $\Rightarrow h = \frac{\text{People}}{b}$ $\quad b$ = Range width

E.g. $4 < t \leq 8$, $b = 4$

Frequency density



[3]

Examiner only

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

A=0 when V is max. t = 4 seconds

[1]

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

$a = \frac{\Delta v}{\Delta t} = \frac{-5}{1} = -5\ ms^{-2}$

[4]

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

Distance = Area

⇒ Distance = 2 Triangle + 2 Trapezium

$= 2(3 \times 15) \times \frac{1}{2} + 2(a+b)\frac{h}{2}$

$= (3 \times 15) + h(a+b)$

$= (3 \times 15) + 1(15+16)$

$= 76\ m$

$\frac{1}{2}(b \times h)$

[4]

END OF PAPER

Examiner only

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.

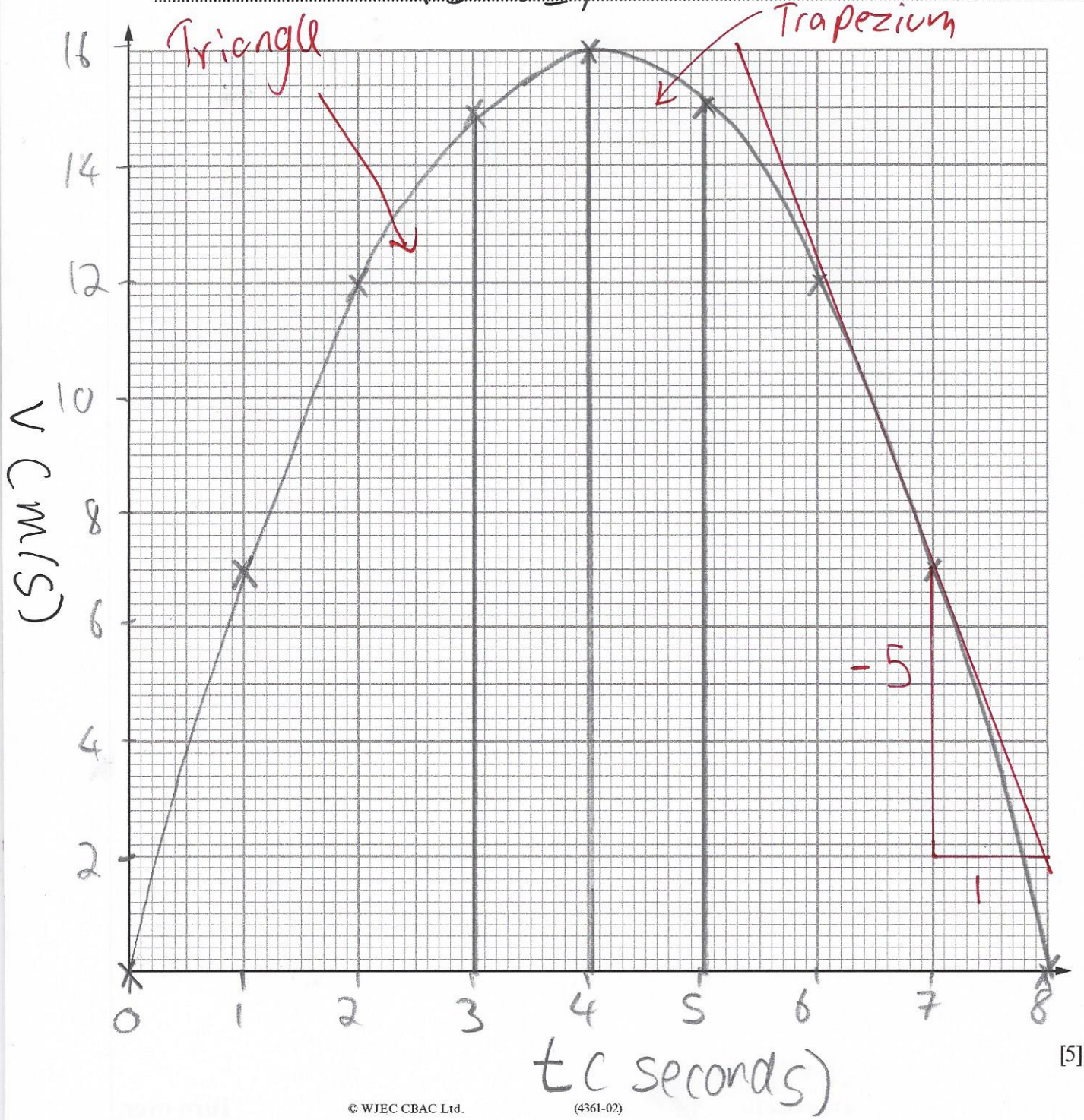
$V = 8t - t^2$

when $V=0$ $t=0$ $t=4$ $V=16$ $t=8$ $V=0$

when $t=1$ $V=7$ $t=5$ $V=15$

$t=2$ $V=12$ $t=6$ $V=12$

$t=3$ $V=15$ $t=7$ $V=7$



[5]

Examiner only

(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.

40 and over as median lies ~~roughly~~ in 8 → 12 group.

[1]