AQA

12/08/2017

Please write clearly in block capitals.

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

Surname RHODES

Forename(s) JACKIE

Candidate signature

GCSE MATHEMATICS

H

Higher Tier Paper 3 Calculator

Tuesday 13 June 2017 Morning Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:
- a calculator
- mathematical instruments.

Instructions
- Use black ink or black ball-point pen. Draw diagrams in pencil.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.
- You may ask for more answer paper, graph paper and tracing paper. These must be tagged securely to this answer book.

Advice
- In all calculations, show clearly how you work out your answer.

For Examiner's Use	
Pages	Mark
2–3	
4–5	
6–7	
8–9	
10–11	
12–13	
14–15	
16–17	
18–19	
20–21	
22–23	
24–25	
26	
TOTAL	

Answer **all** questions in the spaces provided

1 $\mathbf{a} = \begin{pmatrix} -4 \\ -1 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} 3 \\ -1 \end{pmatrix}$

$2\begin{pmatrix} -4 \\ -1 \end{pmatrix} + \begin{pmatrix} 3 \\ -1 \end{pmatrix}$ $-8+3=-5$ $-2+-1=-3$

Circle the vector $2\mathbf{a} + \mathbf{b}$

[1 mark]

$\begin{pmatrix} -5 \\ -3 \end{pmatrix}$ $\begin{pmatrix} -11 \\ -3 \end{pmatrix}$ $\begin{pmatrix} -5 \\ -1 \end{pmatrix}$ $\begin{pmatrix} -11 \\ -1 \end{pmatrix}$

2 Which of these values of n makes 2.7×10^{n} a cube number?

Circle your answer.

[1 mark]

0 1 2 3

$2.7 \times 10^{1} = 27$ $27 = 3^{3}$

3 Rearrange $2x = \frac{y}{w}$ to make w the subject.

Circle your answer.

[1 mark]

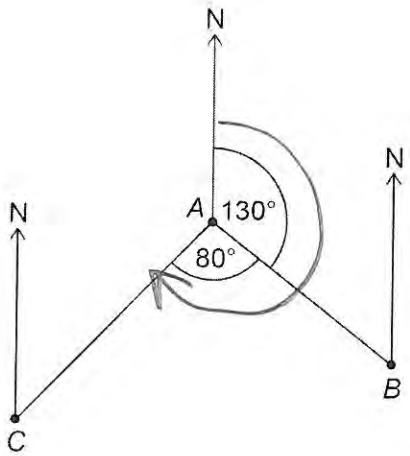
$w = \frac{2y}{x}$ $w = \frac{2x}{y}$ $w = \frac{y}{2x}$ $w = \frac{x}{2y}$

$(\times w)\ 2xw = \frac{y}{w}(\times w)$

$\frac{2xw}{2x} = \frac{y}{2x}$

Do not write outside the box

4



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Work out the bearing of C from A.

Circle your answer.

130 + 80 = 210

[1 mark]

030° 130° 150° 210°

Turn over for the next question

4

5 A coin lands on Tails 200 times.

The relative frequency of Tails is 0.4

Work out the number of times the coin was thrown.

[2 marks]

200 = 40%

$\frac{200}{40\%} = 500$

Answer 500

6 How are the whole number solutions to A and B different?

A Solve $3 \leqslant 3x < 18$

B Solve $3 < 3x \leqslant 18$

[2 marks]

÷3 $3 \leqslant 3x < 18$ ÷3 ÷3 $3 < 3x \leqslant 18$

$1 \leqslant x < 6$ $1 < x \leqslant 6$

Solutions:

A: 1, 2, 3, 4, 5

B: 2, 3, 4, 5, 6

A includes 1 but not 6

B does not include 1 but includes 6

Do not write outside the box

7 (a) The length of a pipe is 6 metres to the nearest metre.

Complete the error interval for the length of the pipe.

[2 marks]

Answer 5.5 m ⩽ length < 6.5 m

7 (b) The length of a different pipe is 4 metres to the nearest metre.

Olly says,

"The total length of the two pipes is 11 metres to the nearest metre."

Give an example to show that he could be correct.

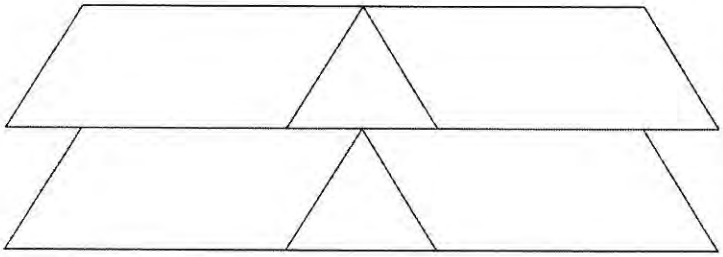
[2 marks]

6.5 + 4.5 = 11

Turn over for the next question

8

8 This shape is made from two triangles and four congruent parallelograms.



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For each statement, tick the correct box.

8 (a) The triangles are equilateral.

[1 mark]

☐ Must be true

☑ Could be true

☐ Must be false

8 (b) The triangles are congruent.

[1 mark]

☑ Must be true

☐ Could be true

☐ Must be false

9 There are 720 boys and 700 girls in a school.

The probability that a boy chosen at random studies French is $\frac{2}{3}$ $\times 720$

The probability that a girl chosen at random studies French is $\frac{3}{5}$ $\times 700$

9 (a) Work out the number of students in the school who study French.

[3 marks]

$\frac{3}{5} \times 700 + \frac{2}{3} \times 720$

$420 + 480 =$

Answer 900

9 (b) Work out the probability that a student chosen at random from the whole school does **not** study French.

[2 marks]

$720 + 700 = 1420$ total students

$1420 - 900 = 520$ do not study French

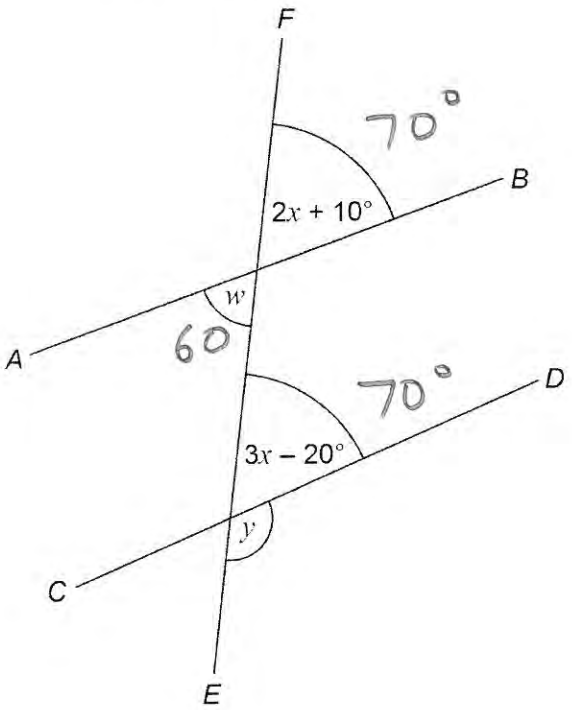
$\frac{520}{900} =$

Answer $\frac{26}{45}$

Turn over for the next question

7

10 *AB*, *CD* and *EF* are straight lines.



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10 (a) Ava assumes that *AB* and *CD* are parallel.

What answer should she get for the size of angle y?

[4 marks]

$2x + 10 = 3x - 20$

$-2x \quad -2x$

$10 = x - 20$

$+20 \quad +20$

$30 = x$

$3x - 20 =$

$3 \times 30 - 20 =$

$90 - 20 = 70$

$y = 180 - 70 = 110$

Answer 110 degrees

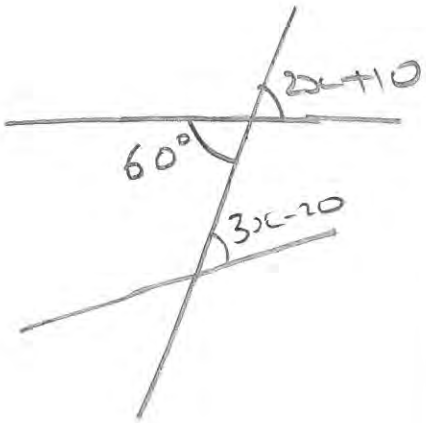
10 (b) In fact,

AB and *CD* are **not** parallel

angle w is 60°

What effect does this have on the size of angle y?

Tick a box.



☑ y is bigger

☐ y is the same

☐ y is smaller

Show working to support your answer.

[3 marks]

$2x + 10 = 60$

$-10 \quad -10$

$2x = 50$

$x = 25$

if $x = 25$

$3x - 20 = 3 \times 25 - 20$

$= 75 - 20$

$= 55°$

$y = 180 - 55 = 125°$

Turn over for the next question

7

11 Purple paint is made by mixing red paint and blue paint in the ratio 5 : 2

Yan has 30 litres of red paint and 9 litres of blue paint.

What is the **maximum** amount of purple paint he can make?

[3 marks]

R B

5 2

×4.5 ( ) ×4.5

22.5 9

22.5 + 9 =

Answer 31.5 litres

12 $\left(ar^b\right)^4 = 16r^{20}$ where a and b are positive integers.

Work out a and b

[2 marks]

$a^4 = 16$ $\quad a = \sqrt[4]{16} = 2$

$r^{b\times 4} = r^{20}$ $\quad b = \frac{20}{4} = 5$

$a =$ 2 $\quad b =$ 5

13 In a class of 28 students

the mean height of the 12 boys is 1.58 metres

the mean height of all 28 students is 1.52 metres.

Work out the mean height of the girls.

[4 marks]

boys $12 \times 1.58 = 18.96$ mean = total / how many

all $28 \times 1.52 = 42.56$

$28 - 12 = 16$ girls

$42.56 - 18.96 = 23.6$

girls mean = $\frac{23.6}{16} =$

Answer 1.475 metres

14 $xy = c$ where c is a constant.

Circle the correct statement.

$x = \frac{c}{y}$, $y = \frac{c}{x}$

[1 mark]

y is directly proportional to x

y is directly proportional to $\frac{1}{x}$

y is inversely proportional to $\frac{1}{x}$

x is directly proportional to y

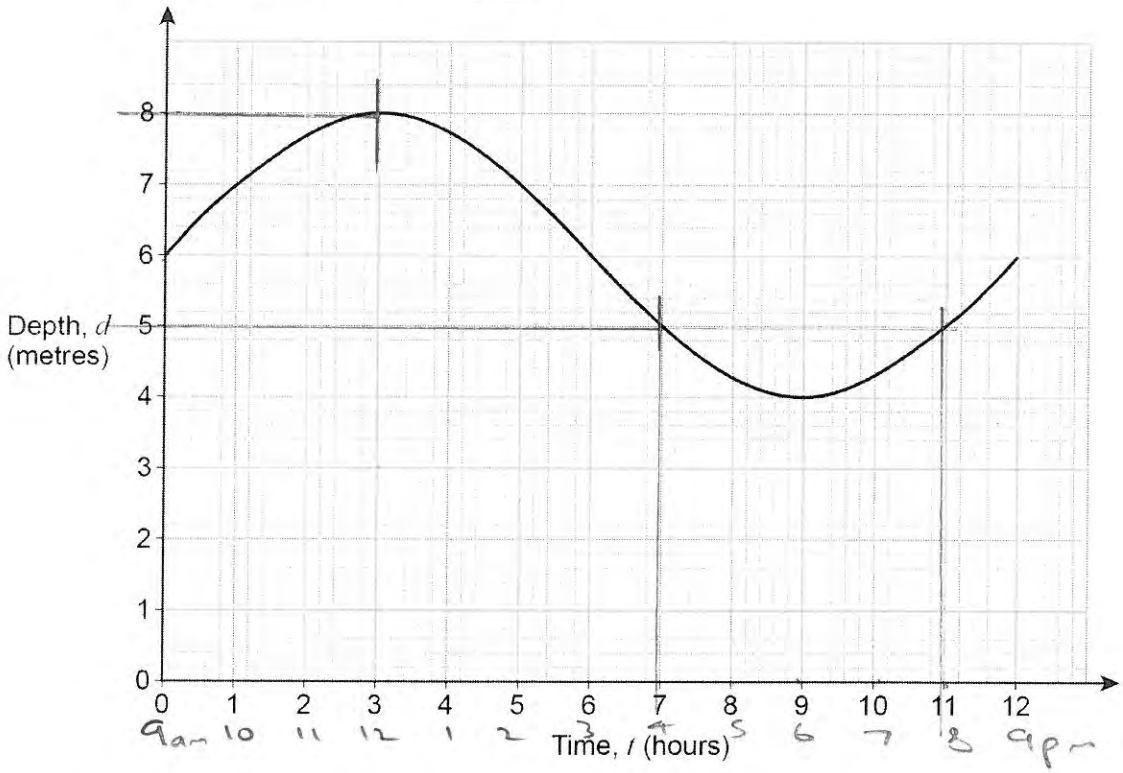
Turn over for the next question

10

15 The graph shows the depth of water in a harbour for 12 hours.

d is the depth of water in a harbour in metres

t is the number of hours after 9 am



15 (a) For how many of the 12 hours is the depth more than 5 metres?

[1 mark]

Answer 8

15 (b) By how much does the depth change between 12 noon and 4 pm?

[1 mark]

Answer 3 metres

16 The value of a new car is £18 000

The value of the car decreases by

25% in the first year 75% left

12% in each of the next 4 years. 88% left

Work out the value of the car after 5 years.

[3 marks]

$18000 \times 75\% \times 88\%^4 = 8095.887$

Answer £ 8095.89

Turn over for the next question

5

17 Liam drives his car.

He drives the first 9 miles in 9 minutes. 60 mph

He then drives at an average speed of 70 miles per hour for 1 hour 36 minutes.

He finds this information about his car.

Distance (mpg)

	Average speed	Miles travelled per gallon
9 miles	65 miles per hour or less	50
112 miles	More than 65 miles per hour	40

Use the information to show that his car uses less than 3 gallons of petrol for the drive.

[5 marks]

$D = S \times T = 70 \times 1\frac{36}{60} = 112$ miles

112 miles at 40 mpg

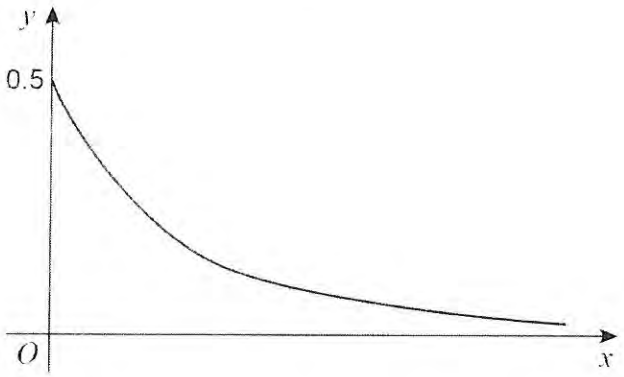
$112 \div 40 = 2.8$ gallons

9 miles at 50 mpg

$9 \div 50 = 0.18$ gallons

$2.8 + 0.18 = 2.98$ gallons of fuel are used

18 Nick sketches the graph of $y = 0.5^x$ for $x \geqslant 0$



Make **one** criticism of his sketch.

[1 mark]

When $x = 0$ $y = 1$ (not 0.5) as $0.5^0 = 1$

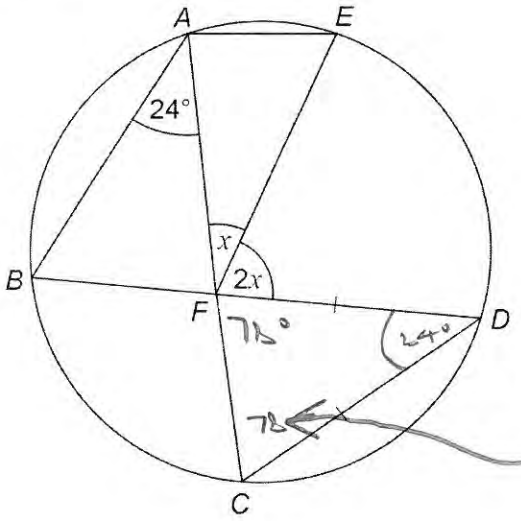
Turn over for the next question

6

19 A, B, C, D and E are points on a circle.

BFD and AFC are straight lines.

$DC = DF$



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180 − 24 = 156

156 ÷ 2 = 78°

Work out the size of angle x.

You **must** show your working which may be on the diagram.

[4 marks]

$78° + 2x + x = 180°$

$78 + 3x = 180$

$-78 \quad -78$

$\frac{3x}{3} = \frac{102}{3}$ $x = 34°$

Answer $x = 34$ degrees

20 This sign shows when a lift is safe to use.

Total mass of people must be 450 kg or less

≤ 450 kg

Ben and some other people are in the lift.

Their total mass is 525 kg to the nearest 5 kg

Ben gets out.

He has a mass of 78 kg to the nearest kg

Is the lift now safe to use?

You **must** show your working.

[4 marks]

Lift: 522.5 527.5

520 | 525 | 530 min 522.5 max 527.5

77.5 78.5

Ben 77 78 79 min 77.5 max 78.5

min load: min − max

522.5 − 78.5 = 444 kg

max load: max − min

527.5 − 77.5 = 450 kg

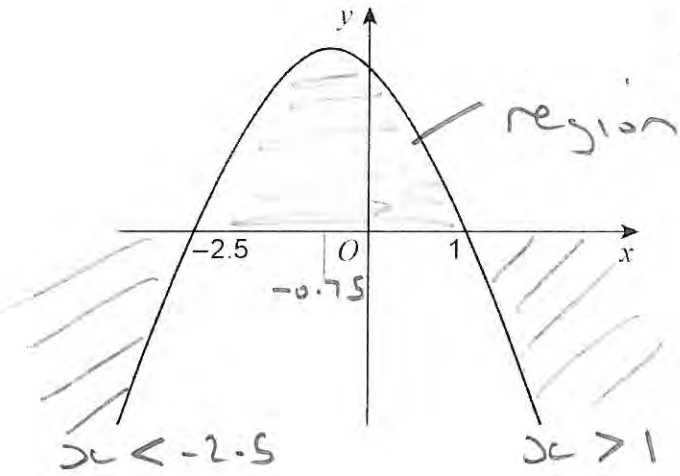
Answer Yes the lift is safe to use.

Turn over for the next question

8

21 Here is a sketch of $y = f(x)$ where $f(x)$ is a quadratic function.

The graph intersects the x-axis where $x = -2.5$ and $x = 1$



Circle the solution of $f(x) > 0$ $y > 0$

[1 mark]

$x < -2.5$ or $x > 1$ ✗

$x > -2.5$ or $x > 1$ ✗

$-2.5 < x < 1$ $x > -2.5, x < 1$

$x > -2.5$ or $x < 1$ ✗

Do not write outside the box

22 Work out an expression for the nth term of the quadratic sequence

2 17 40 71 ....

Give your answer in the form $an^2 + bn + c$ where a, b and c are constants.

[3 marks]

2 17 40 71

15 23 31

8 8 therefore $4n^2$

$4n^2$

$n^2 =$ 1 4 9 16

$4n^2 =$ 4 16 36 64

2 17 40 71

3 6 9 12

-2 1 4 7

+3 +3 +3

$3n - 5$

Answer $4n^2 + 3n - 5$

Turn over for the next question

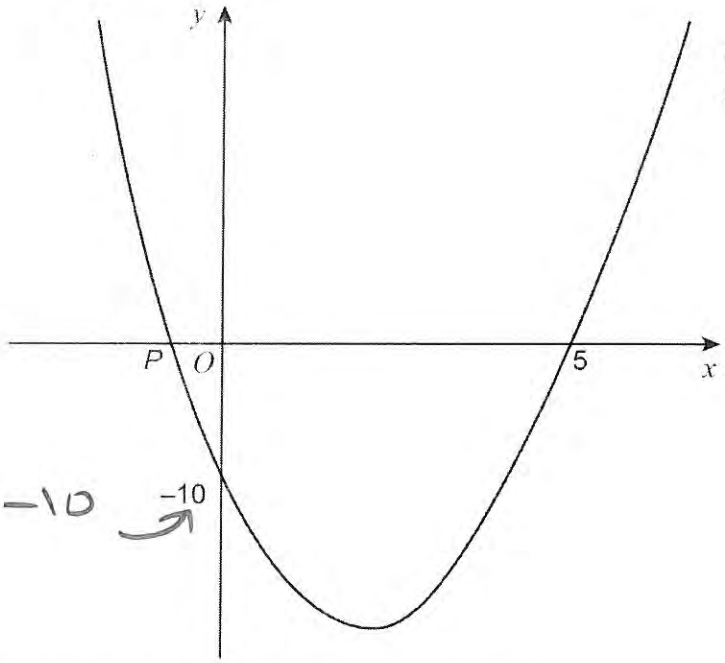
4

23 Here is a sketch of $y = x^2 + bx + c$

The curve intersects

the x-axis at (5, 0) and point P

the y-axis at (0, –10)



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$C = -10$

Work out the x-coordinate of the turning point of the graph.

[4 marks]

$y = x^2 + bx + c$

when $x = 5$ $y = 0$

$0 = 5^2 + 5x - 10$

$0 = 25 - 10 + 5x$

$0 = 15 + 5x$

$-15 \quad -15$

$\frac{-15}{5} = \frac{5x}{5}$

$x = -3$

$y = x^2 - 3x - 10$

$0 = x^2 - 3x - 10$

$0 = (x - 5)(x + 2)$

$x = 5 \quad x = -2$

$P = (-2, 0)$

$-2 \; b + 5 = 7$

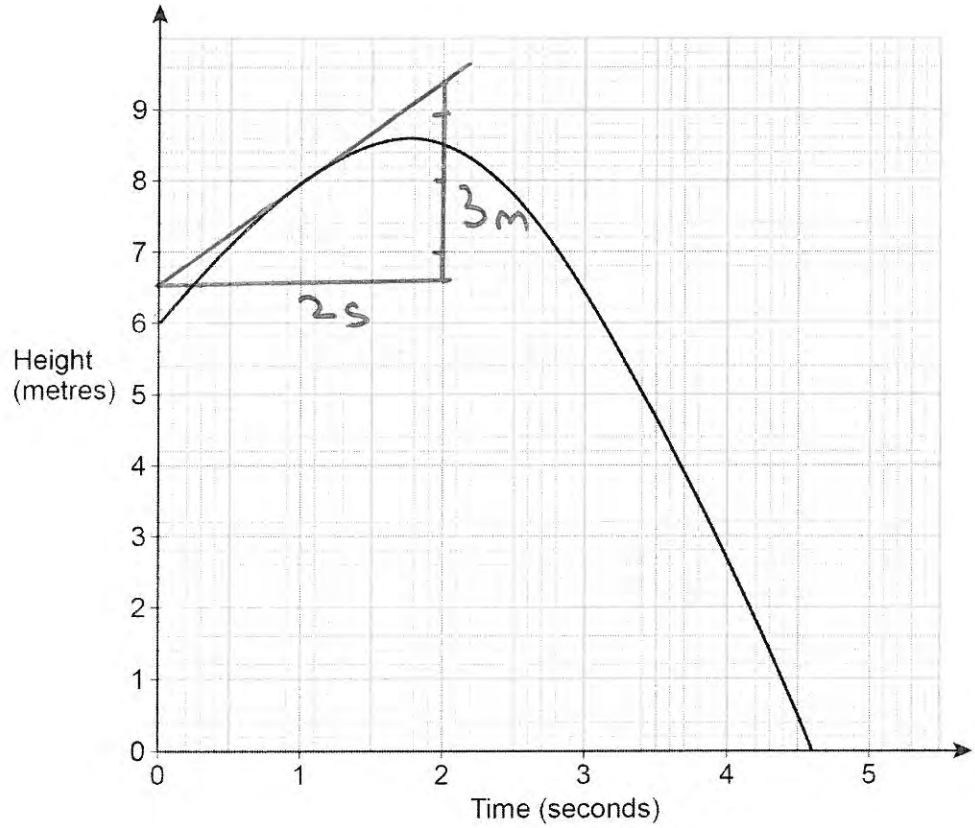
$7 \div 2 = 3.5$

$-2 + 3.5 = 1.5$

Answer $x = 1.5$

24 A ball is thrown from a point 6 metres above the ground.

The graph shows the height of the ball above the ground, in metres.



Estimate the speed of the ball, in m/s, after 1 second.

You **must** show your working.

[2 marks]

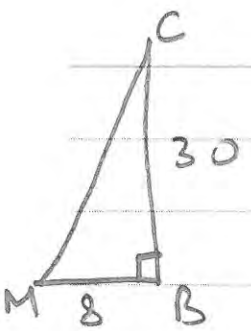
$v = \frac{d}{t} = \frac{3}{2} = 1.5 \text{ m/s}$

Answer 1.5 m/s

6

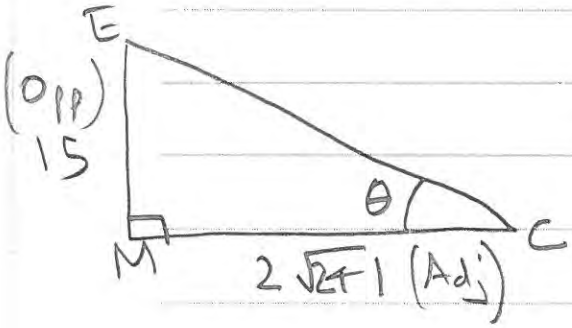
25 (b) Work out the size of angle *ECM*.

[4 marks]



$MC = \sqrt{30^2 + 8^2}$

$MC = 2\sqrt{241}$ $\quad (MC)^2 = 964$



$\tan\theta = \frac{Opp}{Adj}$

$\theta = \tan^{-1}\left(\frac{15}{2\sqrt{241}}\right)$

$\theta = 25.78594$

Answer 25.8 degrees

Turn over for the next question

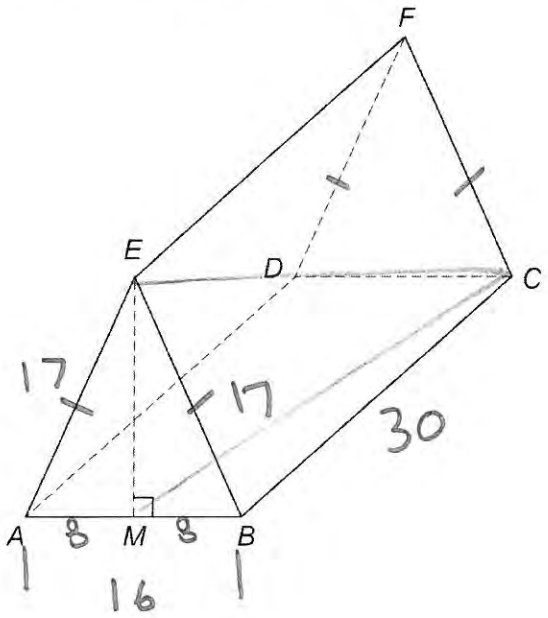
6

25 Rectangle *ABCD* is the horizontal base of a triangular prism *ABCDEF*.

AE = *BE*

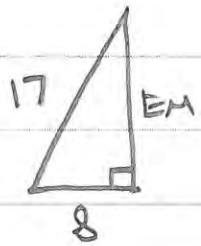
E is vertically above *M*, the midpoint of *AB*.

AB = 16 cm *AE* = 17 cm *BC* = 30 cm



25 (a) Show that *EM* = 15 cm

[2 marks]



$(EM)^2 = 17^2 - 8^2$

$EM = \sqrt{17^2 - 8^2}$

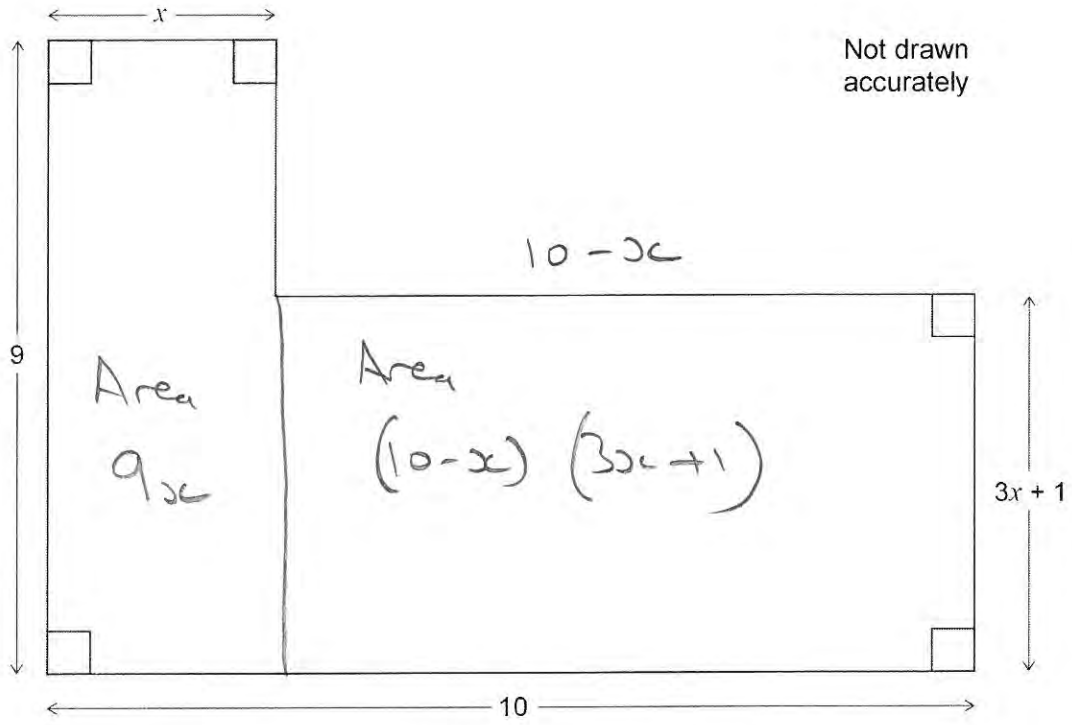
$EM = \sqrt{284 - 64}$

$EM = \sqrt{225}$

$EM = 15\text{ cm}$

26 Here is an L-shape.

All dimensions are in centimetres.



The area of the L-shape is 65 cm^2

Work out the value of x.

[6 marks]

$(10 - 3x)(3x + 1)$

×	10	$-3x$
$3x$	$30x$	$-3x^2$
$+1$	$+10$	$-x$

$-3x^2 + 29x + 10$

Tot area = $-3x^2 + 29x + 9x + 10$

$65 = -3x^2 + 38x + 10$

$-3x^2 - 38x - 10 \quad +3x^2 \quad -38x \quad -10$

$3x^2 - 38x + 55 = 0 \quad a=3 \quad b=-38 \quad c=55$

$$x = \frac{-(-38) \pm \sqrt{(-38)^2 - 4 \times 3 \times 55}}{2 \times 3}$$

$x = 11$

$x = 1.6$

$= \frac{5}{3}$

check

$9x = 9 \times \frac{5}{3} = 15$

$(10 - x) = \frac{25}{3} \quad (3x + 1) = 6 \quad \frac{25}{3} \times 6 = 50$

$50 + 15 = 65$

Answer $x = \frac{5}{3}$

Turn over for the next question

6

27 Prove that $x^2 + x + 1$ is always positive.

[3 marks]

$x(x+1) + 1$

$= (x + 0.5)^2 - 0.25 + 1$

$= (x+0.5)^2 + 0.75$

	$x + 0.5$
x	$x^2 + 0.5x$
$+ 0.5$	$+0.5x + 0.25$
	$x^2 + x + 0.25$

As $(x+0.5)^2$ will always be positive then the solution will always be positive

END OF QUESTIONS

3