

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname StemUp Model Solution

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE MATHEMATICS

H

Higher Tier

Paper 3 Calculator

Monday 8 June 2020

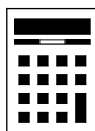
Morning

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.
- Fill in the boxes at the top of this page.
- 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.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- 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.

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	
26–27	
TOTAL	

Advice

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



J U N 2 0 8 3 0 0 3 H 0 1

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

Do not write
outside the
box

- 1** What does $A \cup B$ represent in $P(A \cup B)$?
Circle your answer.

[1 mark]

A or B or both

A but not B

not A and not B

A and B

- 2** Circle the equation of the line that is parallel to $y = \frac{1}{2}x + 3$

[1 mark]

$$y = -2x$$

$$y = 2x$$

$$y = \frac{1}{2}x$$

$$y = -\frac{1}{2}x$$

- 3** Work out 320 as a percentage of 80
Circle your answer.

[1 mark]

25%

75%

300%

400%



- 4 A fair coin is spun four times.
Circle the probability of getting four Heads.

[1 mark]

$\frac{1}{2}$

2

$\frac{1}{8}$

$\frac{1}{16}$

- 5 To the nearest 1000, there are 18 000 people at a festival.

- 5 (a) Write down the minimum possible number of people at the festival.

[1 mark]

Answer 17 500

- 5 (b) Write down the maximum possible number of people at the festival.

[1 mark]

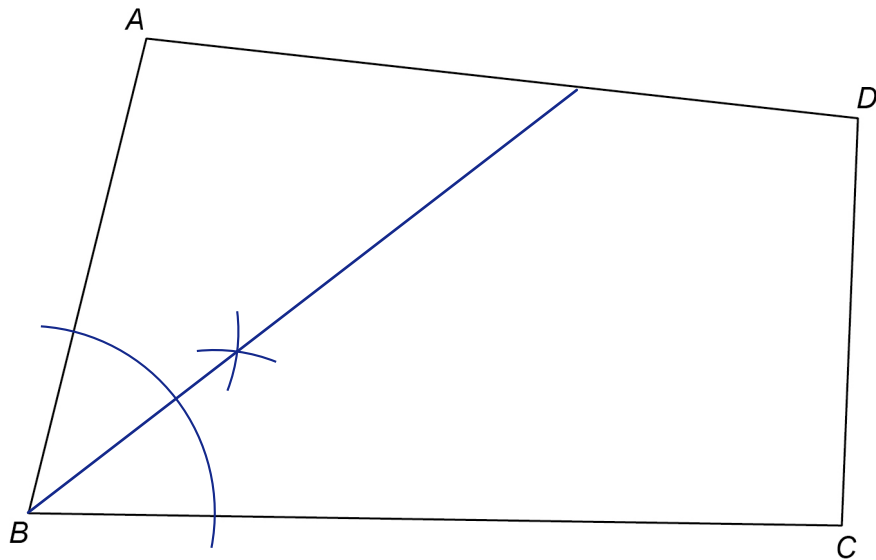
Answer 18 499

Turn over for the next question

Turn over ►



6

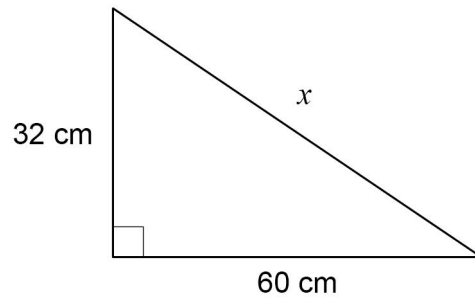
 $ABCD$ represents the plan of a field.

There is a path across the field that
 starts at B
 is the same distance from BA and BC .

Using ruler and compasses, show the position of the path.

[2 marks]

7

Use Pythagoras' theorem to work out the value of x .Not drawn
accurately**[3 marks]**

$$x^2 = 32^2 + 60^2$$

$$x^2 = 1024 + 3600 = 4624$$

$$x = \sqrt{4624}$$

$$x = 68$$

Answer 68 cm

Turn over for the next question

Turn over ►



8

Chris visits a library.

He cycles to the library in half an hour at a speed of 12 miles per hour.

He stays at the library for one hour.

He then cycles home.

The sketch graph represents his visit.



Work out the speed, in miles per hour, at which Chris cycles home.

[3 marks]

$$\text{Distance to library} = 12 \times 0.5 = 6 \text{ miles}$$

$$\text{Time home: } 10.30 \text{ to } 11.15 = 45 \text{ minutes} = 0.75 \text{ hours}$$

$$\text{Speed} = 6 \div 0.75$$

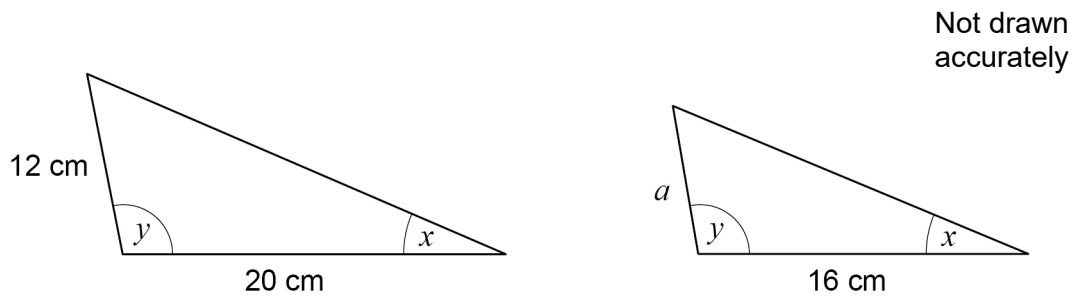
$$= 8 \text{ mph}$$

Answer 8 mph



9

These two triangles are similar.

Work out the value of a .**[2 marks]**

$$\text{Scale factor} = 16 \div 20 = 0.8$$

$$a = 12 \times 0.8 = 9.6$$

Answer 9.6 cm

10

Expand and simplify fully $4(2c + 3) - (5c - 1)$ **[2 marks]**

$$4(2c + 3) - (5c - 1) = 8c + 12 - 5c + 1$$

$$= 3c + 13$$

Answer $3c + 13$

Turn over ►



11

A spinner can land on red, blue or green.

After 350 spins

relative frequency of red = 0.18

relative frequency of blue = 0.62

Work out the number of times the spinner landed on green.

[3 marks]

$$\text{Relative frequency of green} = 1 - 0.18 - 0.62 = 0.2$$

$$\text{Number of greens} = 0.2 \times 350$$

$$= 70$$

Answer 70



12

Here is some information about 26 houses.

 a , b and c are all **different** numbers.

Number of bedrooms	Number of houses
1	7
2	a
3	b
4	c
5	8

The median number of bedrooms is 3.5

Work out a possible set of values for a , b and c .**[3 marks]***Median = 3.5 so it is between the 13th and 14th values**13th value = 3 and 14th value = 4, so $7 + a + b = 13$* *$a + b = 6$ and $c = 26 - 13 - 8 = 5$* *$a = 2$, $b = 4$ (all different)* $a =$ 2 $b =$ 4 $c =$ 5

Turn over ►



13 (a) Simplify $\frac{25a}{8} \times \frac{2a}{5}$

Give your answer as a single fraction in its simplest form.

[2 marks]

$$\frac{25a \times 2a}{8 \times 5} = \frac{50a^2}{40} = \frac{5a^2}{4}$$

Answer $\frac{5a^2}{4}$

13 (b) Sofia is trying to simplify $\frac{6c + 10}{2}$

Her method is

divide $6c$ by 2

then

add 10

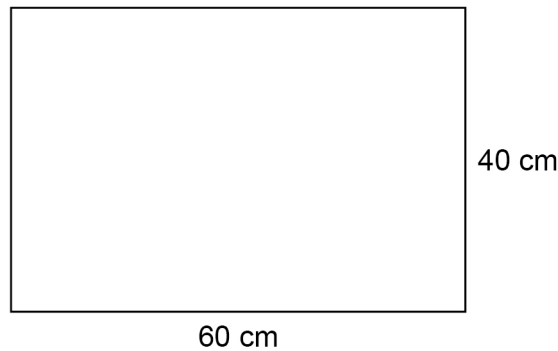
Evaluate her method.

[1 mark]

*She is wrong: she must divide the 10 by 2 as well,
so she should add 5, not 10. The answer is $3c + 5$*



- 14 A rectangle has length 60 cm and width 40 cm



Not drawn
accurately

The length decreases by 15%

The width decreases by 10%

Sue says,

“The perimeter decreases by 25% because 15% + 10% is 25%”

Is she correct?

You **must** show calculations to support your answer.

[4 marks]

$$\text{New length} = 60 \times 0.85 = 51 \text{ cm}$$

$$\text{New width} = 40 \times 0.9 = 36 \text{ cm}$$

$$\text{Original perimeter} = 2 \times 60 + 2 \times 40 = 200 \text{ cm}$$

$$\text{New perimeter} = 2 \times 51 + 2 \times 36 = 174 \text{ cm}$$

$$\text{Decrease} = 200 - 174 = 26 \text{ cm}$$

$$26 \div 200 \times 100 = 13\%$$

No, she is not correct. The perimeter decreases by 13%, not 25%



15 Solve $4 > 11 - \frac{x}{3}$

[2 marks]

Multiply by 3: $12 > 33 - x$

$x > 33 - 12$

$x > 21$

Answer *$x > 21$*

16 The number of goals scored by 20 players in a season is shown.

Number of goals	Frequency	Midpoint	<i>Midpoint $\times$ Freq</i>
0 to 4	6	<i>2</i>	<i>$2 \times 6 = 12$</i>
5 to 9	11	<i>7</i>	<i>$7 \times 11 = 77$</i>
10 to 14	3	<i>12</i>	<i>$12 \times 3 = 36$</i>
Total = 20			<i>Total = 125</i>

Work out an estimate of the mean number of goals per player.

Give your answer as a decimal.

[3 marks]

Total = $12 + 77 + 36 = 125$

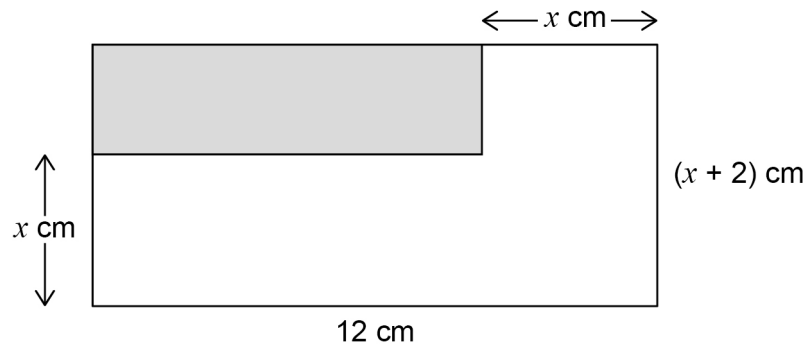
Mean = $125 \div 20 = 6.25$

Answer *6.25*



17

Here are two rectangles.

Not drawn
accurately

The area of the shaded rectangle is $\frac{1}{4}$ the area of the large rectangle.

Work out the value of x .

[4 marks]

$$\text{Shaded rectangle: width} = 12 - x, \text{ height} = (x + 2) - x = 2$$

$$\text{Shaded area} = 2(12 - x) = 24 - 2x$$

$$\text{Large area} = 12(x + 2) = 12x + 24$$

$$24 - 2x = (12x + 24) \div 4$$

$$24 - 2x = 3x + 6$$

$$18 = 5x$$

$$x = 18 \div 5$$

$$x = 3.6$$

Answer 3.6

Turn over ►



18

The pressure in a tyre is 30 pounds per square inch.

Convert the pressure into kilograms per square centimetre.

Use 1 pound = 0.45 kilograms
and
1 inch = 2.54 centimetres

[3 marks]

$$30 \text{ pounds} = 30 \times 0.45 = 13.5 \text{ kg}$$

$$1 \text{ square inch} = 2.54^2 = 6.4516 \text{ cm}^2$$

$$\text{Pressure} = 13.5 \div 6.4516$$

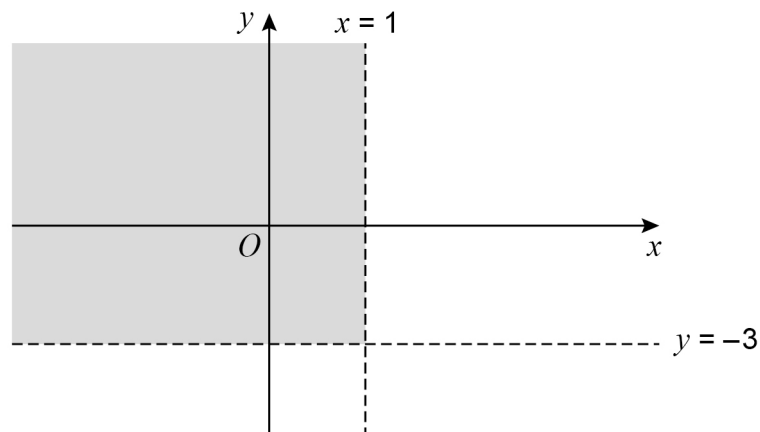
$$= 2.092504185...$$

$$= 2.09 \text{ kg/cm}^2 \text{ (3 s.f.)}$$

Answer 2.09 kg/cm²



- 19 The sketch shows the lines $x = 1$ and $y = -3$



Which pair of inequalities describes the shaded region?

Tick **one** box.

[1 mark]

☐

$x < 1$ and $y < -3$

☒

$x < 1$ and $y > -3$

☐

$x > 1$ and $y > -3$

☐

$x > 1$ and $y < -3$

Turn over for the next question

Turn over ►



20 Amari and Ben each play a game.

20 (a) Here is some information about Amari's scores.

Lowest 12

Highest 20

Lower quartile 13

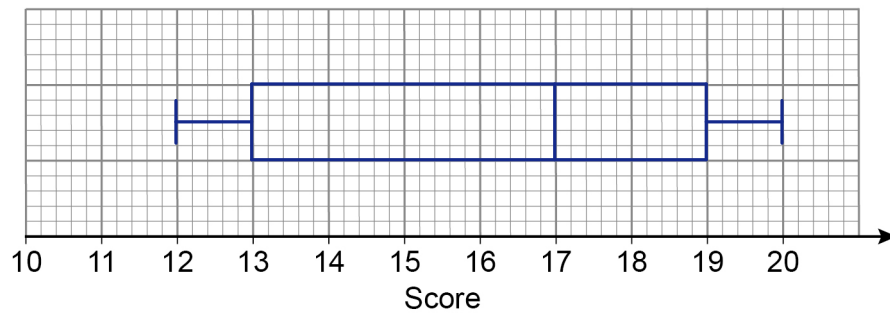
Upper quartile 19

Median 17

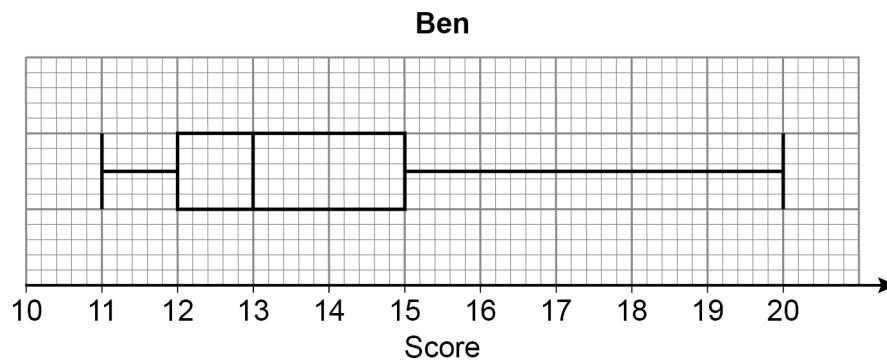
Draw a box plot to represent his scores.

[2 marks]

Amari



20 (b) This box plot represents Ben's scores.



Who had more consistent scores, Amari or Ben?

Work out the interquartile ranges to support your answer.

[2 marks]

$$\text{Amari IQR} = 19 - 13 = 6$$

$$\text{Ben IQR} = 15 - 12 = 3$$

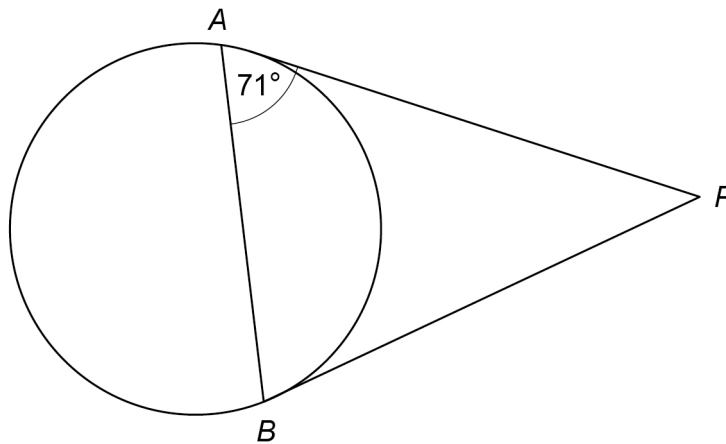
Ben had more consistent scores because his IQR
is smaller ($3 < 6$)

Turn over for the next question

Turn over ►



- 21 (a) A and B are points on a circle.
 PA and PB are tangents.



Not drawn
accurately

Work out the size of angle APB .

[2 marks]

$PA = PB$ (tangents from a point are equal in length)

so triangle APB is isosceles and angle $ABP = 71^\circ$

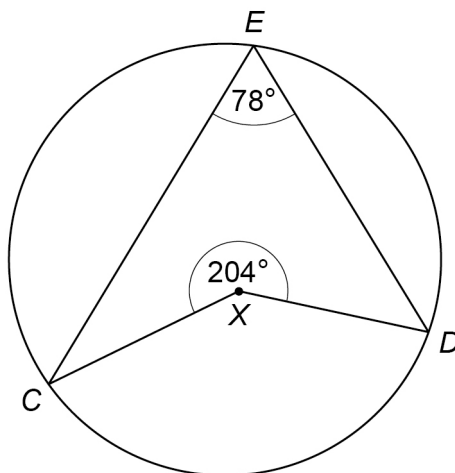
Angle $APB = 180 - 2 \times 71 = 38^\circ$

Answer 38 degrees



21 (b) C, D and E are points on a different circle.

Not drawn
accurately



Is X the centre of the circle?

Tick a box.



Yes



No

Show working to support your answer.

[2 marks]

$$\text{Angle } CXD = 360 - 204 = 156^\circ$$

$$\text{Angle at centre} = 2 \times \text{angle at circumference}$$

$$2 \times 78 = 156^\circ, \text{ which matches, so Yes}$$

Turn over for the next question

Turn over ►



22

Visitors to a museum buy a child ticket or an adult ticket.

Here is some information about two groups of visitors.

Group X	250 visitors, including 120 children
Group Y	number of children : number of adults = 17 : 15

One visitor from each group is picked at random.

Is this statement correct?

Probability of picking two children > probability of picking two adults

You **must** show your working.

[4 marks]

$$\text{Group X: } P(\text{child}) = 120 \div 250 = 0.48$$

$$P(\text{adult}) = 130 \div 250 = 0.52$$

$$\text{Group Y: } P(\text{child}) = 17 \div 32 = 0.53125$$

$$P(\text{adult}) = 15 \div 32 = 0.46875$$

$$P(\text{two children}) = 0.48 \times 0.53125 = 0.255$$

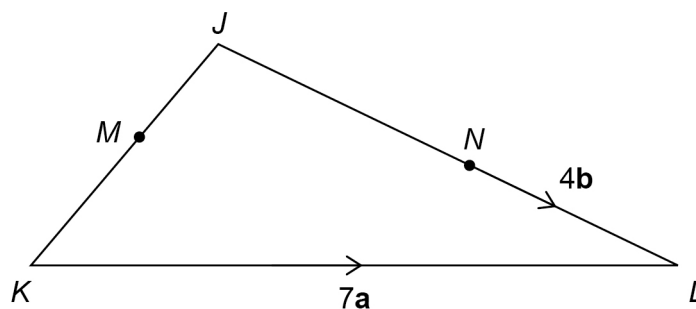
$$P(\text{two adults}) = 0.52 \times 0.46875 = 0.24375$$

$$0.255 > 0.24375$$

so Yes, the statement is correct



23

In triangle JKL M is the midpoint of JK $JN : NL = 3 : 2$ $\overrightarrow{KL} = 7\mathbf{a}$ $\overrightarrow{NL} = 4\mathbf{b}$ Not drawn
accuratelyWork out $\overrightarrow{JM}$ in terms of $\mathbf{a}$ and $\mathbf{b}$.

Give your answer in its simplest form.

[3 marks]

$$\overrightarrow{JN} = \frac{3}{2} \times 4\mathbf{b} = 6\mathbf{b}$$

$$\overrightarrow{JK} = \overrightarrow{JN} + \overrightarrow{NL} + \overrightarrow{LK} = 6\mathbf{b} + 4\mathbf{b} - 7\mathbf{a} = 10\mathbf{b} - 7\mathbf{a}$$

$$\overrightarrow{JM} = \frac{1}{2} \overrightarrow{JK} = \frac{1}{2}(10\mathbf{b} - 7\mathbf{a})$$

$$\overrightarrow{JM} = 5\mathbf{b} - 3.5\mathbf{a}$$

Answer $5\mathbf{b} - 3.5\mathbf{a}$

Turn over for the next question

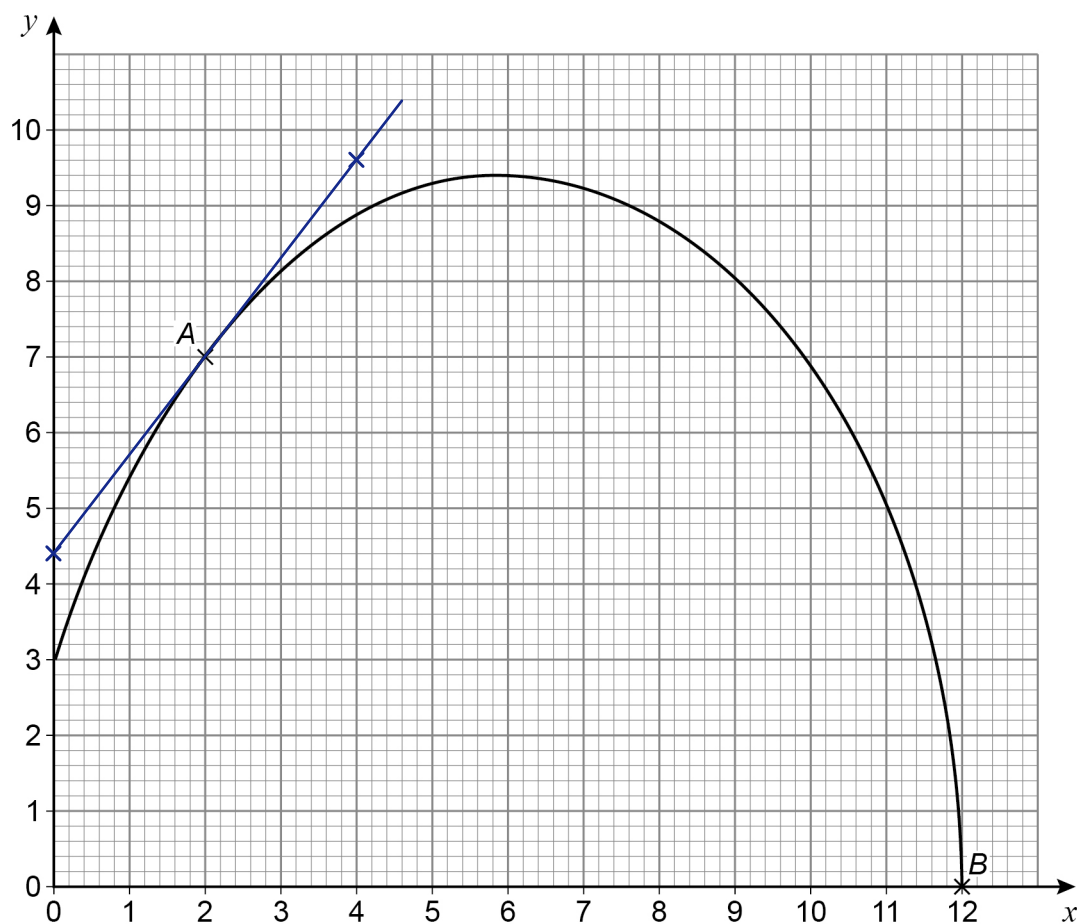
Turn over ►



24

A and B are points on a curve.

A is (2, 7) B is (12, 0)

24 (a) Work out the instantaneous rate of change of y with respect to x at point A.

[2 marks]

Tangent at A passes through (0, 4.4) and (4, 9.6)

Gradient = $(9.6 - 4.4) \div (4 - 0)$

= $5.2 \div 4 = 1.3$

Answer 1.3



24 (b) The average rate of change of y with respect to x between points A and B is worked out.

Which statement is correct?

Tick **one** box.

[1 mark]

☐

It is positive.

☐

It is zero.

☒

It is negative.

☐

You cannot tell if it is positive or negative.

25 The equation of a circle is $x^2 + y^2 = 9$

Work out the length of the **diameter**.

Circle your answer.

[1 mark]

3

6

9

18

Turn over for the next question

Turn over ►



26

Prove algebraically that $3.4\dot{7} = \frac{313}{90}$

[3 marks]

$$\text{Let } x = 3.4777\ldots$$

$$10x = 34.777\ldots$$

$$100x = 347.777\ldots$$

$$100x - 10x = 347.777\ldots - 34.777\ldots$$

$$90x = 313$$

$$x = \frac{313}{90}$$

$$\text{so } 3.4\dot{7} = \frac{313}{90} \text{ as required}$$

27

The equation of a curve is $y = (x - 1)^2 - 6$

Circle the coordinates of the turning point.

[1 mark]

(-1, -6)

(1, 6)

(-1, 6)

(1, -6)



28

Line A has equation $y = 4x - 1$

Line B is

perpendicular to line A

and

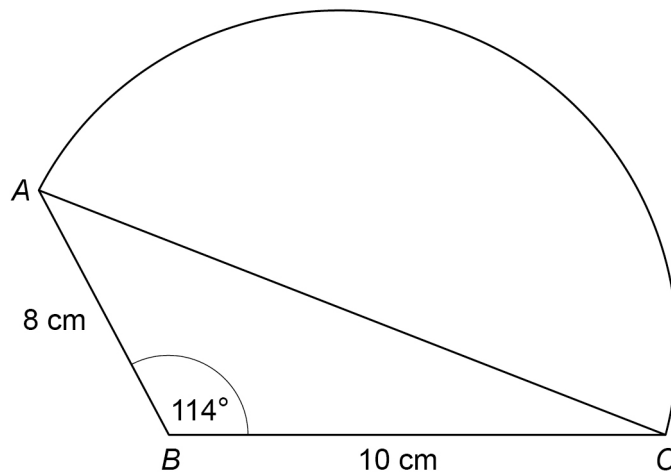
passes through the point (8, 5)

Work out the coordinates of the point where line B intersects the x -axis.**[4 marks]***Gradient of line A = 4, so gradient of line B = $-1/4$* *$y = -1/4x + c$ through (8, 5): $5 = -1/4 \times 8 + c$* *$5 = -2 + c$, so $c = 7$* *Line B: $y = -1/4x + 7$* *Crosses x -axis when $y = 0$: $-1/4x + 7 = 0$* *$1/4x = 7$* *$x = 28$* Answer (28 , 0)**Turn over for the next question****Turn over ►**

29

A shape is made by joining triangle ABC to a semicircle with diameter AC .

Not drawn
accurately



Work out the **total** area of the shape.

[5 marks]

$$\text{Area of triangle } ABC = \frac{1}{2} \times 8 \times 10 \times \sin 114^\circ$$

$$= 36.54181831... \text{ cm}^2$$

$$AC^2 = 8^2 + 10^2 - 2 \times 8 \times 10 \times \cos 114^\circ$$

$$AC^2 = 229.0778629...$$

$$AC = 15.13531839... \text{ so radius} = 7.567659197... \text{ cm}$$

$$\text{Area of semicircle} = \frac{1}{2} \times \pi \times 7.567659197...^2$$

$$= 89.95866640... \text{ cm}^2$$

$$\text{Total} = 36.54181831... + 89.95866640...$$

$$= 126.5004847...$$

$$= 126.5 \text{ cm}^2 \text{ (1 d.p.)}$$

Answer 126.5 cm²



30

$$f(x) = \frac{1}{2}x \quad g(x) = x - x^2$$

Solve $f^{-1}(x) = gf(x)$ **[4 marks]**

$$f(x) = \frac{1}{2}x \text{ so } f^{-1}(x) = 2x$$

$$gf(x) = g(\frac{1}{2}x) = \frac{1}{2}x - (\frac{1}{2}x)^2 = \frac{1}{2}x - \frac{1}{4}x^2$$

$$2x = \frac{1}{2}x - \frac{1}{4}x^2$$

$$\frac{1}{4}x^2 + 1.5x = 0$$

$$x^2 + 6x = 0$$

$$x(x + 6) = 0$$

$$x = 0 \text{ or } x + 6 = 0$$

$$x = 0 \text{ or } x = -6$$

Answer $x = 0 \text{ or } x = -6$ **END OF QUESTIONS**

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3 2



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