



Model Answers

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

I declare this is my own work.

GCSE MATHEMATICS

H

Higher Tier

Paper 3 Calculator

Monday 8 June 2020

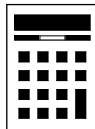
Morning

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.



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IB/M/Jun20/E7

8300/3H

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

- 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]

$y = -2x$

$y = 2x$

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

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

same gradient

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

[1 mark]

25%

75%

300%

400%

$$\frac{80}{100} \times x = 320$$

$$x = \frac{320 \times 100}{80}$$

$$= 400$$



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

[1 mark]

$$\left(\frac{1}{2}\right)^4 = \frac{1}{16}$$

$$\frac{1}{2}$$

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.

$$\text{Error interval} = 1000 \div 2 = 500 \quad \text{Lower limit} = 18\,000 - 500 = 17\,500$$

[1 mark]

Answer 17500

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

$$\text{Error interval} = 1000 \div 2 = 500 \quad \text{Upper limit} = 18\,000 + 500 = 18\,500$$

[1 mark]

Answer 18499

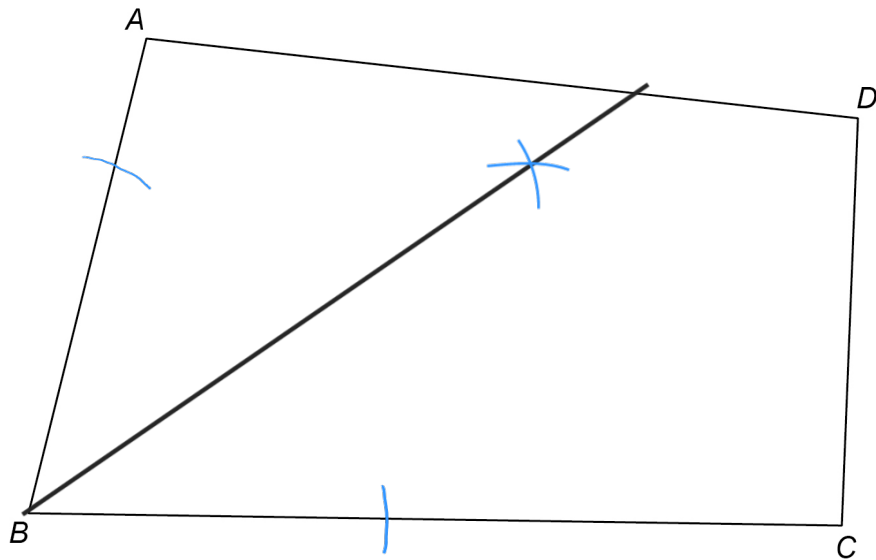
answer must be lower than 18500 because if it is 18500, it will be rounded up to 19000

Turn over for the next question



6

$ABCD$ represents the plan of a field.



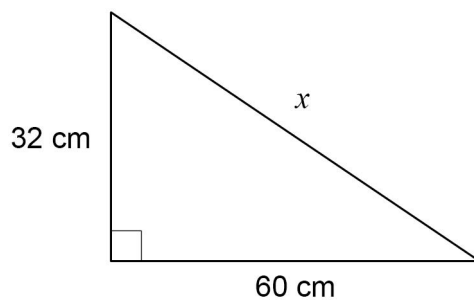
There is a path across the field that
starts at B
is the same distance from BA and BC .

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]

$$x^2 = (32)^2 + (60)^2 \leftarrow \text{Pythagoras' Theorem}$$

$$= 4624$$

$$x = \sqrt{4624}$$

$$= 68 \text{ cm}$$

Answer 68 cm

Turn over for the next question



8

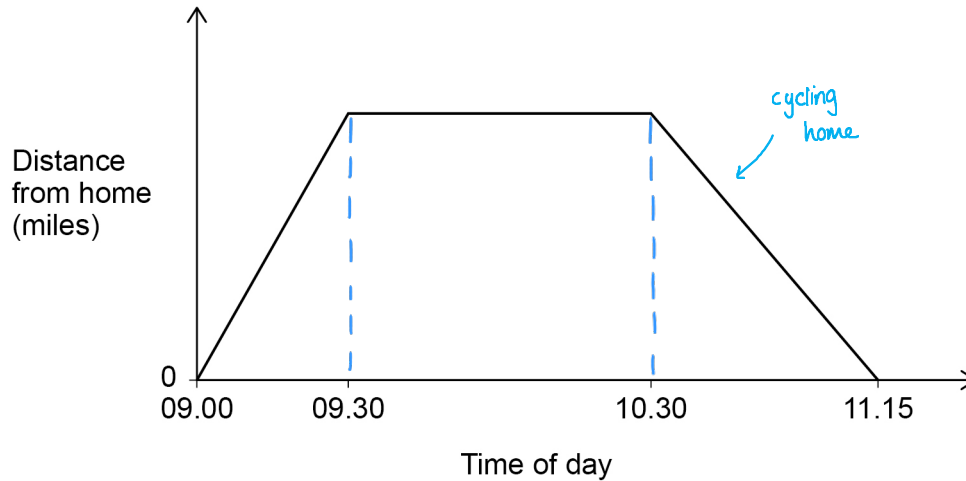
Chris visits a library.

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]

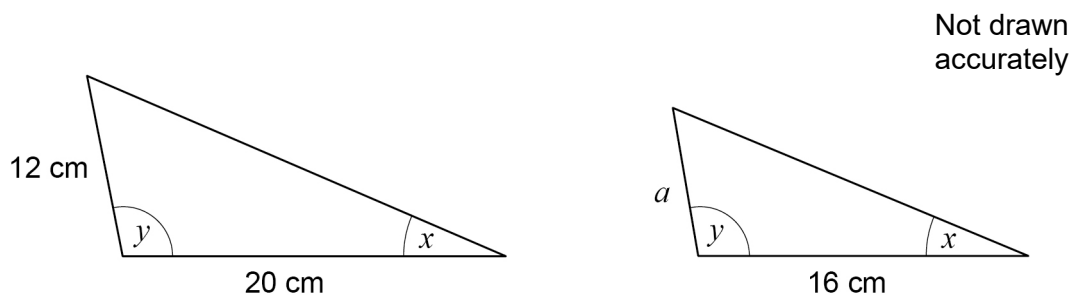
$$\begin{aligned} \text{Distance travelled to the library} &= 12 \text{ miles per hour} \times 0.5 \text{ hour} \\ &= 6 \text{ miles} \end{aligned}$$

$$\text{Time taken to cycle home} = 10:30 \text{ to } 11:15 = 45 \text{ mins}$$

$$45 \text{ mins} / 60 \text{ mins} = 0.75 \text{ hour} \quad \text{Speed home} : 6 / 0.75 = 8 \text{ mph}$$

Answer 8 mph

9 These two triangles are similar.



Work out the value of a .

[2 marks]

$$20 \div 16 = 1.25$$

$$12 \div 1.25 = 9.6$$

$$a = 9.6 \text{ cm}$$

Answer 9.6 cm

10 Expand and simplify fully $4(2c + 3) - (5c - 1)$

[2 marks]

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

$$= 8c + 12 - 5c + 1$$

$$= 8c - 5c + 12 + 1$$

$$= 3c + 13$$

Answer 3c + 13



11 A spinner can land on red, blue or green.

After 350 spins

$$\text{relative frequency of red} = 0.18$$

$$\text{relative frequency of blue} = 0.62$$

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

[3 marks]

$$\text{Total relative frequency} = 1$$

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

$$= 0.2$$

$$\text{Number of times spinner landed on green} = 0.2 \times 350 = 70$$

Answer 70 times



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
median → 3	b
4	c
5	8

Handwritten notes: Brackets on the right side of the table group the first two rows and the last two rows, both labeled '13'. An arrow points to the number 3 in the 'Number of bedrooms' column, labeled 'median'.

The median number of bedrooms is 3.5

Work out a possible set of values for a , b and c .

[3 marks]

$$26 \div 2 = 13$$

$$a = 4 \quad b = 2 \quad (\text{any different numbers that add up to } 6)$$

$$7 + a + b = 13$$

$$a + b = 13 - 7$$

$$8 + c = 13$$

$$a + b = 6$$

$$c = 13 - 8 = 5$$

$$a = \underline{\quad 4 \quad}$$

$$b = \underline{\quad 2 \quad}$$

$$c = \underline{\quad 5 \quad}$$



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

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

[2 marks]

$$\frac{25a}{8} \times \frac{2a}{5} = \frac{25a \times 2a}{8 \times 5}$$

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

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 needs to divide the 10 by 2 before adding it to $(6c/2)$.

She should add 5 instead of 10.



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]

$$\begin{aligned} \text{new length} &= (1 - 0.15) \times 60 \\ &= 0.85 \times 60 = 51 \text{ cm} \end{aligned}$$

$$\begin{aligned} \text{new width} &= (1 - 0.1) \times 40 \\ &= 0.9 \times 40 = 36 \text{ cm} \end{aligned}$$

$$\begin{aligned} \text{New perimeter} &= 2(51) + 2(36) \\ &= 174 \text{ cm} \end{aligned}$$

No, Sue is incorrect.

$$\begin{aligned} \text{Original perimeter} &= 2(60) + 2(40) \\ &= 200 \end{aligned}$$

The perimeter decreases
by 13%.

$$\text{Difference in perimeter} = 200 - 174 = 26$$

$$\text{percentage decrease} = \frac{26}{200} \times 100 = 13\%$$



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

[2 marks]

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

$$x > 7 \times 3$$

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

$$x > 21$$

$$\frac{x}{3} > 7$$

Answer $x > 21$

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

Number of goals	Frequency	Midpoint	Frequency \times midpoint
0 to 4	6	2	$2 \times 6 = 12$
5 to 9	11	7	$11 \times 7 = 77$
10 to 14	3	12	$3 \times 12 = 36$
Total = 20			

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

Give your answer as a decimal.

[3 marks]

$$\text{Total frequency} \times \text{midpoint} = 12 + 77 + 36$$

$$= 125$$

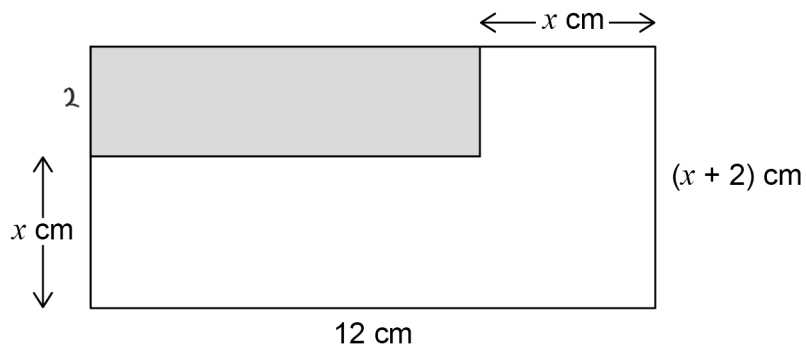
$$\text{Mean number of goals per player} = \frac{125}{20} = 6.25$$

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]

$$\text{length of the smaller rectangle} = 12 - x$$

$$\text{height of the smaller rectangle} = (x + 2) - 2 = x$$

$$\text{Area of shaded region} = (12 - x) \times 2 = 24 - 2x$$

$$\text{Area of larger rectangle} = 12(x + 2) = 12x + 24$$

$$4 \times \text{area of shaded region} = \text{Area of the large rectangle}$$

$$4(24 - 2x) = 12x + 24 \quad x = \frac{72}{20}$$

$$96 - 8x = 12x + 24$$

$$96 - 24 = 12x + 8x \quad x = 3.6$$

$$72 = 20x$$

Answer 3.6



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

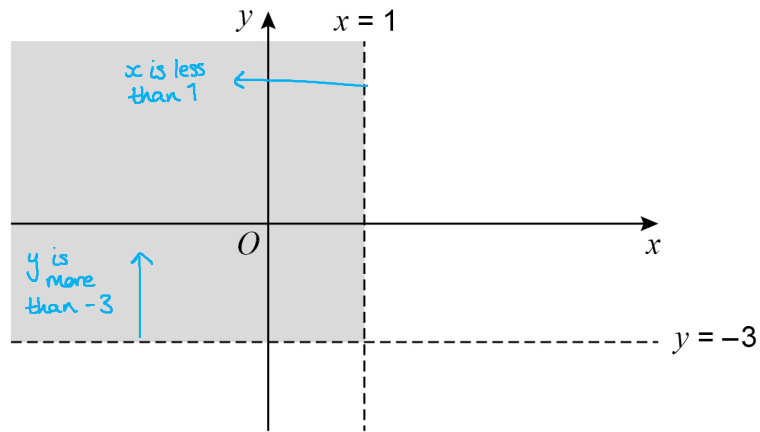
[3 marks]

$$\begin{aligned} 30 \text{ pounds} \times 0.45 \text{ kg} &= 13.5 \text{ kg} \\ (1 \text{ inch})^2 \times (2.54)^2 &= 6.4516 \text{ cm}^2 \\ &= 2.0925 \text{ kg/cm}^2 \\ &\approx 2.09 \text{ kg/cm}^2 \end{aligned}$$

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

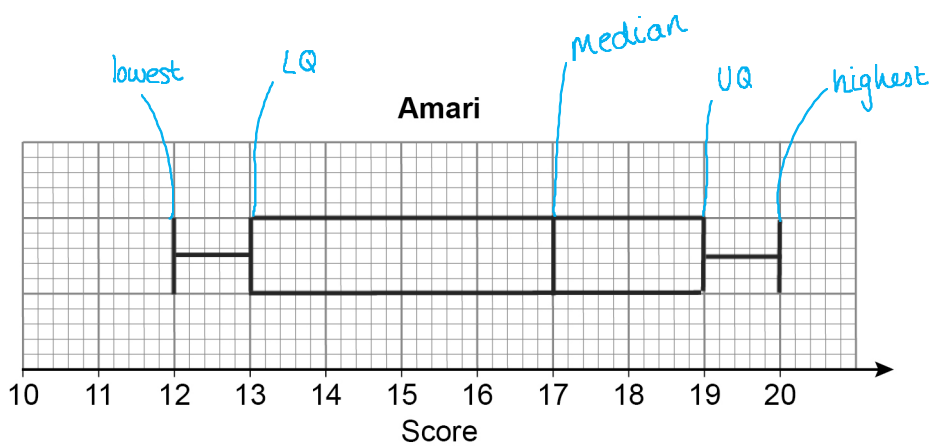


- 20 Amari and Ben each play a game.
- 20 (a) Here is some information about Amari's scores.

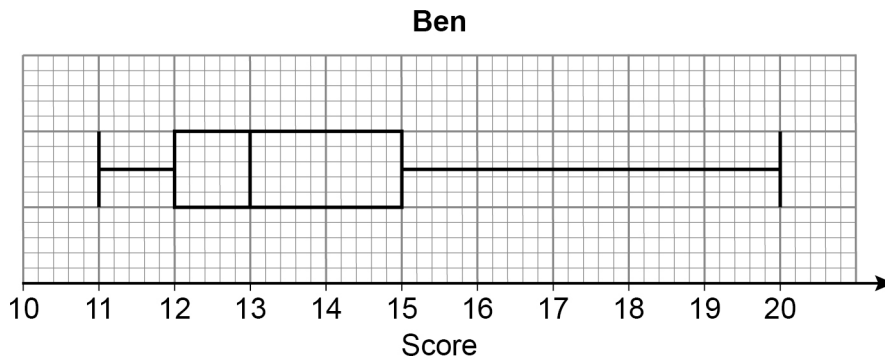
Lowest 12
Highest 20
Lower quartile 13
Upper quartile 19
Median 17

Draw a box plot to represent his scores.

[2 marks]



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]

Interquartile range for Amari : $19 - 13 = 6$

Interquartile range for Ben : $15 - 12 = 3$

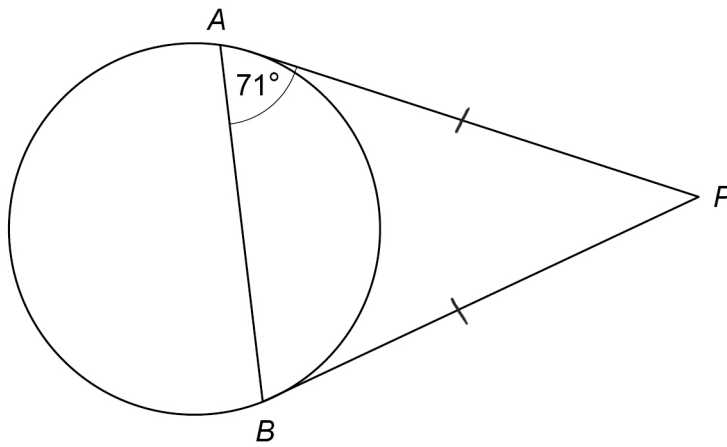
Ben has a lower interquartile range than Amari. Hence, Ben has more consistent scores.

Turn over for the next question



Do not write
outside the
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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, Hence, angles PAB and PBA are equal.

Angle APB = 180° - 2 x 71°

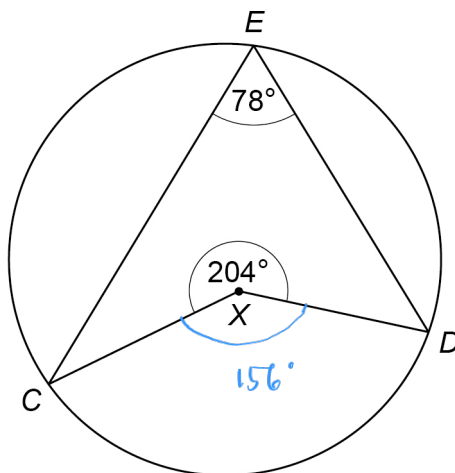
= 38°

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]

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

$$156^\circ \div 2 = 78^\circ \quad (\text{Angle } CED)$$

equal to the angle given

Turn over for the next question



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]

Probability of picking two children from each group:

$$P(\text{Group X : children}) \times P(\text{Group Y : children})$$

$$\frac{120}{250} \times \frac{17}{(17+15)} = \frac{120}{250} \times \frac{17}{32} = \frac{51}{200} = 0.255$$

Probability of picking two adults from each group:

$$P(\text{Group X : adults}) \times P(\text{Group Y : adults})$$

$$\frac{(250-120)}{250} \times \frac{15}{32} = \frac{130}{250} \times \frac{15}{32} = \frac{39}{160} = 0.24375$$

0.255 > 0.24375. Yes, the statement is correct because the probability of children is 0.255 which is more than probability of adults which is only 0.24375



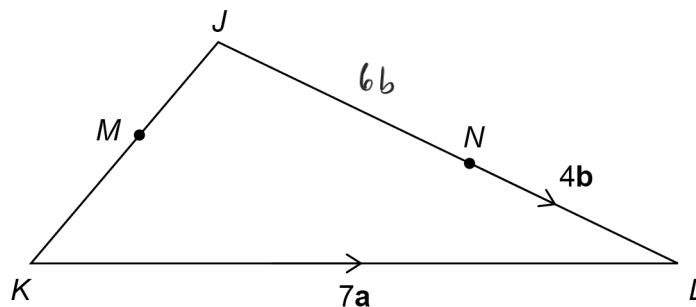
23

In triangle JKL

M is the midpoint of JK

$JN : NL = 3 : 2$

$\vec{KL} = 7\mathbf{a}$ $\vec{NL} = 4\mathbf{b}$



Not drawn
accurately

Work out \vec{JM} in terms of \mathbf{a} and \mathbf{b} .

Give your answer in its simplest form.

[3 marks]

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

$$\vec{JK} = \vec{JN} + \vec{NL} + \vec{LK}$$

$$= 6\mathbf{b} + 4\mathbf{b} - 7\mathbf{a} = 10\mathbf{b} - 7\mathbf{a}$$

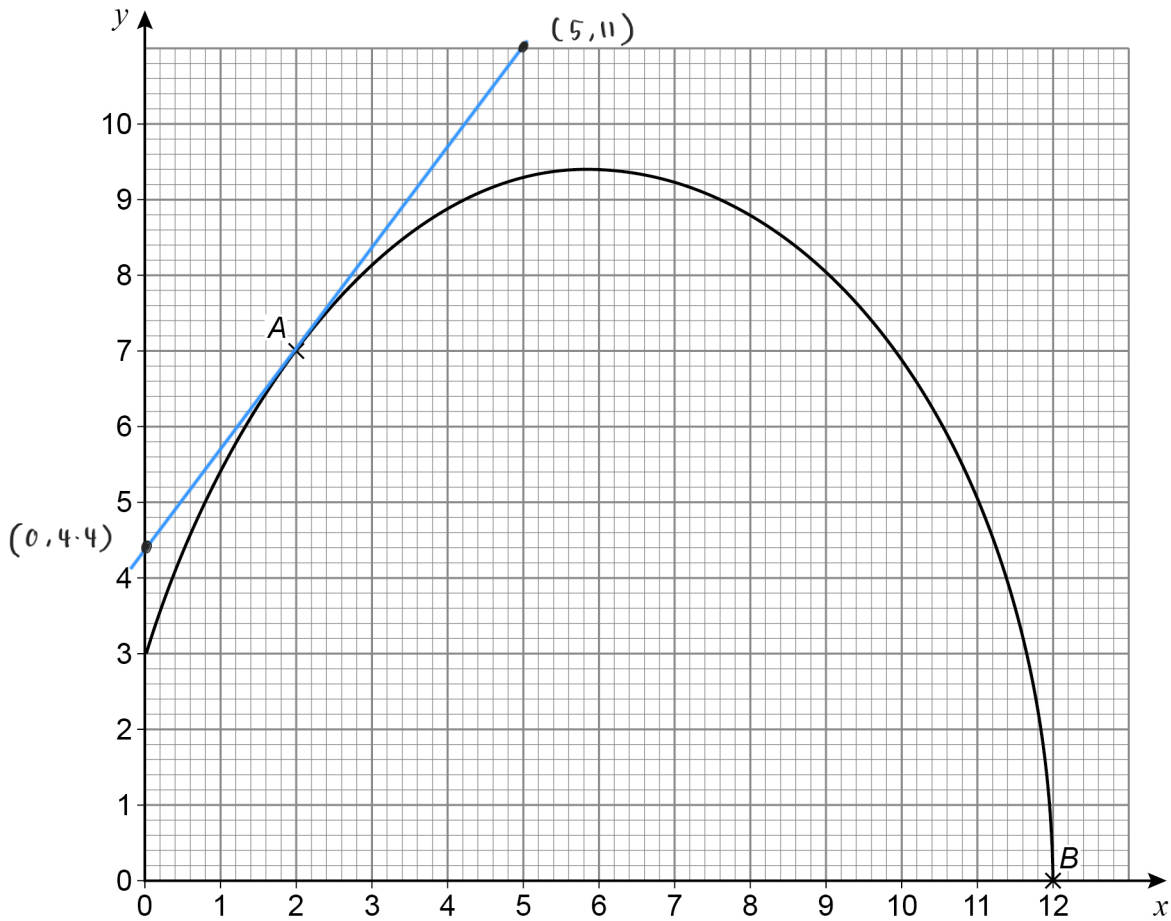
$$\vec{JM} = \frac{10\mathbf{b} - 7\mathbf{a}}{2} = 5\mathbf{b} - 3.5\mathbf{a}$$

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

Turn over for the next question



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]

$$\text{gradient at point A} = \frac{11 - 4.4}{5 - 0} = \frac{6.6}{5} = 1.32$$

Answer 1.32



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.

equal to radius²

[1 mark]

3

6

9

18

$$r^2 = 9$$

$$r = \sqrt{9} = 3$$

$$\text{diameter} = 3 \times 2 = 6$$

Turn over for the next question



26

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

[3 marks]

$$x = 3.47777 \dots$$

$$100x = 347.777 \dots$$

$$10x = 34.7777 \dots$$

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

$$90x = 313$$

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

27

The equation of a curve is $y = (x - 1)^2 - 6$ *max/min y = -6*
max/min x = -(-1) = +1
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]

$$y = 4x - 1 \quad (m_1 = 4)$$

$$m_1 \times m_2 = -1$$

$$(4) \times m_2 = -1$$

$$m_2 = -1/4$$

$$y - y_1 = m(x - x_1)$$

$$y - 5 = -1/4(x - 8)$$

$$y - 5 = -1/4x + 2$$

$$y = -1/4x + 2 + 5$$

$$y = -1/4x + 7 \quad (\text{equation of line B})$$

$$y = -1/4x + 7$$

$y = 0$ when line intersects
the x -axis

$$0 = -\frac{1}{4}x + 7$$

$$1/4x = 7$$

$$x = 7 \times 4$$

$$x = 28$$

$$(28, 0)$$

Answer (28 , 0)

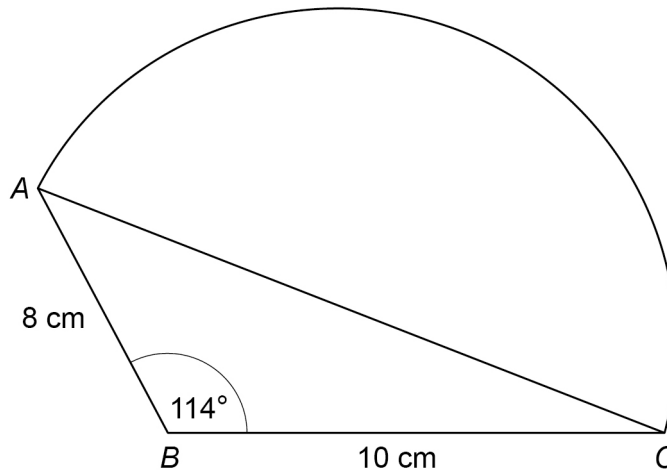
Turn over for the next question



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]

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

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

$$= 229.078$$

$$AC = \sqrt{229.078}$$

$$= 15.135 \text{ cm}$$

$$\text{Radius} = 15.135 \div 2 = 7.5677 \text{ cm}$$

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

$$= \frac{1}{2} \times 8 \times 10 \times \sin 114^\circ$$

$$= 36.5418 \text{ cm}^2$$

$$\text{Area of semicircle} = \frac{1}{2} \pi r^2 = \frac{1}{2} \pi (7.5677)^2 = 89.959 \text{ cm}^2$$

$$\text{Total area of the shape} = 36.5418 + 89.959 = 126.5 \text{ cm}^2$$

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]

$$gf(x) = \left(\frac{1}{2}x\right) - \left(\frac{1}{2}x\right)^2$$

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

$$y = \frac{1}{2}x \quad (\text{let } y = f(x))$$

$$2y = x$$

$$x = 2y \quad (\text{make } x \text{ the subject})$$

$$y = 2x \quad (\text{change } x \text{ and } y \text{ sign})$$

$$f^{-1}(x) = 2x \quad \text{--- ②} \quad (\text{substitute } y = f^{-1}(x)) \quad x^2 + 6x = 0$$

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

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

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

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

$$8x = 2x - x^2$$

$$x = -6$$

$$x^2 + 8x - 2x = 0$$

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

Answer $x = 0$ and $x = -6$

END OF QUESTIONS



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3 2



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