

Please write clearly in block capitals.

Centre number

Candidate number

Surname Miss Perry

Forename(s) worked solutions

Candidate signature _____

I declare this is my own work.

GCSE MATHEMATICS



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.



JUN2083003H01

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]

$y = -2x$

$y = 2x$

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

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

Same
gradient ←

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

[1 mark]

25%

75%

300%

400%

$80\% = 100\%$

$\times 4 \rightarrow 320 = 400\%$



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

[1 mark]

$\frac{1}{2}$

2

$\frac{1}{8}$

$\frac{1}{16}$

$$\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{16}$$

- 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.

$$1000 \div 2 = 500$$

17500

[1 mark]

Answer 17500.

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

[1 mark]

Answer 18499.

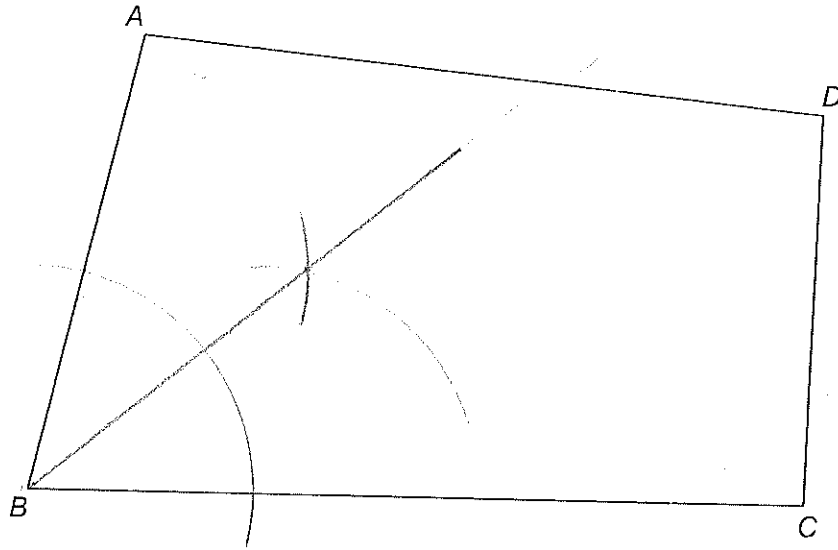
Turn over for the next question

Turn over ►



6

$ABCD$ represents the plan of a field.



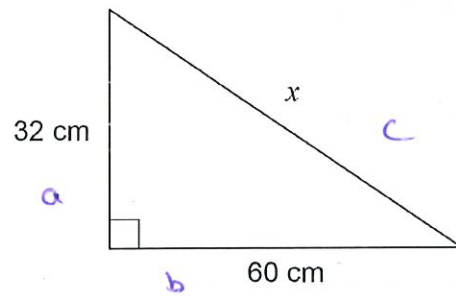
There is a path across the field that
starts at B
is the same distance from BA and BC .

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]

$$a^2 + b^2 = c^2$$

$$32^2 + 60^2 = c^2$$

$$1024 + 3600 = c^2$$

$$c = \sqrt{4624} = 68$$

Answer 68. cm

Turn over for the next question

Turn over ►



8

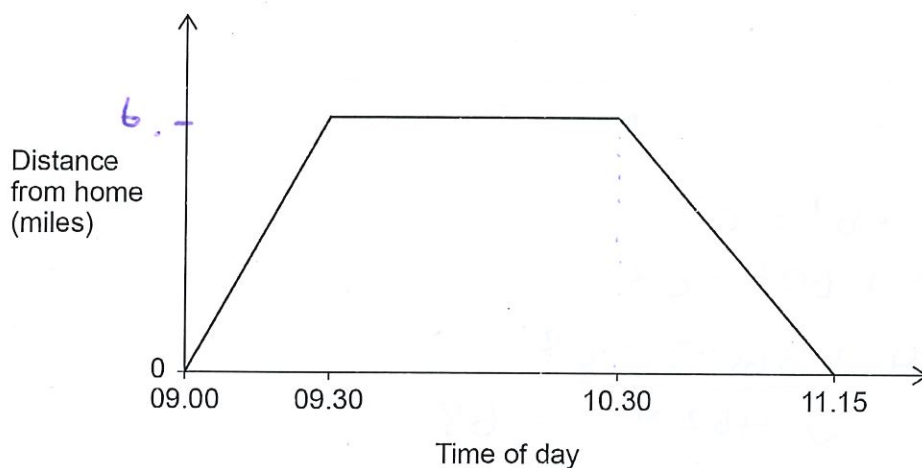
Chris visits a library.

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]

$$S = \frac{D}{T} \quad 12 = \frac{D}{0.5} \quad D = 6$$

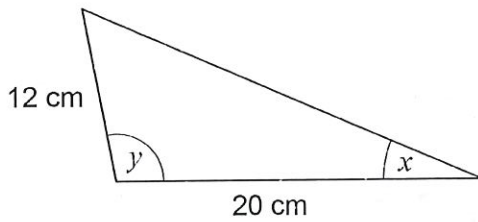
$$S = \frac{D}{T}$$

$$S = \frac{6}{0.75}$$

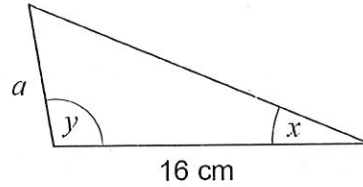
$$= 8$$

Answer 8mph mph

- 9 These two triangles are similar.



Not drawn
accurately



Work out the value of a .

[2 marks]

$$\frac{20}{16} = 1.25$$

$$\frac{12}{a} = 1.25 \quad 12 = 1.25a \quad a = 9.6$$

Answer 9.6 cm

- 10

Expand and simplify fully

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

[2 marks]

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

$$3c + 13$$

Answer 3c + 13



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]

$$\text{red: } 0.18 \times 350 = 63$$

$$\text{blue: } 0.62 \times 350 = 217 = 280$$

$$350 - 280 = 70$$

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

C.F
7
 $7+a$
 $7+a+b$
 $7+a+b+c$
 $15+a+b+c$

The median number of bedrooms is 3.5

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

[3 marks]

$$15 + a + b + c = 26 \quad a + b + c = 11$$

Median - between 3 + 4

between 13th and 14th value

$$7 + a = 13, \quad a = 6$$

$$a = \underline{6}$$

$$b = \underline{3}$$

$$c = \underline{2}$$



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

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

[2 marks]

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

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

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]

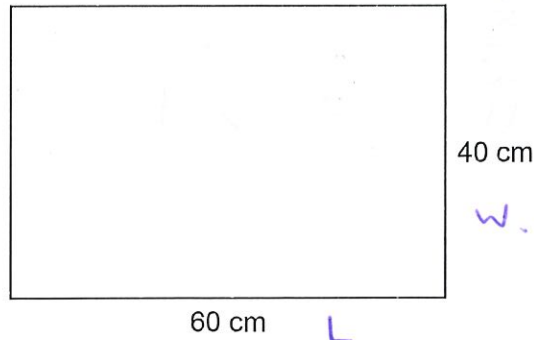
$$\frac{6c+10}{2} = \frac{6c}{2} + \frac{10}{2} = \frac{6c}{2} + 5$$

she should add 5 not 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]

$$\text{Perimeter} = 2L + 2W.$$

$$60 \times 2 + 40 \times 2 = 200$$

$$60 \times 0.85 = 51 \quad 40 \times 0.9 = 36$$

$$51 + 51 + 36 + 36 = 174$$

$$\frac{174}{200} = 0.87$$

It has decreased by 13%
not 25%.



15

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

[2 marks]

$$\begin{array}{r}
 +\frac{x}{3} \quad +\frac{x}{3} \\
 4 > 11 - \frac{x}{3} \\
 \hline
 4 + \frac{x}{3} > 11 \quad \times 3 \quad \times 3 \\
 \hline
 x > 21.
 \end{array}$$

Answer $x > 21$

16

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

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

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

Give your answer as a decimal.

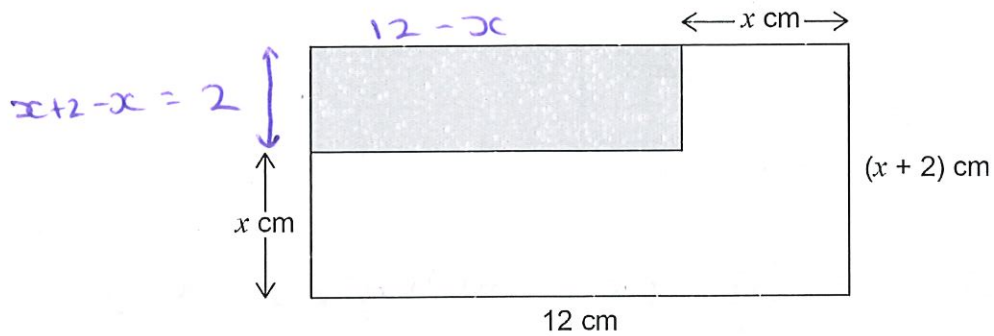
[3 marks]

$$\frac{12 + 77 + 36}{20} = 6.25.$$

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]

$$\frac{1}{4} (12 \times (x + 2)) = 2(12 - x)$$

$$3(x + 2) = 24 - 2x$$

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

$$5x + 6 = 24$$

$$5x = 18$$

$$x = \frac{18}{5}$$

$$x = 3.6$$

Answer 3.6



18

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

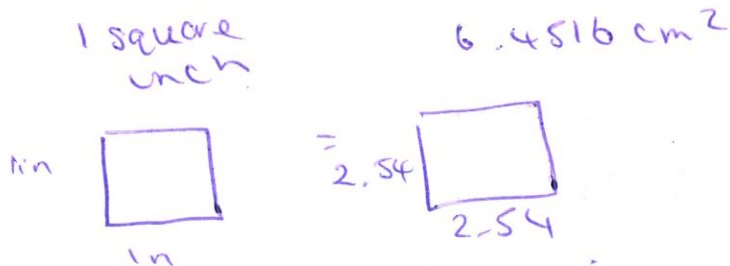
Convert the pressure into kilograms per square centimetre.

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

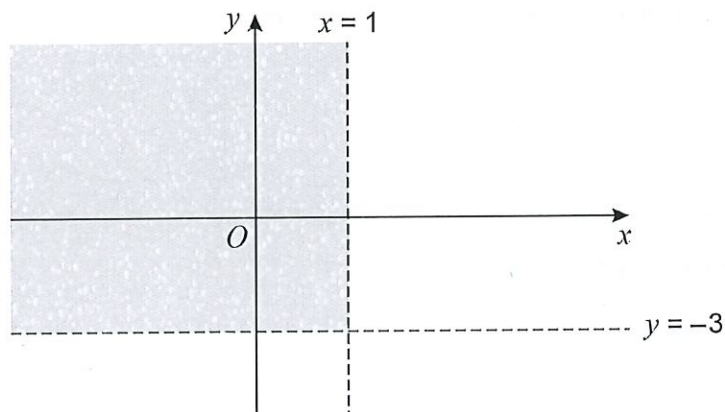
[3 marks]

$$\begin{array}{l}
 \div 6.45 \hookrightarrow 30 \text{ pounds per sq inch} \div 6.45 \\
 \div 6.45 \hookrightarrow 4.65 \text{ pounds per sq cm} \\
 \times 0.45 \hookrightarrow 2.0925 \text{ kg per sq cm}
 \end{array}$$

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 $y < -3$~~

greater than $y = -3$
less than $x = 1$.

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

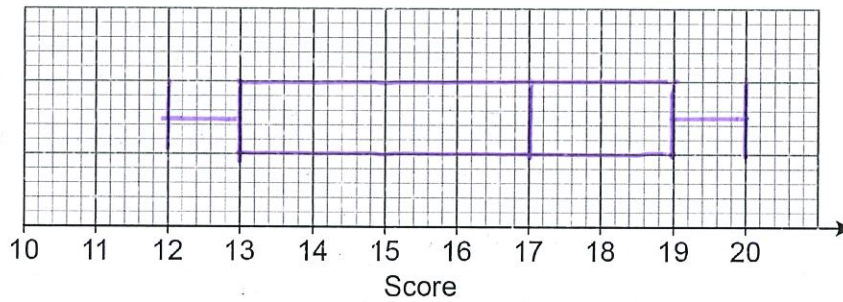
Upper quartile 19

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 is more consistent;

lower IQR

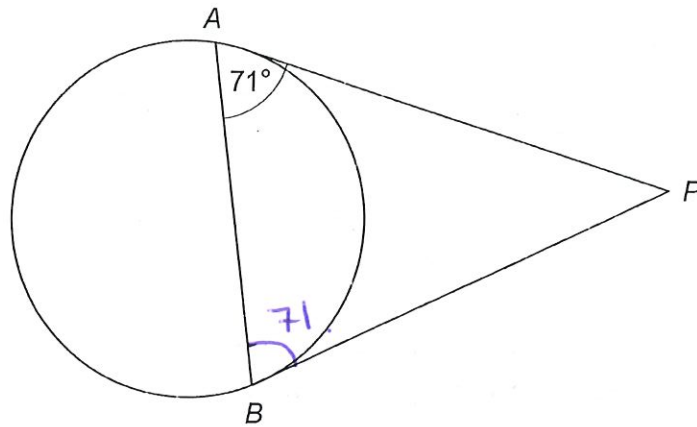
Turn over for the next question

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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]

$$71 + 71 = 142$$

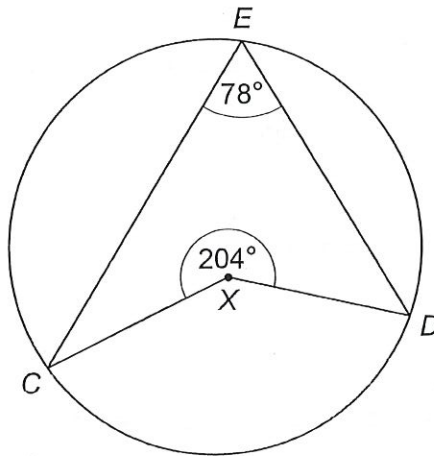
$$180 - 142 = 38$$

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]

$$360 - 204 = 156.$$

$$78 \times 2 = 156.$$

Angle at centre is twice angle at
circumference

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]

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

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

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

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

$$P(2 \text{ children}) = \frac{120}{250} \times \frac{17}{32} = \frac{2040}{8000} = \frac{51}{200}$$

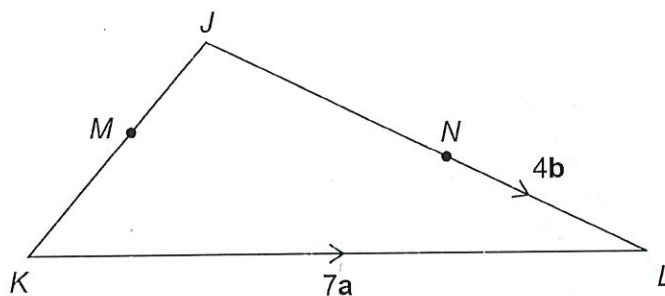
$$P(2 \text{ adult}) = \frac{130}{250} \times \frac{15}{32} = \frac{1950}{8000} = \frac{39}{160}$$

$$\frac{51}{200} = 0.255$$

$$\frac{39}{160} = 0.24375 \quad \text{YES } 0.255 > 0.24375$$



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

Give your answer in its simplest form.

[3 marks]

$$\vec{JM} = \frac{1}{2} \vec{JK}$$

$$\vec{JK} = \vec{JL} + \vec{LK} = \vec{JL} - \vec{KL}$$

$$\vec{JL} = \frac{3}{5} \vec{JL} + \frac{2}{5} \vec{JL} = \frac{2}{5} \vec{JL} + \frac{2}{5} \vec{JL} \quad \text{so} \quad 10\mathbf{b} = 5\mathbf{b}$$

$$\vec{JK} = 10\mathbf{b} - 7\mathbf{a}$$

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

Answer

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

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]

$$\frac{2.4}{1.8} = \frac{24}{18} = 1.3$$

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

$$\begin{aligned}r^2 &= 9 \\r &= 3 \\d &= 6\end{aligned}$$

Turn over for the next question

Turn over ►



26

Prove algebraically that $3.\dot{4}\dot{7} = \frac{313}{90}$

[3 marks]

$$3.\dot{4}\dot{7}$$

$$x = 3.\dot{4}\dot{7}$$

$$10x = 34.\dot{7}$$

$$100x = 347.\dot{7}$$

$$100x - 10x = 347.\dot{7} - 34.\dot{7}$$

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

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

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)

$$y = (x - 1)^2 - 6$$

lowest point
is when $(x - 1)^2 = 0$
 $x = 1$



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]

$$y = 4x - 1 \quad \text{Perp gradient} = -\frac{1}{4}$$

$$(8, 5)$$

$$y = -\frac{1}{4}x + c$$

$$5 = -\frac{1}{4} \times 8 + c$$

$$5 = -2 + c \quad c = 7$$

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

$$\text{when } y = 0 \quad -\frac{1}{4}x + 7 = 0$$

$$\frac{1}{4}x = 7$$

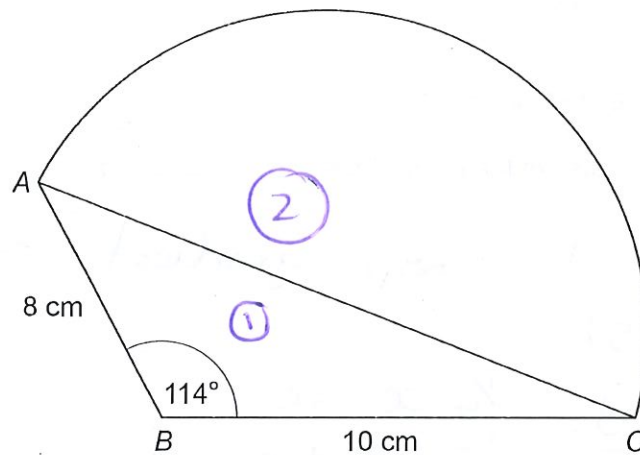
$$x = 28$$

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

[5 marks]

$$\textcircled{1} \text{ Area} = \frac{1}{2} ab \sin C.$$

$$\text{Area} = \frac{1}{2} \times 8 \times 10 \times \sin 114.$$

$$= 36.5418.$$

AC: cosine rule

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

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

$$= 64 + 100 + 65.077$$

$$a^2 = 229.077.$$

$$\text{AC: } a = 15.135.$$

$$\text{radius} = 7.5676$$

$$\frac{\pi r^2}{2} = 89.958$$

2

$$36.5 + 89.958 = 126.458$$

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]

$$f(x) = \frac{1}{2}x$$

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

$$f^{-1}(x) = 2x$$

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

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

$$f^{-1}(x) = gf(x)$$

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

$$\frac{1}{4}x^2 + \frac{3}{2}x = 0$$

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

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

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

Answer _____

END OF QUESTIONS



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3 2



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