



Please write clearly in block capitals.

Centre number

Candidate number

Surname \_\_\_\_\_

Forename(s) \_\_\_\_\_

Candidate signature \_\_\_\_\_

I declare this is my own work.

# GCSE MATHEMATICS



Higher Tier Paper 1 Non-Calculator

Friday 19 May 2023

Morning

Time allowed: 1 hour 30 minutes

### Materials

For this paper you must have:

- mathematical instruments
- the Formulae Sheet (enclosed).



You must **not** use a calculator.

### 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.

### 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	
<b>TOTAL</b>	



JUN2383001H01

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

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outside the  
box

1 (a) Work out  $0.7 \times 0.5$

[1 mark]

$$0.7 \times 0.5 = 0.35$$

Answer  $0.35$  (1)

1 (b) Work out  $\frac{5}{6} \div 3$

[1 mark]

$$\frac{5}{6 \times 3} = \frac{5}{18}$$

Answer  $\frac{5}{18}$  (1)

1 (c) Work out  $27 \div 0.6$

[1 mark]

$$27 \div \frac{6}{10}$$

$$\frac{27}{6} \times 10 = 45$$

Answer  $45$  (1)



Do not write  
outside the  
box2 Solve  $2x < 26$ 

[1 mark]

$$2x < 26$$

$$x < 13$$

Answer  $x < 13$  (1)3 Work out the value of  $\left(\frac{3}{2}\right)^2$ 

Give your answer as a mixed number.

[1 mark]

$$\left(\frac{3}{2}\right)^2 = \frac{9}{4} = \frac{4}{4} + \frac{4}{4} + \frac{1}{4}$$
$$= 2\frac{1}{4}$$

Answer  $2\frac{1}{4}$  (1)

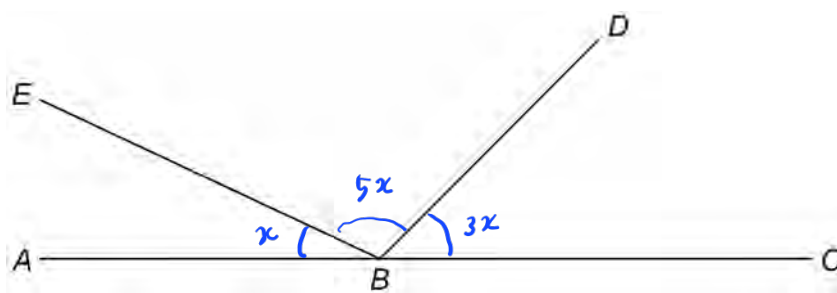
Turn over for the next question

Turn over ►



4  $ABC$ ,  $BD$  and  $BE$  are straight lines.

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Not drawn  
accurately

$$\text{angle } EBD = 5 \times \text{angle } ABE$$

$$\text{angle } DBC = 3 \times \text{angle } ABE$$

Work out the size of angle  $EBD$ .

[3 marks]

$$\text{Let } ABE = x$$

$$\text{total angle} = x + 5x + 3x = 9x \quad (1)$$

$$EBD = \frac{5x}{9x} \times 180^\circ = 100^\circ$$

Answer 100 °



- 5 Two prime numbers are multiplied together.  
The answer is an **even** number between 50 and 60  
Complete the calculation.

[3 marks]

$$\boxed{29} \times \boxed{2} = \boxed{58}$$

prime number : (2) 3, 5, 7, 11, 13, 17, 19, 23, (29)

Even number  $50 < x < 60$  : 52, 54, 56, (58)

- 6 Andrew and Bruce share some money in the ratio 5 : 6  
Bruce gets £96

Andrew gives  $\frac{1}{4}$  of his share to Carl.

Bruce gives  $\frac{2}{3}$  of his share to Carl.

How much money does Carl receive?

[4 marks]

$$\text{Andrew : } \frac{96}{6} \times 5 = 80 \quad (1)$$

$$\text{Andrew gives : } \frac{1}{4} \times 80 = 20 \quad (1)$$

$$\text{Bruce gives : } \frac{2}{3} \times 96 = 64 \quad (1)$$

$$\text{Carl : } 20 + 64 = 84 \quad (1)$$

Answer £ 84



7  $2^a \times 3 \times 5^2 = 600$

Work out the value of  $a$ .

You **must** show your working.

[3 marks]

$$2^a \times 3 \times 25 = 600$$

$$2^a \times 75 = 600$$

$$2^a = \frac{600}{75} = 8$$

$$2^a = 8$$

$$a = 3$$

$$a = 3$$

8 Expand and simplify fully  $5(3x + 4) - 2(x - 1)$

[2 marks]

$$15x + 20 - 2x + 2$$

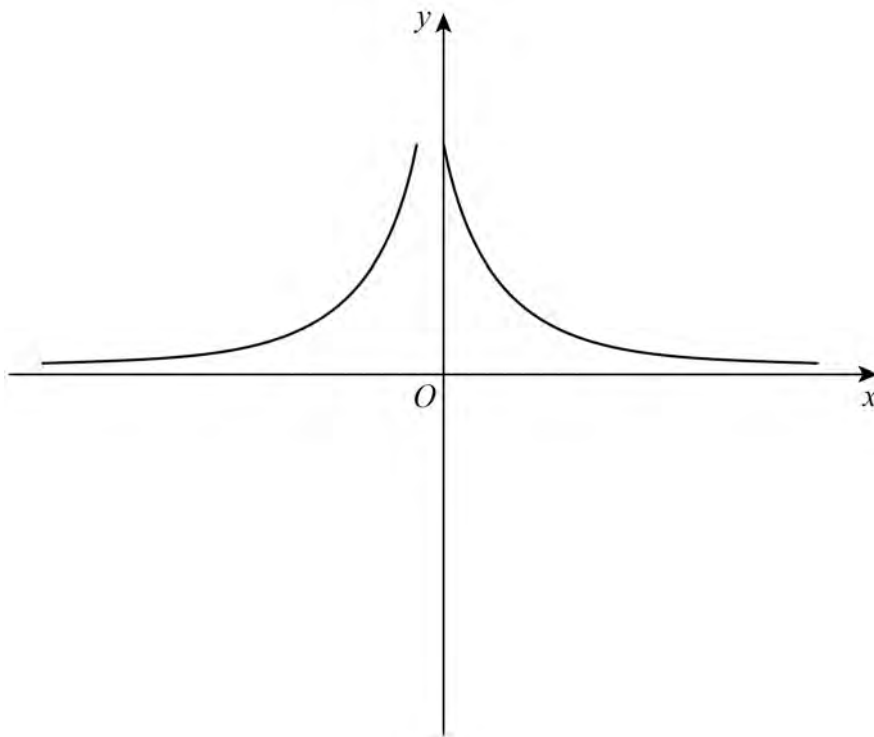
$$= 13x + 22$$

Answer  $13x + 22$



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- 9 Erika tries to sketch the graph  $y = \frac{1}{x}$  with  $x \neq 0$



Make **two** different criticisms of her sketch.

[2 marks]

Criticism 1 The graph touches the y-axis (1)

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Criticism 2 The graph on the left of y-axis should be  
below x-axis. (1)

---



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7
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Turn over ►



10

Sunita is  $x$  years old.

Beth is one year younger than Sunita.

Joel is double Sunita's age.

The mean of their ages is 5

How old is **Joel**?**[5 marks]**

$$\text{Beth : } x - 1$$

$$\text{Joel : } 2x$$

$$\text{Total their ages : } 3 \times 5 = 15 \quad (1)$$

$$x + x - 1 + 2x = 15 \quad (1)$$

$$4x = 16$$

$$x = 4 \quad (1)$$

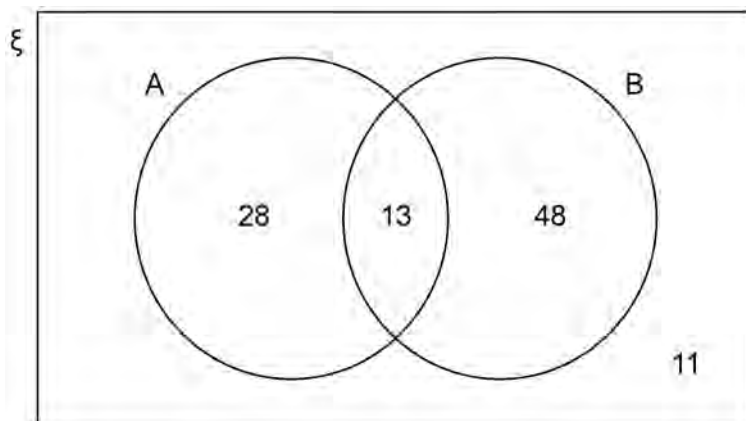
$$\text{Joel} = 2(4) = 8 \quad (1)$$

Answer 8



- 11 The Venn diagram represents 100 items.

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- 11 (a) Write down  $P(A \cap B)$

[1 mark]

Answer  $\frac{13}{100}$  (1)

- 11 (b) Work out  $P(A')$

[1 mark]

$$48 + 11 = 59$$

Answer  $\frac{59}{100}$  (1)

- 11 (c) Work out  $P(A \cup B)$

[1 mark]

$$28 + 48 + 13 = 89$$

Answer  $\frac{89}{100}$  (1)



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12 (a)  $a \times 10^n$  is a number in standard form.

Complete the inequality for the value of  $a$ .

[1 mark]

$$\underline{\quad 1 \quad} \leq a < \underline{\quad 10 \quad} \textcircled{1}$$

12 (b)  $b \times 10^n$  is the number 7200 written in standard form.

Work out  $b \times 10^{-n}$

Write your answer as an ordinary number.

[2 marks]

$$7200 = 7.2 \times 10^3$$

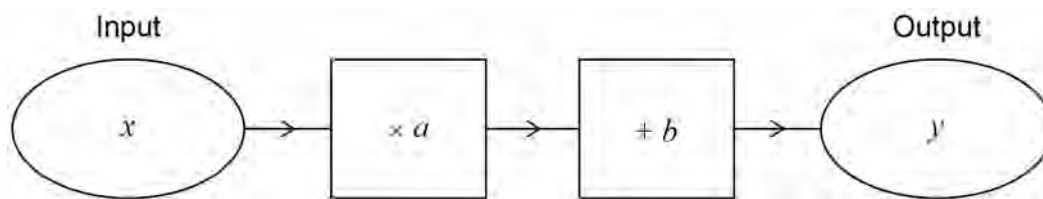
$$0.\underbrace{00}_{\text{two zeros}}7.2 \times 10^{-3} = 0.0072$$

Answer  $\underline{\quad 0.0072 \quad} \textcircled{2}$



- 13 (a) Here is a number machine.

Do not write  
outside the  
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Show that when the input increases by 2 the output increases by  $2a$ .

[2 marks]

$$ax + b = y$$

when input =  $x+2$ ,

$$a(x+2) + b = y$$

$$ax + (2a) + b = y \quad (2)$$

- 13 (b)  $f(x) = kx^2$  where  $k$  is a constant.

Kai says that  $\frac{f(6)}{f(2)}$  is equal to  $f(3)$  because  $\frac{6}{2} = 3$

Is he correct?

Show working to support your answer.

[2 marks]

$$f(6) = k(6)^2 = 36k$$

$$f(2) = k(2)^2 = 4k$$

$$f(3) = k(3)^2 = 9k$$

$$\frac{f(6)}{f(2)} = \frac{36k}{4k} = 9 \quad (1) \quad f(3) = 9k \quad (1)$$

$\therefore$  No. Kai is not correct.

Turn over ►



14

Here is a list of 11 whole numbers in numerical order.

The lower quartile, median, upper quartile and highest value are missing.

5	8	12	13	19	24	25	28	30	34	41
---	---	----	----	----	----	----	----	----	----	----

(2)

$36 + 5 = 41$

- median =  $2 \times$  lower quartile
- upper quartile =  $2.5 \times$  lower quartile
- range =  $2 \times$  interquartile range

Complete the list.

[2 marks]

$$\text{let } LQ = x$$

$$\text{median} = 2x$$

$$uQ = 2.5x$$

$$\text{range} = 2(2.5x - x)$$

$$= 3x$$

$$\text{when } x = 12, \text{ median} = 24, uQ = 30, \text{ range} = 36$$

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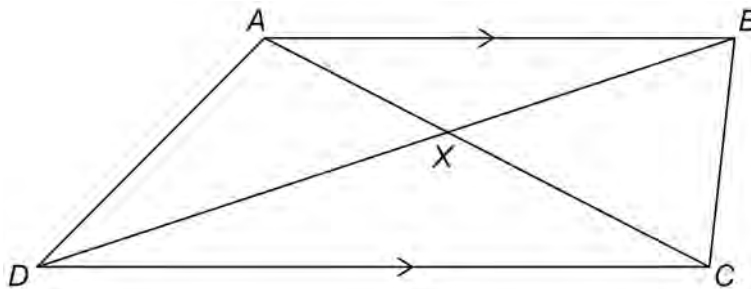
15

$ABCD$  is a trapezium.

All four sides are different lengths.

$AB$  is parallel to  $CD$ .

The diagonals intersect at  $X$ .



Not drawn accurately

For each statement, tick the correct box.

[4 marks]

	True	May be true	Not true
Triangles $AXB$ and $CXD$ are similar	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Triangles $AXD$ and $BXC$ are congruent	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Angle $ADB =$ angle $BDC$	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Area of triangle $ABC =$ area of triangle $ABD$	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Turn over for the next question

6

Turn over ►



16

Solve the simultaneous equations

$$2x - 5y = 13 \quad x = \frac{13 + 5y}{2} \quad \text{--- (1)}$$

$$3x + 4y = 8 \quad \text{--- (2)}$$

[4 marks]

substitute (1) into (2) :

$$3 \left( \frac{13 + 5y}{2} \right) + 4y = 8 \quad \text{(1)}$$

$$39 + 15y + 8y = 16$$

$$23y = -23$$

$$y = -1$$

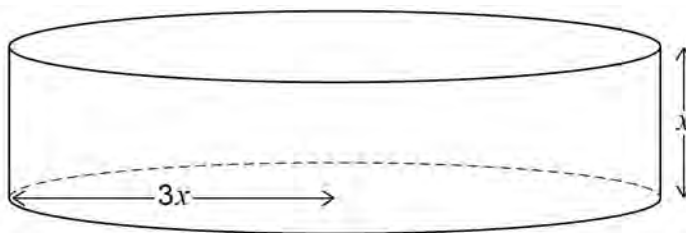
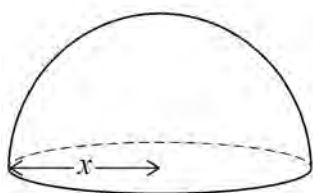
$$x = \frac{13 + 5(-1)}{2} \quad \text{(1)}$$

$$= \frac{13 - 5}{2} = 4$$

$$x = \underline{4} \quad \text{(1)} \quad y = \underline{-1} \quad \text{(1)}$$



17

A solid hemisphere has radius  $x$ .A solid cylinder has radius  $3x$  and height  $x$ .

Surface area of a sphere =  $4\pi r^2$   
where  $r$  is the radius

Work out the ratio

total surface area of the hemisphere : total surface area of the cylinder

Give your answer in its simplest form.

You **must** show your working.

[3 marks]

$$\text{surface area of hemisphere : } \frac{4\pi x^2}{2} + \pi x^2 = 3\pi x^2$$

①

$$\text{Surface area of cylinder : } 2 \times \pi (3x)^2 +$$

$$: 18\pi x^2 + 2\pi(3x)x$$

$$: 18\pi x^2 + 6\pi x^2 = 24\pi x^2$$

①

$$\text{s.a. of hemisphere : s.a of cylinder} = 3\pi x^2 : 24\pi x^2$$

$$= 3 : 24$$

$$= 1 : 8$$

①

Answer 1 : 8Do not write  
outside the  
box

7

Turn over ►



18

$$6 < \sqrt[3]{x} < 7$$

Circle the possible value of  $x$ .

[1 mark]

1.9

20

45

290

①

19

Work out how many 5-digit **odd** numbers can be made using these digits **once** each.

2

4

6

7

9

Do **not** list them.

[2 marks]

last digit must be odd : either 7 or 9 (2 options)

first digit has 4 options left (4 options)

remaining 3 digit =  $3 \times 2 \times 1 = 6$

Total =  $2 \times 4 \times 6 = 48$  ①

Answer 48 ①

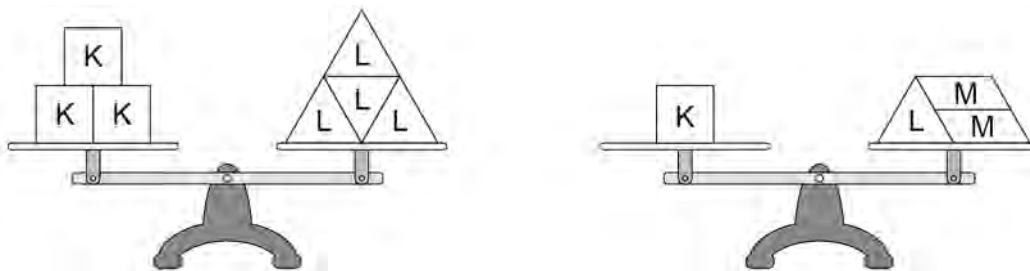




20

K, L and M are weights.

Both of the scales balance exactly.

Do not write  
outside the  
boxHow many M weights are needed to balance **one** L weight?**[3 marks]**

$$3K = 4L \quad (1)$$

$$K = \frac{4}{3}L$$

$$\frac{4}{3}L = L + 2M \quad (1)$$

$$\frac{1}{3}L = 2M$$

$$L = 6M \quad (1)$$

Answer 6

Turn over for the next question

6

Turn over ►



21 Express  $x^2 - 6x - 15$  in the form  $(x - a)^2 - b$  where  $a$  and  $b$  are integers.

[2 marks]

$$(x-3)^2 - 9 - 15$$

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

Answer  $(x-3)^2 - 24$  (2)

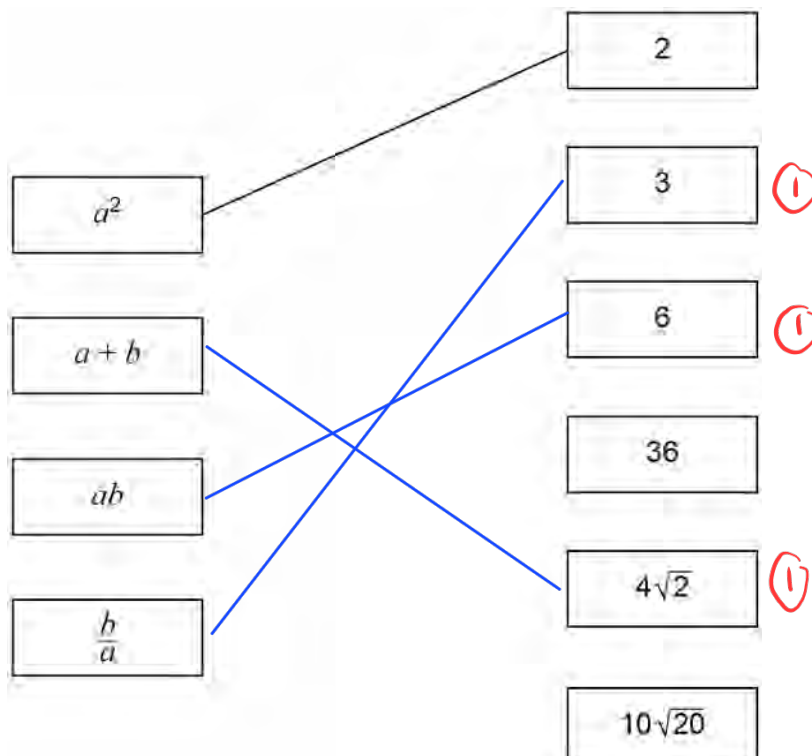
22

$$a = \sqrt{2} \quad \text{and} \quad b = \sqrt{18}$$

Match each expression to its value.

One has been done for you.

[3 marks]



23

Write  $0.\dot{1}3$  as a fraction in its simplest form.

[3 marks]

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$$\text{let } x = 0.\dot{1}3 \dots$$

$$100x = 13.33 \dots \quad (1)$$

$$100x - x = 13.33 - 0.13$$

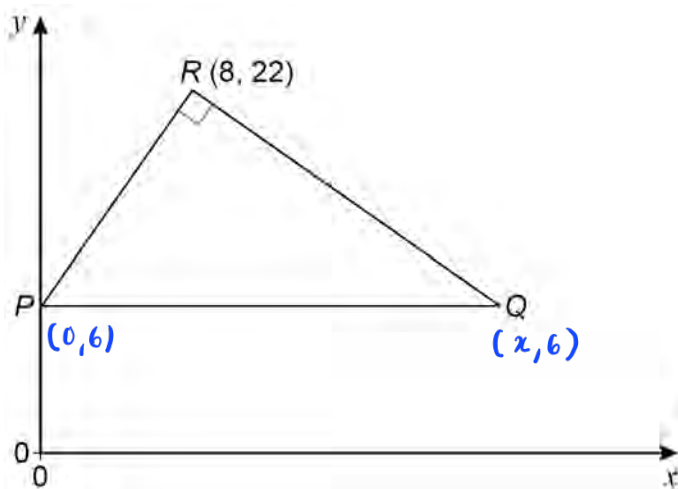
$$99x = 13.2 \quad (1)$$

$$x = \frac{13.2}{99} \div 6.6 = \frac{2}{15} \quad (1)$$

Answer  $\frac{2}{15}$



24

Points  $P$ ,  $Q$  and  $R(8, 22)$  form a triangle.Do not write  
outside the  
boxNot drawn  
accurately $PQ$  is a horizontal line, with  $P$  on the  $y$ -axis.Angle  $PRQ$  is a right angle.The gradient of  $PR$  is 2Work out the coordinates of  $Q$ .**[5 marks]**

$$m_{PR} = 2 = \frac{22 - y}{8 - 0}$$

$$2(8) = 22 - y$$

$$y = 22 - 16$$

$$= 6 \quad (1)$$

$$m_{PR} \times m_{RQ} = -1$$

$$m_{RQ} = \frac{-1}{2} \quad (1)$$

$$-\frac{1}{2} = \frac{6 - 22}{x - 8} \quad (1)$$

$$-x + 8 = 12 - 44$$

$$-x = -40 \quad (1)$$

$$x = 40$$

Answer ( 40 , 6 )



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25

Show that  $\frac{4 \sin 30^\circ - \tan 45^\circ}{2 \cos 30^\circ}$  can be written as  $\tan x$ , where  $x$  is an acute angle.

[4 marks]

$$\sin 30^\circ = \frac{1}{2}, \quad \tan 45^\circ = 1, \quad \cos 30^\circ = \frac{\sqrt{3}}{2}$$

(1)

$$\frac{4\left(\frac{1}{2}\right) - 1}{2\left(\frac{\sqrt{3}}{2}\right)} = \frac{2-1}{\sqrt{3}}$$

(1)

$$= \frac{1}{\sqrt{3}} = \tan 30^\circ$$

(1)

$$x = 30^\circ$$

Turn over for the next question

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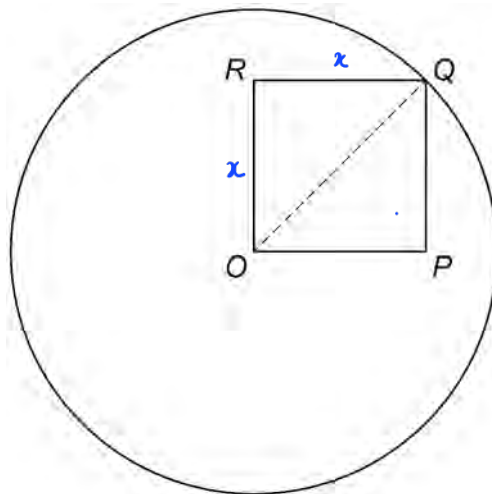
26

A circle, centre  $O$ , has circumference  $20\pi$  cm

$Q$  is a point on the circle.

$OPQR$  is a **square**.

Not drawn  
accurately



perimeter of the square : circumference of the circle =  $\sqrt{a} : \pi$  where  $a$  is an integer.

Work out the value of  $a$ .

You **must** show your working.

[4 marks]

$$2 \times \pi \times r = 20\pi$$

$$r = 10 \quad (1)$$

$$OQ = 10$$

$$OQ = \sqrt{x^2 + x^2}$$

$$= \sqrt{2x^2}$$

$$100 = 2x^2$$

$$50 = x^2 \quad (1)$$

$$x = \sqrt{50} = 5\sqrt{2} \quad (1)$$

$$\text{perimeter of square : circumference of circle} = \frac{20\sqrt{2}}{\sqrt{2}} : \frac{20\pi}{\pi} = 20 : 20$$

$$a = \underline{\quad 2 \quad (1) \quad}$$

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27

A journey has two stages.

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	Distance (km)	Average speed (km/h)	Time (h)
Stage 1	30	$a$	$\frac{30}{a}$
Stage 2	30	$b$	$\frac{30}{b}$

Show that the average speed for the **whole** journey, in km/h, is

$$\frac{2ab}{a+b}$$

[3 marks]

$$\text{total time} = \frac{30}{a} + \frac{30}{b} = \frac{30a + 30b}{ab} \quad (1)$$

$$\text{total distance} = 30 + 30 = 60$$

$$\text{average speed} = \frac{60(ab)}{30a + 30b} = \frac{30(2ab)}{30(a+b)}$$

$$= \frac{2ab}{a+b} \quad (1)$$

END OF QUESTIONS



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