

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname StemUp Model Solution

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Candidate signature _____

I declare this is my own work.

GCSE MATHEMATICS

H

Higher Tier Paper 1 Non-Calculator

Friday 19 May 2023

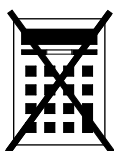
Morning

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	
TOTAL	



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

Answer **all** questions in the spaces provided.1 (a) Work out 0.7×0.5

[1 mark]

$$7 \times 5 = 35$$

$$0.7 \times 0.5 = 0.35$$

Answer 0.35 1 (b) Work out $\frac{5}{6} \div 3$

[1 mark]

$$\frac{5}{6} \div 3 = \frac{5}{6} \times \frac{1}{3} = \frac{5}{18}$$

Answer $\frac{5}{18}$ 1 (c) Work out $27 \div 0.6$

[1 mark]

$$27 \div 0.6 = 270 \div 6$$

$$= 45$$

Answer 45 

2 Solve $2x < 26$

[1 mark]

$$2x < 26$$

$$x < 26 \div 2$$

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

Give your answer as a mixed number.

[1 mark]

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

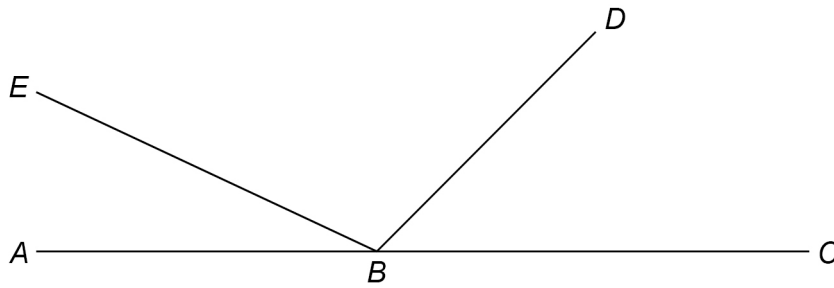
Answer $2\frac{1}{4}$

Turn over for the next question

Turn over ►



4

 ABC , BD and BE are straight lines.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]**

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

$$\text{angle } EBD = 5x, \text{ angle } DBC = 3x$$

$$x + 5x + 3x = 180 \quad (\text{angles on a straight line add to } 180^\circ)$$

$$9x = 180, \text{ so } x = 180 \div 9 = 20$$

$$\text{angle } EBD = 5 \times 20 = 100^\circ$$

Answer 100°

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

[3 marks]

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

Even answer, so one of the primes must be 2

Even numbers 52, 54, 56, 58: $\div 2$ gives 26, 27, 28, 29

Only 29 is prime, so $2 \times 29 = 58$

- 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]

Bruce gets 6 parts = £96, so 1 part = $96 \div 6 = £16$

Andrew gets 5 parts = $5 \times 16 = £80$

Andrew gives $80 \div 4 = £20$ to Carl

Bruce gives $96 \div 3 \times 2 = 32 \times 2 = £64$ to Carl

Carl receives $20 + 64 = £84$

Answer £ 84

Turn over ►

7

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

Work out the value of a .

You **must** show your working.

[3 marks]

$$3 \times 5^2 = 3 \times 25 = 75$$

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

$$2^a = 600 \div 75 = 8$$

$$8 = 2 \times 2 \times 2 = 2^3$$

$$\text{so } a = 3$$

$$a = \underline{\quad 3 \quad}$$

8

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

[2 marks]

$$5(3x + 4) = 15x + 20$$

$$-2(x - 1) = -2x + 2$$

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

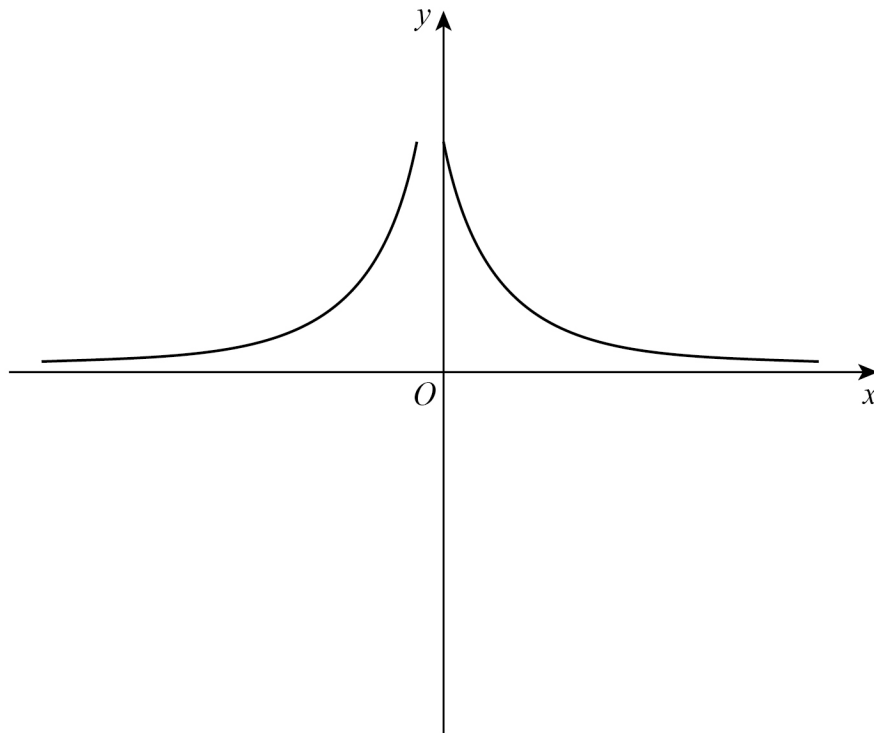
$$= 13x + 22$$

$$\text{Answer } \underline{\quad 13x + 22 \quad}$$



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, but $x \neq 0$,
so the curves should never meet the y-axis ($x = 0$).

Criticism 2 For negative x , $y = 1/x$ is negative, so the left
branch should be below the x-axis (bottom-left), not top-left.



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]**

$$\text{Sunita} = x, \quad \text{Beth} = x - 1, \quad \text{Joel} = 2x$$

$$\text{Total of ages} = \text{mean} \times 3 = 5 \times 3 = 15$$

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

$$4x - 1 = 15$$

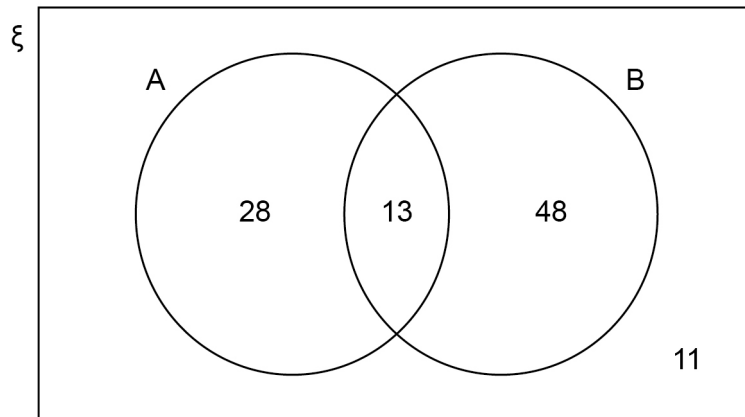
$$4x = 16$$

$$x = 4$$

$$\text{Joel} = 2 \times 4 = 8$$

Answer 8

- 11 The Venn diagram represents 100 items.



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

[1 mark]

Answer $\frac{13}{100}$

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

[1 mark]

Not in A: $48 + 11 = 59$

$P(A') = 59 \text{ out of } 100$

Answer $\frac{59}{100}$

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

[1 mark]

In A or B: $28 + 13 + 48 = 89$

(or $100 - 11 = 89$)

Answer $\frac{89}{100}$



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

Complete the inequality for the value of a .

[1 mark]

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

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]

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

$$\text{so } b = 7.2 \text{ and } n = 3$$

$$b \times 10^{-n} = 7.2 \times 10^{-3}$$

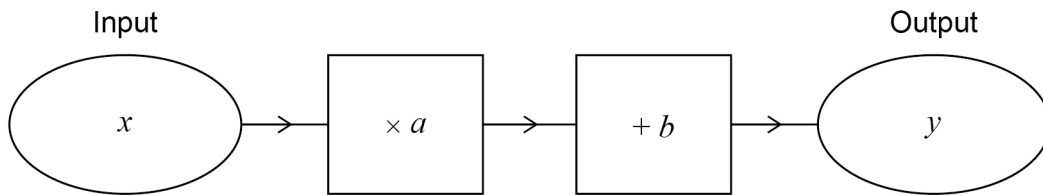
$$= 7.2 \div 1000$$

$$= 0.0072$$

Answer $\underline{0.0072}$



- 13 (a) Here is a number machine.



Show that when the input increases by 2 the output increases by $2a$.

[2 marks]

$$\text{Input } x: \text{ output} = ax + b$$

$$\text{Input } x + 2: \text{ output} = a(x + 2) + b$$

$$= ax + 2a + b$$

$$\text{Increase} = (ax + 2a + b) - (ax + b)$$

$$= 2a$$

So the output increases by $2a$

- 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]

$$f(6) = k \times 6^2 = 36k, \quad f(2) = k \times 2^2 = 4k$$

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

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

$9 \neq 9k$ (they are only equal when $k = 1$)

No, he is not correct.



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

Complete the list.

[2 marks]

LQ is the 3rd value, median the 6th, UQ the 9th

LQ between 8 and 13; try LQ = 12

median = $2 \times 12 = 24$, UQ = $2.5 \times 12 = 30$

IQR = $30 - 12 = 18$, range = $2 \times 18 = 36$

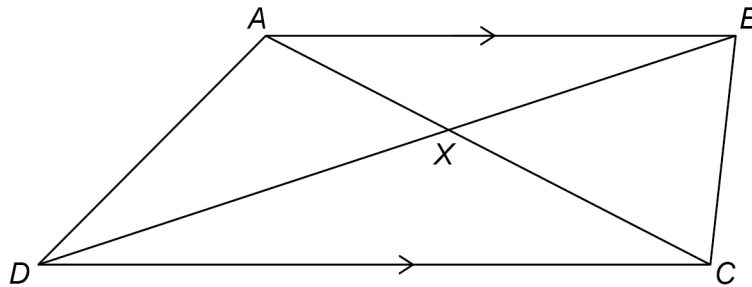
highest = $5 + 36 = 41$



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	☒	☐	☐
Triangles AXD and BXC are congruent	☐	☐	☒
Angle ADB = angle BDC	☐	☐	☒
Area of triangle ABC = area of triangle ABD	☒	☐	☐

Turn over for the next question

Turn over ►



16

Solve the simultaneous equations

$$2x - 5y = 13$$

$$3x + 4y = 8$$

[4 marks]

$$2x - 5y = 13 \quad (\times 4) \quad 8x - 20y = 52$$

$$3x + 4y = 8 \quad (\times 5) \quad 15x + 20y = 40$$

$$\text{Add: } 23x = 92$$

$$x = 92 \div 23 = 4$$

$$\text{Substitute: } 2(4) - 5y = 13$$

$$8 - 5y = 13$$

$$-5y = 5$$

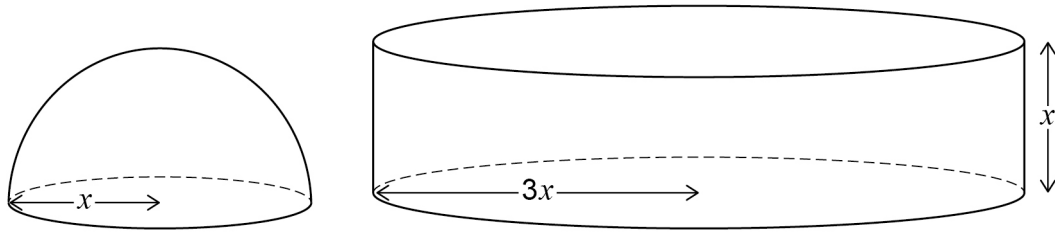
$$y = -1$$

$$\text{Check: } 3(4) + 4(-1) = 12 - 4 = 8 \checkmark$$

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



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]**

$$\text{Hemisphere: curved} = 4\pi x^2 \div 2 = 2\pi x^2, \quad \text{flat} = \pi x^2$$

$$\text{total} = 2\pi x^2 + \pi x^2 = 3\pi x^2$$

$$\text{Cylinder: two ends} = 2 \times \pi(3x)^2 = 2 \times 9\pi x^2 = 18\pi x^2$$

$$\text{curved} = 2\pi \times 3x \times x = 6\pi x^2$$

$$\text{total} = 18\pi x^2 + 6\pi x^2 = 24\pi x^2$$

$$3\pi x^2 : 24\pi x^2$$

$$= 3 : 24 = 1 : 8$$

Answer 1 : 8

Turn over ►



18

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

Circle the possible value of x .

[1 mark]

1.9

20

45

290

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: 7 or 9 (2 choices)

$$4 \times 3 \times 2 \times 1 \times 2 = 48$$

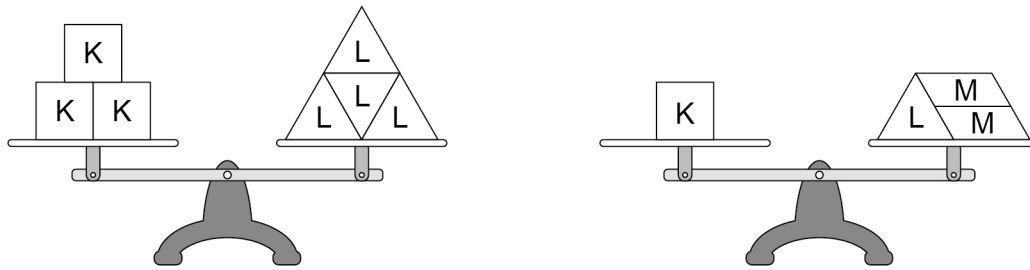
Answer 48



20

K, L and M are weights.

Both of the scales balance exactly.

How many M weights are needed to balance **one** L weight?**[3 marks]**

$$\text{Left scale: } 3K = 4L$$

$$\text{Right scale: } K = L + 2M$$

$$\text{Substitute: } 3(L + 2M) = 4L$$

$$3L + 6M = 4L$$

$$6M = L$$

Answer 6

Turn over for the next question

Turn over ►



21

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

[2 marks]

$$x^2 - 6x - 15 = (x - 3)^2 - 9 - 15$$

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

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

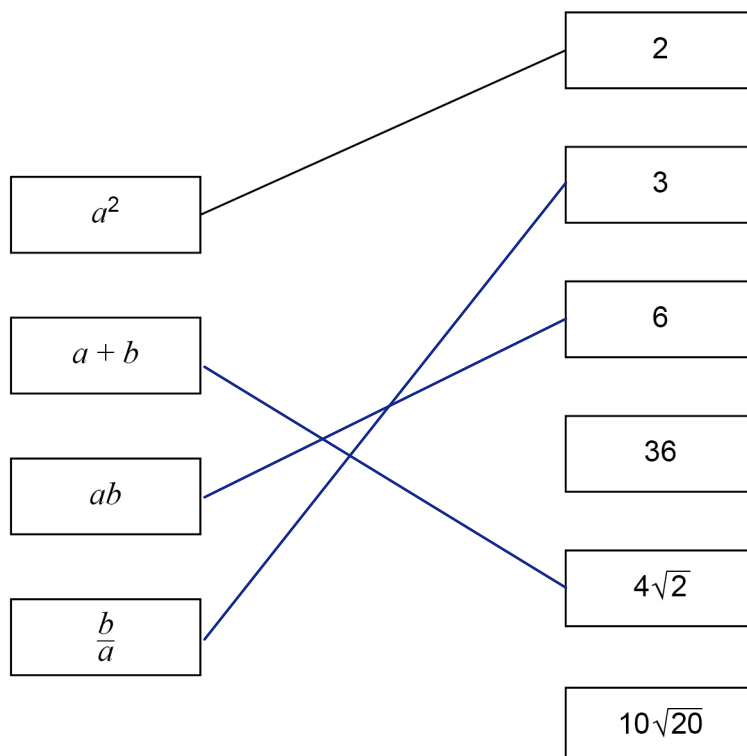
22

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

Match each expression to its value.

One has been done for you.

[3 marks]



$$a + b = \sqrt{2} + 3\sqrt{2} = 4\sqrt{2}, \quad ab = \sqrt{36} = 6, \quad b \div a = \sqrt{9} = 3$$



23

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

[3 marks]

$$x = 0.1333\ldots$$

$$10x = 1.333\ldots$$

$$100x = 13.333\ldots$$

$$100x - 10x = 13.333\ldots - 1.333\ldots$$

$$90x = 12$$

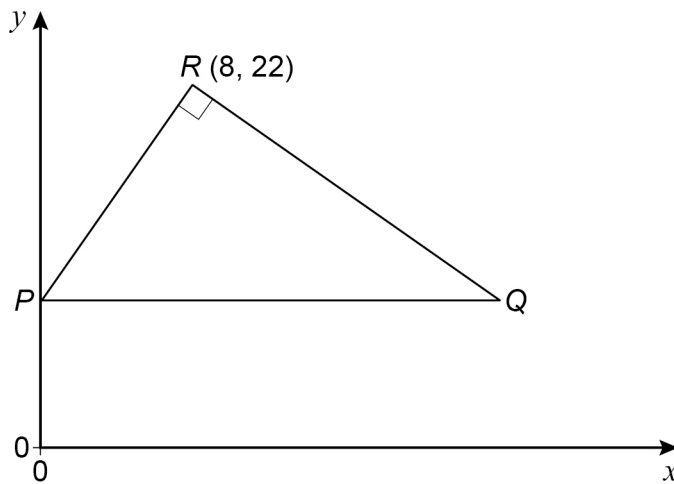
$$x = \frac{12}{90} = \frac{2}{15}$$

Answer $\frac{2}{15}$

Turn over ►



24

Points P , Q and $R(8, 22)$ form a triangle.Not 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]**

$$PR: y = 2x + c \text{ through } R(8, 22)$$

$$22 = 2 \times 8 + c, \text{ so } c = 6 \rightarrow P = (0, 6)$$

$$RQ \text{ is perpendicular to } PR: \text{ gradient of } RQ = -1 \div 2 = -0.5$$

$$RQ: y = -0.5x + c, \quad 22 = -0.5 \times 8 + c$$

$$22 = -4 + c, \text{ so } c = 26$$

$$RQ: y = -0.5x + 26$$

$$Q \text{ is level with } P, \text{ so } y = 6: 6 = -0.5x + 26$$

$$0.5x = 20$$

$$x = 40$$

Answer (40 , 6)

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]

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

$$\text{Numerator: } 4 \times \frac{1}{2} - 1 = 2 - 1 = 1$$

$$\text{Denominator: } 2 \times \frac{\sqrt{3}}{2} = \sqrt{3}$$

$$\frac{4 \sin 30^\circ - \tan 45^\circ}{2 \cos 30^\circ} = \frac{1}{\sqrt{3}} = \frac{\sqrt{3}}{3} = \tan 30^\circ$$

So it equals $\tan x$ with $x = 30^\circ$, which is acute.

Turn over for the next question

Turn over ►



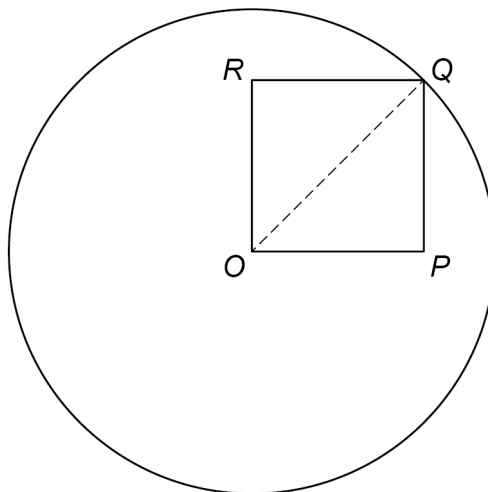
26

A circle, centre O , has circumference 20π 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]

$$\text{Circumference } 2\pi r = 20\pi, \text{ so } r = 10 \text{ cm} = OQ$$

$$\text{Side of square} = s: s^2 + s^2 = 10^2 \quad (\text{Pythagoras})$$

$$2s^2 = 100, \quad s^2 = 50$$

$$s = \sqrt{50} = 5\sqrt{2}$$

$$\text{Perimeter} = 4 \times 5\sqrt{2} = 20\sqrt{2}$$

$$20\sqrt{2} : 20\pi = \sqrt{2} : \pi$$

$$\text{so } a = 2$$

$$a = \underline{\hspace{2cm} 2 \hspace{2cm}}$$



27

A journey has two stages.

	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]

$$\text{Total distance} = 30 + 30 = 60 \text{ km}$$

$$\text{Total time} = \frac{30}{a} + \frac{30}{b} = \frac{30b + 30a}{ab} = \frac{30(a+b)}{ab}$$

$$\text{Average speed} = \text{total distance} \div \text{total time} = 60 \div \frac{30(a+b)}{ab}$$

$$= 60 \times \frac{ab}{30(a+b)} = \frac{60ab}{30(a+b)}$$

$$= \frac{2ab}{a+b} \text{ km/h as required}$$

END OF QUESTIONS

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2 8



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