AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE MATHEMATICS

Example-Problem Past Paper

H

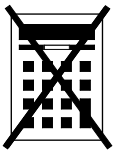
Higher Tier Paper 1 Non-Calculator

June 2023

Materials

For this paper you must have:

- mathematical instruments.



You must **not** use a calculator.

Instructions

- Engage with the fully-worked solutions in full before attempting the shadow questions.
- Explain the fully-worked solutions to yourself, anticipating the next steps in the worked solutions, making links between the problems and the mathematics used to solve them.
- Apply the methods learnt from the fully-worked solutions to the shadow questions, writing down all the workings in the spaces provided. Your thought process is important.
- 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.
- You may ask for more answer paper, graph paper and tracing paper.
- You should ask your teacher for help on a question if you do not fully understand a part of the fully-worked solution. Remember to be specific, understanding why the step was completed, rather than simply getting the correct answer.

Advice

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

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

Do not write outside the box

1 (a) Work out 0.7×0.5

$\frac{7}{10} \times \frac{5}{10} = \frac{35}{100}$

[1 mark]

Answer 0.35

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

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

[1 mark]

Answer $\frac{5}{18}$

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

$\frac{27}{0.6} = \frac{270}{6}$

$6 \overline{)270}$ = 045

[1 mark]

Answer 45

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

Do not write outside the box

1 (a) Work out 0.3×0.2

[1 mark]

Answer _____

1 (b) Work out $\frac{4}{5} \div 7$

[1 mark]

Answer _____

1 (c) Work out $16 \div 0.2$

[1 mark]

Answer _____

3

Turn over ►

Do not write outside the box

2 Solve $2x < 26$

[1 mark]

$2x < 26$

$\div 2 \quad \div 2$

$x < 13$

Answer $x < 13$

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

Do not write outside the box

2 Solve $5x < 60$

[1 mark]

Answer _____

Do not write outside the box

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

Give your answer as a mixed number.

[1 mark]

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

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

Do not write outside the box

3 Work out the value of $\left(\frac{5}{3}\right)^2$

Give your answer as a mixed number.

[1 mark]

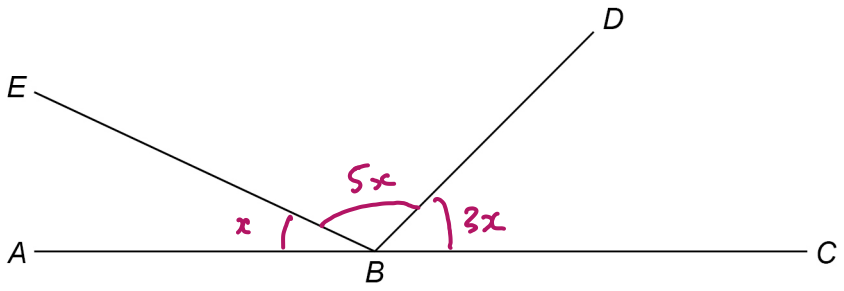
Answer _____

1

Turn over ►

Do not write outside the box

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



Not drawn accurately

angle *EBD* = 5 × angle *ABE*

angle *DBC* = 3 × angle *ABE*

Work out the size of angle *EBD*.

[3 marks]

$x + 5x + 3x = 9x$

$9x = 180°$

$\div 9 \quad \div 9$

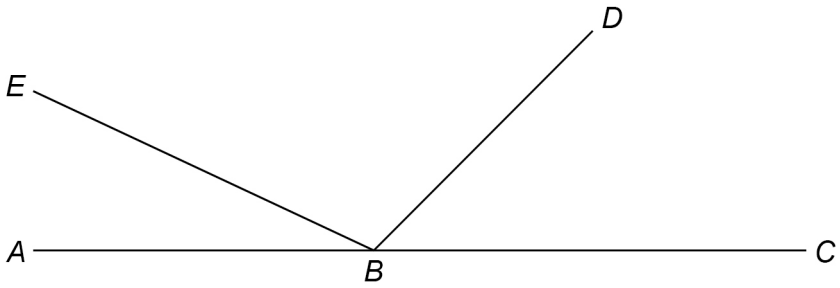
$x = 20°$

$5x = 5 \times 20 = 100$

Answer 100 °

Do not write outside the box

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



Not drawn accurately

angle *EBD* = 6 × angle *ABE*

angle *DBC* = 3 × angle *ABE*

Work out the size of angle *DBC*.

[3 marks]

Answer _____ °

3

Turn over ►

Do not write outside the box

5 Two prime numbers are multiplied together. 2, 3, 5, 7, 11, 13, 17, 19, 23, 29

The answer is an **even** number between 50 and 60

Complete the calculation.

[3 marks]

2	×	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]

A ○○○○○ 16 × 5 = 80 A : £80

$\frac{1}{4}$ of £80 = £20

B ○○○○○○ 96 ÷ 6 = 16 B : £96

96

$\frac{2}{3}$ of £96 = £64

£20 + £64 = £84

Answer £ 84

Do not write outside the box

5 Two prime numbers are multiplied together.

The answer is an **even** number between 40 and 50

Complete the calculation.

[3 marks]

$\square \times \square = \square$

6 Chloe and Mikey share some money in the ratio 3 : 4

Mikey gets £72

Chloe gives $\frac{1}{6}$ of her share to Pippa.

Mikey gives $\frac{4}{9}$ of his share to Pippa.

How much money does Pippa receive?

[4 marks]

Answer £ _____

7

Do not write outside the box

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

Work out the value of a.

You **must** show your working.

[3 marks]

$600 : 60 \times 10$

$: 6 \times 10 \times 10$

$: 2 \times 3 \times 2 \times 5 \times 2 \times 5$

$: 2 \times 2 \times 2 \times 3 \times 5 \times 5$

$: 2^3 \times 3 \times 5^2$

$a =$ 3

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

[2 marks]

	$3x + 4$
5	$15x + 20$

	$x - 1$
-2	$-2x + 2$

$15x + 20 - 2x + 2$

$15x - 2x + 20 + 2$

Answer $13x + 22$

Do not write outside the box

7 $2^a \times 3^2 \times 5 = 360$

Work out the value of a.

You **must** show your working.

[3 marks]

$a =$ _____

8 Expand and simplify fully $2(5x + 6) - 3(x - 2)$

[2 marks]

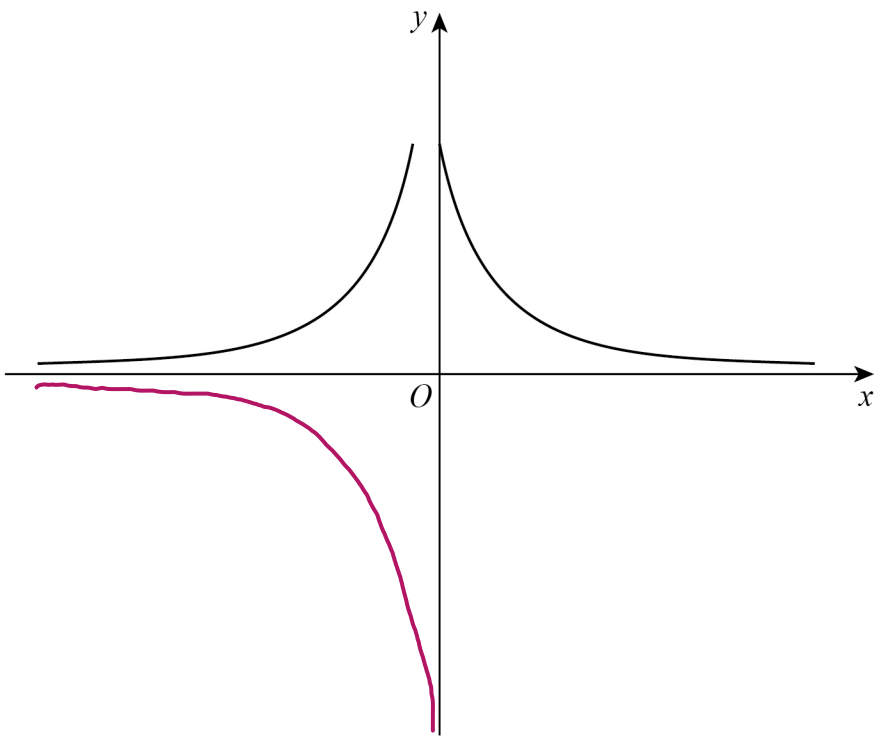
Answer _____

5

Turn over ►

Do not write outside the box

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



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

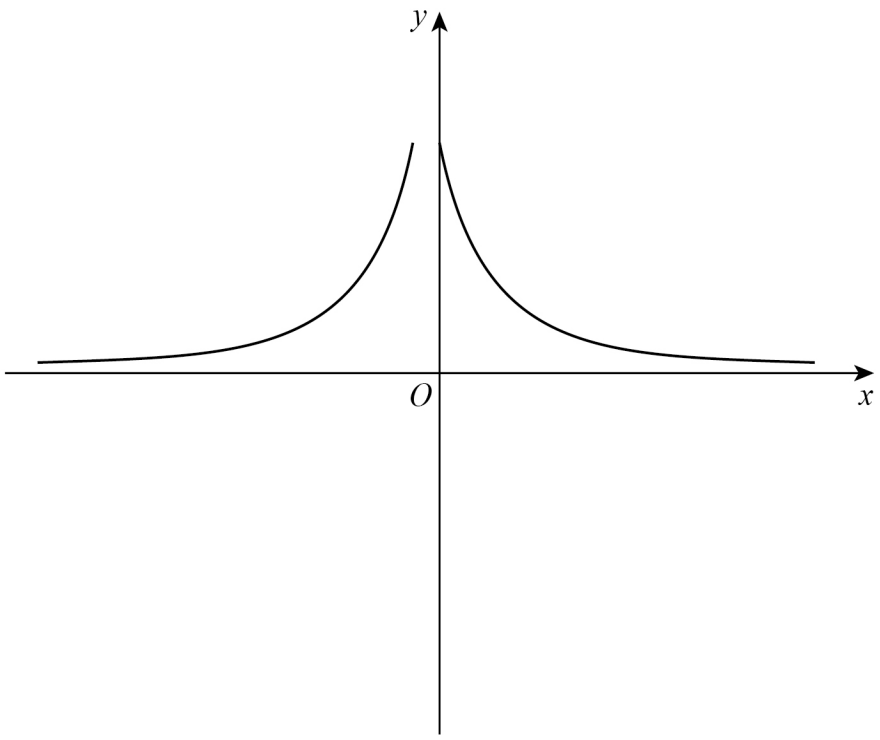
[2 marks]

Criticism 1 The decreasing part of the graph shouldn't meet the x-axis. The x-axis is an assymptote.

Criticism 2 The increasing part of the graph should be reflected in the x-axis.

Do not write outside the box

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 _____

_____

_____

Criticism 2 _____

_____

_____

2

Turn over ►

Do not write outside the box

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]

S x

B $x-1$

J $2x$

$$\frac{x + x - 1 + 2x}{3} = 5$$

$$\frac{4x - 1}{3} = 5$$

$\times 3 \quad \times 3$

$4x - 1 = 15$

$+1 \quad +1$

$4x = 16$

$\div 4 \quad \div 4$

$x = 4$

$2x = 2 \times 4 = 8$

Answer 8

Do not write outside the box

10 Wenjie is x years old.

Megan is five years older than Wenjie.

Conor is three times as old as Wenjie.

The mean of their ages is 35.

How old is **Conor**?

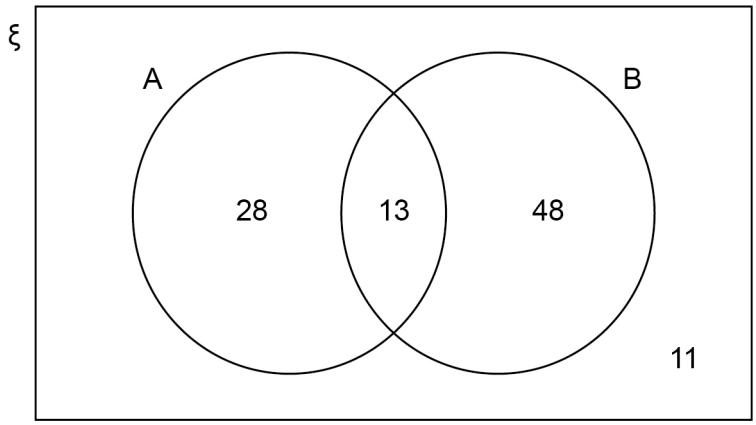
[5 marks]

Answer _____

5

Do not write outside the box

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]**

$13 + 48 + 11 = 72$

Answer $\frac{72}{100} = \frac{18}{25}$

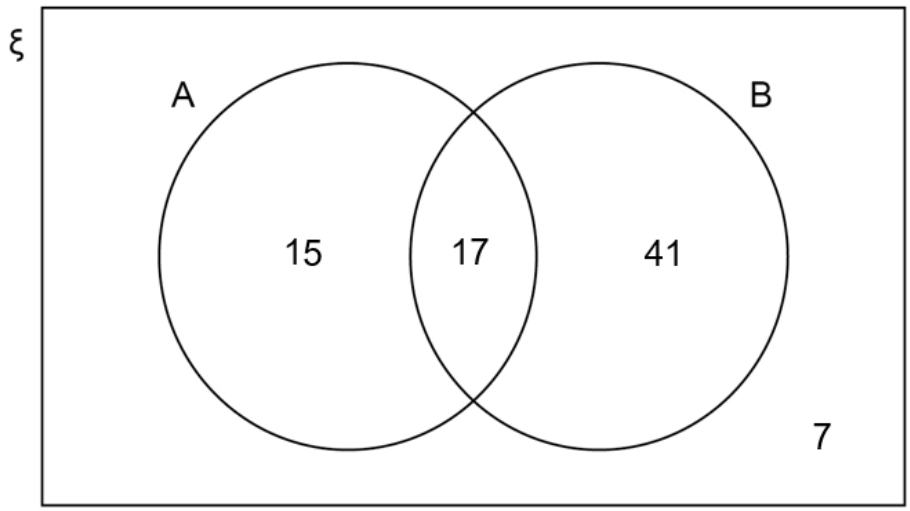
11 (c) Work out $P(A \cup B)$ **[1 mark]**

$28 + 13 + 48 = 89$

Answer $\frac{89}{100}$

Do not write outside the box

11 The Venn diagram represents 80 items.



11 (a) Write down P(B)

[1 mark]

Answer _____

11 (b) Work out P(A U B)

[1 mark]

_____

_____

Answer _____

11 (c) Work out P(A' ∩ B)

[1 mark]

_____

_____

Answer _____

3

Turn over ►

Do not write outside the box

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

Complete the inequality for the value of a.

[1 mark]

1 $\leqslant a <$ 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]

$7200 : 7.2 \times 10^3$ b: 7.2, n: 3

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

Answer 0.0072

Do not write outside the box

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

Complete the inequality for the value of a.

[1 mark]

_____ $\leqslant a <$ _____

12 (b) $b \times 10^n$ is the number 45 000 written in standard form.

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

Write your answer as an ordinary number.

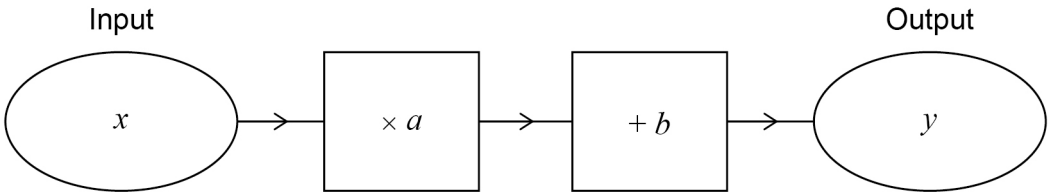
[2 marks]

Answer _____

3

Do not write outside the box

13 (a) Here is a number machine.



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

[2 marks]

x $\quad ax \quad ax+b$

$x+2 \quad a(x+2) \quad ax+2a+b$

$ax+2a$

An increase 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]

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

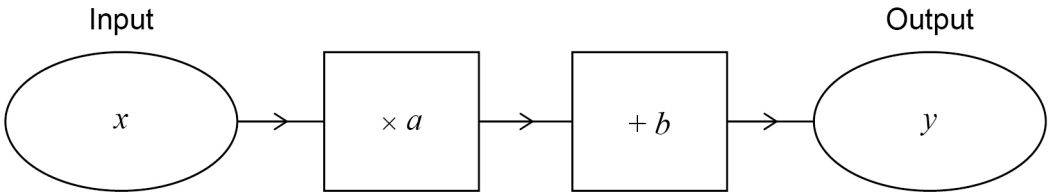
$f(2) = k \times 2^2 = 4k$

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

No.

Do not write outside the box

13 (a) Here is a number machine.



Show that when the input decreases by 3 the output decreases by $3a$.

[2 marks]

13 (b) $f(x) = kx^3$ where k is a constant.

Josh says that $f(2) \times f(1)$ is equal to $f(2)$ because $2 \times 1 = 2$

Is he correct?

Show working to support your answer.

[2 marks]

4

Do not write outside the box

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
		LQ			median			UQ		

- median = 2 × lower quartile
- upper quartile = 2.5 × lower quartile
- range = 2 × interquartile range

Complete the list.

[2 marks]

UQ : 2.5 × ___ , between 28 and 34 (30)

LQ × 2.5 : 30 30 ÷ 2.5 : 12

M : 2 × LQ : 24

IQR : 30 - 12 = 18

Range : 2 × 18 : 36

5 + 36 = 41

Do not write outside the box

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

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

1	3		9	13		23	32		44	

- median = 3.5 × lower quartile
- upper quartile = 6 × lower quartile
- range = 1.5 × interquartile range

Complete the list.

[2 marks]

2

Turn over ►

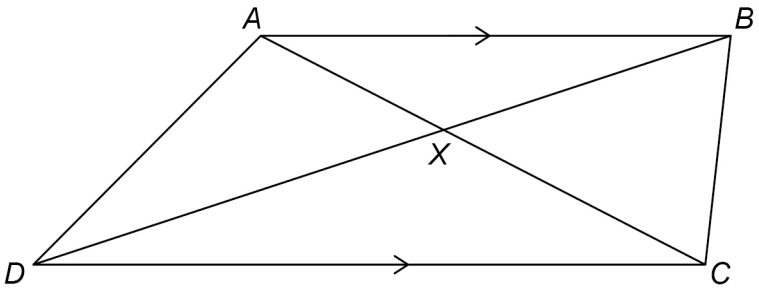
Do not write outside the box

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*	✓		

Do not write outside the box

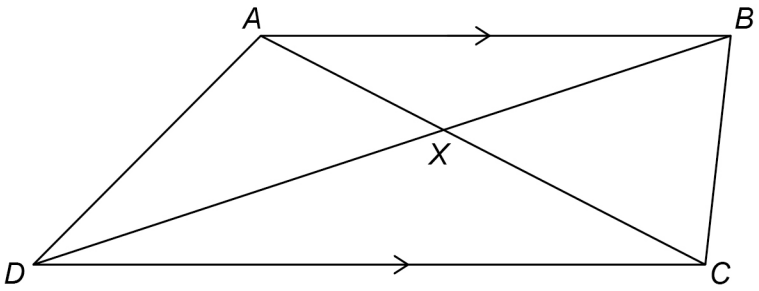
15 *ABCD* is a trapezium.

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 *AXD* and *BCX* are similar	☐	☐	☐
Triangles *ABX* and *CDX* are congruent	☐	☐	☐
Angle *BAC* = angle *ACD*	☐	☐	☐
Area of triangle *BCD* = area of triangle *ACD*	☐	☐	☐

4

Do not write outside the box

16 Solve the simultaneous equations

$2x - 5y = 13$ — ①

$3x + 4y = 8$ — ②

[4 marks]

① × 4 $8x - 20y = 52$ — ③

② × 5 $15x + 20y = 40$ — ④

③ + ④ $23x = 92$

$\div 23 \quad \div 23$

$x = 4$

② $3x + 4y = 8$

$3(4) + 4y = 8$

$12 + 4y = 8$

$-12 \quad -12$

$4y = -4$

$\div 4 \quad \div 4$

$y = -1$

$x =$ 4 $y =$ -1

Do not write outside the box

16 Solve the simultaneous equations

$5x + 3y = 9$

$2x - 4y = 14$

[4 marks]

$x =$ _____ $y =$ _____

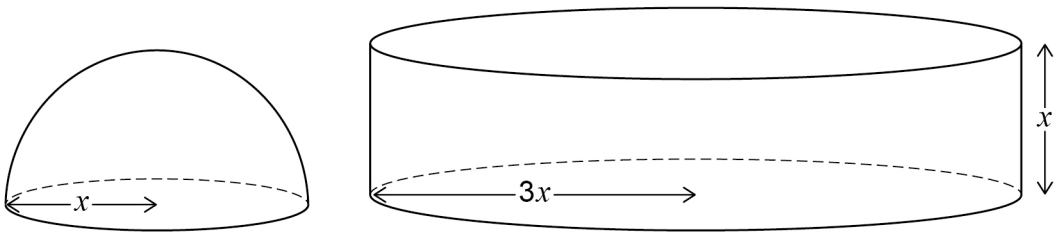
4

Turn over ►

Do not write outside the box

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]

Cylinder : $\pi \times (3x)^2 + \pi \times 6x \times x + \pi \times (3x)^2$

: $9x^2\pi + 6x^2\pi + 9x^2\pi$

: $24x^2\pi$

Hemisphere : $\frac{1}{2} \times 4 \times \pi \times x^2 + \pi \times x^2$

: $2x^2\pi + x^2\pi$

: $3x^2\pi$

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

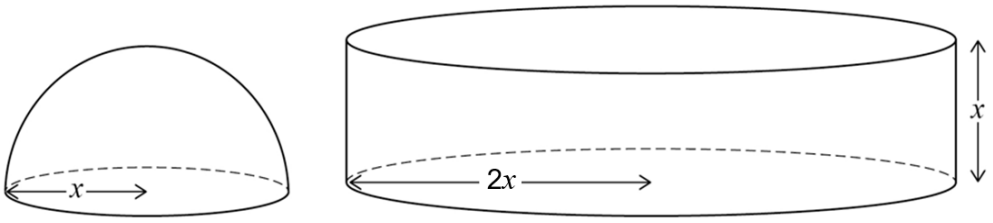
: 3 : 24

Answer 1 : 8

Do not write outside the box

17 A solid hemisphere has radius x.

A solid cylinder has radius $2x$ and height x.



Volume of a sphere $= \frac{4}{3}\pi r^3$

where r is the radius

Work out the ratio

volume of the hemisphere : volume of the cylinder

Give your answer in its simplest form.

You **must** show your working.

[3 marks]

Answer _____ : _____

3

Turn over ►

Do not write outside the box

18 $6 < \sqrt[3]{x} < 7$

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

$216 < x < 343$

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

4 choices for first digit after 7 or 9 : 4 _ _ _ 2

3 for second... $4 \times 3 \times 2 \times 1 \times 2$

Answer 48

Do not write outside the box

18 $4 < \sqrt[3]{x} < 5$

Circle the possible value of x.

[1 mark]

1.4 64 102 500

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

2 4 6 7 9

Do **not** list them.

[2 marks]

Answer _____

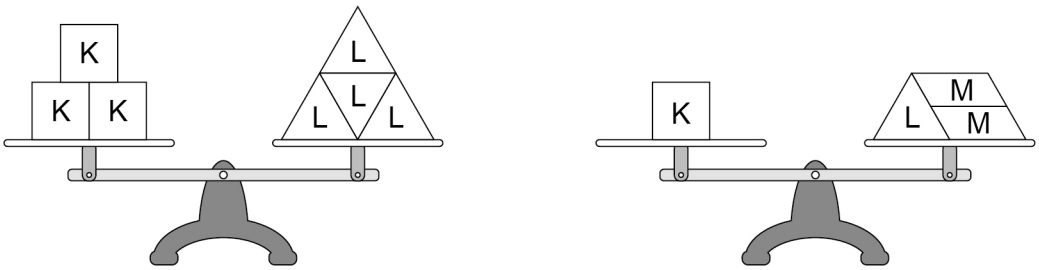
3

Turn over ►

Do not write outside the box

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]

$3K = 4L$

$K = L + 2M$

$3K = 3L + 6M$

$4L = 3L + 6M$

$-3L \quad -3L$

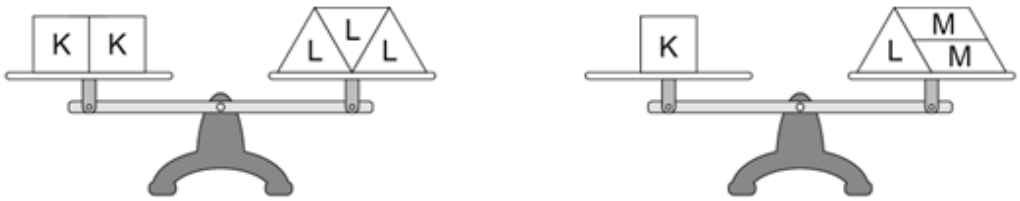
$L = 6M$

Answer 6

Do not write outside the box

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]

Answer _____

3

Turn over ►

Do not write outside the box

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

[2 marks]

$x \quad -3$

$(x-3)^2 : x^2 - 6x + 9$

$x^2 - 6x - 15 : (x-3)^2 - 24$

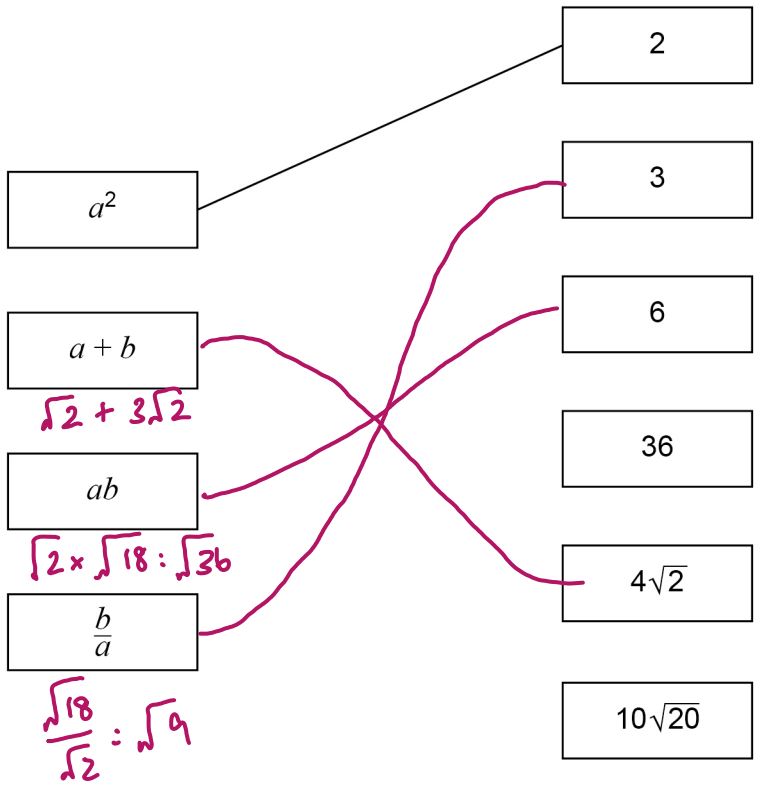
Answer $(x-3)^2 - 24$

22 $a = \sqrt{2}$ and $b = \sqrt{18}$: $\sqrt{9} \times \sqrt{2} : 3\sqrt{2}$

Match each expression to its value.

One has been done for you.

[3 marks]



Do not write outside the box

21 Express $x^2 - 8x + 9$ in the form $(x - a)^2 - b$ where a and b are integers.

[2 marks]

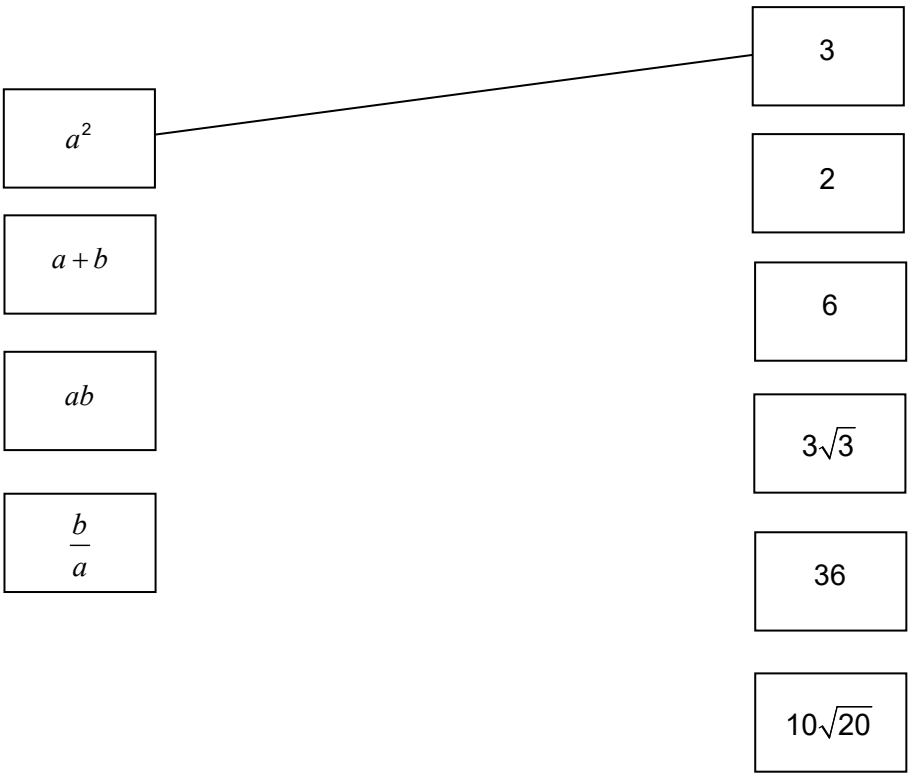
Answer _____

22 $a = \sqrt{3}$ and $b = \sqrt{12}$

Match each expression to its value.

One has been done for you.

[3 marks]



5

Turn over ►

Do not write outside the box

23 Write $0.1\dot{3}$ as a fraction in its simplest form.

[3 marks]

$x = 0.1\dot{3}$

$x = 0.133333\ldots$

$10x = 1.333333\ldots$

$100x = 13.333333\ldots$

$100x - 10x = 13.\dot{3} - 1.\dot{3}$

$90x = 12$

$\div 90 \quad \div 90$

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

Answer $\frac{2}{15}$

Do not write outside the box

23 Write $0.\dot{2}\dot{4}$ as a fraction in its simplest form.

[3 marks]

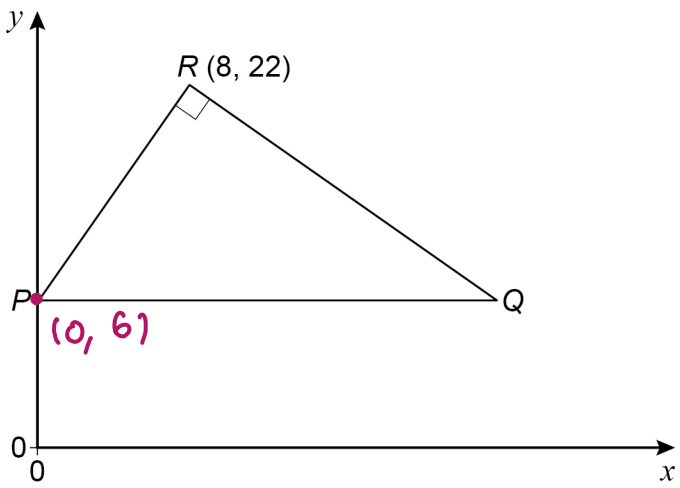
Answer _____

3

Turn over ►

Do not write outside the box

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 2

Work out the coordinates of Q.

[5 marks]

$\frac{\Delta y}{\Delta x} = 2$ $\frac{\Delta y}{8} = 2$ $\Delta y = 16$ $22 - 16 = 6$

$\text{Gradient}_{RQ} = \frac{-1}{\text{Gradient}_{PR}} = \frac{-1}{2}$ $y = \frac{-1}{2}x + c$

$22 = \frac{-1}{2}(8) + \_\_$

$22 = -4 + 26$ $y = \frac{-1}{2}x + 26$

$6 = \frac{-1}{2}x + 26$

$-26 \quad -26$

$-20 = \frac{-1}{2}x$

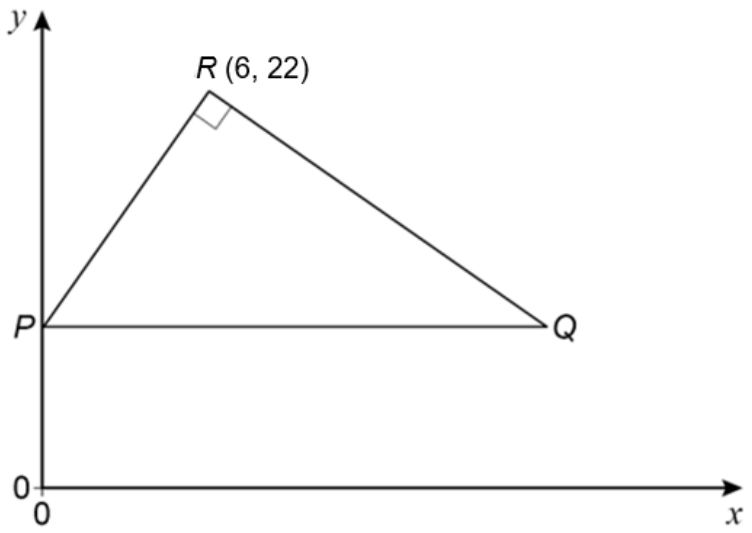
$\times -2 \quad \times -2$

$40 = x$

Answer (40 , 6)

Do not write outside the box

24 Points P, Q and R (6, 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 3

Work out the coordinates of Q.

[5 marks]

Answer (_____ , _____)

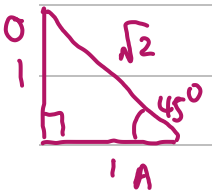
5

Turn over ►

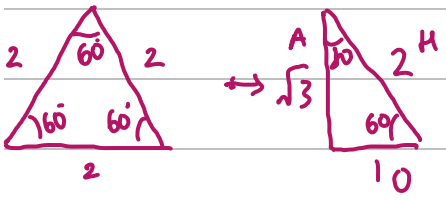
Do not write outside the box

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

[4 marks]



$\tan\theta = \frac{O}{A}$ $\quad \tan 45 = \frac{1}{1}$

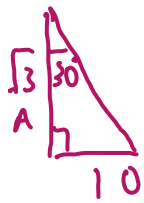


$\sin\theta = \frac{O}{H}$ $\quad \sin 30 = \frac{1}{2}$

$\cos\theta = \frac{A}{H}$ $\quad \cos 30 = \frac{\sqrt{3}}{2}$

$$\frac{4\sin 30 - \tan 45}{2\cos 30} = \frac{4\left(\frac{1}{2}\right) - (1)}{2\left(\frac{\sqrt{3}}{2}\right)} = \frac{2-1}{\sqrt{3}} = \frac{1}{\sqrt{3}}$$

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



Turn over ►

Do not write outside the box

25 Show that $\dfrac{5\sin 60° - \cos 30°}{2\tan 60°}$ can be written as $\tan x$, where x is an acute angle.

[4 marks]

4

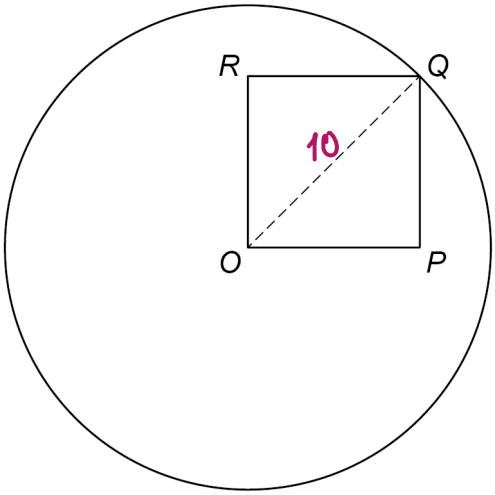
Do not write outside the box

26 A circle, centre O, has circumference 20π cm

Q is a point on the circle.

$OPQR$ is a **square**.

Not drawn accurately



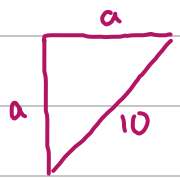
perimeter of the square : circumference of the circle = $\sqrt{a}$: π where a is an integer.

Work out the value of a.

You **must** show your working.

[4 marks]

$C = 20\pi$ $d = 20$ $r = 10$



$a^2 + a^2 = 10^2$

$2a^2 = 100$

$a^2 = 50$

$a = \sqrt{50} = \sqrt{25} \times \sqrt{2} = 5\sqrt{2}$

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

$= \sqrt{2} : \pi$

$a =$ 2

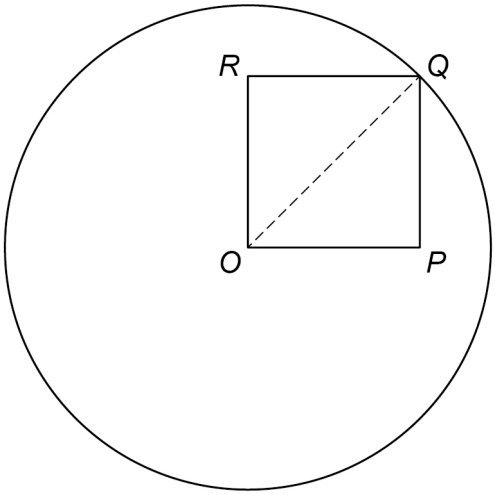
Do not write outside the box

26 A circle, centre O, has an area of 36π cm

Q is a point on the circle.

$OPQR$ is a **square**.

Not drawn accurately



area of the square : area of the circle $= \frac{1}{a} : \pi$ where a is an integer.

Work out the value of a.

You **must** show your working.

[4 marks]

$a =$ _____

4

Turn over ►

Do not write outside the box

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]

Speed: $\frac{\text{distance}}{\text{time}}$

Total distance: $30 + 30 = 60$

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

Speed: distance $\div$ time $= 60 \div \frac{30a+30b}{ab} = 60 \times \frac{ab}{30a+30b}$

$= {}^{2}\!\cancel{60} \times \frac{ab}{30(a+b)}$

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

END OF QUESTIONS

Do not write outside the box

27 Liquid C is made by mixing liquid A and liquid B.

	Mass (g)	**Density (g/cm^3)**	**Volume (cm^3)**
Liquid A	200	a	$\frac{200}{a}$
Liquid B	300	b	$\frac{300}{b}$

Show that the density of liquid C, in g/cm^3, is $\frac{5ab}{3a+2b}$

[3 marks]

END OF QUESTIONS

3