

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 10 June 2024

Morning

Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- a calculator
- mathematical instruments
- the Formulae Sheet (enclosed).



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	
24-25	
26	
TOTAL	



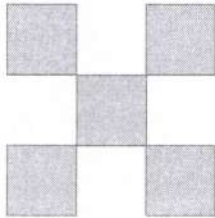
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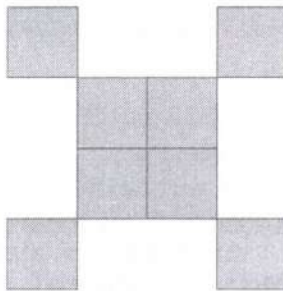
8300/3H

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

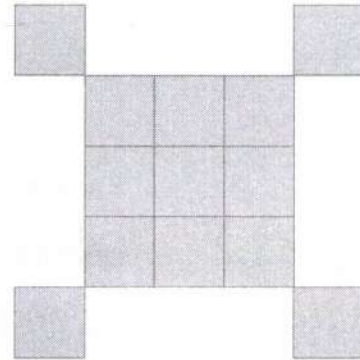
- 1 Here are the first three Patterns in a sequence made up of small squares.



Pattern 1



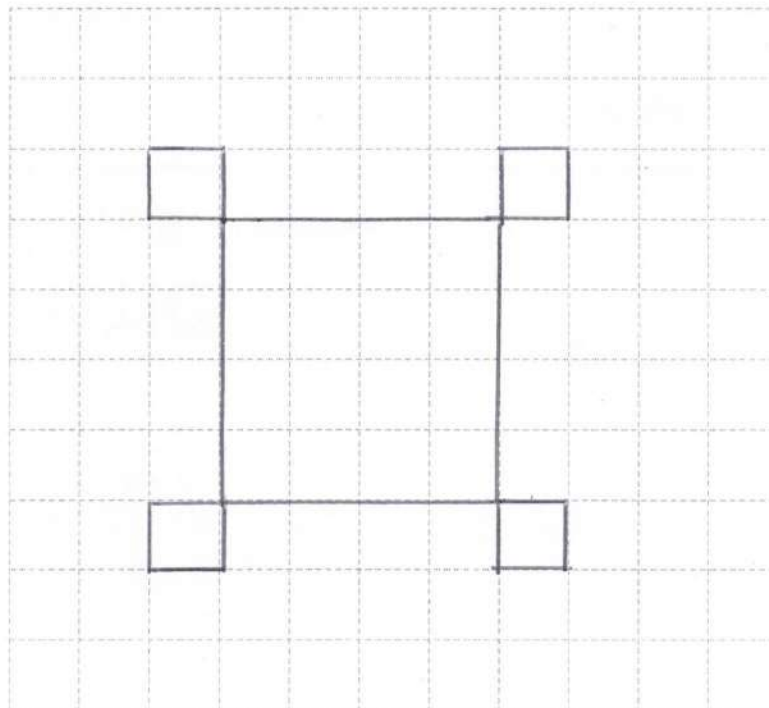
Pattern 2



Pattern 3

- 1 (a) On the grid, draw Pattern 4

[1 mark]



- 1 (b) The expression for the number of small squares in Pattern n is $n^2 + 4$

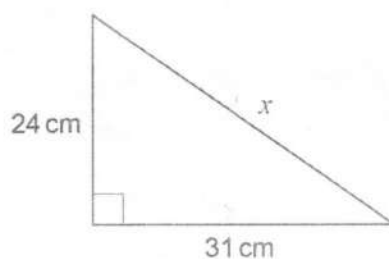
Work out the least value of n for which the number of small squares is greater than 500

[1 mark]

$$\sqrt{500-4} = 22.2...$$

$$n = 23$$

2



Not drawn
accurately

Use Pythagoras' theorem to work out the value of x .

Give your answer as a decimal.

[3 marks]

$$x = \sqrt{24^2 + 31^2}$$

$$= \sqrt{1537}$$

$$= 39.20459...$$

Answer 39.2 cm

(ms; 39 only with 1537 seen)

Turn over ►



- 3 Rick claims most of the flats in his 8-floor building are energy efficient.
He samples 45 flats from floors 1 to 5

Give a reason why this sample may **not** be useful in testing Rick's claim.

[1 mark]

Should sample flats from all 8 floors

- 4 $3(x - 1) \equiv 3x - 3$ is an identity.

Tick **one** box.

[1 mark]

☒

It is true for **all** values of x

☐

It is true for **some** values of x

☐

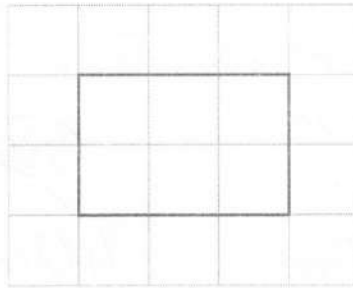
It is true for **no** values of x



5

The front elevation of a cuboid is shown on this centimetre grid.

Front elevation

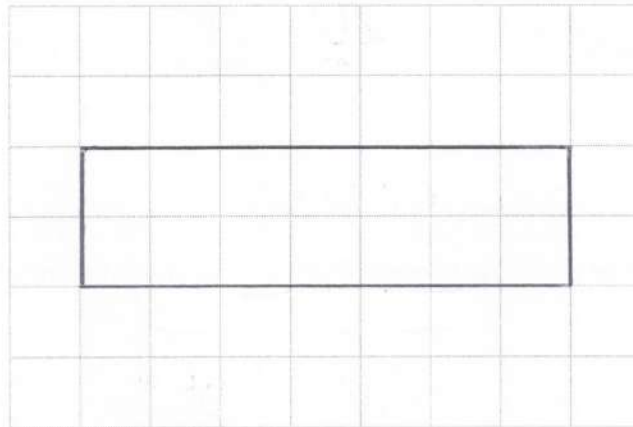


The volume of the cuboid is $42 \text{ cm}^3 = 3 \times 2 \times 7$

Draw the **side elevation** on this centimetre grid.

[2 marks]

Side elevation



Turn over ►



- 6 (a) On Monday, Larrs swims 50 metres in 40 **seconds** at a constant speed.
On Tuesday, Larrs swims 1.5 kilometres.

Assume he swims at the same constant speed as on Monday.

How many **minutes** does he swim for on Tuesday?

[5 marks]

$$1.5\text{km} = 1500\text{m}$$

$$\begin{array}{l} \textcircled{\times 30} \nearrow 50\text{m} = 40\text{secs} \\ \textcircled{\times 30} \rightarrow 1200\text{secs} \end{array}$$

$$1200 \div 60$$

Answer 20 minutes

- 6 (b) In fact, on Tuesday Larrs swims at a slower constant speed than on Monday.

What does this mean about the number of minutes he swims for on Tuesday?

Tick the correct box.

[1 mark]

☐

It is less than the answer to part (a)

☐

It is the same as the answer to part (a)

☒

It is greater than the answer to part (a)

☐

It is not possible to say



7

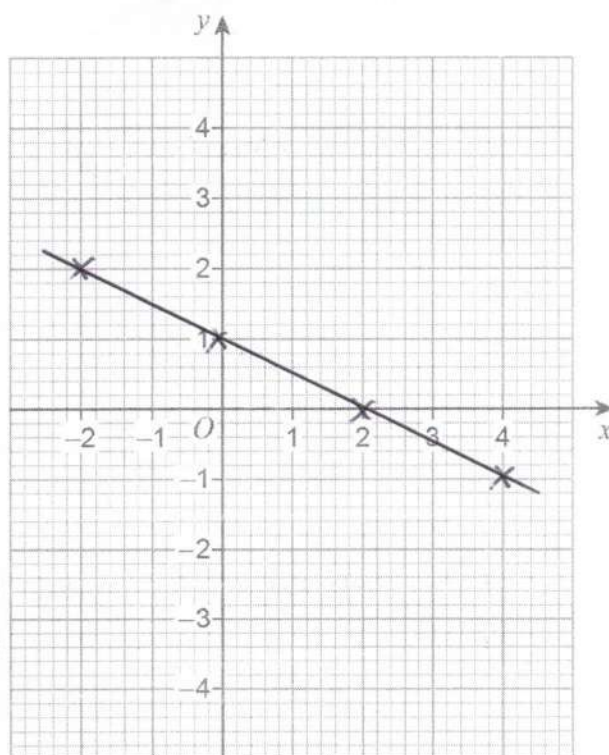
Draw the graph of $y = 1 - \frac{1}{2}x$ for values of x from -2 to 4

[3 marks]

$$y = mx + c$$

$$m = -\frac{1}{2} \quad c = 1$$

x	0	2	4
y	1	0	-1



Turn over ►



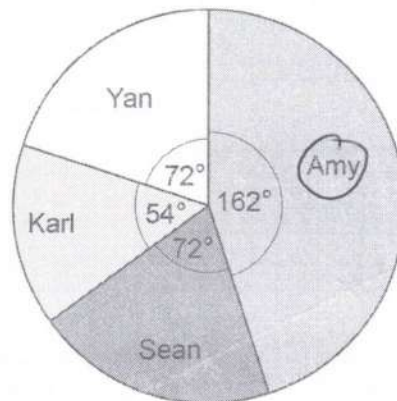
8

Four people are taking part in a television talent show.

Here are Amy's marks from the 6 judges.

8	9	9	6	9	10
---	---	---	---	---	----

The pie chart represents the phone vote.



Amy's total score is found by

$$4 \times \text{the mean of her marks} \\ + \\ \text{her percentage of the phone vote}$$



Work out Amy's total score.

[4 marks]

$$\frac{8+9+9+6+9+10}{6} = 8.5$$

$$\% = \frac{162}{360} \times 100 = 45$$

$$45 + (4 \times 8.5)$$

Answer 79

Turn over for the next question

Do not write
outside the
box

Turn over ►



9

Town A has

a population of 84 000

an area of 7 square miles.Town B has a population density of 4695 people per square kilometre.

$$\text{Population density} = \frac{\text{population}}{\text{area}}$$

Which town has the greater population density?

Use 1 square mile = 2.6 square kilometres

Tick a box.

Town A

☐

Town B

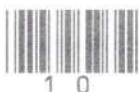
☒

Show working to support your answer.

[3 marks]

$$A = \frac{84000}{7 \times 2.6} = 4615.38...$$

$$B = 4695$$



10

On a biased dice,

$$P(\text{lands on } 6) = 0.38$$

This dice is rolled 150 times.

How many times would you expect the dice not to land on 6 ?

[3 marks]

$$150 \times (1 - 0.38)$$

Answer 93

Turn over for the next question

Turn over ►



11


Write a number in each box to make the calculations correct.

[2 marks]

Do not write
outside the
box

$$\boxed{10} \div \boxed{-2} \times \boxed{-1} = \boxed{5}$$

$$\boxed{\frac{1}{3}} \times \boxed{4\pi} \times \boxed{6} = \boxed{8\pi}$$

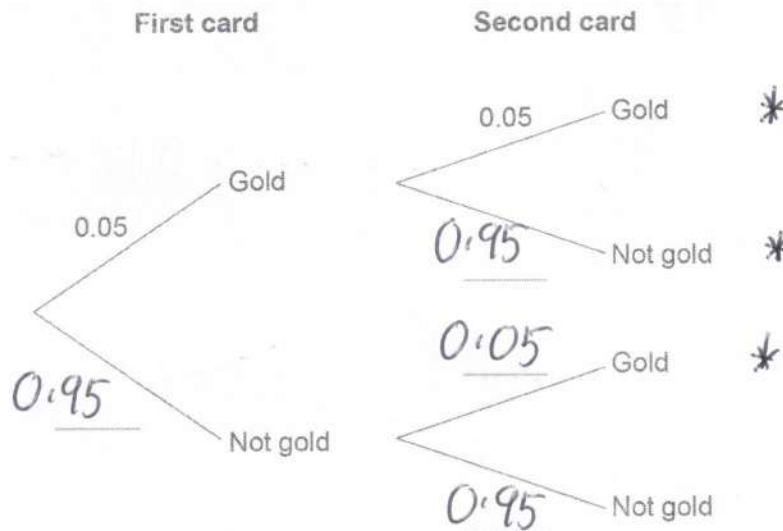

 2



- 12 Cards are either gold or not gold.
 $P(\text{gold}) = 0.05$
 Harim chooses a card at random and replaces it.
 He then chooses a second card.

- 12 (a) Complete the tree diagram.

[2 marks]



- 12 (b) What is the probability that **at least one** of Harim's cards is gold?

[3 marks]

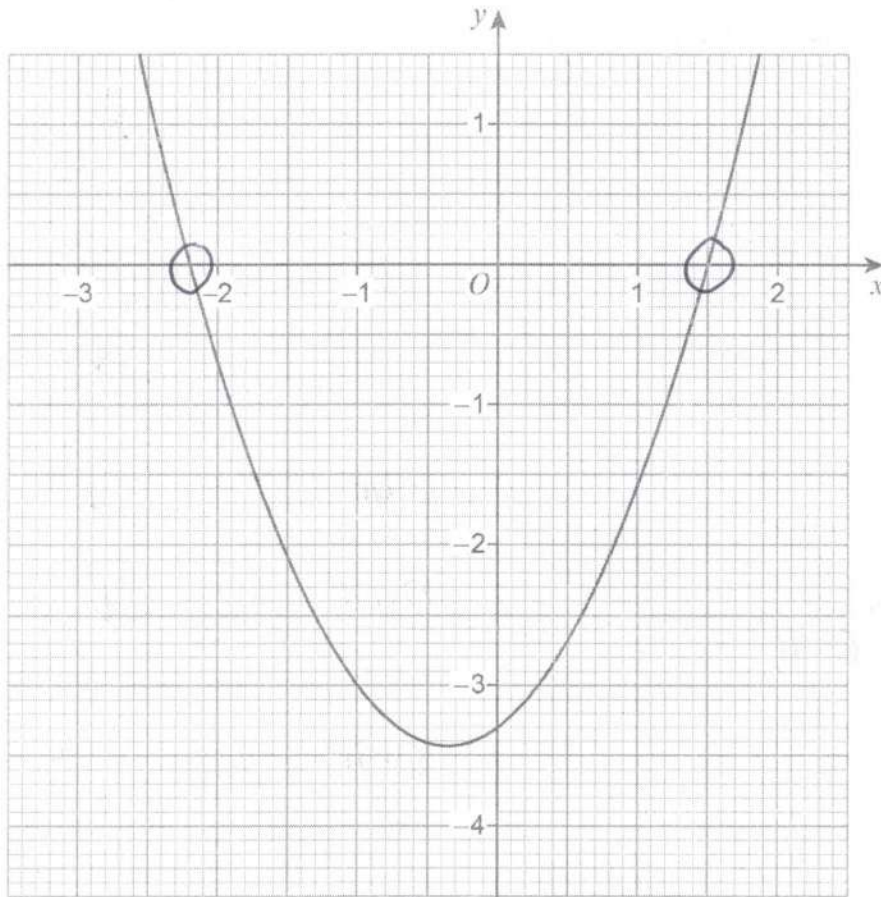
$$= 1 - \text{Both not}$$

$$= 1 - (0.95 \times 0.95)$$

Answer $\frac{39}{400} = 0.0975$



13

Here is a quadratic graph with equation $y = f(x)$ 

→ solutions

Write down the roots of the equation $f(x) = 0$

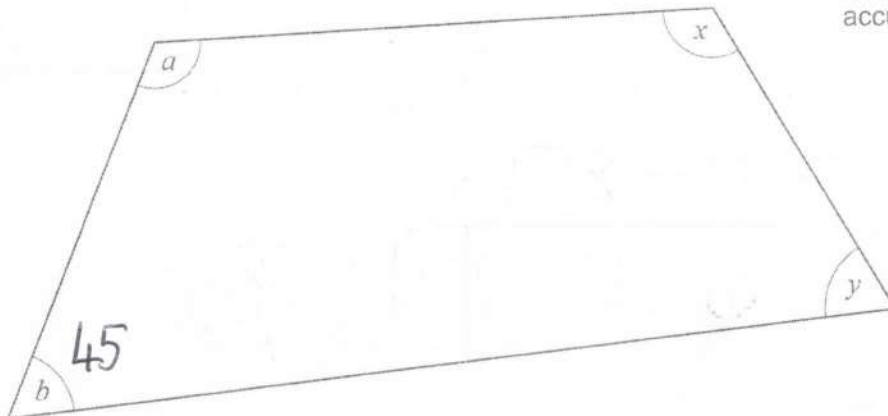
[2 marks]

Answer

1.5, -2.2



14

Do not write
outside the
box

$$b = 45^\circ \quad \text{and} \quad a : b = 7 : 3 \quad \text{and} \quad x : y = 4 : 1$$

Show that $a : y = 5 : 2$

[3 marks]

$$360 - 45 = 315$$

$$\begin{array}{l} a : b \\ \times 15 \quad \swarrow \quad \searrow \quad \times 15 \\ 7 : 3 \\ \hline 105 : 45 \end{array}$$

$$315 - 105 = 210$$

$$y = \frac{1}{5} \times 210 = 42$$

$$\begin{array}{l} a : y \\ 105 : 42 \end{array}$$

$$(\div 21)$$

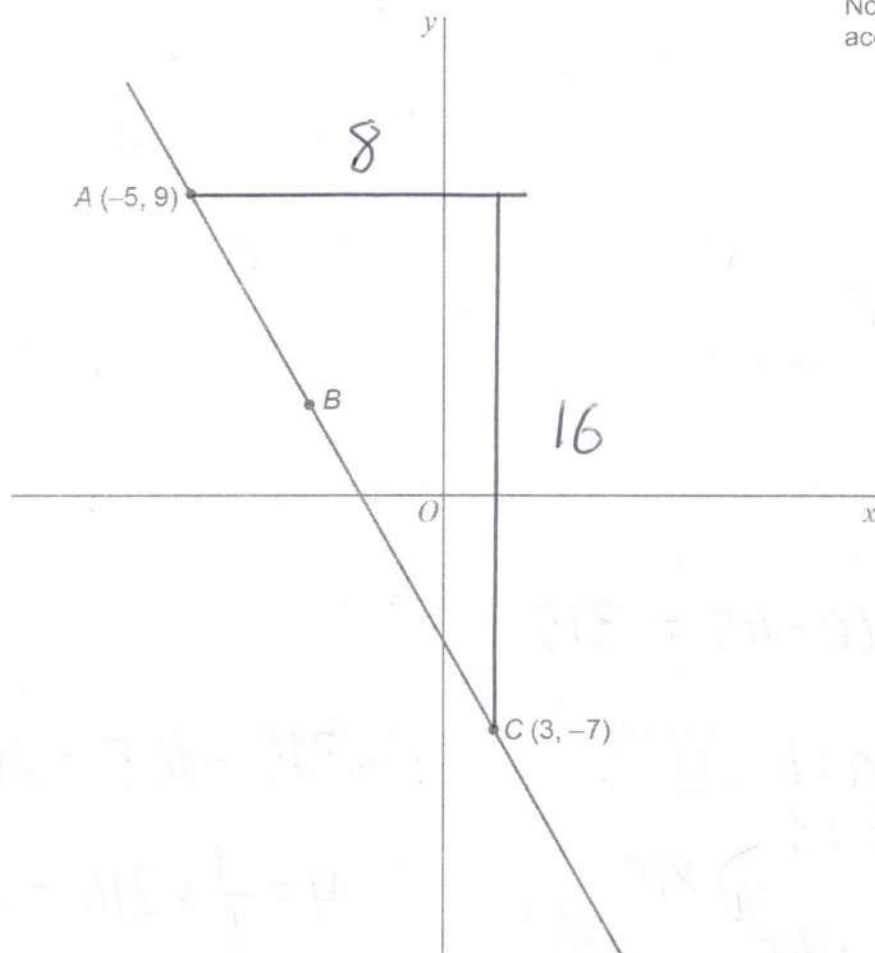
$$(\div 21)$$

$$5 : 2$$

Turn over ►



15

A straight line passes through points A $(-5, 9)$, B and C $(3, -7)$.Not drawn
accurately15 (a) $AB : BC = 1 : 3$

Work out the coordinates of point B.

[3 marks]

$$\textcircled{x} \quad -5 + \frac{1}{4} \times 8 = -3$$

$$\textcircled{y} \quad 9 - \frac{1}{4} \times 16 = 5$$

Answer (-3 , 5)

- 15 (b) Work out the equation of the line perpendicular to AC that passes through C.

[4 marks]

$$m_{AC} = -\frac{16}{8} = -2$$

$$m_{\perp} = \frac{1}{2}$$

$$y = mx + c$$

$$(3, -7) \quad -7 = \frac{1}{2} \times 3 + c$$

$$c = -8.5$$

Answer

$$y = \frac{1}{2}x - 8.5$$

Turn over for the next question

Turn over ►



16

Jing rolls a fair six-sided dice 72 times.

	1	2	3	4	5	6
Frequency	16	11	10	8	14	13

Is the relative frequency of rolling a 5 greater than the theoretical probability?

Tick a box.

Yes

☒

No

☐

Give a reason for your answer.

[3 marks]

$$P(5) = \frac{14}{72} = 0.194$$

$$P(5) = \frac{1}{6} = 0.16$$



- 17 (a) a and b are different prime numbers.

$$a^3 \times b^2 = 200$$

Work out the value of $a^4 \times b$

[3 marks]

$$\begin{array}{c}
 200 \\
 \swarrow \searrow \\
 20 \quad 10 \\
 \swarrow \searrow \quad \swarrow \searrow \\
 (5) \quad 4 \quad (5) \quad (2) \\
 \swarrow \searrow \\
 (2) \quad (2)
 \end{array}
 = 2^3 \times 5^2$$

$$a = 2 \quad b = 5$$

$$2^4 \times 5$$

$$= 80$$

Answer _____

- 17 (b) c and d are different prime numbers.

Circle the equation for which $c^4 \times d^2 \times e$ is a cube number.

[1 mark]

$$e = cd$$

$$e = c^2d$$

$$e = c^2d^2$$

$$e = c^3d^3$$

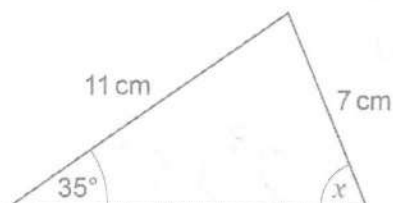
Turn over for the next question

Turn over ►



18

Here is triangle A.

Not drawn
accurately

18 (a)

Use the sine rule to show that $x = 64^\circ$ to the nearest degree.

[3 marks]

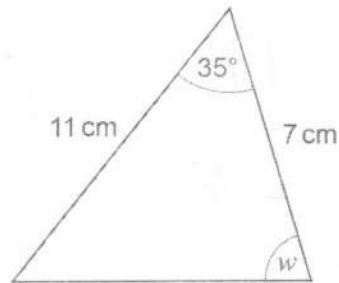
$$\frac{\sin x}{11} = \frac{\sin 35}{7}$$

$$\sin x = \frac{11 \times \sin 35}{7} = 0.901...$$

$$x = \sin^{-1}(0.901...) = 64.3^\circ = 64^\circ$$



18 (b) Here is triangle B.



Not drawn
accurately

Anna thinks that w must be 64° to the nearest degree.

She says,

"This is because triangle B has two sides and one angle the same as triangle A."

Without further calculation, is she correct?

Tick a box.

Yes

☐

No

☒

Give a reason for your answer.

[1 mark]

A and B aren't congruent.

Turn over for the next question

Turn over ►



19 $f(x) = x - 3$ $g(x) = 4x - 7$

19 (a) Work out the value of $fg(6)$

[2 marks]

$$g(6) = 4 \times 6 - 7 = 17$$

$$f(17) = 17 - 3$$

Answer 14

19 (b) Solve $(f(x))^2 = g(x)$

[4 marks]

$$(x-3)^2 = 4x-7$$

$$x^2 - 6x + 9 = 4x - 7$$

$$x^2 - 10x + 16 = 0$$

$$(x-8)(x-2) = 0$$

Answer $x = 2, x = 8$



20

 P , Q , and R have positive values. P is directly proportional to Q When $P = 8$, $Q = 2$ R is inversely proportional to Q^2 When $R = 10$, $Q = 3$ Work out the value of R when $P = 0.5$

[5 marks]

$$P = cQ$$

$$R = \frac{K}{Q^2}$$

$$8 = c \times 2$$

$$c = 4$$

$$10 = \frac{K}{3^2}$$

$$K = 90$$

$$P = 4Q$$

$$R = \frac{90}{Q^2}$$

$$P = 0.5, Q = 0.5 \div 4 = 0.125$$

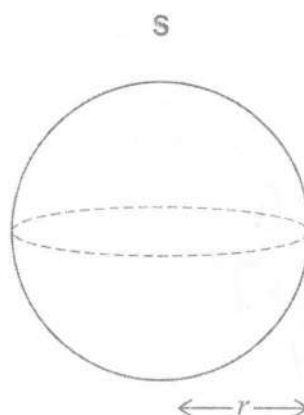
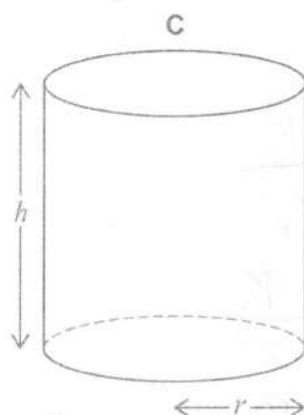
$$R = \frac{90}{0.125^2}$$

$$R = 5760$$

Turn over for the next question



21

A cylinder, C, and a sphere, S, each have radius r C has height h 

$$V = \pi r^2 h$$

Volume of a sphere = $\frac{4}{3}\pi r^3$
where r is the radius

21 (a) volume of C = volume of S

Work out the ratio $r : h$ You **must** show your working.

[3 marks]

$$\pi r^2 h = \frac{4}{3} \pi r^3$$

$$h = \frac{4}{3} r$$

$$3h = 4r$$

$$4r = 3h$$

Answer $\frac{3}{4}$
 $r : h$



- 21 (b) A different cylinder has radius $3r$ and height $2h$.

How many times bigger is the volume of this cylinder than the volume of C?

[2 marks]

\downarrow
 $\times 3$

\downarrow
 $\times 2$

$$r r h = 3 \times 3 \times 2$$

Answer 18

22

Fatima is choosing a 4-digit code.

Each digit is a whole number from 0 to 9

She decides

all her digits will be odd numbers

no digits will be repeated.

— — — —

How many different codes can she make?

[2 marks]

$$1, 3, 5, 7, 9 = 5$$

$$5 \times 4 \times 3 \times 2$$

Answer 120



23

Quadrilateral $ABCD$ is reflected in edge BC .

How many of the vertices are invariant?

Circle your answer.

[1 mark]

1

2

0

4

24

Write $2x^2 - 12x + 7$ in the form $d(x + e)^2 + f$
where d , e and f are integers.

[3 marks]

$$2[x^2 - 6x] + 7$$

$$2[(x-3)^2 - 9] + 7$$

$$2(x-3)^2 - 18 + 7$$

Answer $2(x-3)^2 - 11$

END OF QUESTIONS

