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

H

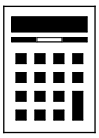
Higher Tier Paper 3 Calculator

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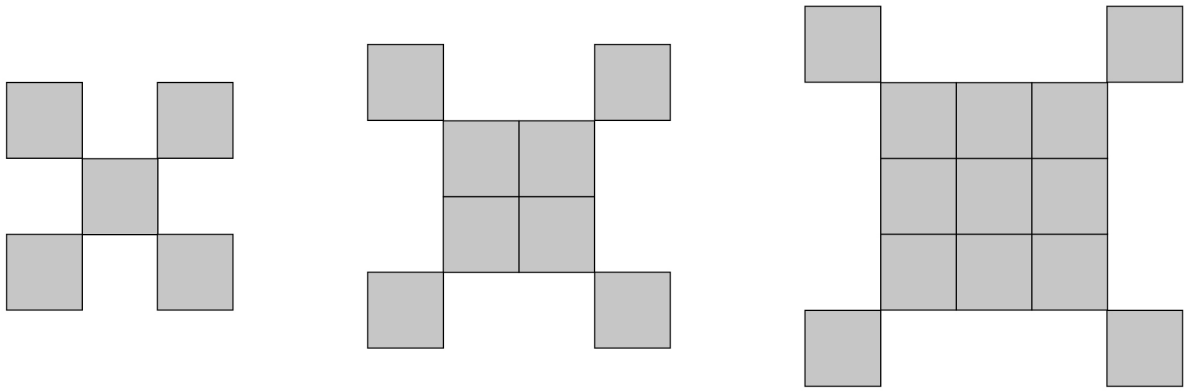
Answer **all** questions in the spaces provided.

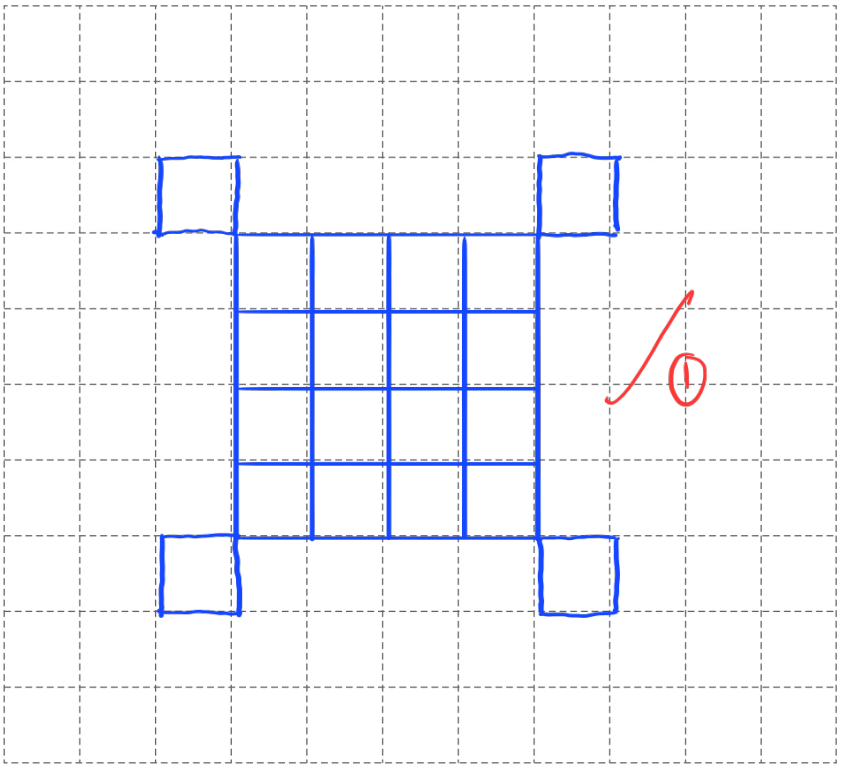
1 Here are the first three Patterns in a sequence made up of small squares.



Pattern 1 Pattern 2 Pattern 3

1 (a) On the grid, draw Pattern 4

[1 mark]



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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]

$n^2 + 4 > 500$

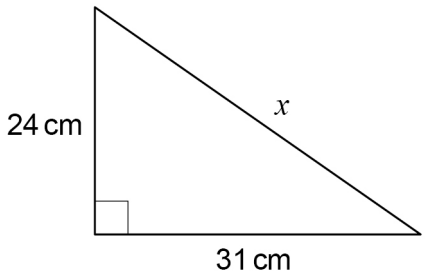
$n^2 > 496$

$n > 22.3...$

$n = 23$ (smallest integer after 22.3...)

$n =$ 23 ✓1

2



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

Give your answer as a decimal.

[3 marks]

$x^2 = 24^2 + 31^2$ ✓1

$x = \sqrt{24^2 + 31^2}$ ✓1

$= \sqrt{1537}$

$= 39.2$ ✓1

Answer 39.2 cm

5

Do not write outside the box

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]

The data only consists 5 out of 8 floors ✓1

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

Tick **one** box.

[1 mark]

- [✓] It is true for **all** values of x ✓1
- [ ] It is true for **some** values of x
- [ ] It is true for **no** values of x

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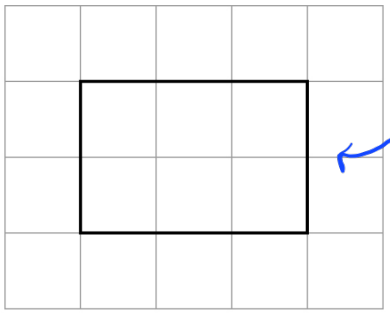
5 The front elevation of a cuboid is shown on this centimetre grid.

Front elevation



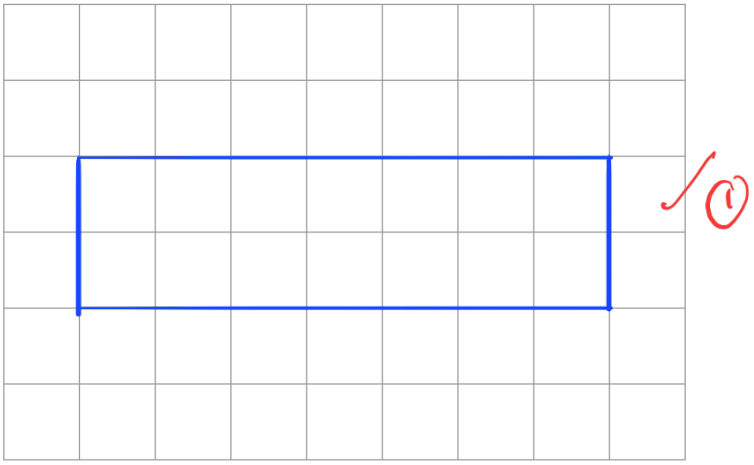
The volume of the cuboid is 42 cm^3

$\frac{42\ cm^3}{6\ cm^2} = 7\ cm$ (width) ✓1

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

[2 marks]

Side elevation



4

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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]

Speed = $\frac{50\ m}{40\ s}$ = 1.25 ms^{-1}

Time on Tuesday : $\frac{1500\ m}{t}$ = 1.25 ms^{-1} ✓(1)

$t = \frac{1500}{1.25}$ = 1200 s (2)

= 1200 s × $\frac{1\ min}{60\ s}$ ✓(1)

= 20 min

Answer 20 ✓(1) 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)
- ☑ ✓(1) It is greater than the answer to part (a)
- ☐ It is not possible to say

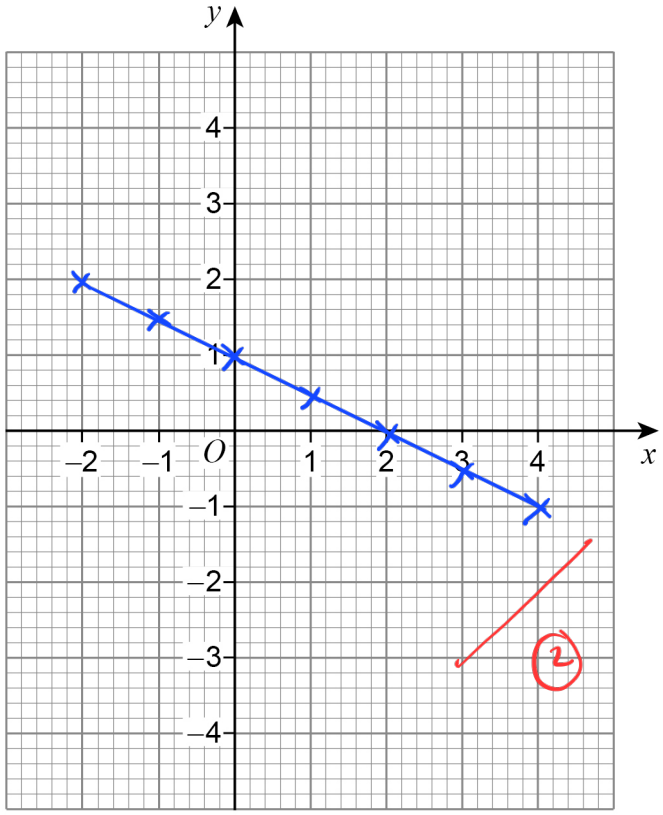
Do not write outside the box

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

[3 marks]

x	-2	-1	0	1	2	3	4
y	2	1.5	1	0.5	0	-0.5	-1

(1)



(2)

9

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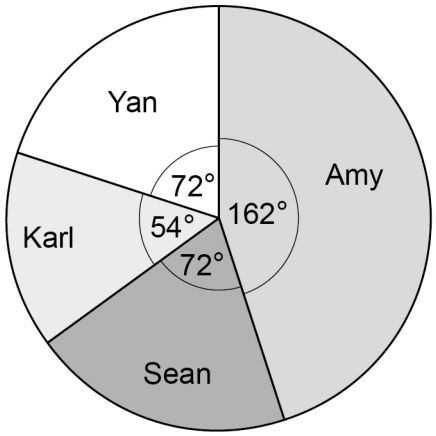
8 Four people are taking part in a television talent show.

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 × the **mean** of her marks

+

her **percentage** of the phone vote

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Work out Amy's total score.

[4 marks]

mean of marks = $\frac{8+9+9+6+9+10}{6} = 8.5$ ✓(1)

Percentage of phone vote = $\frac{162^\circ}{360^\circ} \times 100\% = 45\%$ ✓(1)

Total score = $(4 \times 8.5) + 45$ ✓(1)

= 79 ✓(1)

Answer 79

Turn over for the next question

4

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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]

Town A area = 7 × 2.6 square km

= 18.2 square km

Town A population density = $\frac{84000}{18.2}$ = 4615 people per square km (2)

∴ Town B has greater population density (1)

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10 On a biased dice,

P(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]

P(not lands on 6) = 1 − 0.38 = 0.62 ✓(1)

150 × 0.62 = 93 ✓(1) ✓(1)

Answer 93

Turn over for the next question

6

Do not write outside the box

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

[2 marks]

10	÷	–2	×	-1	=	5

(1)

$\frac{1}{3}$	×	4π	×	6	=	8π

(1)

Do not write outside the box

12 Cards are either gold or not gold.

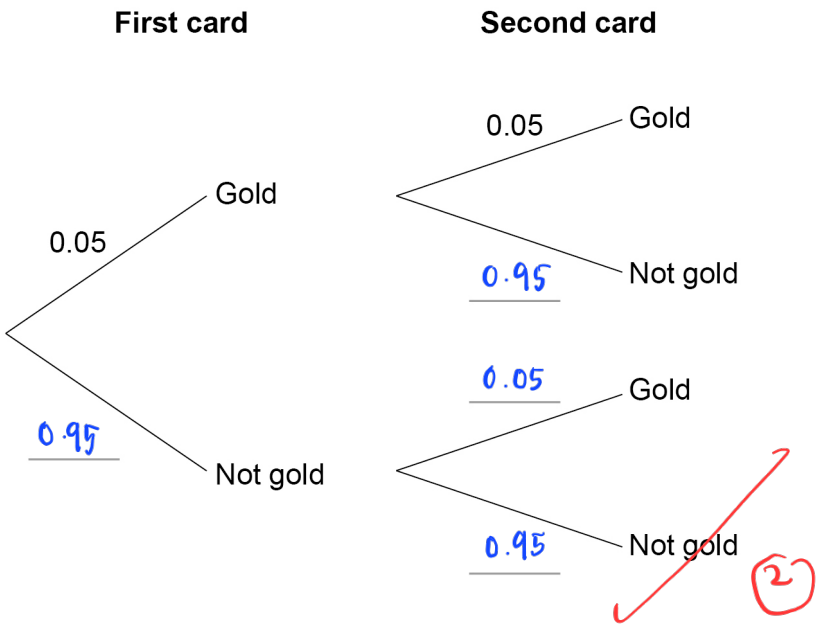
P(gold) = 0.05

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]

one is gold = (G, NG) or (NG, G)

= 0.05 × 0.95 + 0.95 × 0.05

= 0.095 (1)

both are gold = 0.05 × 0.05 = 0.0025 (1)

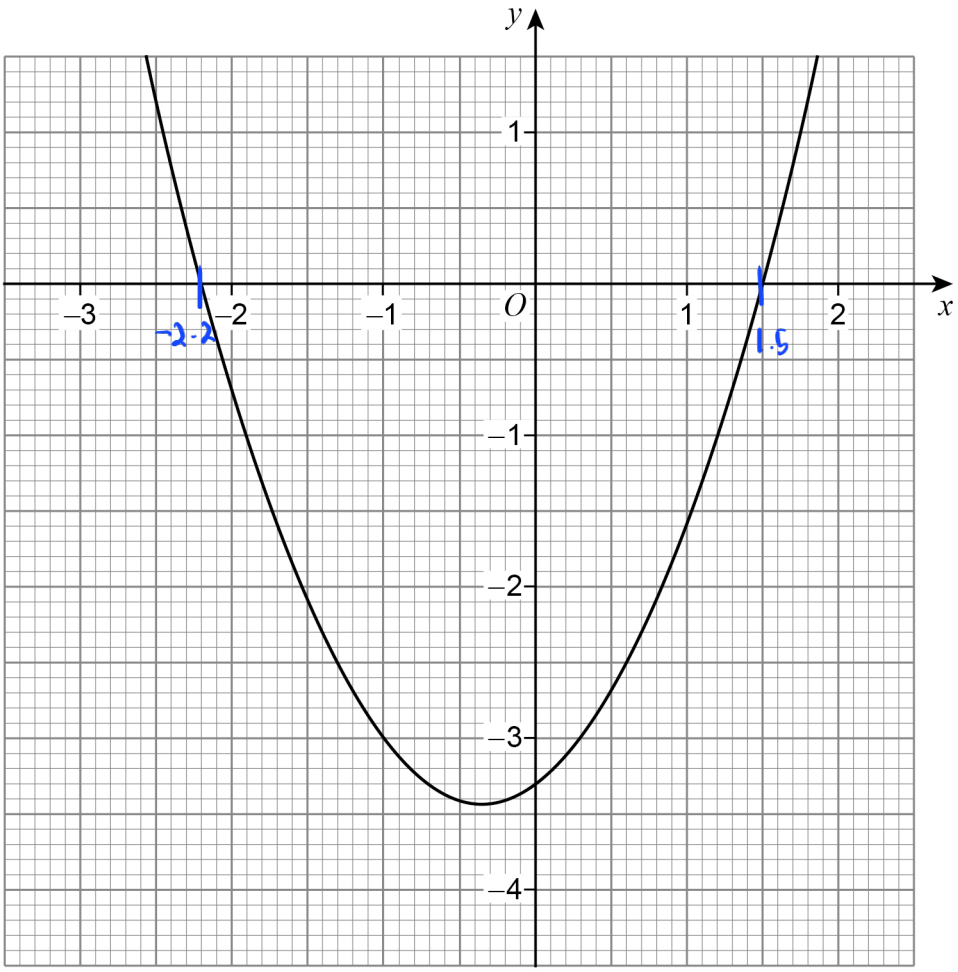
∴ 0.095 + 0.0025 = 0.0975

Answer 0.0975 (1)

7

Do not write outside the box

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



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

[2 marks]

Answer −2·2 , 1·5

(2)

14

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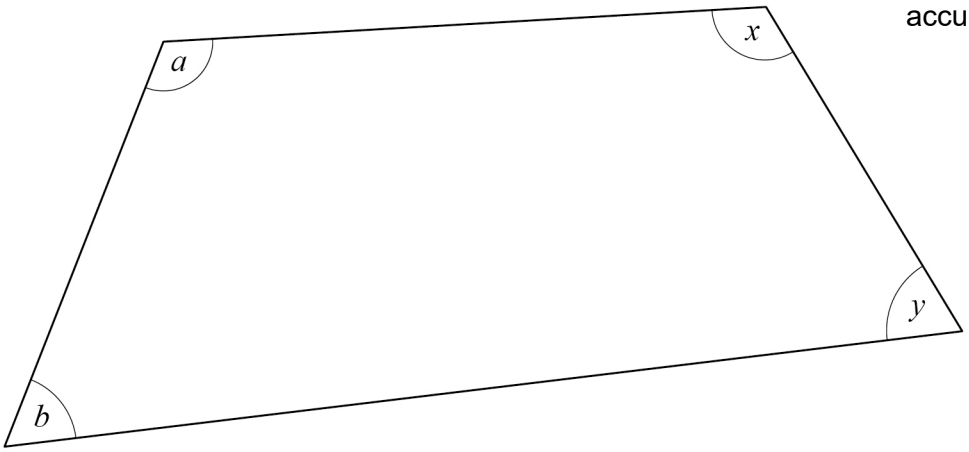

$b = 45°$ and $a : b = 7 : 3$ and $x : y = 4 : 1$

Show that $a : y = 5 : 2$

[3 marks]

$a = 45° \times \frac{7}{3} = 105°$ ✓ (1)

$y = \frac{360° - 45° - 105°}{5}$

$= \frac{210°}{5} = 42°$ ✓ (1)

$a : y = 105° : 42°$ ✓ (1)

$\div 21 \quad \div 21$

$= 5 : 2$ (shown)

5

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Do not write outside the box

15 A straight line passes through points A (–5, 9), B and C (3, –7).

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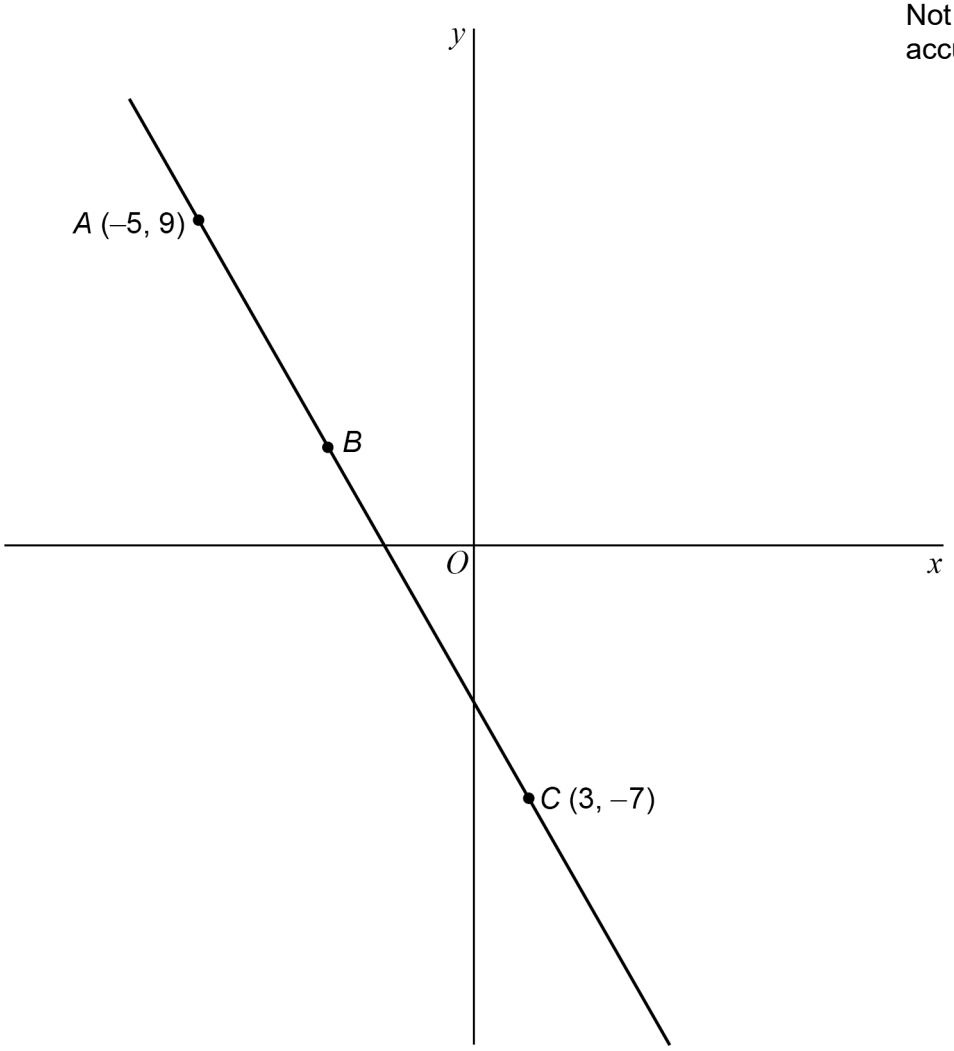


15 (a) $AB : BC = 1 : 3$

Work out the coordinates of point B.

[3 marks]

difference in x : $3 - (-5) = 8$

difference in y : $9 - (-7) = 16$ ✓ (1)

x-coordinate of B = $-5 + \left(\frac{1}{4}(8)\right) = -3$

y-coordinate of B = $9 - \left(\frac{1}{4}(16)\right) = 5$ ✓ (1)

Answer (−3 , 5) ✓ (1)

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

[4 marks]

Do not write outside the box

$m_{AC} = \frac{9-(-7)}{-5-3} = \frac{16}{-8} = -2$ ✓ (1)

gradient perpendicular to AC $= -\frac{1}{(-2)}$

$= \frac{1}{2}$ ✓ (1)

At C $(3, -7)$: $-7 = \frac{1}{2}(3) + c$

$-7 = 1.5 + c$

$c = -8.5$ ✓ (1)

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

Answer $y = \frac{1}{2}x - 8.5$ ✓ (1)

Turn over for the next question

7

Do not write outside the box

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 ☑ (1) No ☐

Give a reason for your answer.

[3 marks]

Rolling a 5 :

Theoretical probability = $\frac{1}{6} \times 72 = 12$ (1)

Relative frequency = 14 (1)

Yes, greater than theoretical probability.

Do not write outside the box

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]

Factors of 200 : 1, 2, 4, 5, 8, 10, 20, 25, 40, 50, 100, 200

Cubic number = 8, so $a = 2$

$b^2 = \frac{200}{8} = 25$

$b = 5$

$a^4 \times b = 2^4 \times 5 = 16 \times 5$

$= 80$

Answer 80 (3)

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]

$e = cd$ $\quad$ $e = c^2d$ (1) $\quad$ $e = c^2d^2$ $\quad$ $e = c^3d^3$

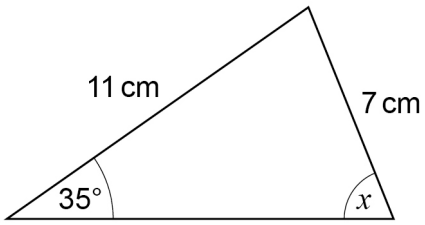
Turn over for the next question

7

Do not write outside the box

18 Here is triangle A.

Not drawn accurately



18 (a) Use the sine rule to show that $x = 64°$ to the nearest degree.

[3 marks]

$\frac{\sin x}{11} = \frac{\sin 35^\circ}{7}$ ✓ (1)

$\sin x = \sin 35^\circ \times \frac{11}{7}$ ✓ (1)

$= 0.901$

$x = \sin^{-1} 0.901$

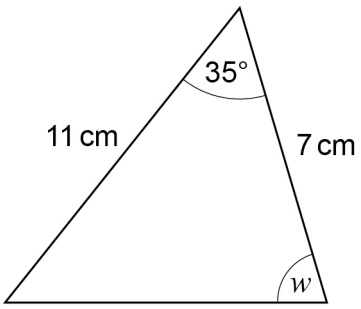
$= 64.33$ ✓ (1)

$= 64^\circ$ (nearest degree)

Do not write outside the box

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]

the '7 cm side' is a different side

Turn over for the next question

4

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

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

[2 marks]

$fg(x) = (4x - 7) - 3$

$= 4x - 10$ ✓ (1)

$fg(6) = 4(6) - 10 = 14$ ✓ (1)

Answer 14

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

[4 marks]

$(x-3)^2 = 4x - 7$ ✓ (1)

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

$x^2 - 10x + 16 = 0$ ✓ (1)

$(x-8)(x-2) = 0$ ✓ (1)

$x = 8, x = 2$

Answer $x = 8$ and $x = 2$ ✓ (1)

Do not write outside the box

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]

$P = kQ$ (1)

$8 = k(2)$

$k = 4$, $P = 4Q$ (1)

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

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

$m = 90$, $R = \frac{90}{Q^2}$ (1)

when $P = 0.5$, $0.5 = 4Q$

$Q = 0.125$

$R = \frac{90}{0.125^2} = 5760$ (1) (1)

$R =$ 5760

Turn over for the next question

11

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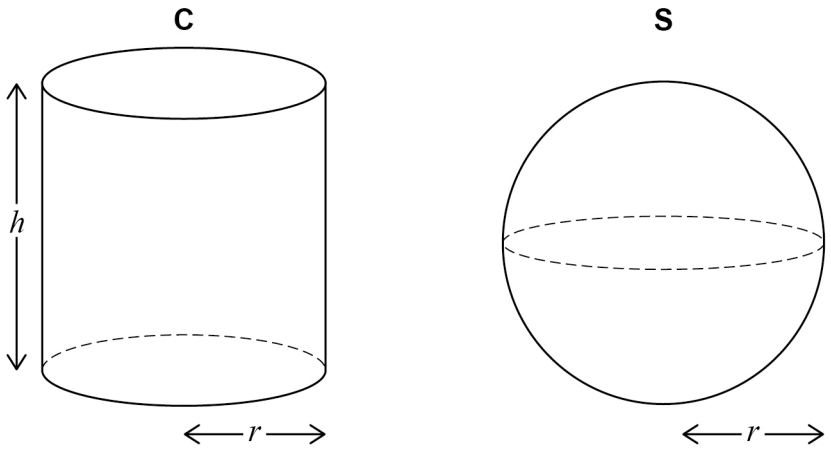
21 A cylinder, C, and a sphere, S, each have radius r

C has height 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]

volume of C $= \pi r^2 h$ (1)

volume of S $= \frac{4}{3}\pi r^3$

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

$h = \frac{4}{3}r$ (1)

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

Answer 3 : 4 (1)

Do not write outside the box

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]

$V = \pi(3r)^2(2h)$ ✓1

$= \pi(9r^2)(2h)$

$= 18(\pi r^2 h)$

Answer 18 ✓1

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]

odd numbers : 1, 3, 5, 7, 9 (5 choices)

$5 \times 4 \times 3 \times 2 = 120$ ✓1 ✓1

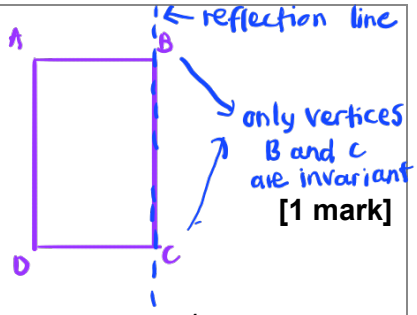
Answer 120

7

23 Quadrilateral *ABCD* is reflected in edge *BC*.

How many of the vertices are invariant?

Circle your answer.



[1 mark]

1 2 0 4

2 ✓ 1

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24 Write $2x^2 - 12x + 7$ in the form $d(x + e)^2 + f$

where d, e and f are integers.

[3 marks]

$2x^2 - 12x + 7$

$= 2(x^2 - 6x) + 7$ ✓ 1

$= 2[(x-3)^2 - 3^2] + 7$ ✓ 1

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

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

$= 2(x-3)^2 - 11$ ✓ 1

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

END OF QUESTIONS

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