

CCEA MATHS

M6 – M8



Exam Questions
Booklet

Name:



M6

- 1 a) Convert 13 into binary

Answer: 1101

- b) Convert 111101 into a decimal number

Answer: 61

- c) A computer game stores a score using binary.

The binary number shown is 110110

The score increases by 3.

Write down the new score in binary

$$54 + 3 = 57$$

32	16	8	4	2	1
1	1	1	0	0	1

Answer: 111001

- d) Explain the difference between the binary number system and the denary number system.

Binary is base 2 number system, denary is a base 10
number system or
Binary uses only digits 0 and 1, denary uses digits 0 to 9.

- 2 Simplify:

a) $x^2 \times x^5 = x^7$

b) $y^7 \div y^3 = y^4$

c) $(x^2)^3 = x^6$

d) $a^4 \times a^2 \div a = a^5$

e) $\frac{x^7}{x^5 \times x} = x$



M6

3 Use trial and improvement to solve $x^3 + x = 20$

Give your answer to 1 decimal place.

x	$x^3 + x$	
2	$2^3 + 2 = 10$	Too low
3	$3^3 + 3 = 30$	Too high
2.5	$2.5^3 + 2.5 = 18.125$	Too low
2.6	$2.6^3 + 2.6 = 20.176$	Too high
2.55	$2.55^3 + 2.55 = 19.131...$	Too low



Answer: $x = 2.6$



M6

- 4 Solve the inequalities.
Represent your answer on a number line.

a) $6x < 24$

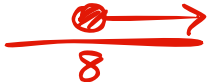
Answer: $x < 4$ 

b) $2x + 4 \geq 20$

$-4 \quad -4$

$2x \geq 16$

$x \geq 8$

Answer: $x \geq 8$ 

c) $5(x - 4) < 10$

$5x - 20 < 10$

$+20 \quad +20$

$5x < 30$

$x < 6$

Answer: $x < 6$ 



M6

5 a) Make x the subject of:

$$y = 4x - 6$$

$+6$ $+6$

$$y+6 = 4x$$
$$\frac{y+6}{4} = x$$

Answer: $x = \frac{y+6}{4}$

b) Make x the subject of:

$$y = \frac{x+4}{3}$$

$\times 3$ $\times 3$

$$3y = x+4$$

-4 -4

$$3y-4 = x$$

Answer: $x = 3y-4$

6 a) Find the n th term of:

9, 12, 15, 18, ...

Answer: $3n+6$

b) Find the n th term of:

12, 8, 4, 0, ...

Answer: $-4n+16$



M6

c) Here is a sequence:

7, 12, 17, 22, ...

What is the first term in the sequence greater than 1000?

$$\begin{array}{r} 5n + 2 > 1000 \\ -2 \quad -2 \end{array}$$

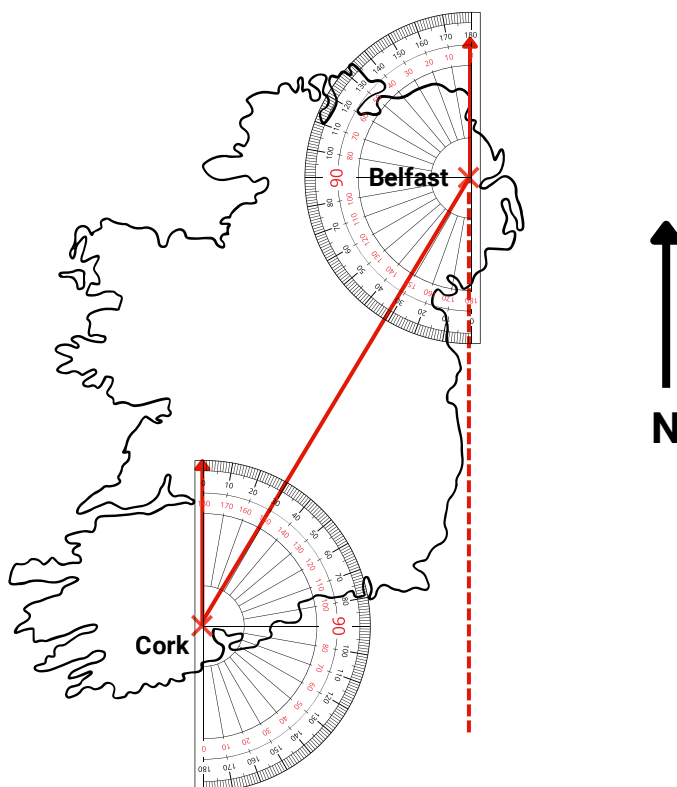
$$5n > 998$$

$$n > \frac{998}{5} \quad n > 199.6$$

$$n = 200$$

Answer: 200

7 This map shows the position of Belfast to Cork



a) Measure the bearing of Cork from Belfast.

Answer: 210°

b) Measure the bearing of Belfast from Cork.

Answer: 30°



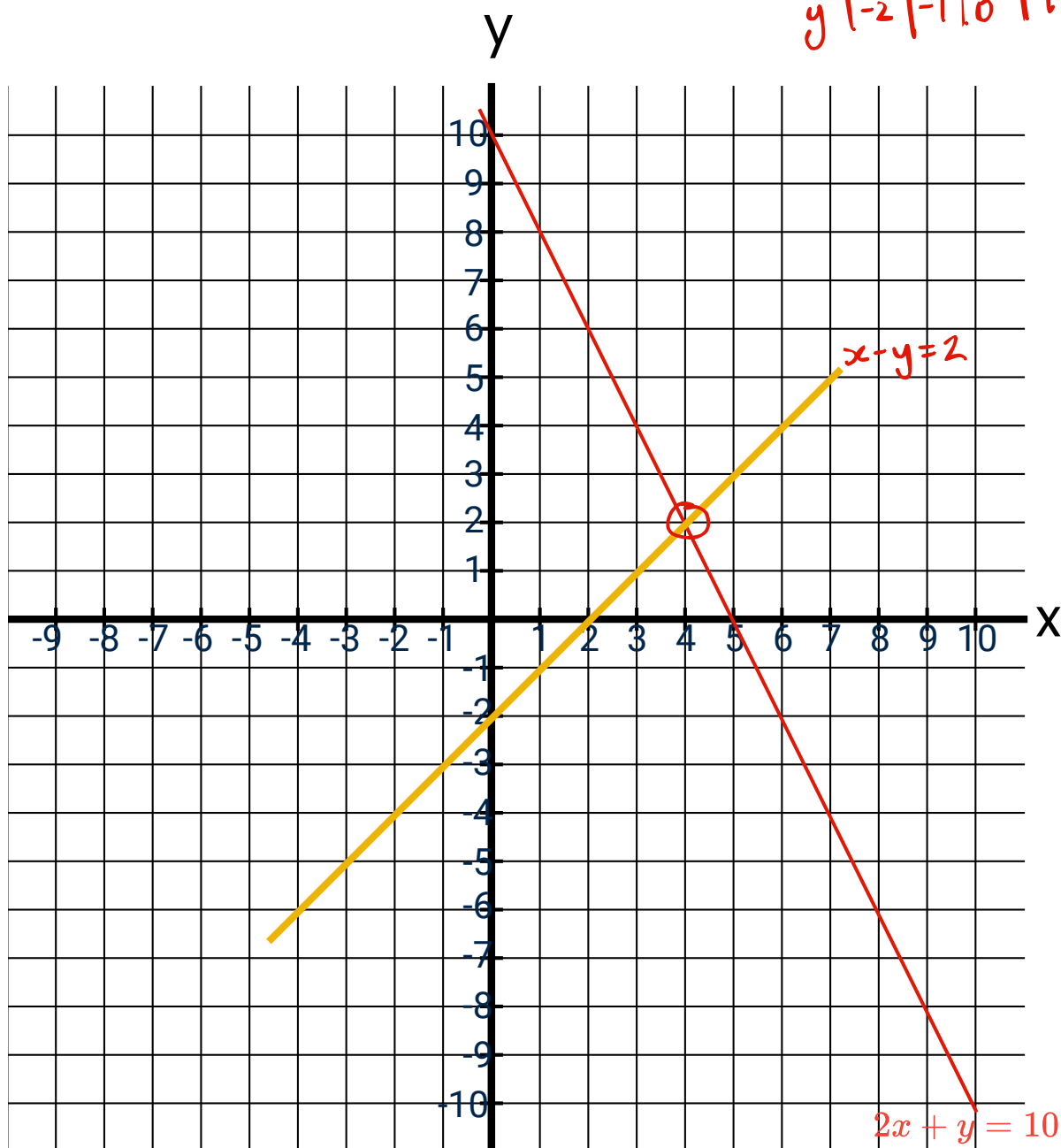
M6

- 8 Use the graph to solve the simultaneous equations.

$$2x + y = 10$$

$$x - y = 2$$

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



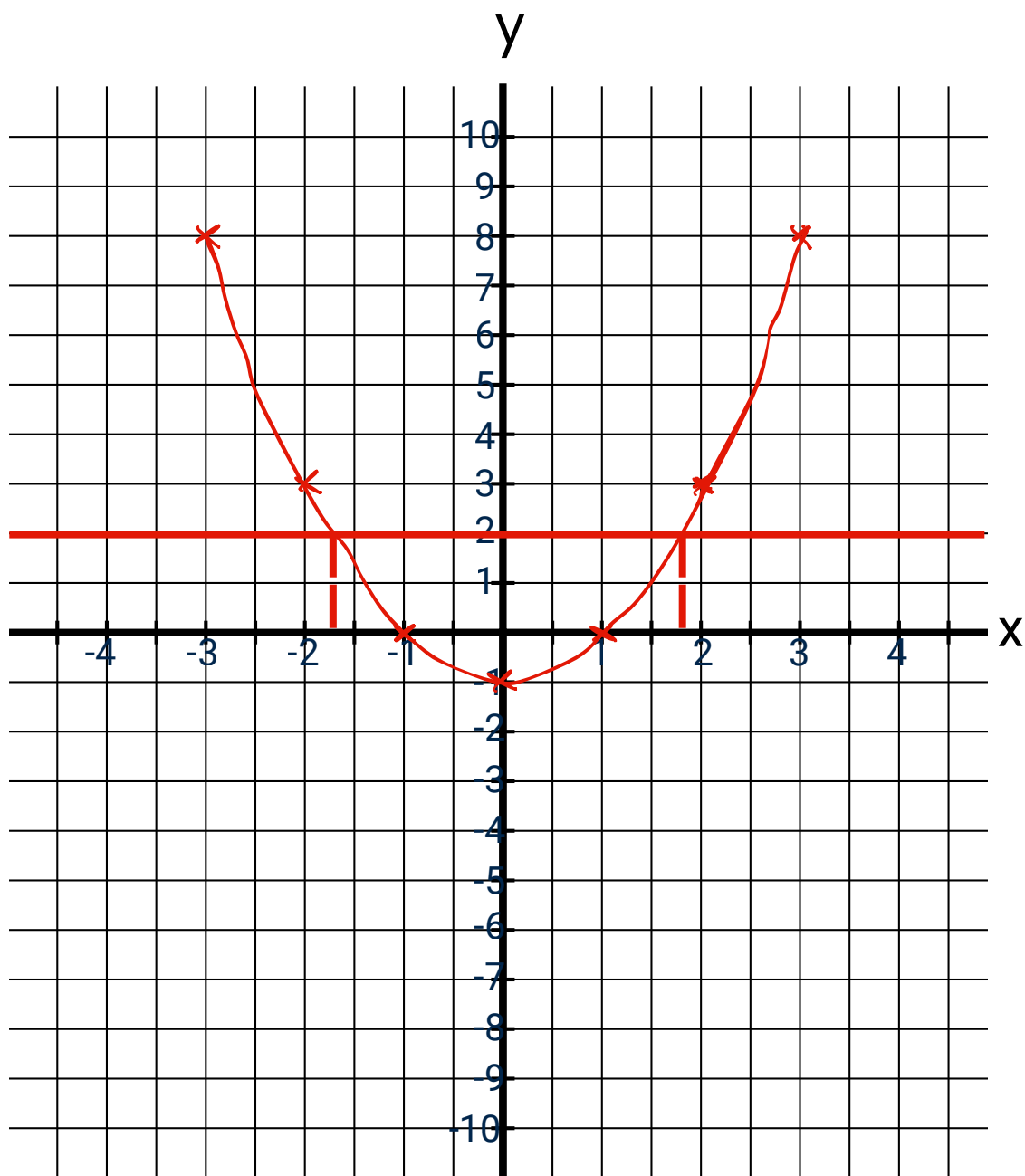
Answer: $x=4, y=2$



M6

- 9 a) Plot the graph of: $y = x^2 - 1$
For the values of x from -3 to 3

x	-3	-2	-1	0	1	2	3
y	8	3	0	-1	0	3	8



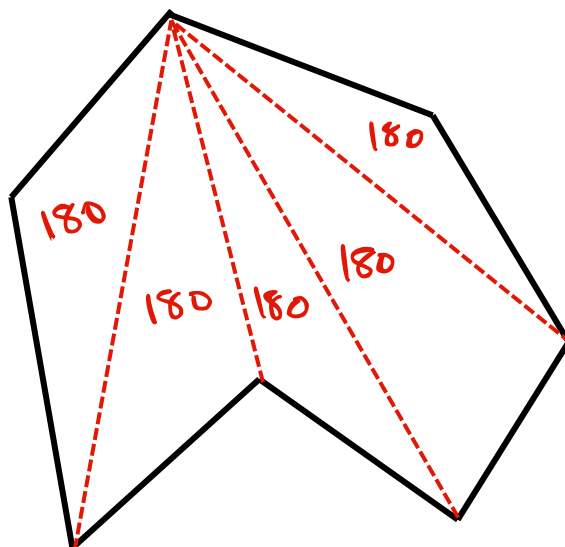
- b) Use your graph to solve $x^2 - 1 = 2$

Answer: $x = -1.7$ or 1.7



M6

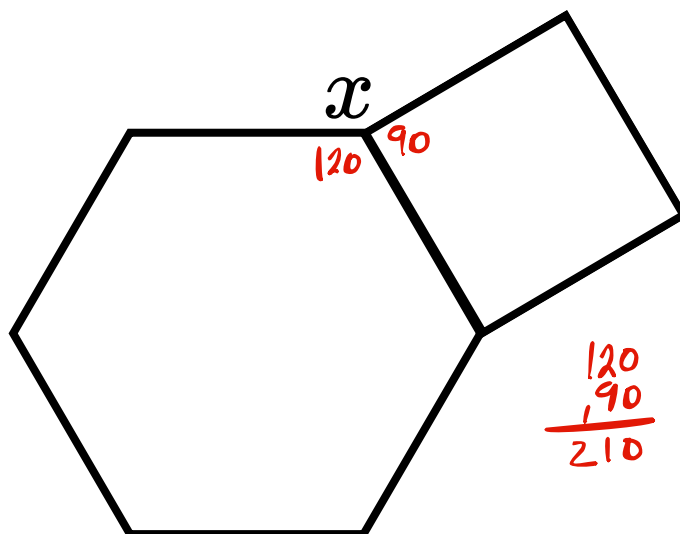
- 10 a) The diagram shows a heptagon.
Calculate the sum of the interior angles of the heptagon.
You must show all your working.



$$(7-2) \times 180$$
$$900$$

Answer: 900°

- b) A regular hexagon is joined to a square as shown.
Calculate the size of angle x.



$$(6-2) \times 180$$
$$4 \times 180$$
$$720$$
$$\frac{720}{6}$$

$$\frac{120}{90}$$
$$210$$

$$\frac{360}{-210}$$
$$150$$

Answer: 150°



M6

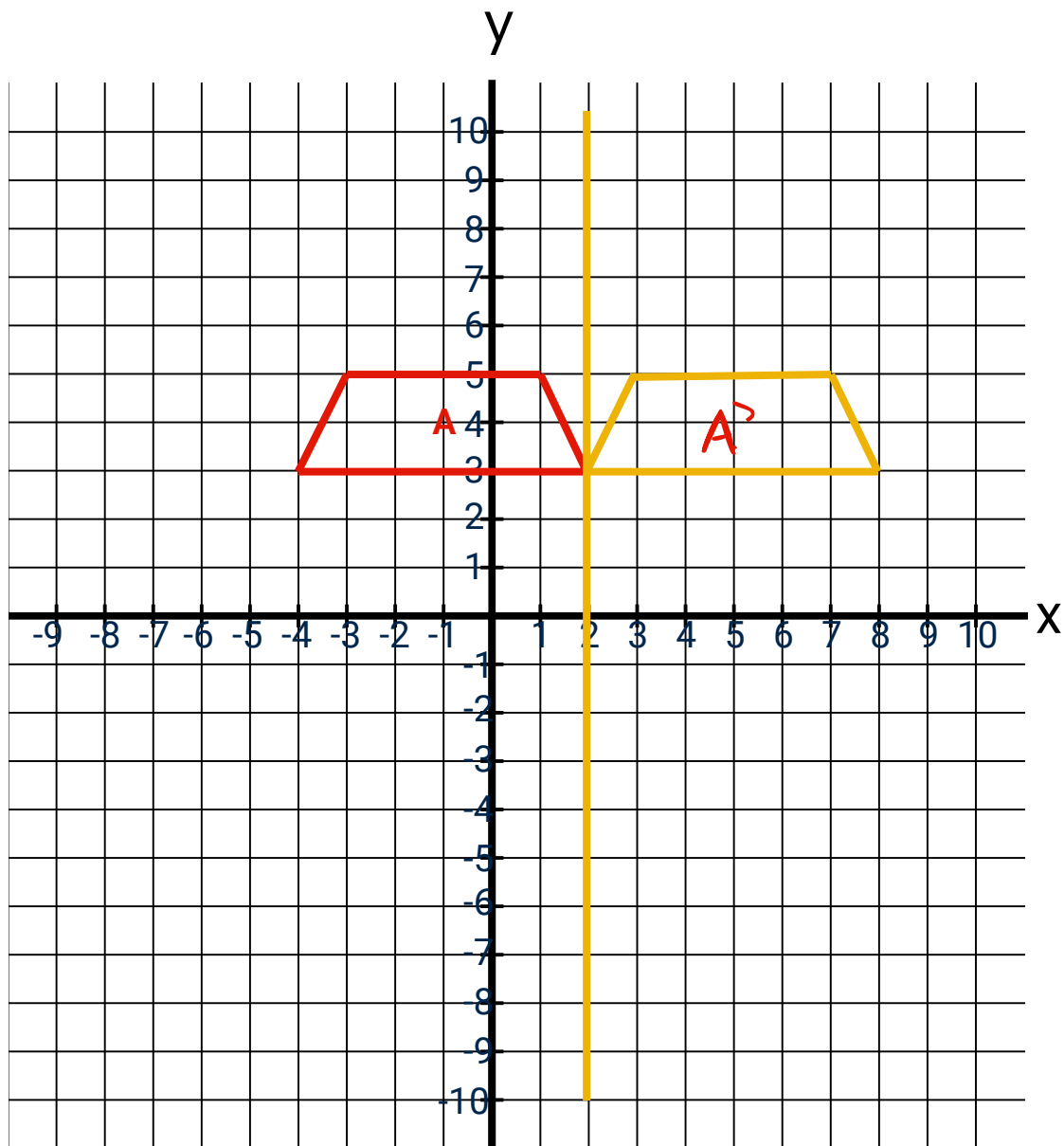
- c) Each interior angle of a regular polygon is 156°
Calculate the number of sides of the polygon.

$$\text{ext} = 180 - 156 = 24$$

$$\frac{360}{24} = 15$$

Answer: 15

- 11 Reflect shape A in the line $x = 2$. Label the reflected shape A'

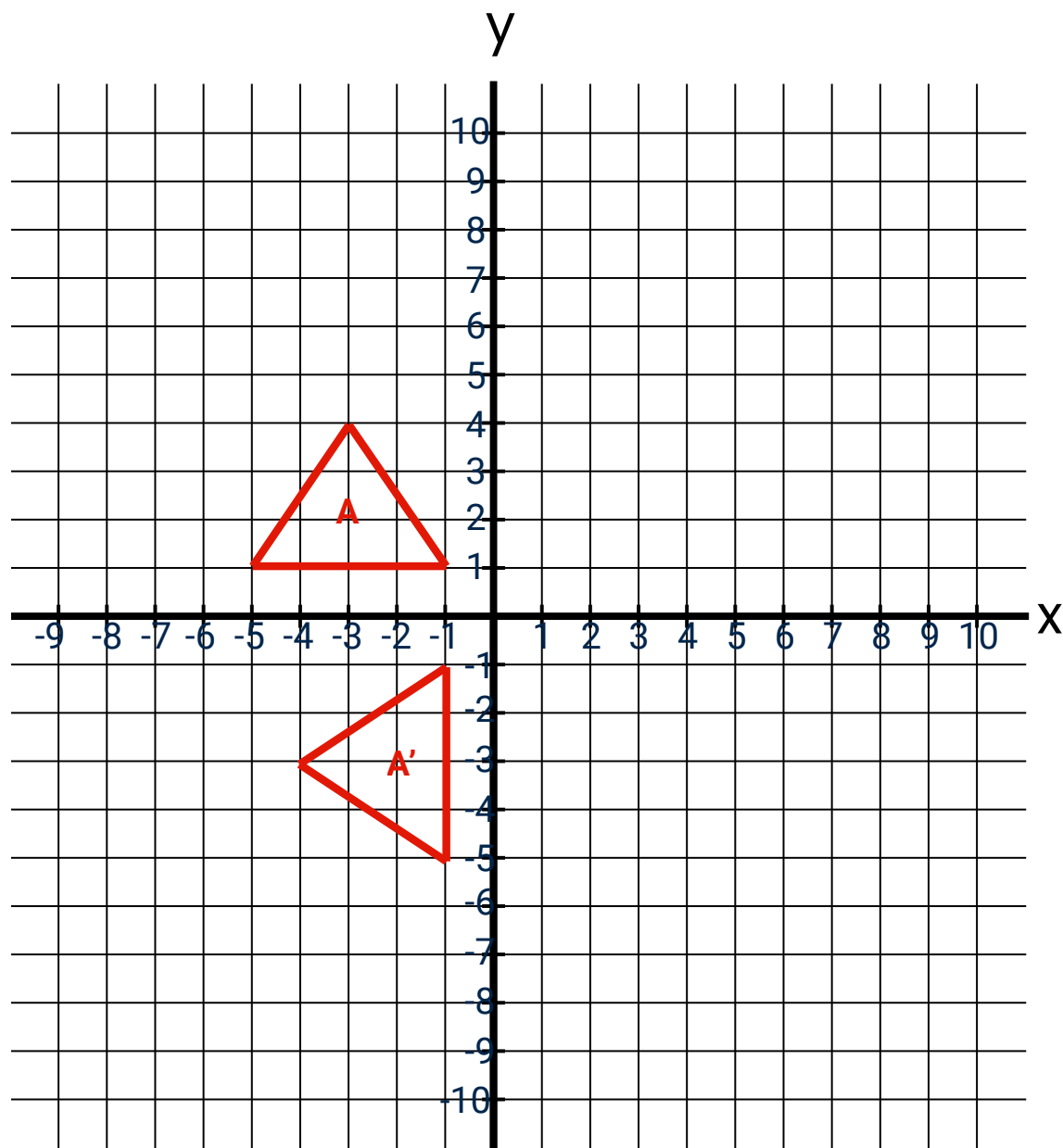




M6

12

Describe fully the single transformation that maps shape A onto shape A'



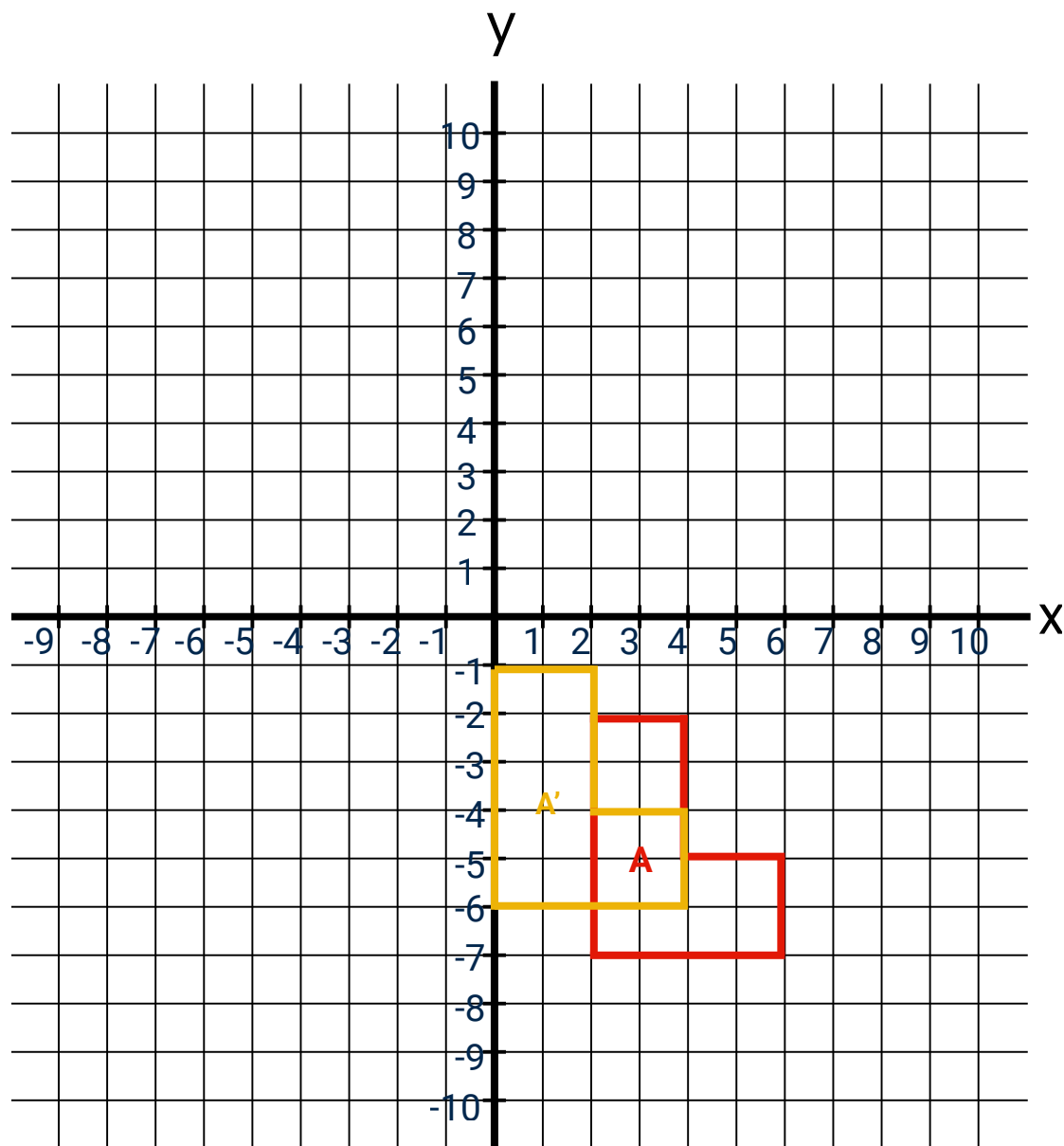
Answer: Rotation 90° anti-clockwise
about the origin.



M6

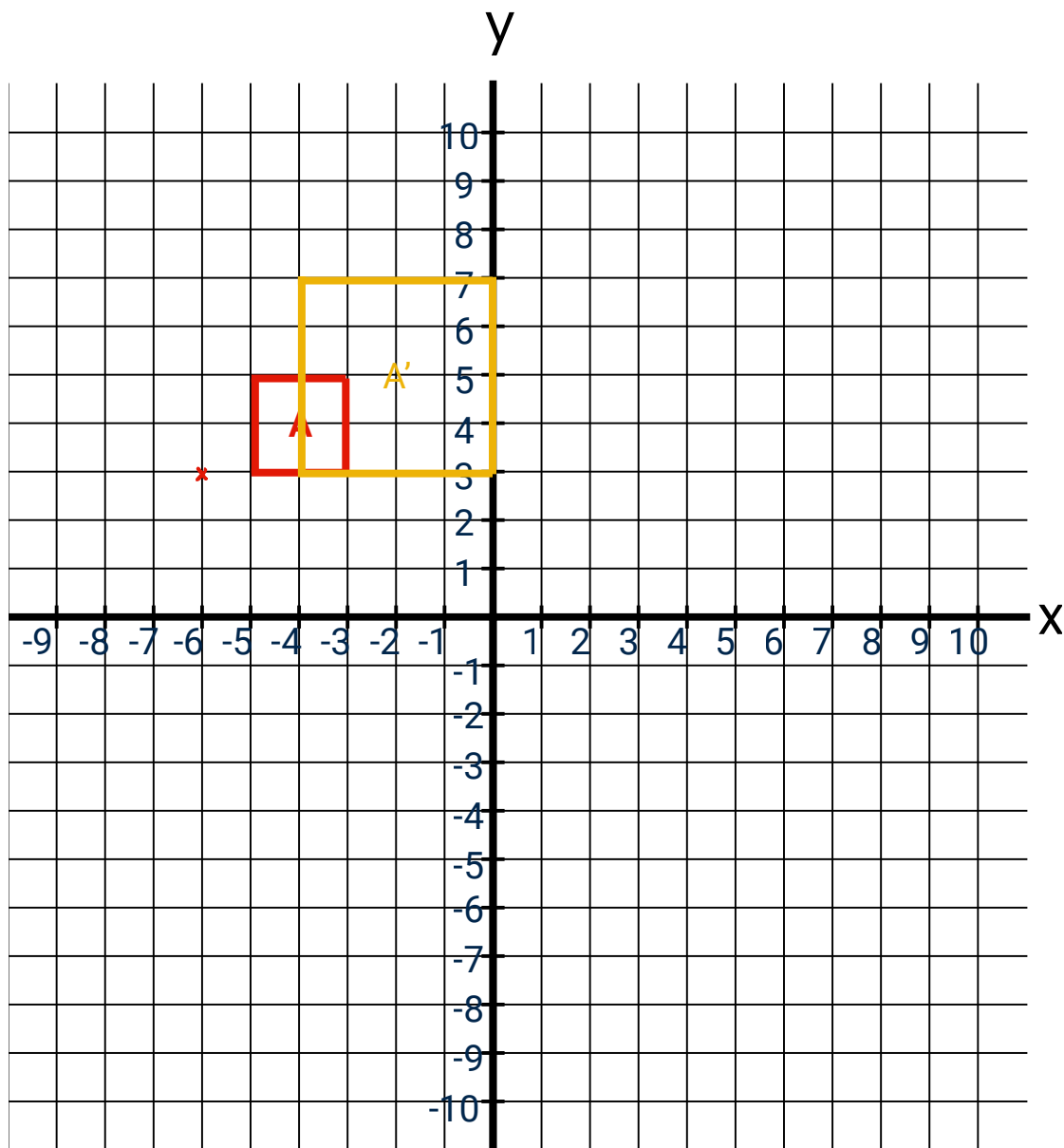
- 13 Translate shape A by the vector $\begin{pmatrix} -2 \\ 1 \end{pmatrix}$

Label the translated shape A'





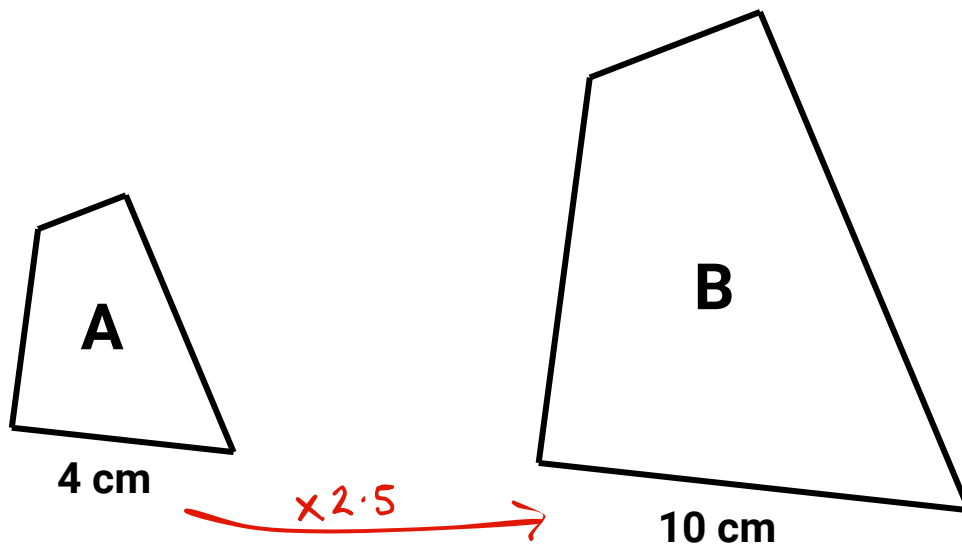
- 14** Enlarge shape A by scale factor 2 with centre of enlargement $(-6, 3)$
Label the enlarged shape A'





M6

- 15 Shape B is an enlargement of Shape A.



The perimeter of shape A is 18cm

The area of shape A is 12 cm^2

- a) Calculate the perimeter of shape B

$$18 \times 2.5$$

Answer: 45cm

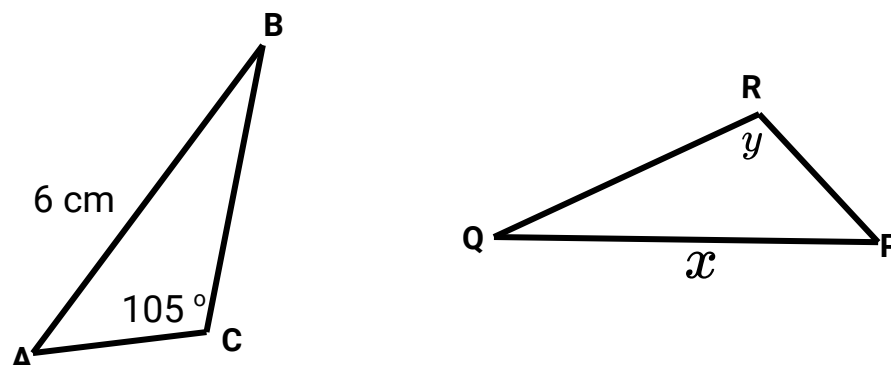
- b) Calculate the area of shape B

$$12 \times 2.5^2 = 75 \text{ cm}^2$$

Answer: 75cm²

- 16 The diagram shows two congruent triangles.

Triangle ABC is congruent to triangle PQR.



Calculate the size of side x and angle y.

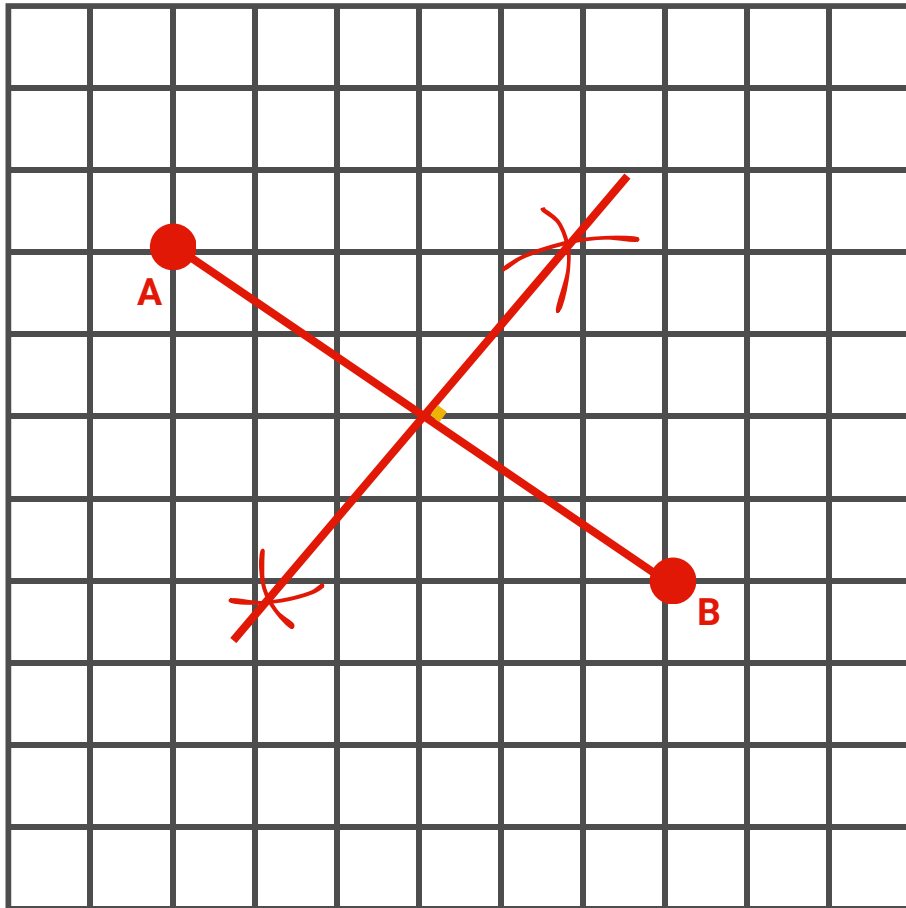
$$x = \underline{6 \text{ cm}}$$

$$y = \underline{105^\circ}$$



M6

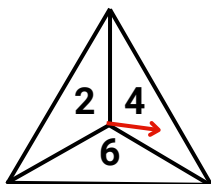
- 17 Draw the locus of points that are equidistant from A and B.



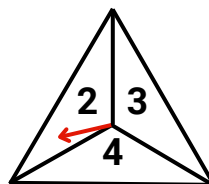


M6

- 18 Patrick plays a game using two fair spinners.



Spinner 1



Spinner 2

Patrick spins both spinners once and adds the scores together.

		<u>Spinner 1</u>		
		2	4	6
<u>Spinner 2</u>	2	4	6	8
	3	5	7	9
	4	6	8	10

- a) Complete the table of possible outcomes.
- a) Find the probability that Patrick scores a prime number.

Answer: $\frac{2}{9}$



M6

- 19 A cafe records how many customers buy hot chocolate.

The table shows the results.

Number of customers recorded	100	200	300	400	500
Number buying hot chocolate	42	70	<u>111</u>	145	<u>180</u>
Relative frequency	0.42	<u>0.35</u>	0.37	<u>0.3625</u>	0.36

- a) Calculate the missing values in the table.
- b) Estimate how many customers out of 1000 would buy hot chocolate.

$$0.36 \times 1000$$

Answer: 360



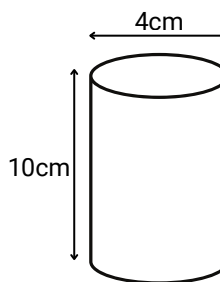
M7

- 1 a) Calculate the volume of the cylinder.
Give your answer in terms of π .

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

$$= \pi \times 2^2 \times 10$$

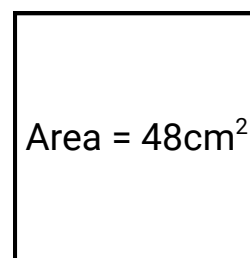
$$= 40\pi$$



Answer: $40\pi \text{ cm}^3$

- b) The area of a square is 48cm^2
Calculate the length of one side of the square.
Give your answer in simplest surd form.

$$\begin{aligned} x &= \sqrt{48} \\ &\quad \swarrow \quad \searrow \\ &\quad \sqrt{16} \quad \sqrt{3} \\ &\quad 4\sqrt{3} \text{ cm} \end{aligned}$$



Answer: $4\sqrt{3} \text{ cm}$

- 2 Simplify:

a) $x^4 \div x^4 = x^0 = 1$

c) $\frac{(x^3)^2}{x^{-2}} = \frac{x^6}{x^{-2}} = x^8$

b) $x^5 \times x^{-2} = x^3$



M7

3 a) Calculate: $(7 \times 10^4) \times (3 \times 10^3)$

Give your answer in standard form.

$$\begin{array}{r} 21 \times 10^7 \\ \div 10 \downarrow \quad \downarrow \times 10 \\ 2.1 \times 10^8 \end{array}$$

Answer: 2.1×10^8

b) Calculate: $\frac{(4 \times 10^8)}{(8 \times 10^{-2})}$

Give your answer in standard form.

$$\begin{array}{r} 0.5 \times 10^{10} \\ \div 10 \downarrow \quad \downarrow \times 10 \\ 5 \times 10^9 \end{array}$$

Answer: 5×10^9

4 Solve the simultaneous equations:

$$\begin{array}{rcl} 5x + 3y = 29 & \xrightarrow{\times 2} & 10x + 6y = 58 \\ 3x + 2y = 18 & \xrightarrow[\times 3]{-} & 9x + 6y = 54 \\ & & \hline & & x = 4 \end{array}$$

Sub $x=4$

$$\begin{array}{l} 3(4) + 2y = 18 \\ 2y = 6 \\ y = 3 \end{array}$$

Check: $5(4) + 3(3) = 29$
 $20 + 9 = 29$
 $29 = 29 \checkmark$

Answer: $x=4, y=3$

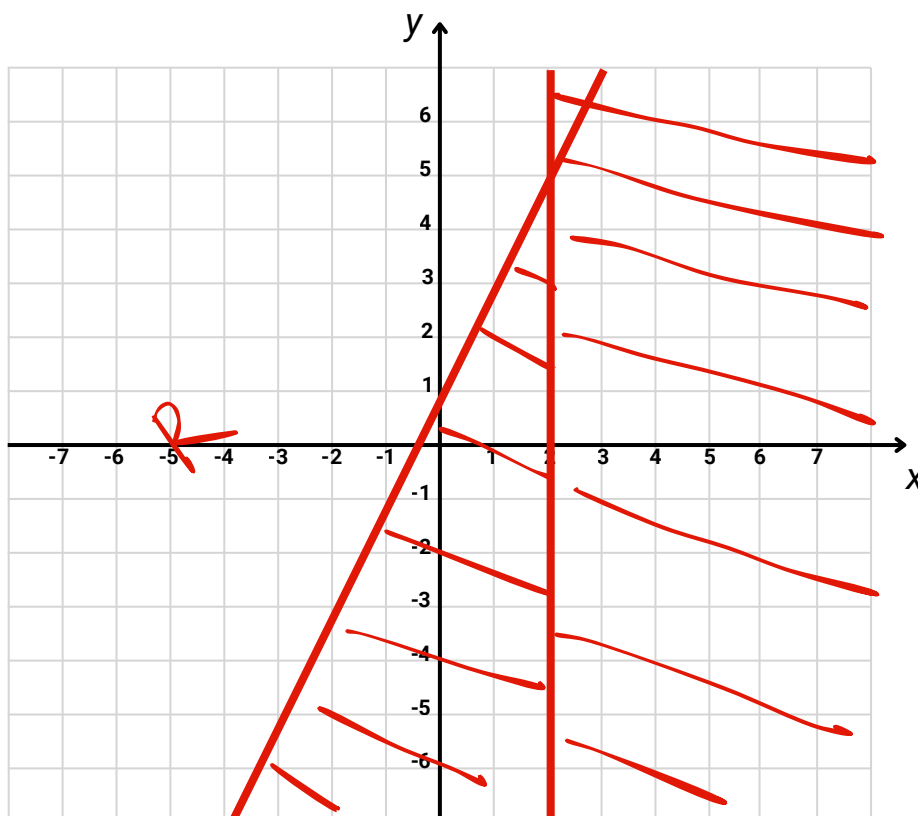


- 5 On the grid, show the region that satisfies the following inequalities.

$$x \leq 2$$

$$y \geq 2x + 1$$

x	0	1	2
y	1	3	5



Test (0,0) $y \geq 2x + 1$

$$0 \geq 2(0) + 1$$

$$0 \geq 1 \quad \text{No}$$



M7

6 a) Make x the subject of: $y = x^2 + 7$

$$\begin{aligned}
 y - 7 &= x^2 \\
 \sqrt{y-7} &= x
 \end{aligned}$$

Answer: $x = \pm\sqrt{y-7}$

b) Make x the subject of: $y + bx = 3ax$

$$\begin{aligned}
 y &= 3ax - bx \\
 y &= x(3a - b) \\
 \frac{y}{3a-b} &= x
 \end{aligned}$$

Answer: $x = \frac{y}{3a-b}$

7 Here is a sequence. 2, 9, 20, 35, 54

Find an expression for the nth term of the sequence.

$$\begin{array}{cccccc}
 2 & 9 & 20 & 35 & 54 \\
 \underbrace{\quad} & \underbrace{\quad} & \underbrace{\quad} & \underbrace{\quad} & \underbrace{\quad} \\
 7 & 11 & 16 & 19 \\
 \underbrace{\quad} & \underbrace{\quad} & \underbrace{\quad} & \underbrace{\quad} \\
 4 & 4 & 4
 \end{array}$$

2nd diff = +4 so $2n^2$

T	2	9	20	35	54
$2n^2$	-2	8	18	32	50
	0	1	2	3	4

$\underbrace{\quad\quad\quad}_{n-1}$

$2n^2 + n - 1$

Answer: $2n^2 + n - 1$

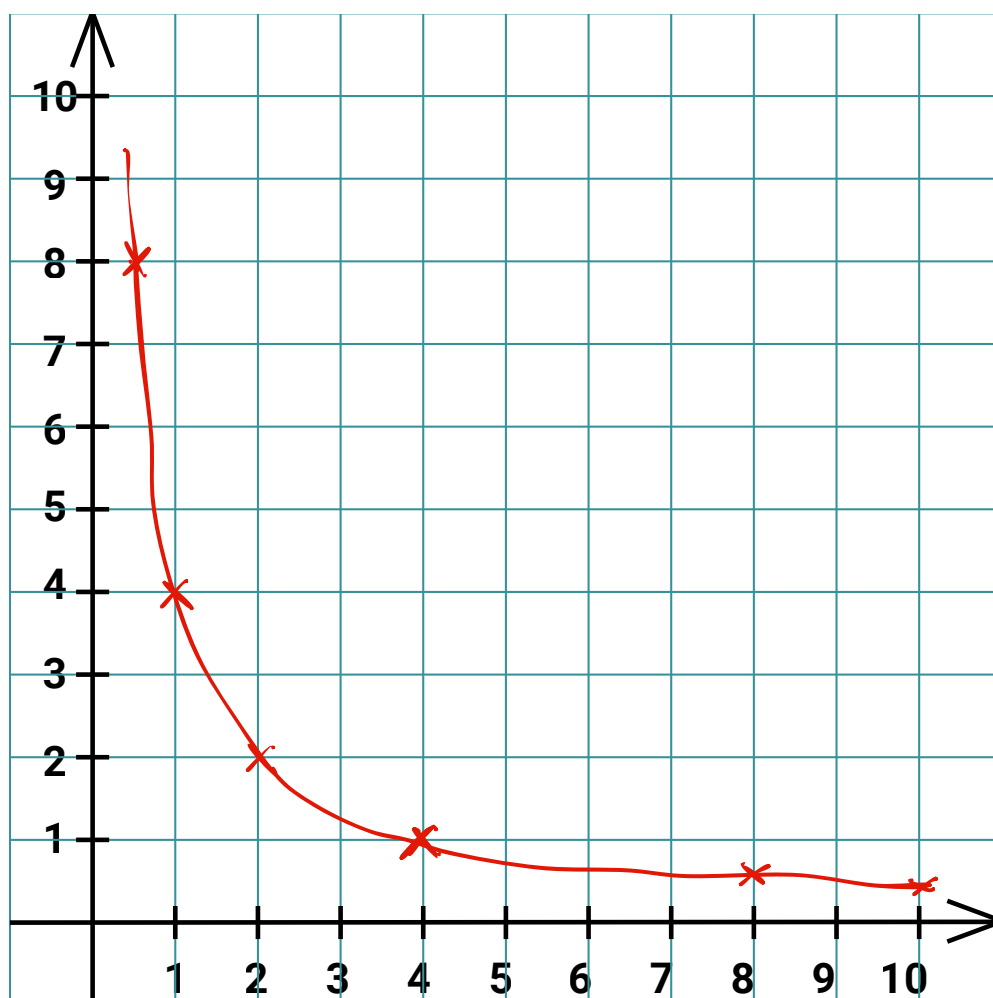


M7

- 8 Complete the table of values for $y = \frac{4}{x}$

x	0.5	1	2	4	8	10
y	8	4	2	1	0.5	0.4

On the grid, draw the graph of $y = \frac{4}{x}$





M7

- 9 a is directly proportional to b
When $a = 28$, $b = 7$

- a) Work out an equation connecting a and b .

$$\begin{aligned} a &\propto b \\ a &= kb \\ 28 &= k \times 7 \\ 4 &= k \end{aligned} \rightarrow a = 4b$$

Answer: $a = 4b$

- b) Work out the value of b when $a = 12$

$$\begin{aligned} a &= 4b \\ 12 &= 4b \\ 3 &= b \end{aligned}$$

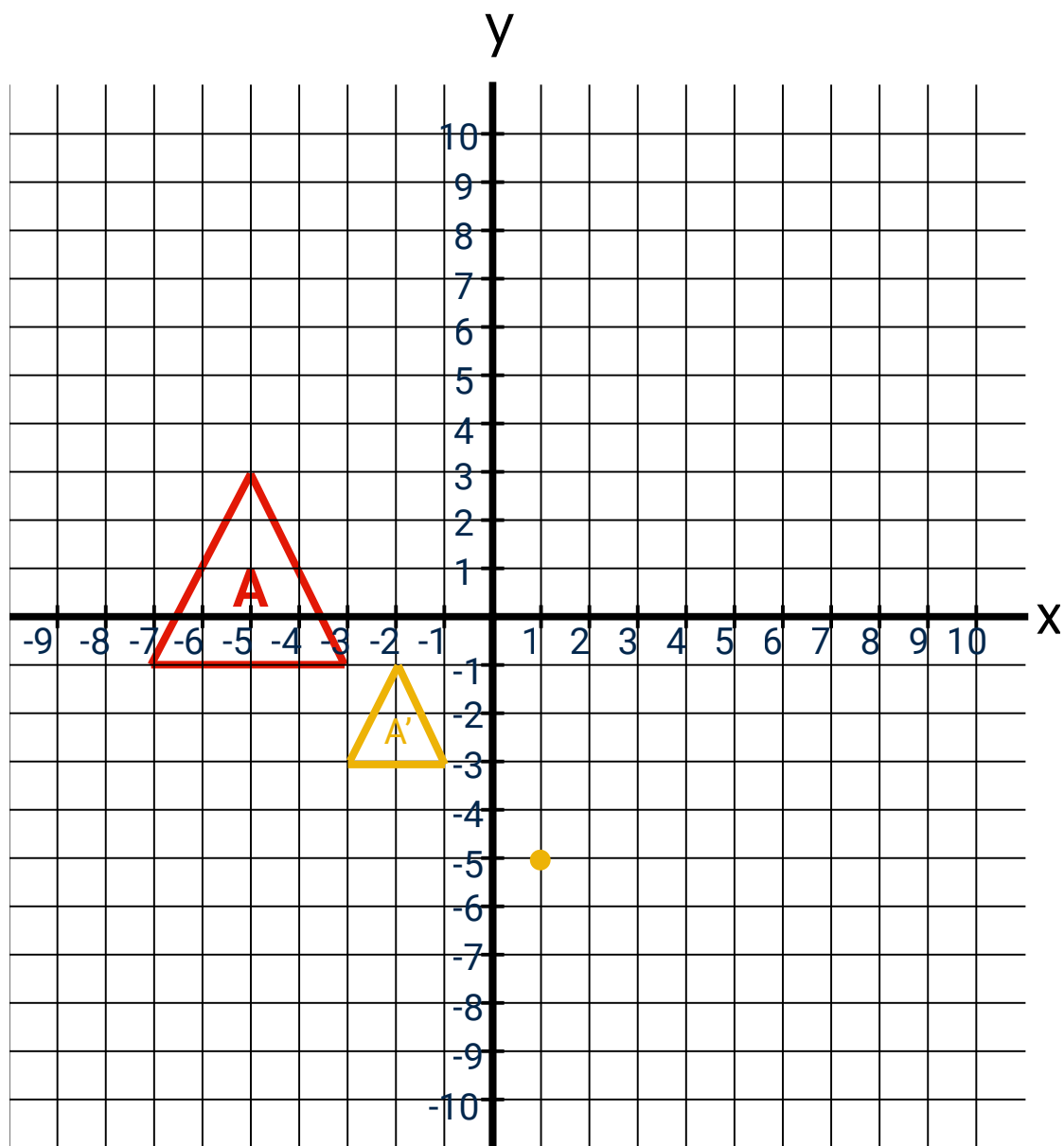
Answer: 3



M7

- 10 Enlarge shape A by scale factor $\frac{1}{2}$ with centre of enlargement (1,-5).

Label the image A'.



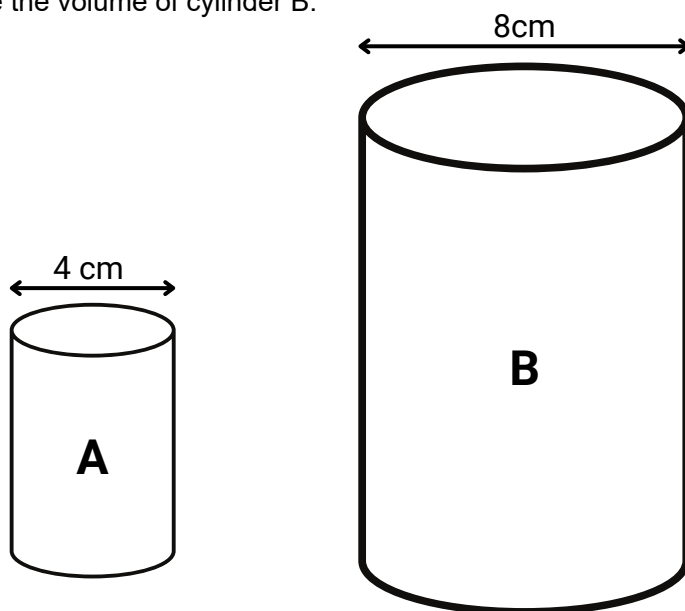


M7

- 11 Cylinder B is mathematically similar to cylinder A.

The volume of cylinder A is 35cm^3

Calculate the volume of cylinder B.



$$LSF = \frac{8}{4} = 2$$

$$VSF = 2^3 = 8$$

$$35 \times 8 = 280\text{cm}^3$$

Answer: 280cm^3

- 12 Ryan is trying to remember a 3-digit locker code.
He knows that:

- The first digit is a prime number
- The second digit is a factor of 12
- The third digit is an even number.

How many different codes are possible?

$$\begin{array}{c|c|c} P & F \text{ of } 12 & \text{Even} \\ \hline 2, 3, 5, 7 & 1, 2, 3, 4, 6 & 0, 2, 4, 6, 8 \\ \hline 4 & \times & 5 \times 5 \end{array}$$

Answer: 100



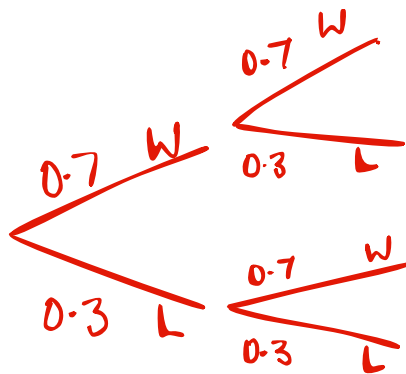
M7

- 13** A tennis player has a probability of 0.7 of winning any match.

The player takes part in a local league and plays two matches.

The outcomes of the matches are independent.

- a)** Complete a tree diagram to show the possible outcomes of the two matches.



- b)** Calculate the probability that the player wins exactly two matches.

$$WW = 0.7 \times 0.7$$

Answer: 0.49

- c)** Calculate the probability that the player wins at least one match.

$$1 - P(LL)$$

$$1 - (0.3 \times 0.3)$$

Answer: 0.91



M8

- 1 Harry says:
"All numbers written as square roots are irrational."

Is Harry correct?
Use examples to justify your answer.

Not correct, eg $\sqrt{25} = 5 \rightarrow$ rational.

- 2 Convert $1.\overline{27}$

to a fraction in its simplest form.

$$\begin{aligned}x &= 1.\overline{277777} \\10x &= 12.\overline{777777} \\100x &= 127.\overline{777777}\end{aligned}$$

$$90x = 115$$

$$x = \frac{115}{90} = \frac{23}{18}$$

Answer: $\frac{23}{18}$



M8

3 Evaluate:

a) $81^{\frac{3}{4}}$

$$\left(\sqrt[4]{81}\right)^3$$
$$3^3$$

Answer: 27

b) $64^{-\frac{1}{2}}$

$$\frac{\sqrt{1}}{\sqrt{64}} = \frac{1}{8}$$

Answer: $\frac{1}{8}$

c) $\left(\frac{27}{64}\right)^{-\frac{2}{3}}$

$$\left(\frac{\sqrt[3]{64}}{\sqrt[3]{27}}\right)^2$$

$$\frac{4^2}{3^2} = \frac{16}{9}$$

Answer: $\frac{16}{9}$

4 Write: 16×8^{3x}

as a power of 2 in terms of x.

$$2^4 \times (2^3)^{3x}$$

$$2^4 \times 2^{9x} = 2^{4+9x}$$

Answer: 2^{4+9x}



M8

5

Claire invests £800 in an account that pays compound interest.

She wants to have at least £950 in the account after 4 years.

Work out, to 1 decimal place, the minimum annual interest rate she needs.

$$950 = 800(1+r)^4$$

$$\frac{950}{800} = (1+r)^4$$

$$\sqrt[4]{\frac{19}{16}} = 1+r$$

$$\sqrt[4]{\frac{19}{16}} - 1 = r$$

$$0.0438988 = r$$

$$4.39 = r$$

$$4.4\%$$

Answer: 4.4%

6

Rationalise the denominator of $\frac{5}{2\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{5\sqrt{3}}{2 \times 3} = \frac{5\sqrt{3}}{6}$

Give your answer in its simplest form.

Answer: $\frac{5\sqrt{3}}{6}$



M8

- 7 Solve algebraically the simultaneous equations:
- $$x^2 + y^2 = 50$$
- $$y - 4x = 10$$

$$y = 4x + 10$$

$$x^2 + (4x + 10)(4x + 10) = 50$$

$$x^2 + 16x^2 + 80x + 100 = 50$$

$$17x^2 + 80x + 50 = 0$$

FACTORISE or QUAD FORMULA

$$(17x + 10)(x + 5) = 0$$

$$x = -\frac{10}{17} \text{ or } x = -5$$

$$y = \frac{130}{17}$$

$$y = -10$$

Answer: $(-5, -10)$ or $(-\frac{10}{17}, \frac{130}{17})$

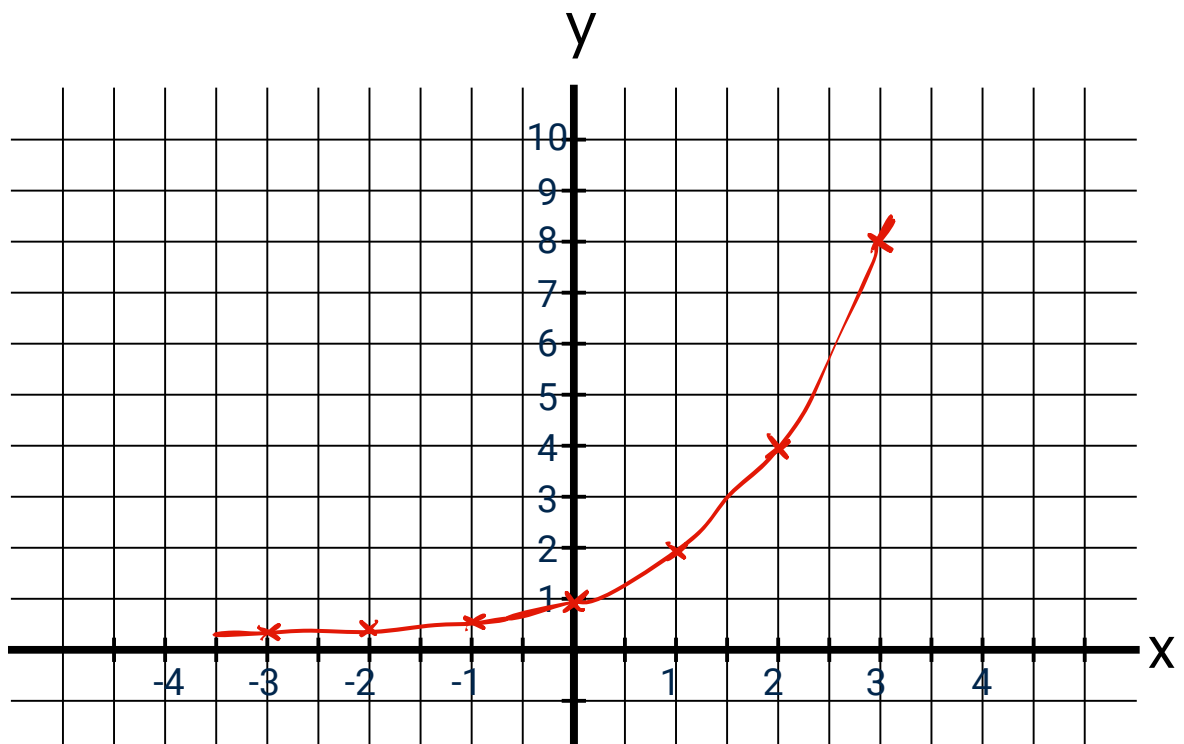


M8

8 Complete the table of values for $y = 2^x$

x	-3	-2	-1	0	1	2	3
y	$\frac{1}{8}$	$\frac{1}{4}$	$\frac{1}{2}$	1	2	4	8

Draw the graph of $y = 2^x$ for values of x from -3 to 3



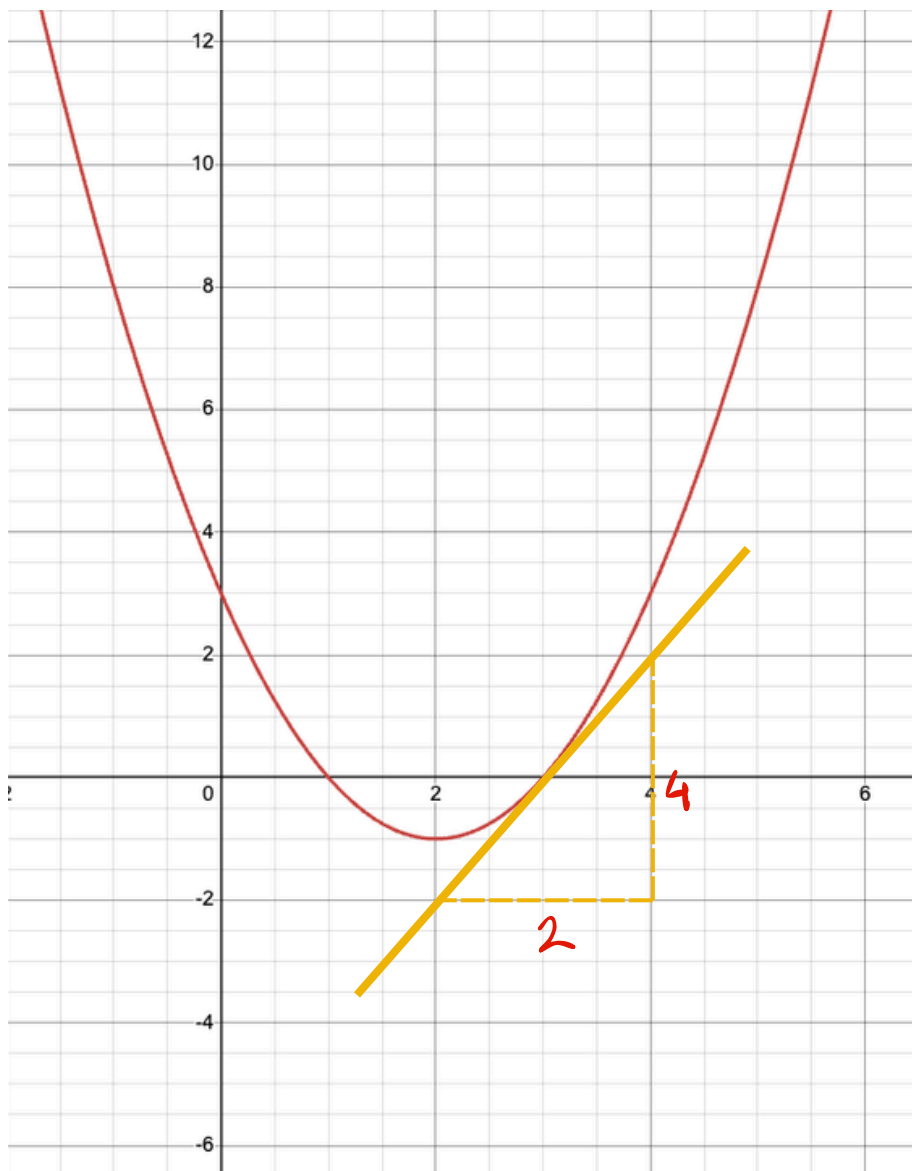


M8

9 The diagram shows part of a graph of $y = x^2 - 4x + 3$

P is a point on the graph of $y = x^2 - 4x + 3$ where $x = 3$

Calculate an estimate for the gradient of the graph at the point P .



$$\frac{\Delta y}{\Delta x} = \frac{4}{2} = 2$$

Answer: 2



M8

- 10 A circle has equation

$$x^2 + y^2 = 50$$

AB is a chord of the circle.

AB has equation

$$y = 2x + 5$$

- a) Find the coordinates of A and B.

$$x^2 + (2x+5)(2x+5) = 50$$

$$x^2 + 4x^2 + 20x + 25 = 50$$

$$5x^2 + 20x - 25 = 0$$

$$x^2 + 4x - 5 = 0$$

$$(x+5)(x-1) = 0$$

$$x = -5 \text{ or } x = 1$$

$$\text{Sub in } y = 2x + 5$$

$$y = -5 \quad y = 7$$

Answer: $(-5, -5)$ or $(1, 7)$

- b) Find the equation of the diameter of the circle which is perpendicular to AB.

$$y = 2x + 5$$

$$m = 2$$

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

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

diameter passes through $(0, 0)$

$$y = \frac{1}{2}x + c$$

$$0 = \frac{1}{2}(0) + c$$

$$0 = c$$

Answer: $y = \frac{1}{2}x$



M8

- 11** P is inversely proportional to the square root of Q .
 $P=12$ when $Q=25$

- a) Work out an equation connecting P and Q .

$$P = \frac{k}{\sqrt{Q}}$$

$$12 = \frac{k}{\sqrt{25}}$$

$$60 = k$$

Answer: $P = \frac{60}{\sqrt{Q}}$

- b) Work out the value of P when $Q=144$

$$P = \frac{60}{\sqrt{144}}$$

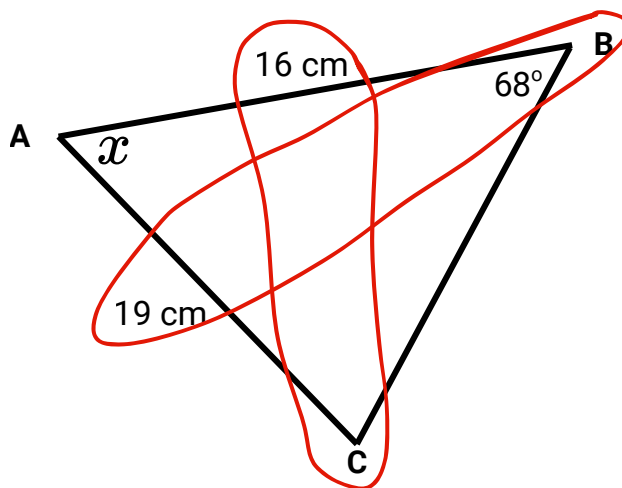
$$\frac{60}{12} = 5$$

Answer: 5



M8

12 Calculate the size of angle x



$$\frac{\sin C}{16} = \frac{\sin 68}{19}$$

$$\sin C = \frac{\sin 68}{19} \times 16$$

$$C = 51.3326^\circ$$

$$51.3326 + 68 = 119.3326$$

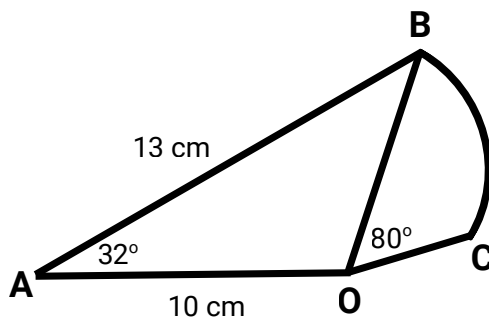
$$180 - \text{Ans} = 60.7^\circ$$

Answer: 60.7°



M8

- 13 OAB is a triangle.
 OBC is a sector of a circle, centre O .



Calculate the area of sector OBC .
Give your answer correct to 3 significant figures.

$$OB^2 = 13^2 + 10^2 - 2(13)(10)\cos 32$$

$$OB^2 = 48.507$$

$$OB = 6.9647$$

$$\text{Area of Sector} = \frac{80}{360} \times \pi \times \text{Ans}^2$$

$$33.9 \text{ cm}^2$$

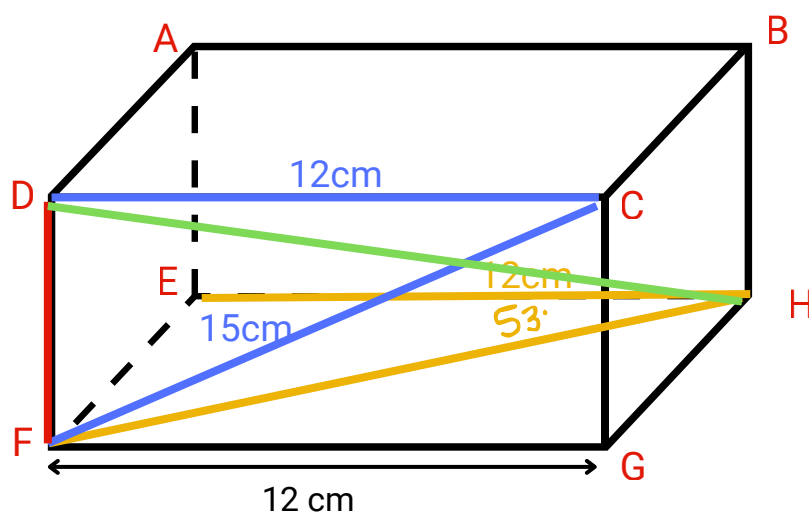
Answer: 33.9 cm²



M8

14 $ABCDEFGH$ is a cuboid.

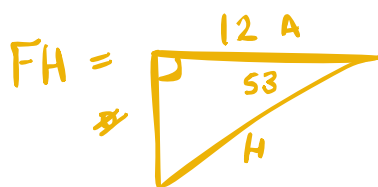
- $FG = 12\text{cm}$
- $FC = 15\text{cm}$
- Angle $EHF = 53^\circ$



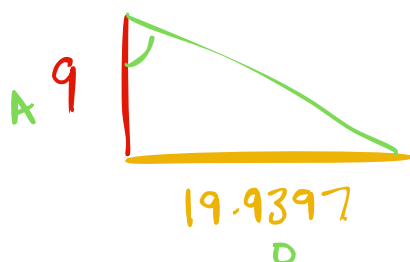
Work out the size of angle FDH .

Give your answer correct to the nearest degree.

$$DF = \sqrt{15^2 - 12^2}$$
$$= 9$$



$$\frac{12}{\cos 53} = 19.9397$$



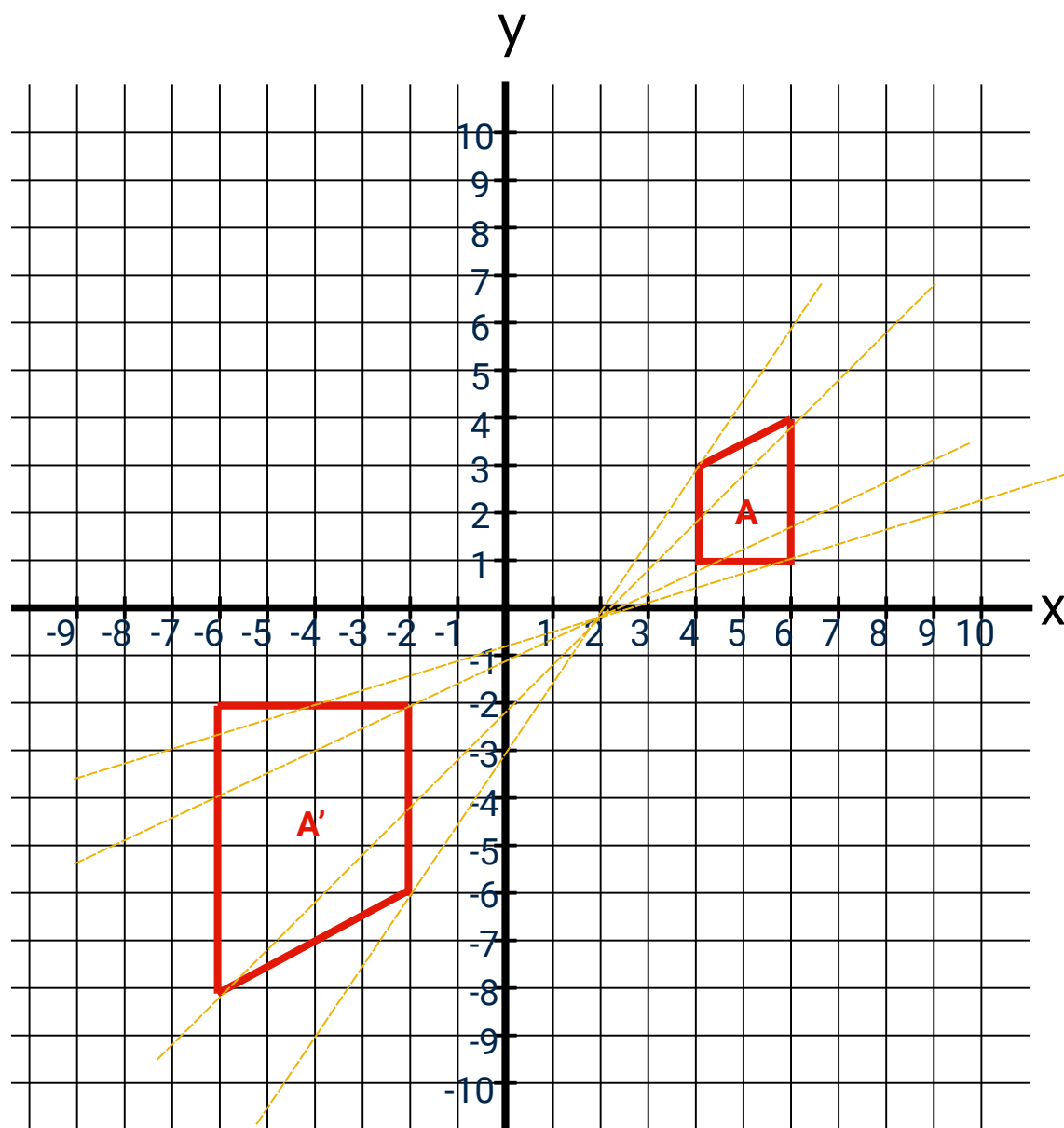
Answer: 65.7

$$\tan^{-1}\left(\frac{19.9397}{9}\right)$$



M8

15 Describe the single transformation from shape A to shape A'.



Answer: Enlargement SF -2
about (2,0)

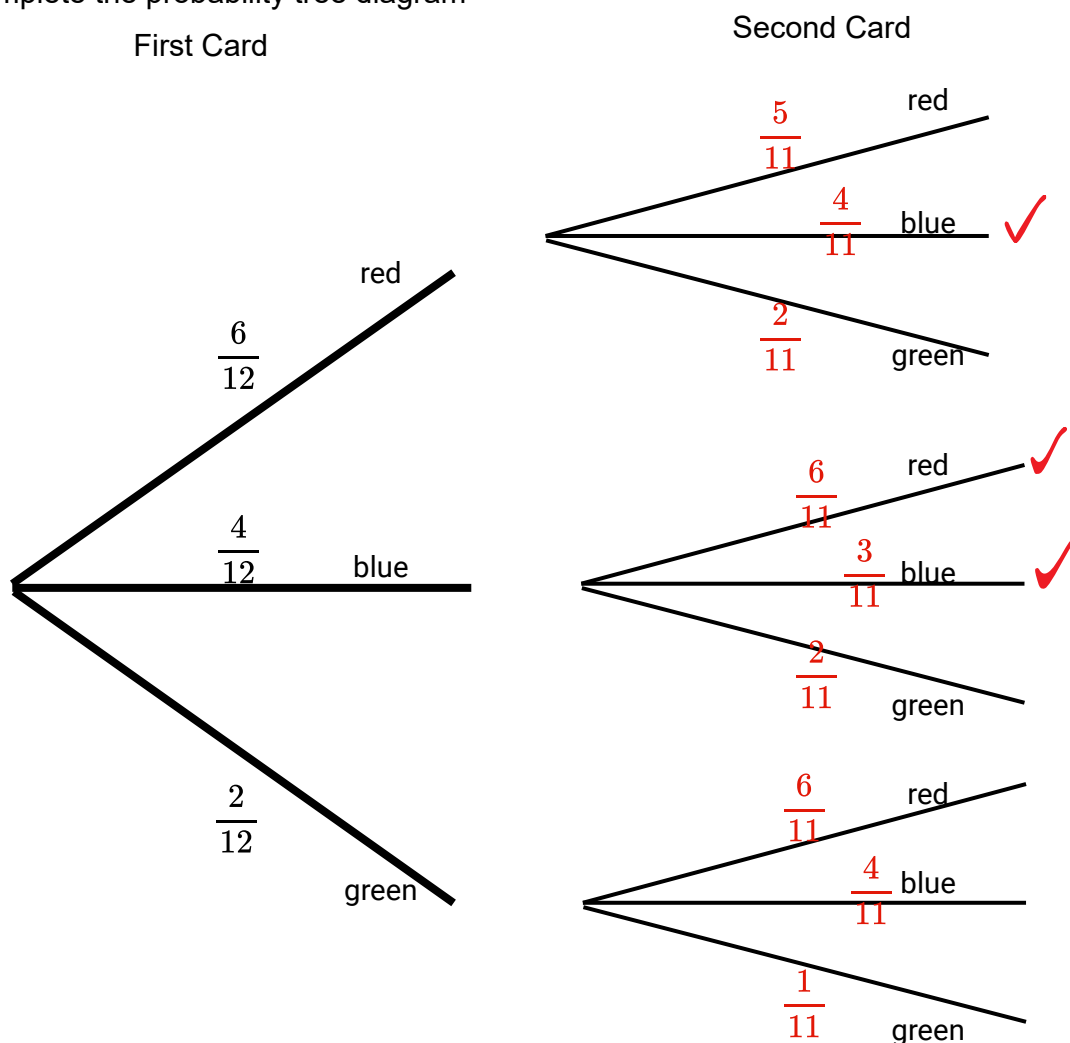


M8

16 Megan has 12 cards.

There are 6 red cards, 4 blue cards, 2 green cards. Megan takes at random one of the cards. She does not replace the card. Megan then takes at random a second card.

a) Complete the probability tree diagram



b) Work out the probability that Megan takes at least one blue card and no green cards.

$$P(RB) + P(BR) + P(BB)$$

$$\frac{6}{12} \times \frac{4}{11} + \frac{4}{12} \times \frac{6}{11} + \frac{4}{12} \times \frac{3}{11}$$

$$\frac{24}{132} + \frac{24}{132} + \frac{12}{132} = \frac{60}{132} = \frac{5}{11}$$

Answer: $\frac{5}{11}$

M8



**END OF
QUESTIONS**
