

Write your name here

Surname

Model answers

Other names

Pearson Edexcel

Centre Number

Candidate Number

Level 1/Level 2 GCSE (9–1)

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Mathematics

Paper 1 (Non-Calculator)

Higher Tier

Thursday 24 May 2018 – Morning

Time: 1 hour 30 minutes

Paper Reference

1MA1/1H

You must have: Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser.
Tracing paper may be used.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- You must **show all your working.**
- Diagrams are **NOT** accurately drawn, unless otherwise indicated.
- **Calculators may not be used.**



Information

- The total mark for this paper is 80
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ➔

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Pearson

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 (a) Work out $2\frac{1}{7} + 1\frac{1}{4}$

$$2\frac{1}{7} = \frac{14}{7} + \frac{1}{7} = \frac{15}{7} \quad \text{convert to improper fractions}$$

$$1\frac{1}{4} = \frac{4}{4} + \frac{1}{4} = \frac{5}{4}$$

$$\frac{15}{7} = \frac{60}{28} \quad \frac{5}{4} = \frac{35}{28} \quad \text{common denominator}$$

$$2\frac{1}{7} + 1\frac{1}{4} = \frac{60}{28} + \frac{35}{28} = \frac{95}{28} \quad \text{add numerators}$$

$$\frac{95}{28} \quad (2)$$

(b) Work out $1\frac{1}{5} \div \frac{3}{4}$

Give your answer as a mixed number in its simplest form.

$$1\frac{1}{5} = \frac{5}{5} + \frac{1}{5} = \frac{6}{5} \quad \text{convert to improper fraction}$$

$$\frac{6}{5} \div \frac{3}{4} = \frac{6}{5} \times \frac{4}{3} \quad \text{flip and multiply}$$

$$2\frac{6}{5} \times \frac{4}{3} = \frac{2}{5} \times 4 = \frac{8}{5} \quad \text{cancel common factors to make multiplication easier}$$

$$\frac{8}{5} = 1\frac{3}{5} \quad \text{convert back to mixed number}$$

$$\frac{8}{5} = \frac{5}{5} + \frac{3}{5} = 1 + \frac{3}{5} = 1\frac{3}{5}$$

$$1\frac{3}{5} \quad (2)$$

(Total for Question 1 is 4 marks)

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2 In a village

the number of houses and the number of flats are in the ratio 7 : 4

the number of flats and the number of bungalows are in the ratio 8 : 5

There are 50 bungalows in the village.

How many houses are there in the village?

flats : bungalows

$$\begin{array}{l} \times 10 \quad 8 : 5 \quad \times 10 \\ \quad \quad 80 : 50 \end{array}$$

houses : flats

$$\begin{array}{l} \times 20 \quad 7 : 4 \quad \times 20 \\ \quad \quad 140 : 80 \end{array}$$

140 houses

140

(Total for Question 2 is 3 marks)



- 3 Renee buys 5 kg of sweets to sell.
She pays £10 for the sweets.

Renee puts all the sweets into bags.
She puts 250 g of sweets into each bag.
She sells each bag of sweets for 65p.

Renee sells all the bags of sweets.

Work out her percentage profit.

$$5000 \div 250 = 20 \text{ bags of sweets}$$

$$20 \times 0.65 = £13 \text{ from selling all bags of sweets}$$

$$\text{Renee's profit} = 13 - 10 = £3$$

$$\begin{aligned} \text{percentage profit} &= \frac{\text{amount of profit}}{\text{amount spent}} \times 100\% \\ &= \frac{3}{10} \times 100\% = 30\% \end{aligned}$$

30 %

(Total for Question 3 is 4 marks)

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4 A cycle race across America is 3069.25 miles in length.

Juan knows his average speed for his previous races is 15.12 miles per hour. For the next race across America he will cycle for 8 hours per day.

(a) Estimate how many days Juan will take to complete the race.

$$3069.25 \approx 3000 \text{ miles}$$

$$15.12 \approx 15 \text{ miles per hour}$$

20 mph is 15.5

estimate: round to 1 or 2 significant figures

$$\text{miles per day} = 8 \times 15 = 120$$

$$\text{number of days} = 3000 \div 120 = 25$$

$$\begin{array}{r} 25 \\ 12 \overline{) 300} \end{array}$$

approximately 25 days

25
(3)

Juan trains for the race.

The average speed he can cycle at increases.

It is now 16.27 miles per hour.

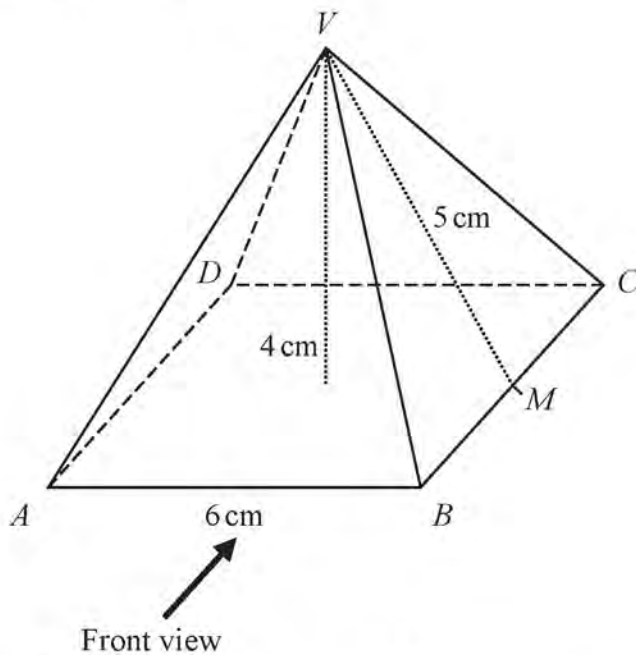
(b) How does this affect your answer to part (a)?

Less days $\text{speed} = \frac{\text{distance}}{\text{time}}$ If speed increases but distance stays the same, the time taken decreases. Juan will cycle more miles per day so the race will take less days. (1)

(Total for Question 4 is 4 marks)



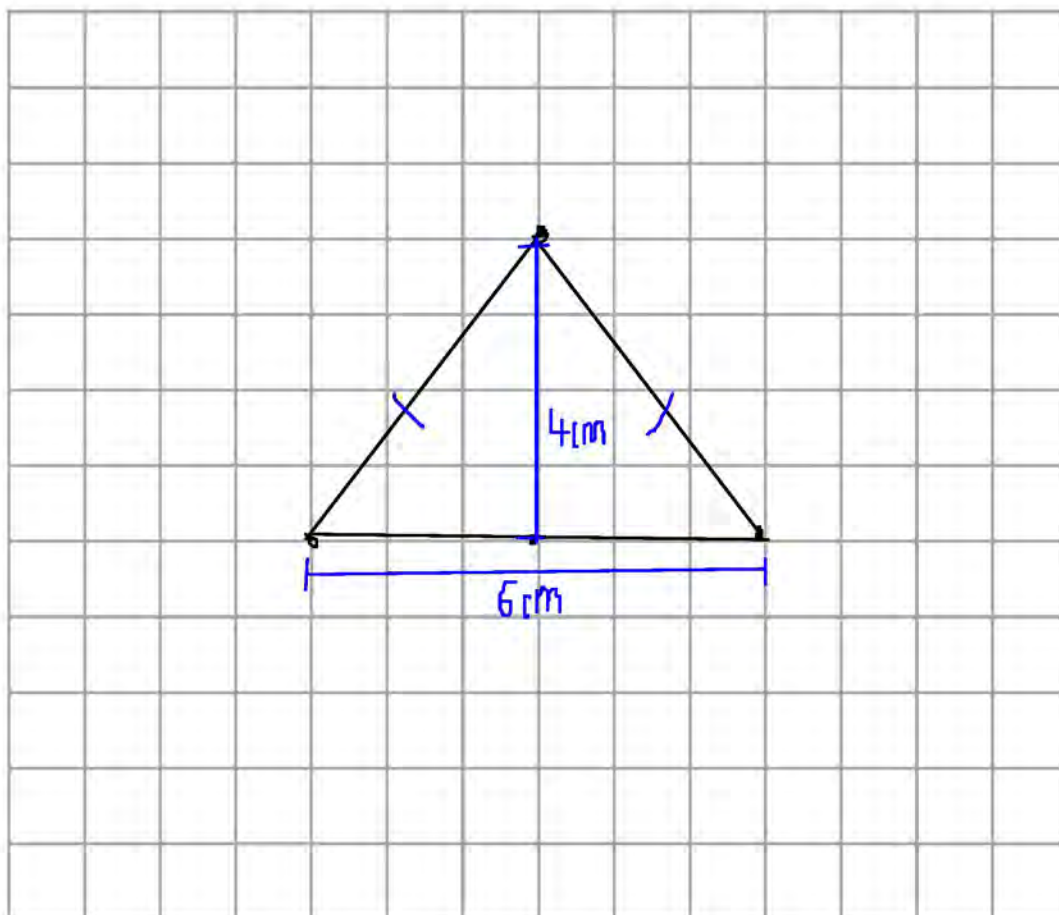
5 Here is a solid square-based pyramid, $VABCD$.



The base of the pyramid is a square of side 6 cm.
 The height of the pyramid is 4 cm.
 M is the midpoint of BC and $VM = 5$ cm.

(scale: 1 square = 1 cm)

(a) Draw an accurate front elevation of the pyramid from the direction of the arrow.



(2)

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(b) Work out the total surface area of the pyramid.

$$\text{area of base} = 6 \times 6 = 36 \text{ cm}^2$$

$$\text{area of triangular face} = \frac{1}{2} \times b \times h = \frac{1}{2} \times 6 \times 5 = 15 \text{ cm}^2$$

$$4 \text{ triangular faces} \rightarrow 4 \times 15 = 60 \text{ cm}^2$$

$$\text{total surface area} = 96 \text{ cm}^2$$

$$\underline{96 \text{ cm}^2}$$

(4)

(Total for Question 5 is 6 marks)

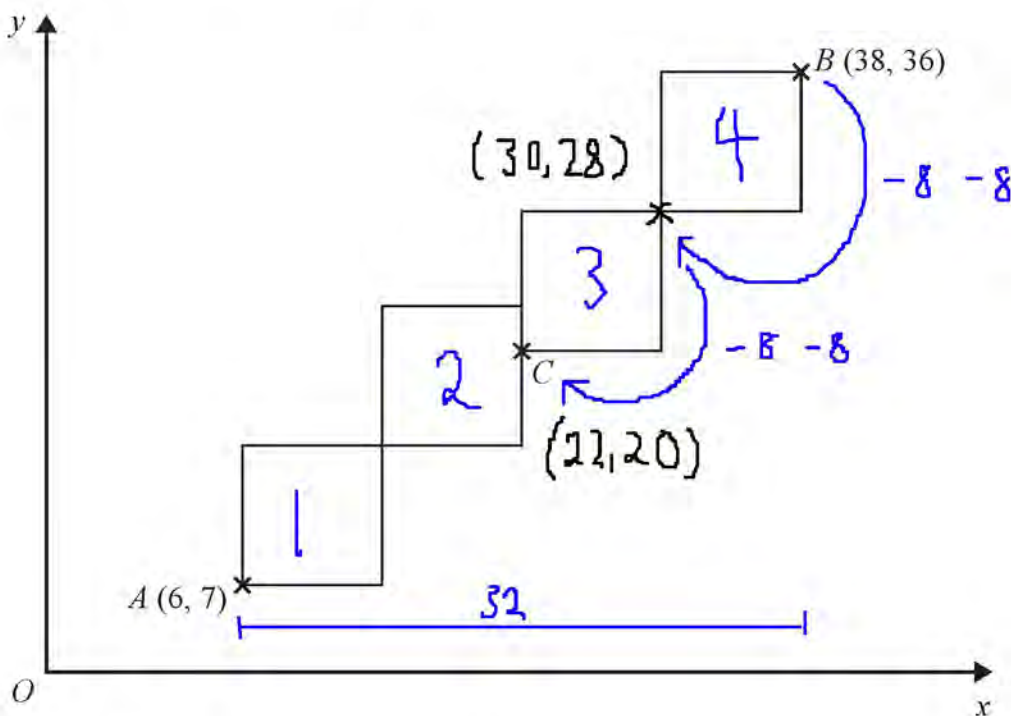
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- 6 A pattern is made from four identical squares.
The sides of the squares are parallel to the axes.



Point A has coordinates (6, 7)
Point B has coordinates (38, 36)
Point C is marked on the diagram.

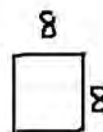
Work out the coordinates of C.

↔ distance in x-direction

$$x_2 - x_1 = 38 - 6 = 32 \text{ units}$$

$$32 = 4 \times \text{length of side of square}$$

$$\text{length of one side} = \frac{32}{4} = 8 \text{ units}$$



$$x\text{-coordinate} = 38 - (2 \times 8) = 22$$

$$y\text{-coordinate} = 36 - (2 \times 8) = 20$$

$$C: (22, 20)$$

(22 , 20)

(Total for Question 6 is 5 marks)

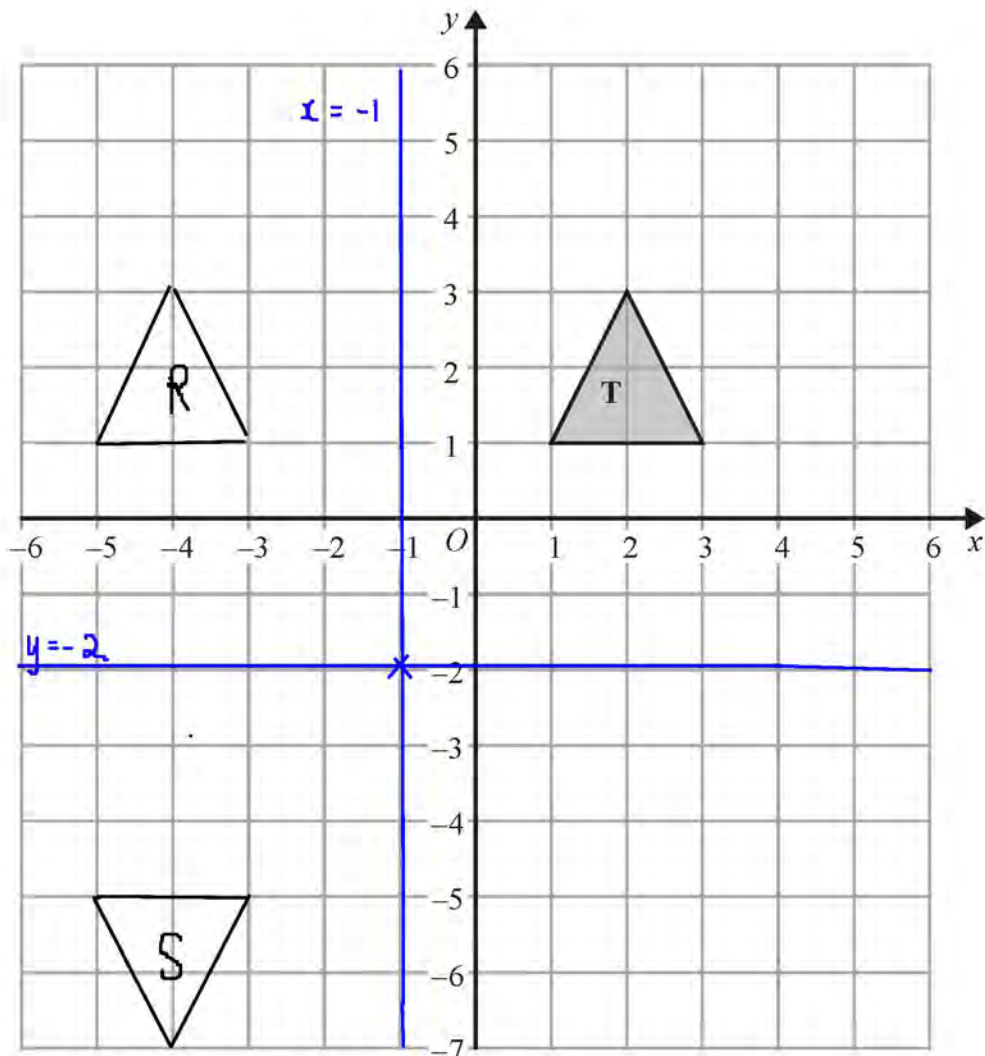
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7



Shape **T** is reflected in the line $x = -1$ to give shape **R**.
 Shape **R** is reflected in the line $y = -2$ to give shape **S**.

Describe the **single** transformation that will map shape **T** to shape **S**.

$T \rightarrow S$

rotation 180°

centre $(-1, 2)$

(Total for Question 7 is 2 marks)

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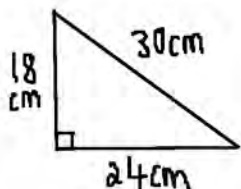


- 8 The perimeter of a right-angled triangle is 72 cm.
The lengths of its sides are in the ratio 3 : 4 : 5

Work out the area of the triangle.

$$3 : 4 : 5 \quad \text{sum of parts: } 3 + 4 + 5 = 12$$

$$72 \div 12 = 6 \quad \text{length of sides: } \begin{aligned} 3 \times 6 &= 18 \text{ cm} \\ 4 \times 6 &= 24 \text{ cm} \\ 5 \times 6 &= 30 \text{ cm} \end{aligned}$$



$$\text{pythagoras: } a^2 + b^2 = c^2$$

$$18^2 + 24^2 = 30^2 \quad \text{as } 3^2 + 4^2 = 5^2$$

$$\text{Area} = \frac{1}{2}bh = \frac{1}{2} \times 24 \times 18 = 12 \times 18 = 216 \text{ cm}^2$$

$$\begin{array}{r} 12 \\ \times 18 \\ \hline 96 \\ + 120 \\ \hline 216 \\ \hline \end{array}$$

216 cm²

(Total for Question 8 is 4 marks)

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- 9 (a) Write down the value of $36^{\frac{1}{2}}$

$$\sqrt{36} = 6$$

Laws of Indices

$$a^{\frac{1}{2}} = \sqrt{a}$$

$$a^0 = 1$$

$$a^{-n} = \frac{1}{a^n}$$

$$a^{\frac{m}{n}} = (\sqrt[n]{a})^m$$

6

(1)

- (b) Write down the value of 23^0

$$23^0 = 1$$

1

(1)

- (c) Work out the value of $27^{-\frac{2}{3}}$

$$27^{-\frac{2}{3}} = \left(\frac{1}{27}\right)^{\frac{2}{3}} = \left(\sqrt[3]{\frac{1}{27}}\right)^2 = \left(\frac{1}{3}\right)^2 = \frac{1}{9}$$

$\frac{1}{9}$

(2)

(Total for Question 9 is 4 marks)

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10 The table gives some information about the heights of 80 girls.

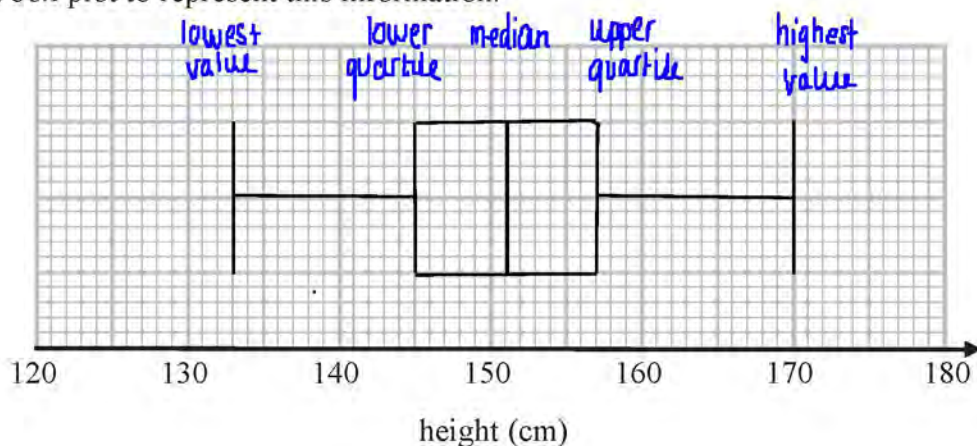
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| Least height | 133 cm |
| Greatest height | 170 cm |
| Lower quartile | 145 cm |
| Upper quartile | 157 cm |
| Median | 151 cm |

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(a) Draw a box plot to represent this information.



(3)

(b) Work out an estimate for the number of these girls with a height between 133 cm and 157 cm.

75% of the data is less than upper quartile (157cm)

$$80 \times \frac{3}{4} = 60 \text{ girls}$$

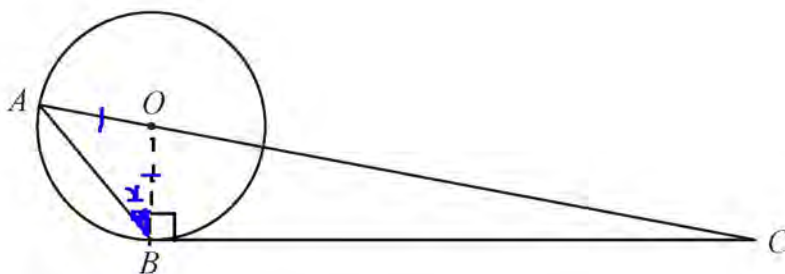
60

(2)

(Total for Question 10 is 5 marks)



11



A and B are points on a circle, centre O .

BC is a tangent to the circle.

AOC is a straight line.

Angle $ABO = x^\circ$.

Find the size of angle ACB , in terms of x .

Give your answer in its simplest form.

Give reasons for each stage of your working.

angle $OBC = 90^\circ$ (radius through B is perpendicular to tangent at B)

triangle ABO is isosceles as $AO = BO = \text{radius of circle}$

angle $BAO = \text{angle } ABO = x$ (base angles in isosceles triangle are equal)

triangle ABC : $x + x + 90^\circ + \hat{A}CB = 180^\circ$ (sum of internal angles of a triangle is 180°)

$$\hat{A}CB = 180 - 90 - x - x = 90 - 2x$$

$$\text{angle } ACB = 90 - 2x$$

(Total for Question 11 is 5 marks)



12 Prove that the square of an odd number is always 1 more than a multiple of 4

odd number: $2n+1$ (where n is any integer)

$$\begin{aligned}(2n+1)^2 &= (2n+1)(2n+1) = 4n^2 + 2n + 2n + 1 \\ &= 4n^2 + 4n + 1 \\ &= 4(n^2+n) + 1\end{aligned}$$

$4(n^2+n)$ is a multiple of 4

$4(n^2+n)+1$ is 1 more than a multiple of 4

(Total for Question 12 is 4 marks)

13 $\sqrt{5}(\sqrt{8} + \sqrt{18})$ can be written in the form $a\sqrt{10}$ where a is an integer.

Find the value of a .

$$\begin{aligned}\sqrt{5}(\sqrt{8} + \sqrt{18}) &= (\sqrt{8} \times \sqrt{5}) + (\sqrt{18} \times \sqrt{5}) \\ &= \sqrt{40} + \sqrt{90}\end{aligned}$$

$$\sqrt{a} \times \sqrt{b} = \sqrt{ab}$$

$$\sqrt{40} = \sqrt{4} \times \sqrt{10} = 2\sqrt{10}$$

$$\sqrt{90} = \sqrt{9} \times \sqrt{10} = 3\sqrt{10}$$

$$\sqrt{40} + \sqrt{90} = 2\sqrt{10} + 3\sqrt{10} = 5\sqrt{10}$$

$$a = 5$$

$$a = 5$$

(Total for Question 13 is 3 marks)



14 y is inversely proportional to d^2

When $d = 10$, $y = 4$

d is directly proportional to x^2

When $x = 2$, $d = 24$

Find a formula for y in terms of x .

Give your answer in its simplest form.

$$y \propto \frac{1}{d^2} \rightarrow y = \frac{k}{d^2}$$

$$y = 4, d = 10 \quad \text{substitute in values}$$

$$4 = \frac{k}{10^2} = \frac{k}{100} \quad k = 4 \times 100 = 400$$

$$y = \frac{400}{d^2}$$

$$d \propto x^2 \rightarrow d = kx^2$$

\uparrow constant of proportionality

$$x = 2, d = 24$$

$$24 = k(2)^2 = 4k \quad k = 24 \div 4 = 6$$

$$d = 6x^2$$

$$y = \frac{400}{(6x^2)^2} = \frac{400}{36x^4} = \frac{100}{9x^4}$$

cancel common factors

$$y = \frac{100}{9x^4}$$

(Total for Question 14 is 5 marks)



15 (a) Factorise $a^2 - b^2$

$$(a+b)(a-b) \text{ difference of 2 squares}$$

$$\underline{(a+b)(a-b)} \quad (1)$$

(b) Hence, or otherwise, simplify fully $(x^2 + 4)^2 - (x^2 - 2)^2$

$$\begin{aligned} & a^2 - b^2 \\ & (x^2+4)^2 - (x^2-2)^2 \\ & = [(x^2+4)+(x^2-2)][(x^2+4)-(x^2-2)] \\ & = (2x^2+2) \times 6 \text{ collect like terms} \\ & = 6(2x^2+2) \text{ take out} \\ & = 12(x^2+1) \end{aligned}$$

$$\underline{12(x^2+1)} \quad (3)$$

(Total for Question 15 is 4 marks)

16 There are only red counters, blue counters and purple counters in a bag.

The ratio of the number of red counters to the number of blue counters is 3 : 17

Sam takes at random a counter from the bag.

The probability that the counter is purple is 0.2

Work out the probability that Sam takes a red counter.

$$\begin{array}{l} \text{red : blue} \\ 3 : 17 \end{array} \quad \begin{array}{l} p(\text{purple}) = 0.2 = \frac{1}{5} \\ p(\text{not purple}) = 1 - \frac{1}{5} = \frac{4}{5} \end{array}$$

$$p(\text{not purple}) = p(\text{red or blue}) = \frac{4}{5}$$

$$3 + 17 = 20$$

$$p(\text{a specific red or blue counter is selected}) = \frac{4}{5} \div 20 = \frac{4}{100} = 0.04$$

$$p(\text{red}) = 3 \times 0.04 = 0.12$$

$$\underline{0.12}$$

(Total for Question 16 is 3 marks)

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17 Simplify fully $\frac{3x^2 - 8x - 3}{2x^2 - 6x}$

$$\frac{3x^2 - 8x - 3}{2x^2 - 6x} = \frac{(3x+1)(x-3)}{2x(x-3)} = \frac{3x+1}{2x}$$

factorise

$$3x^2 - 8x - 3$$

$$-3 \times 3 = -9$$

$$-9 \times 1 = -9 \quad \checkmark$$

$$-9 + 1 = -8 \quad \checkmark$$

$$3x^2 - 9x + x - 3 \quad \leftarrow \begin{array}{l} \text{split term} \\ \text{in middle} \end{array}$$

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

$$3x(x-3) + (x-3) \rightarrow (3x+1)(x-3)$$

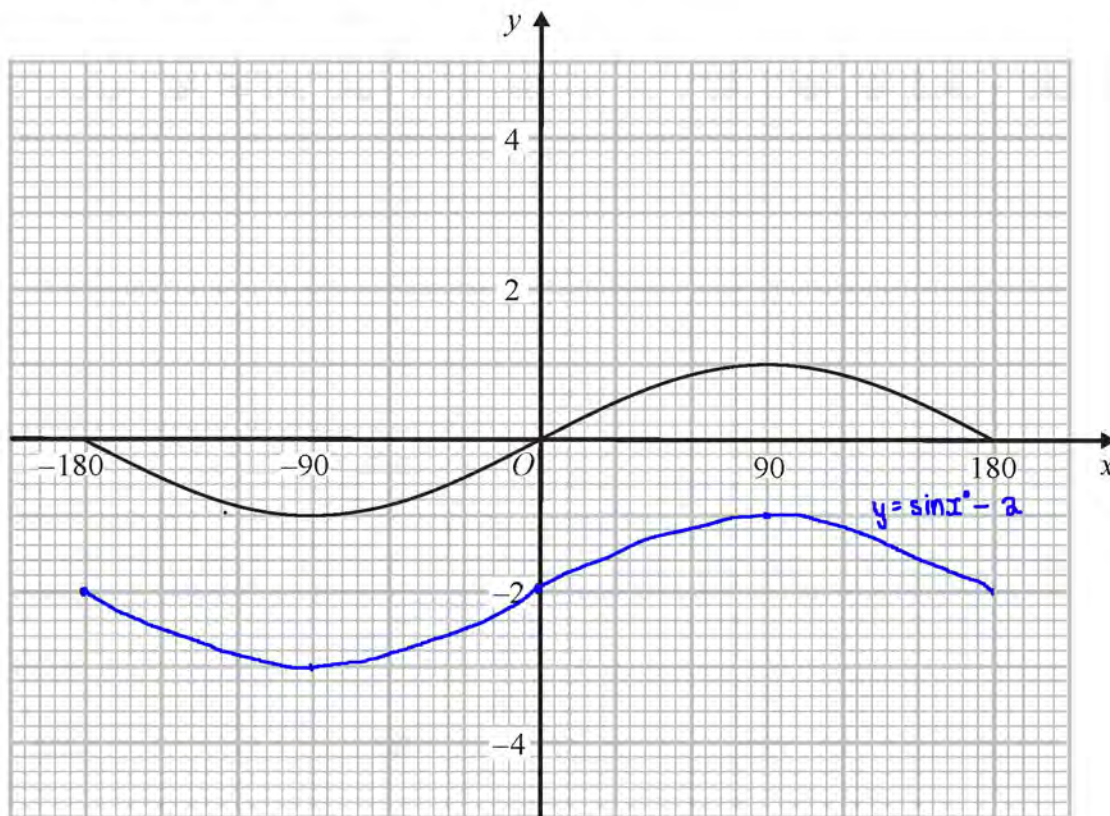
cancel common factors

$$\frac{3x+1}{2x}$$

(Total for Question 17 is 3 marks)



18 Here is the graph of $y = \sin x^\circ$ for $-180 \leq x \leq 180$



On the grid, sketch the graph of $y = \sin x^\circ - 2$ for $-180 \leq x \leq 180$

translation $\begin{pmatrix} 0 \\ -2 \end{pmatrix}$ 2 units \downarrow

(Total for Question 18 is 2 marks)



- 19 The point P has coordinates $(3, 4)$
The point Q has coordinates (a, b)

A line perpendicular to PQ is given by the equation $3x + 2y = 7$

Find an expression for b in terms of a .

$$\text{gradient of } PQ = \frac{y_2 - y_1}{x_2 - x_1} = \frac{b - 4}{a - 3}$$

$$\text{Line perpendicular to } PQ: 3x + 2y = 7$$

$$2y = -3x + 7$$

$$\rightarrow y = -\frac{3}{2}x + \frac{7}{2}$$

$$y = mx + c \quad m = -\frac{3}{2}$$

gradient of perpendicular lines

$$m_{PQ} \times m = -1$$

$$m_{PQ} \times \frac{-3}{2} = -1$$

$$m_{PQ} = \frac{2}{3}$$

$$\frac{b - 4}{a - 3} = \frac{2}{3}$$

$$\frac{b - 4}{a - 3} \xrightarrow{\text{cross multiply}} \frac{2}{3}$$

$$3(b - 4) = 2(a - 3)$$

$$3b - 12 = 2a - 6$$

$$3b = 2a + 6$$

$$b = \frac{2}{3}a + 2$$

rearrange to make b the subject

$$b = \frac{2}{3}a + 2$$

(Total for Question 19 is 5 marks)



20 n is an integer such that $3n + 2 \leq 14$ and $\frac{6n}{n^2 + 5} > 1$

Find all the possible values of n .

$$\begin{aligned} 3n + 2 &\leq 14 \\ -2 &\quad -2 \\ 3n &\leq 12 \\ \div 3 &\quad \div 3 \\ n &\leq 4 \end{aligned}$$

$$\frac{6n}{n^2 + 5} > 1$$

$$6n > (n^2 + 5)$$

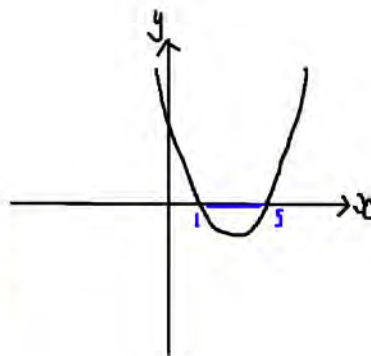
$$n^2 - 6n + 5 < 0$$

$$(n - 5)(n - 1) < 0$$

$$1 < n < 5$$

$$n = 2, 3, 4$$

sketch
graph



$$n = 2, 3, 4$$

(Total for Question 20 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS

