

1 (a) A company makes compost by mixing loam, sand and coir in the following ratio.

$$\text{loam : sand : coir} = 7 : 2 : 3$$

(i) How much loam is there in a 72 litre bag of the compost?

Answer(a)(i) litres [2]

(ii) In a small bag of the compost there are 13.5 litres of coir.

How much compost is in a small bag?

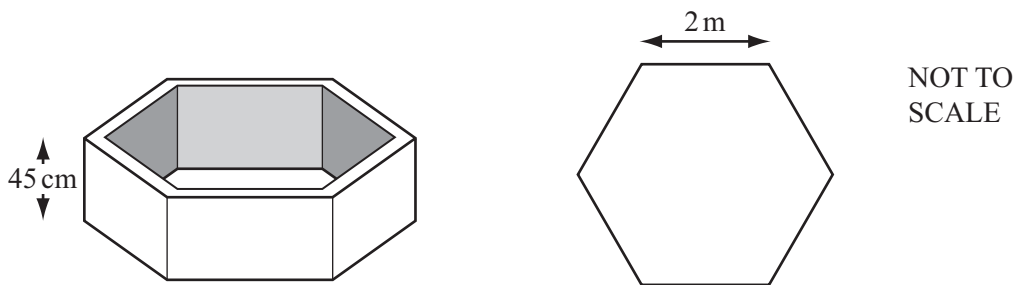
Answer(a)(ii) litres [2]

(iii) The price of a large bag of compost is \$8.40 .
This is an increase of 12% on the price last year.

Calculate the price last year.

Answer(a)(iii) \$ [3]

(b) Teresa builds a raised garden bed in the shape of a hexagonal prism.



The garden bed has a height of 45 cm.
The cross section of the inside of the garden bed is a regular hexagon of side 2 m.

- (i) Show that the area of the cross section of the inside of the garden bed is 10.4 m^2 to 3 significant figures.

Answer(b)(i)

[3]

- (ii) Calculate the volume of soil needed to fill the garden bed.

Answer(b)(ii) m^3 [2]

- (iii) Teresa wants to fill the garden bed with organic top soil. She sees this advertisement in the local garden centre.

ORGANIC TOP SOIL	Number of tonnes purchased		
	1 to 5	6 to 10	Over 10
Cost per tonne	\$47.00	\$45.50	\$44.00

Organic top soil is sold in one tonne bags.
 1 m^3 of organic top soil has a mass of 1250 kg.

Calculate the cost of the organic top soil needed to fill the garden bed completely.
 [1 tonne = 1000 kg]

Answer(b)(iii) \$ [4]

2 (a) Rearrange the formula $v^2 = u^2 - 2as$ to make u the subject.

Answer(a) $u = \dots\dots\dots$ [2]

(b) Chuck cycles along Skyline Drive.
He cycles 60 km at an average speed of x km/h.
He then cycles a further 45 km at an average speed of $(x + 4)$ km/h.
His total journey time is 6 hours.

(i) Write down an equation in x and show that it simplifies to $2x^2 - 27x - 80 = 0$.

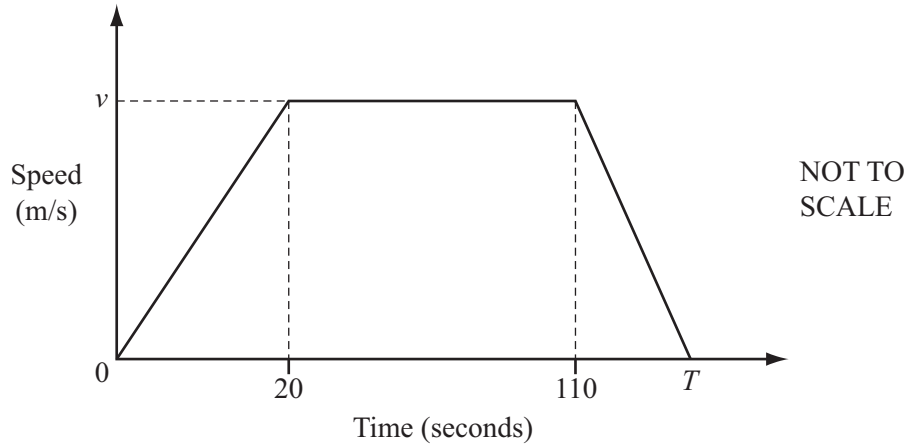
Answer(b)(i)

[4]

(ii) Solve $2x^2 - 27x - 80 = 0$ to find the value of x .

Answer(b)(ii) $x = \dots\dots\dots$ [3]

(c) The diagram shows the speed-time graph for a car travelling along a road for T seconds.



To begin with the car accelerated at 0.75 m/s^2 for 20 seconds to reach a speed of $v \text{ m/s}$.

(i) Show that the speed, v , of the car is 15 m/s .

Answer(c)(i)

[1]

(ii) The total distance travelled is **1.8 kilometres**.

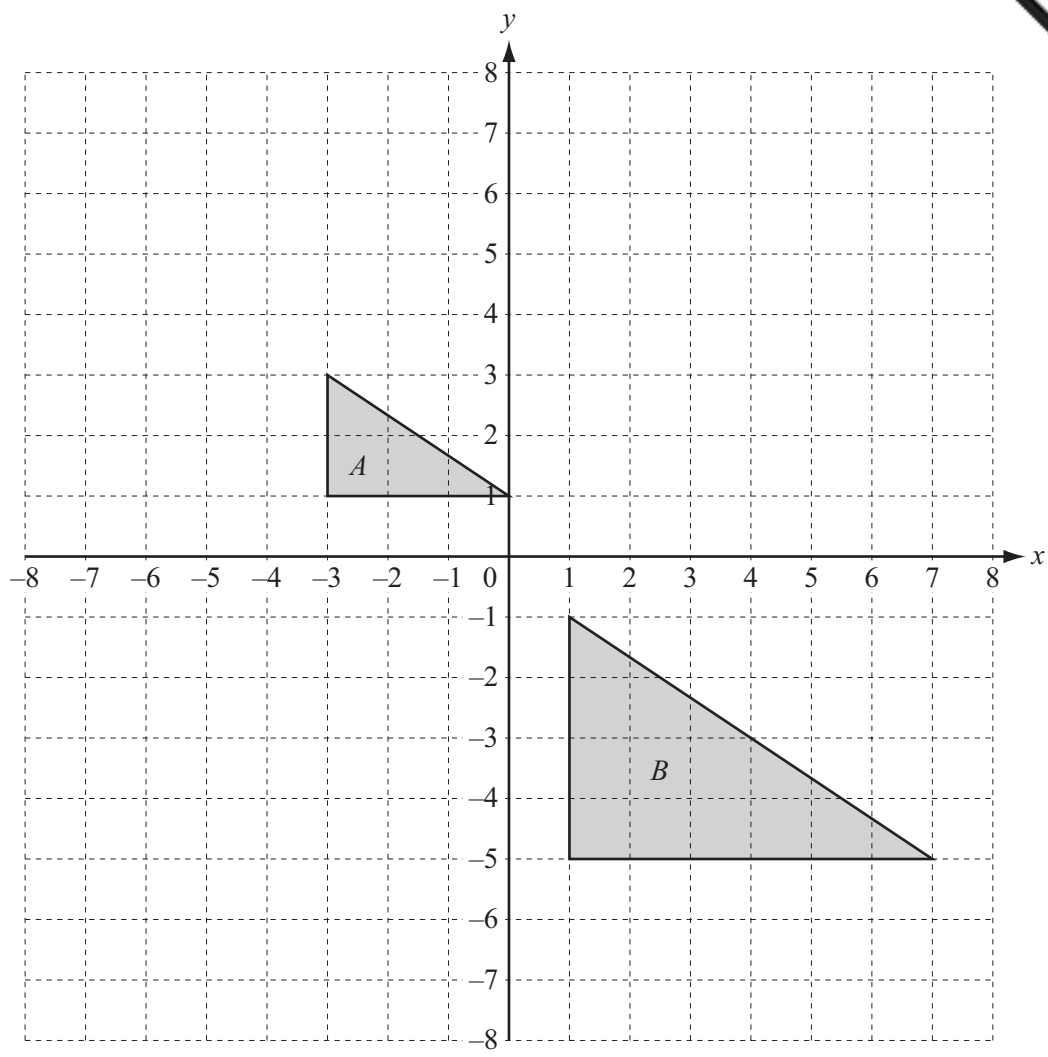
Calculate the total time, T , of the journey.

Answer(c)(ii) seconds [4]

(d) Asma runs 22 kilometres, correct to the nearest kilometre.
She takes $2\frac{1}{2}$ hours, correct to the nearest half hour.

Calculate the upper bound of Asma's speed.

Answer(d) km/h [3]



(a) Draw the image when triangle *A* is reflected in the line $x = 0$. [1]

(b) Draw the image when triangle *A* is rotated through 90° anticlockwise about $(-4, 0)$. [2]

(c) (i) Describe fully the **single** transformation that maps triangle *A* onto triangle *B*. [3]

Answer(c)(i)
 [3]

(ii) Complete the following statement.

Area of triangle *A* : Area of triangle *B* = : [2]

(d) Write down the matrix that represents a stretch, factor 4 with the y -axis invariant.

Answer(d) $\left(\begin{array}{cc} & \\ & \end{array} \right)$

(e) (i) On the grid, draw the image of triangle A after the transformation represented by the matrix $\begin{pmatrix} 1 & 0 \\ 2 & 1 \end{pmatrix}$.

[3]

(ii) Describe fully this **single** transformation.

Answer(e)(ii)
..... [3]

(iii) Find the inverse of the matrix $\begin{pmatrix} 1 & 0 \\ 2 & 1 \end{pmatrix}$.

Answer(e)(iii) $\left(\begin{array}{cc} & \\ & \end{array} \right)$ [2]

4 (a) Expand and simplify.

(i) $4(2x - 1) - 3(3x - 5)$

Answer(a)(i) [2]

(ii) $(2x - 3y)(3x + 4y)$

Answer(a)(ii) [3]

(b) Factorise.

$$x^3 - 5x$$

Answer(b) [1]

(c) Solve the inequality.

$$\frac{2x + 1}{3} \leq \frac{5x - 8}{4}$$

Answer(c) [3]

(d) (i) $x^2 - 9x + 12 = (x - p)^2 - q$

Find the value of p and the value of q .

Answer(d)(i) $p = \dots\dots\dots$

$q = \dots\dots\dots$ [3]

(ii) Write down the minimum value of $x^2 - 9x + 12$.

Answer(d)(ii) $\dots\dots\dots$ [1]

(iii) Write down the equation of the line of symmetry of the graph of $y = x^2 - 9x + 12$.

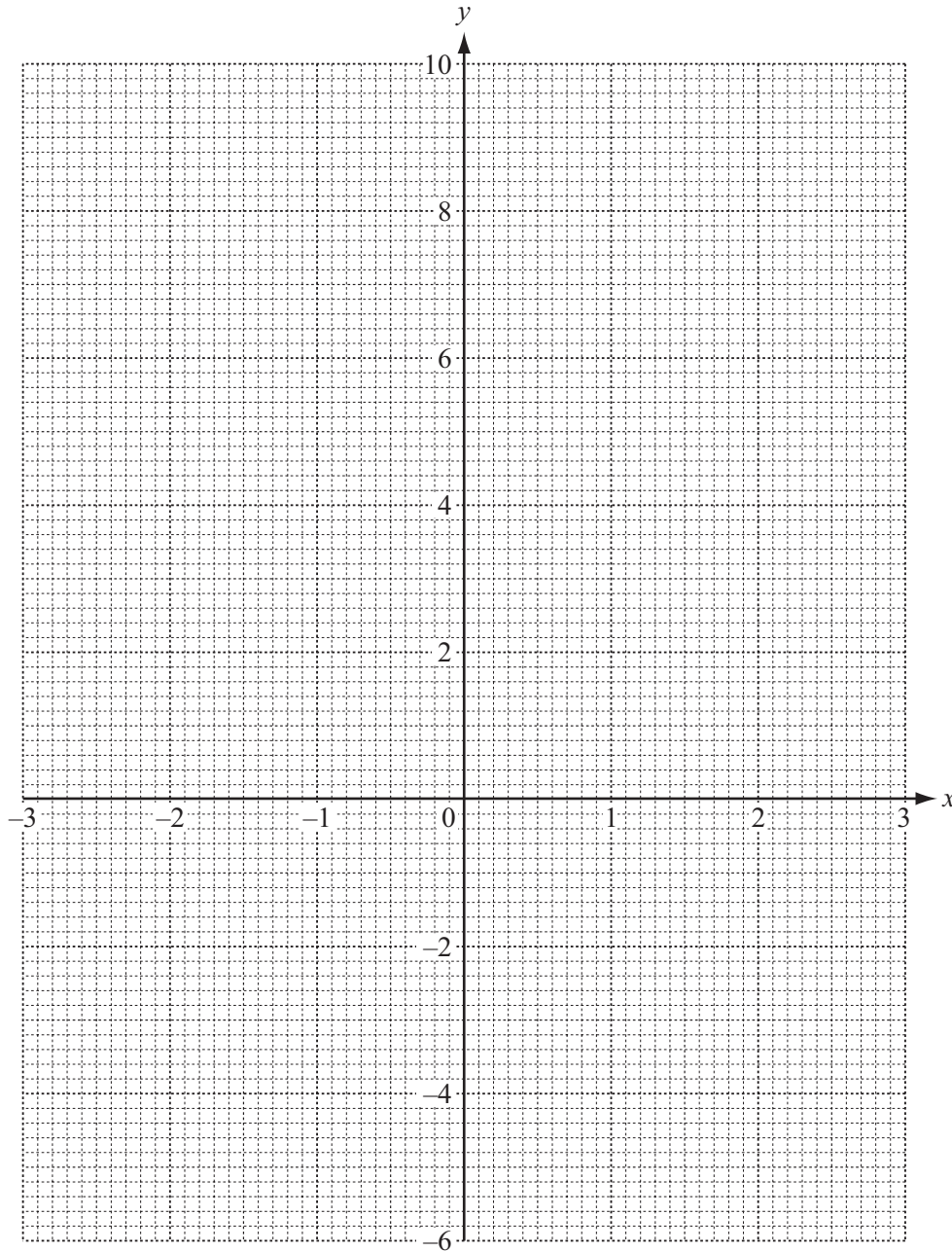
Answer(d)(iii) $\dots\dots\dots$ [1]

5 (a) Complete the table of values for $y = x^2 + \frac{3}{x}$, $x \neq 0$.

x	-3	-2	-1	-0.5		0.4	0.6	1	1.5	2	3
y	8	2.5		-5.8		7.7	5.4	4	4.3		10

[2]

(b) Draw the graph of $y = x^2 + \frac{3}{x}$ for $-3 \leq x \leq -0.5$ and $0.4 \leq x \leq 3$.



[5]

(c) Use your graph to solve the equation $x^2 + \frac{3}{x} = 5$.

Answer(c) $x = \dots\dots\dots$ or $x = \dots\dots\dots$ or $x = \dots\dots\dots$ [3]

(d) By drawing a suitable straight line, solve the equation $x^2 + \frac{3}{x} = x + 5$.

Answer(d) $x = \dots\dots\dots$ or $x = \dots\dots\dots$ or $x = \dots\dots\dots$ [4]

- 6 A company tested 200 light bulbs to find the lifetime, T hours, of each bulb. The results are shown in the table.

Lifetime (T hours)	Number of bulbs
$0 < T \leq 1000$	10
$1000 < T \leq 1500$	30
$1500 < T \leq 2000$	55
$2000 < T \leq 2500$	72
$2500 < T \leq 3500$	33

- (a) Calculate an estimate of the mean lifetime for the 200 light bulbs.

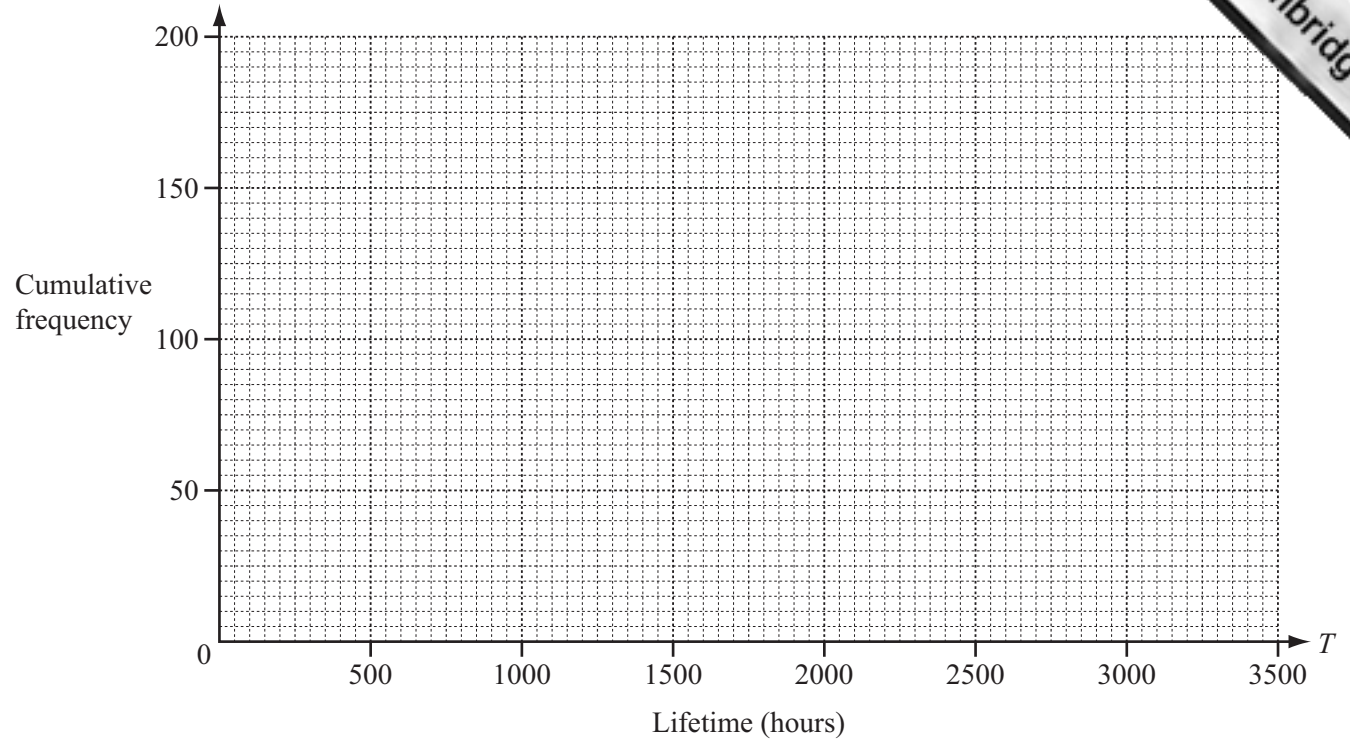
Answer(a) hours [4]

- (b) (i) Complete the cumulative frequency table.

Lifetime (T hours)	$T \leq 1000$	$T \leq 1500$	$T \leq 2000$	$T \leq 2500$	$T \leq 3500$
Number of bulbs					

[2]

(ii) On the grid, draw a cumulative frequency diagram to show this information.



[3]

(iii) The company says that the average lifetime of a bulb is 2200 hours.

Estimate the number of bulbs that lasted longer than 2200 hours.

Answer(b)(iii) [2]

(c) Robert buys one energy saving bulb and one halogen bulb.

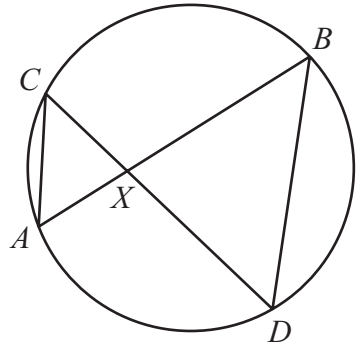
The probability that the energy saving bulb lasts longer than 3500 hours is $\frac{9}{10}$.

The probability that the halogen bulb lasts longer than 3500 hours is $\frac{3}{5}$.

Work out the probability that exactly one of the bulbs will last longer than 3500 hours.

Answer(c) [4]

7 (a) The diagram shows a circle with two chords, AB and CD , intersecting at X .



NOT TO SCALE

(i) Show that triangles ACX and DBX are similar.

Answer(a)(i)

[2]

(ii) $AX = 3.2$ cm, $BX = 12.5$ cm, $CX = 4$ cm and angle $AXC = 110^\circ$.

(a) Find DX .

Answer(a)(ii)(a) $DX = \dots\dots\dots$ cm [2]

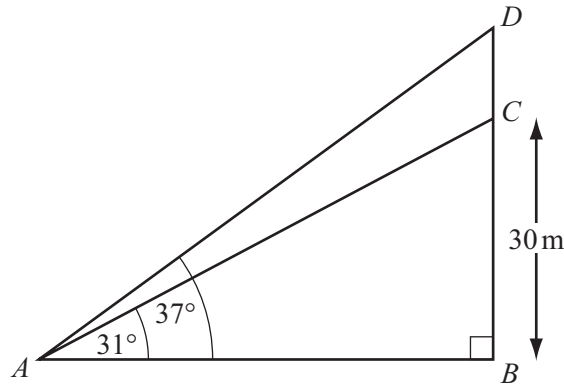
(b) Use the cosine rule to find AC .

Answer(a)(ii)(b) $AC = \dots\dots\dots$ cm [4]

(c) Find the area of triangle BXD .

Answer(a)(ii)(c) cm^2 [2]

(b)

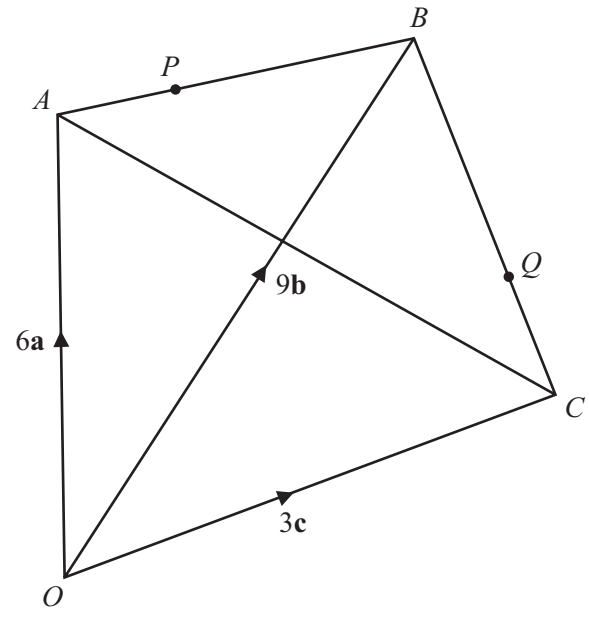


NOT TO SCALE

In the diagram, BC represents a building 30 m tall.
A flagpole, DC , stands on top of the building.
From a point, A , the angle of elevation of the top of the building is 31° .
The angle of elevation of the top of the flagpole is 37° .

Calculate the height, DC , of the flagpole.

Answer(b) m [5]



NOT TO SCALE

In the diagram, O is the origin and $\vec{OA} = 6\mathbf{a}$, $\vec{OB} = 9\mathbf{b}$ and $\vec{OC} = 3\mathbf{c}$.
The point P lies on AB such that $\vec{AP} = 3\mathbf{b} - 2\mathbf{a}$.
The point Q lies on BC such that $\vec{BQ} = 2\mathbf{c} - 6\mathbf{b}$.

- (a) Find, in terms of \mathbf{b} and \mathbf{c} , the position vector of Q .
Give your answer in its simplest form.

Answer(a) [2]

(b) Find, in terms of **a** and **c**, in its simplest form

(i) \vec{AC} ,

Answer(b)(i) $\vec{AC} = \dots\dots\dots$ [1]

(ii) \vec{PQ} .

Answer(b)(ii) $\vec{PQ} = \dots\dots\dots$ [2]

(c) Explain what your answers in **part (b)** tell you about PQ and AC .

Answer(c)

..... [2]

9

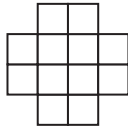


Diagram 1

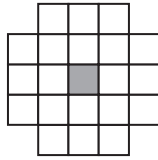


Diagram 2

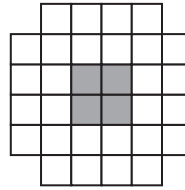


Diagram 3

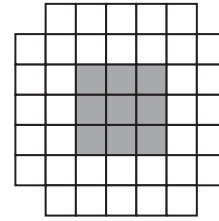


Diagram 4

The first four diagrams in a sequence are shown above.
The diagrams are drawn using white squares \square and grey squares \blacksquare .

(a) Complete the columns in the table for Diagram 4 and Diagram n .

Diagram	1	2	3	4		n
Number of white squares	12	20	28			
Number of grey squares	0	1	4			
Total number of squares	12	21	32			$(n + 1)(n + 5)$

[6]

(b) Work out the number of the diagram which has a total of 480 squares.

Answer(b) [2]

(c) The **total** number of squares in the **first n diagrams** is

$$\frac{1}{3}n^3 + pn^2 + qn.$$

(i) Use $n = 1$ in this expression to show that $p + q = 11\frac{2}{3}$.

Answer(c)(i)

[1]

(ii) Use $n = 2$ in the expression to show that $4p + 2q = 30\frac{1}{3}$.

Answer(c)(ii)

[2]

(iii) Find the values of p and q .

Answer(c)(iii) $p = \dots\dots\dots$

$q = \dots\dots\dots$ [3]

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