

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 (a) Work out the value of $\frac{25 - \sqrt{43.87}}{6 + 2.1^2}$

Write down all the figures on your calculator display.

1.76527923

(2)

(b) Work out the value of the reciprocal of 0.625

$$\frac{1}{0.625}$$
$$= \frac{8}{5} = 1\frac{3}{5}$$

1.6

(1)

(Total for Question 1 is 3 marks)

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2 Write 60 as a product of its prime factors.

$$\begin{aligned}
 60 &= 6 \times 10 \\
 &= 2 \times 3 \times 2 \times 5 \\
 &= 2^2 \times 3 \times 5
 \end{aligned}$$

$$2^2 \times 3 \times 5$$

(Total for Question 2 is 2 marks)

3 There are 48 counters in a bag.
There are only red counters and blue counters in the bag.

number of red counters : number of blue counters = 1 : 2

$$\begin{aligned}
 48 \div 3 &= 16 \\
 16 : 32
 \end{aligned}$$

Helen has to work out how many red counters are in the bag.

She says,

“There are 24 red counters in the bag because 1 is half of 2 and 24 is half of 48”

Is Helen correct?

You must give a reason for your answer.

No, the fraction of red counters is one third not one half.

(Total for Question 3 is 1 mark)



P 7 5 1 5 0 A 0 3 2 8

4 $-2 \leq n < 5$

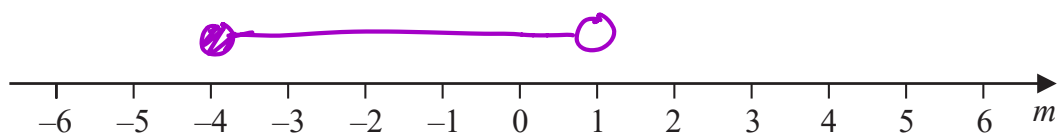
n is an integer.

(a) Write down the greatest possible value of n .

$-2, -1, 0, 1, 2, 3, 4$

4 (1)

(b) On the number line below, show the inequality $-4 \leq m < 1$



(2)

(c) Solve $\frac{2}{5}g - 4 < 6$

$$\frac{2}{5}g < 10$$

$$2g < 50$$

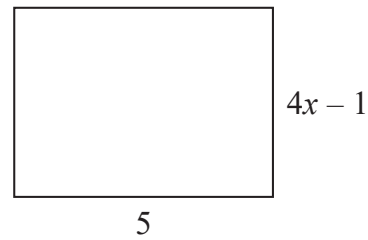
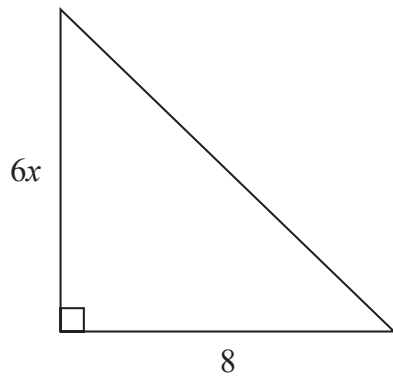
$$g < \frac{50}{2}$$

$g < 25$ (3)

(Total for Question 4 is 6 marks)



5 Here is a triangle and a rectangle.



All measurements are in centimetres.

The area of the triangle is 10 cm^2 greater than the area of the rectangle.

Work out the value of x .

$$\begin{aligned} \triangle &\Rightarrow \frac{6x \times 8}{2} \\ &= 24x \end{aligned}$$

$$\begin{aligned} \square &\Rightarrow 5(4x - 1) \\ &= 20x - 5 \end{aligned}$$

$$\triangle = \square + 10$$

$$24x = 20x - 5 + 10$$

$$4x = 5$$

$$x = \frac{5}{4}$$

$$= 1.25$$

$$x = \dots\dots\dots 1.25$$

(Total for Question 5 is 4 marks)

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- 6 Last year a family recycled 800 kg of household waste.
57% of this waste was paper and glass.

weight of paper recycled : weight of glass recycled = 12 : 7

Calculate the weight of glass the family recycled.

$$\begin{aligned} & 800 \text{ kg} \\ P + G &= 57\% \text{ of } 800 \\ &= 0.57 \times 800 \\ &= 456 \text{ kg} \end{aligned}$$

$$\begin{aligned} P &: G \\ 12 &: 7 \\ \hline 456 \div 19 &= 24 \\ 12 \times 24 &: 7 \times 24 \\ 288 &: 168 \end{aligned}$$

..... 168 kg

(Total for Question 6 is 3 marks)

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- 7 A number, d , is rounded to 1 decimal place.
The result is 12.7

Complete the error interval for d .

$$12.6 \quad \uparrow \quad 12.7 \quad \uparrow \quad 12.8$$

$$\dots 12.65 \dots \leq d < \dots 12.75 \dots$$

(Total for Question 7 is 2 marks)

- 8 Tamsin buys a house with a value of £150 000
The value of Tamsin's house increases by 4% each year.

Rachel buys a house with a value of £160 000
The value of Rachel's house increases by 1.5% each year.

At the end of 2 years, whose house has the greater value?
You must show how you get your answer.

Tamsin

$$150000 \times 1.04^2$$

$$= 162\,240$$

Rachel

$$160000 \times 1.015^2$$

$$= 164\,836$$

Rachel

$$164\,836 > 162\,240$$

(Total for Question 8 is 4 marks)



- 9 The cumulative frequency table gives information about the ages of 80 people working for a company.

Age (a years)	Cumulative frequency
$20 < a \leq 30$	20
$20 < a \leq 40$	48
$20 < a \leq 50$	64
$20 < a \leq 60$	75
$20 < a \leq 70$	80

- (a) On the grid opposite, draw a cumulative frequency graph for this information.

(2)

- (b) Use your graph to find an estimate for the median age.

Your graph may vary slightly

..... *37* years

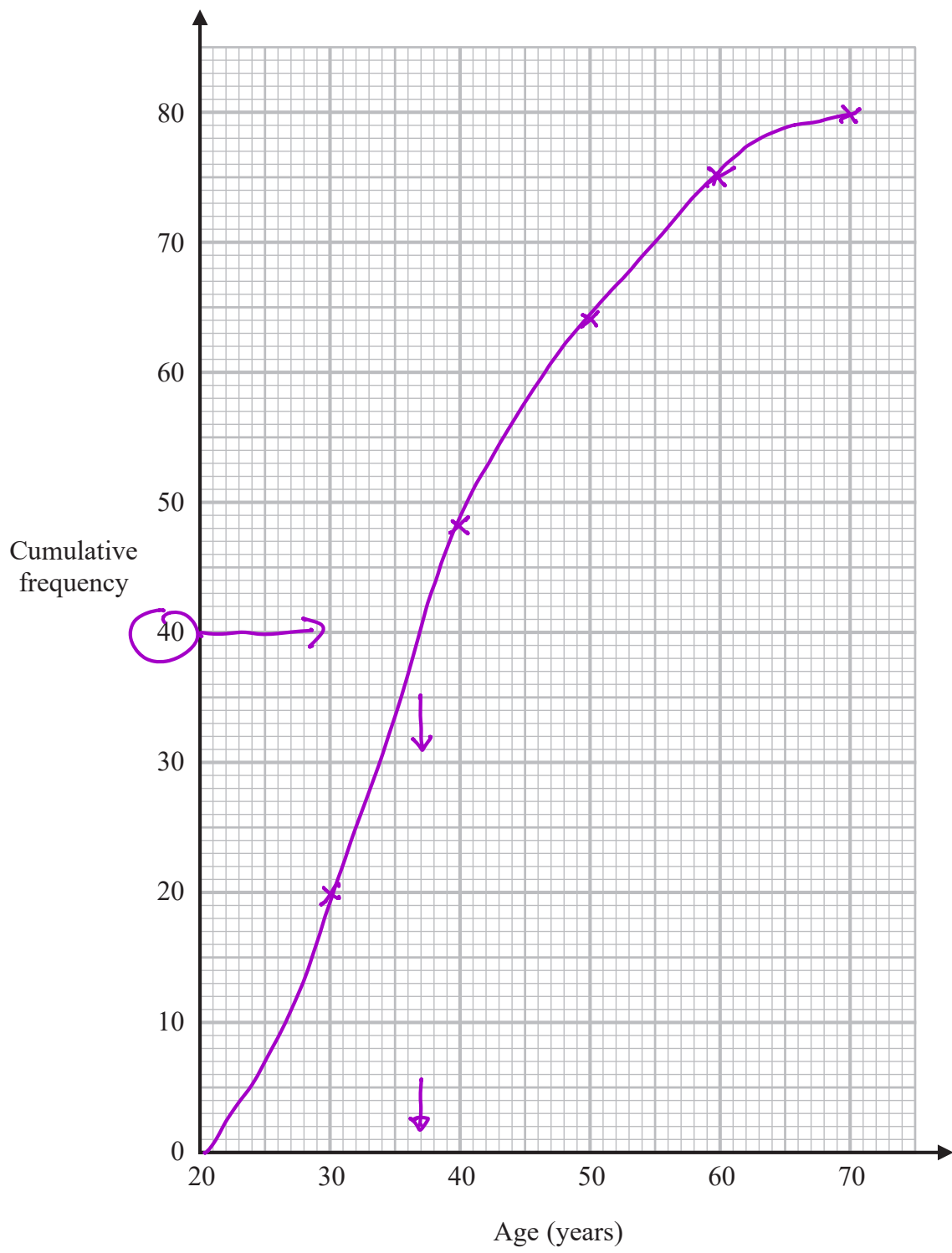
(1)



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(Total for Question 9 is 3 marks)



10 A biased dice is thrown 60 times.

The table shows information about the number that the dice lands on each time.

Number on dice	1	2	3	4	5	6
Frequency	12	7	8	9	9	15

Gethin throws the dice twice.

(a) Work out an estimate for the probability that the dice will land on 6 both times.

$$P(6) = \frac{15}{60} = \frac{1}{4}$$

$$P(6, 6) = \frac{1}{4} \times \frac{1}{4} = \frac{1}{16}$$

$$\frac{1}{16} \quad \left(\frac{225}{3600} \right)$$

(3)

Sally is going to throw the same dice n times and record the number it lands on each time.

She will use her results to work out a more reliable estimate for the probability in part (a).

(b) What can you say about the value of n ?

The greater the value of n , the more reliable her results will be so n should be greater than 60

(1)

(Total for Question 10 is 4 marks)



11 Use algebra to solve the simultaneous equations

$$\begin{aligned} 2x + 6y &= 5 & \textcircled{1} & \times 3 \\ 3x - 4y &= -12 & \textcircled{2} & \times 2 \end{aligned}$$

$$\begin{aligned} 6x + 18y &= 15 & \textcircled{3} \\ 6x - 8y &= -24 & \textcircled{4} \end{aligned}$$

-

$$26y = 39$$

$$y = \frac{39}{26} = 1.5$$

$$18 - -8 = 26$$

$$15 - -24 = 39$$

sub into $\textcircled{1}$ $2x + 6(1.5) = 5$

$$2x = -4$$

$$x = -2$$

$$x = \underline{\underline{-2}}$$

$$y = \underline{\underline{1.5}}$$

(Total for Question 11 is 4 marks)

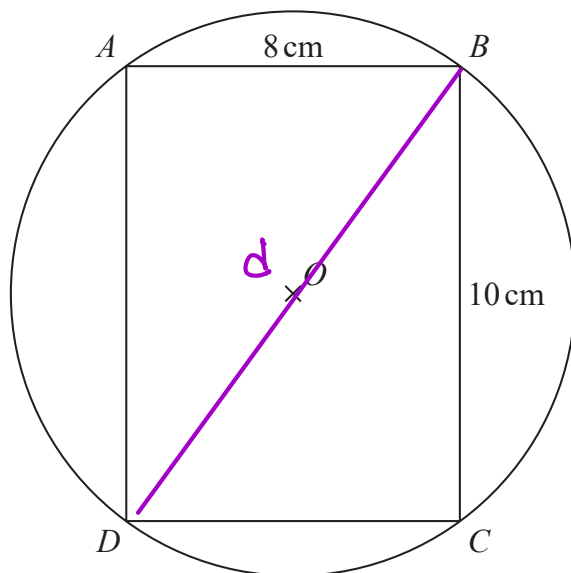
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- 12 The points A, B, C and D lie on a circle, centre O .
 $ABCD$ is a rectangle.



$$C = \pi d$$

$$A = \pi r^2$$

$$AB = 8 \text{ cm} \quad BC = 10 \text{ cm}$$

Work out the circumference of the circle.

Give your answer correct to 3 significant figures.

$$d = \sqrt{10^2 + 8^2}$$

$$= \sqrt{164}$$

$$C = \pi \times \sqrt{164}$$

$$= 40.2320 \dots$$

3.s.f.

$$= 40.2$$

..... 40.2 cm

(Total for Question 12 is 4 marks)

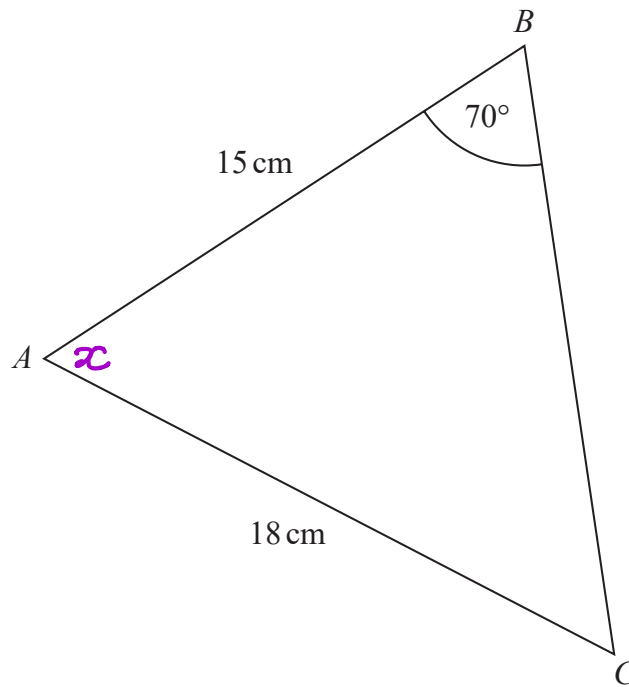
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13 ABC is a triangle.



Calculate the size of angle BAC .
Give your answer correct to 1 decimal place.

$$\frac{\sin 70}{18} = \frac{\sin \angle BCA}{15}$$

$$\begin{aligned}\angle BCA &= \sin^{-1} \left(\frac{\sin 70}{18} \times 15 \right) \\ &= 51.54 \dots\end{aligned}$$

$$\begin{aligned}\angle BAC &= 180 - (70 + 51.54 \dots) \\ &= 58.4568 \dots \\ &\quad \text{1 dp} \\ &\quad 58.5\end{aligned}$$

58.5

(Total for Question 13 is 4 marks)



- 14 Show that $\frac{x^2 - x - 6}{2x^2 - 5x - 3}$ can be written in the form $\frac{ax + b}{cx + d}$ where a, b, c and d are integers.

$$x^2 - x - 6 = (x - 3)(x + 2)$$

$$2x^2 - 5x - 3 = (2x + 1)(x - 3)$$

$$\frac{(x - 3)(x + 2)}{(2x + 1)(x - 3)} = \frac{x + 2}{2x + 1} \quad \begin{array}{l} a = 1 \\ b = 2 \\ c = 2 \\ d = 1 \end{array}$$

(Total for Question 14 is 3 marks)

- 15 Here are the first four terms of a quadratic sequence.

3 9 17 27

Find an expression, in terms of n , for the n th term of this sequence.

$$\begin{array}{cccc} n = & 1 & 2 & 3 & 4 \\ & 3 & 9 & 17 & 27 \\ & & \underbrace{\quad}_6 & \underbrace{\quad}_8 & \underbrace{\quad}_{10} \\ & & & \underbrace{\quad}_2 & \underbrace{\quad}_2 \\ \text{so } n^2 \Rightarrow & 1 & 4 & 9 & 16 \\ & 2 & 5 & 8 & 11 \quad \leftarrow \\ & & \underbrace{\quad}_3 & \underbrace{\quad}_3 & \underbrace{\quad}_3 \end{array} \quad \begin{array}{l} 2 \div 2 = 1 \\ 3n - 1 \end{array}$$

so $n^2 + 3n - 1$

$$\dots n^2 + 3n - 1$$

(Total for Question 15 is 3 marks)

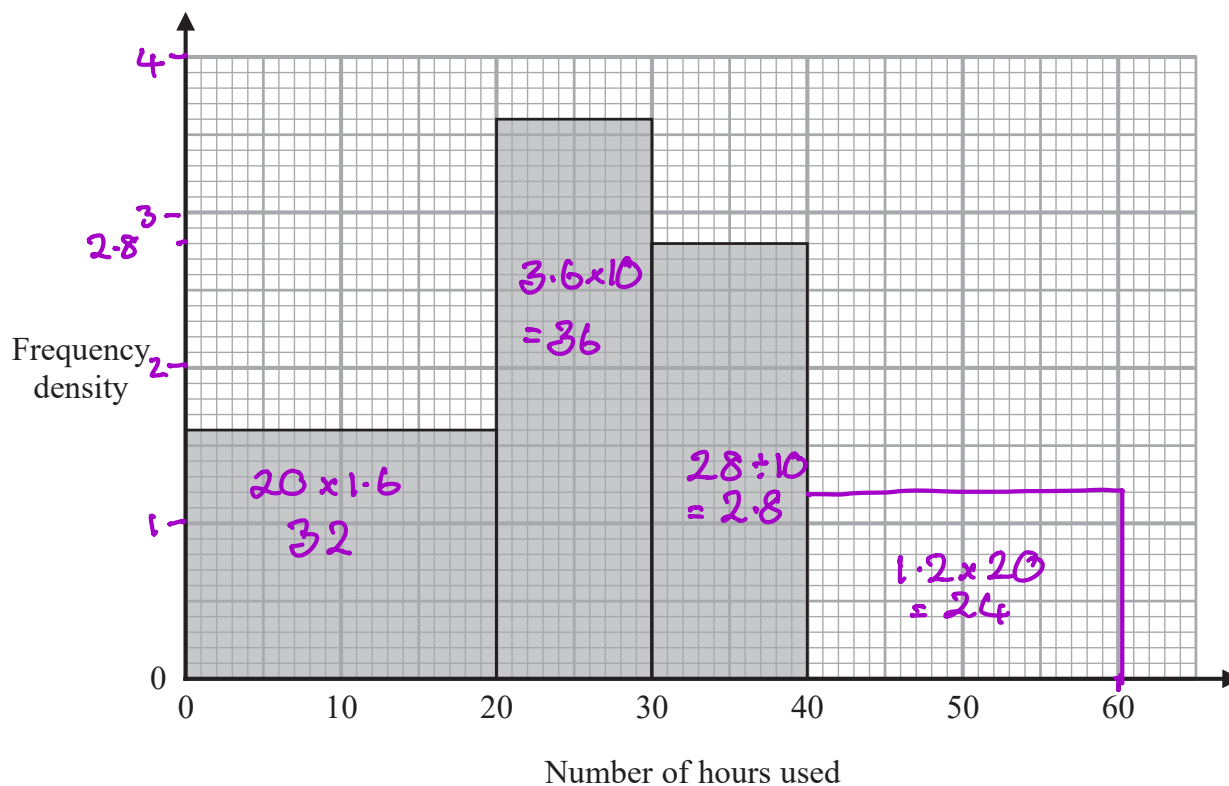


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- 16 The histogram gives information about the number of hours some students used their phones last week.
The histogram is incomplete.



28 students used their phones for between 30 and 40 hours.

24 students used their phones for between 40 and 60 hours. $24 \div 20 = 1.2$

- (a) Use this information to complete the histogram.

(2)

No student used their phone for more than 60 hours.

- (b) Work out the total number of students.

$$32 + 36 + 28 + 24 = 120$$

120

(2)

(Total for Question 16 is 4 marks)



17 (a) Show that the equation $x^4 - x^2 - 5 = 0$ can be written in the form $x = \sqrt[4]{x^2 + 5}$

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

$$x = \sqrt[4]{x^2 + 5}$$

(1)

(b) Starting with $x_0 = 1.5$

use the iteration formula $x_{n+1} = \sqrt[4]{x_n^2 + 5}$ three times to find an estimate for a solution of $x^4 - x^2 - 5 = 0$

$$x_0 = 1.5$$

$$x_1 = \sqrt[4]{1.5^2 + 5} = 1.6409$$

$$x_2 = \sqrt[4]{1.6409^2 + 5} = 1.66539\dots$$

$$x_3 = \sqrt[4]{1.66\dots^2 + 5} = 1.6697\dots$$

Both x_2 and x_3 round to 1.67

1.67

(3)

(Total for Question 17 is 4 marks)



18 $2a:5c = 6:25$
 $4b:7c = 20:21$

Show that $a+b:b+c = 17:20$

$$\begin{array}{l} 2a : 5c \\ 6 : 25 \end{array}$$

$$\begin{array}{l} a : c \\ 3 : 5 \\ 9 : 15 \quad \times 3 \end{array}$$

$$\begin{array}{l} 4b : 7c \\ 20 : 21 \end{array}$$

$$\begin{array}{l} b : c \\ 5 : 3 \\ 25 : 15 \quad \times 5 \end{array}$$

$$\begin{array}{l} a : b : c \\ 9 : 25 : 15 \end{array}$$

$$a + b = 34$$

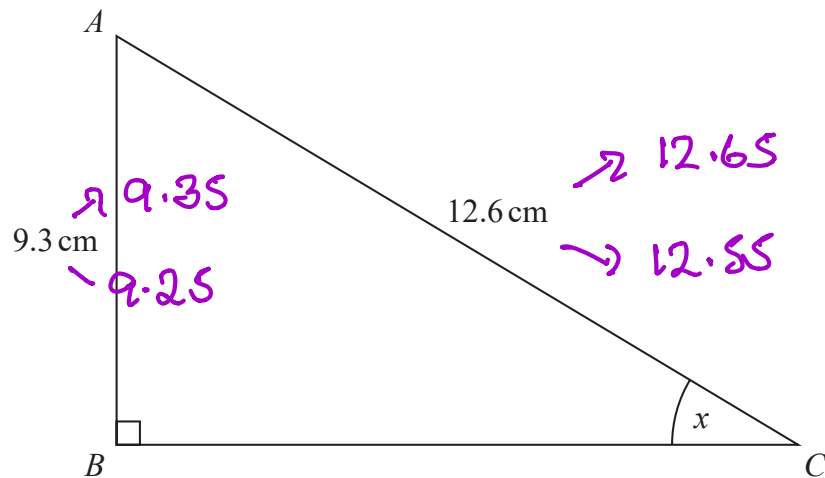
$$b + c = 40$$

$$\begin{array}{l} 34 : 40 \\ = 17 : 20 \quad \text{as required.} \end{array}$$

(Total for Question 18 is 3 marks)



19 ABC is a right-angled triangle.



$AB = 9.3\text{ cm}$ correct to the nearest mm.

$AC = 12.6\text{ cm}$ correct to the nearest mm.

Calculate the lower bound for the size of the angle marked x .

You must show all your working.

$$\sin x = \frac{9.25}{12.65} = 0.731\dots$$

$$= 46.98\dots$$

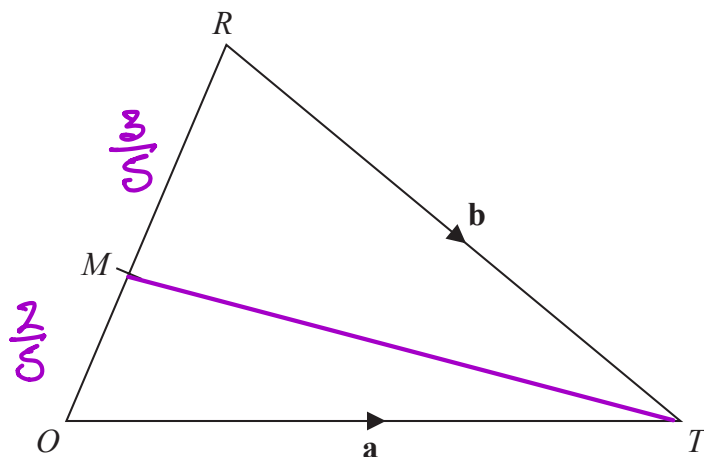
$$= 47 \text{ to the nearest degree}$$

47

(Total for Question 19 is 3 marks)



20 ORT is a triangle.



$$\vec{OT} = \mathbf{a} \quad \vec{RT} = \mathbf{b}$$

M is the point on OR such that $OM:MR = 2:3$

Express \vec{MT} in terms of \mathbf{a} and \mathbf{b} .

Give your answer in its simplest form.

$$\vec{OR} = \mathbf{a} - \mathbf{b}$$

$$\vec{MT} = \vec{MR} + \vec{RT}$$

$$= \frac{3}{5}(\mathbf{a} - \mathbf{b}) + \mathbf{b}$$

$$= \frac{3}{5}\mathbf{a} - \frac{3}{5}\mathbf{b} + \mathbf{b}$$

$$= \frac{3}{5}\mathbf{a} + \frac{2}{5}\mathbf{b}$$

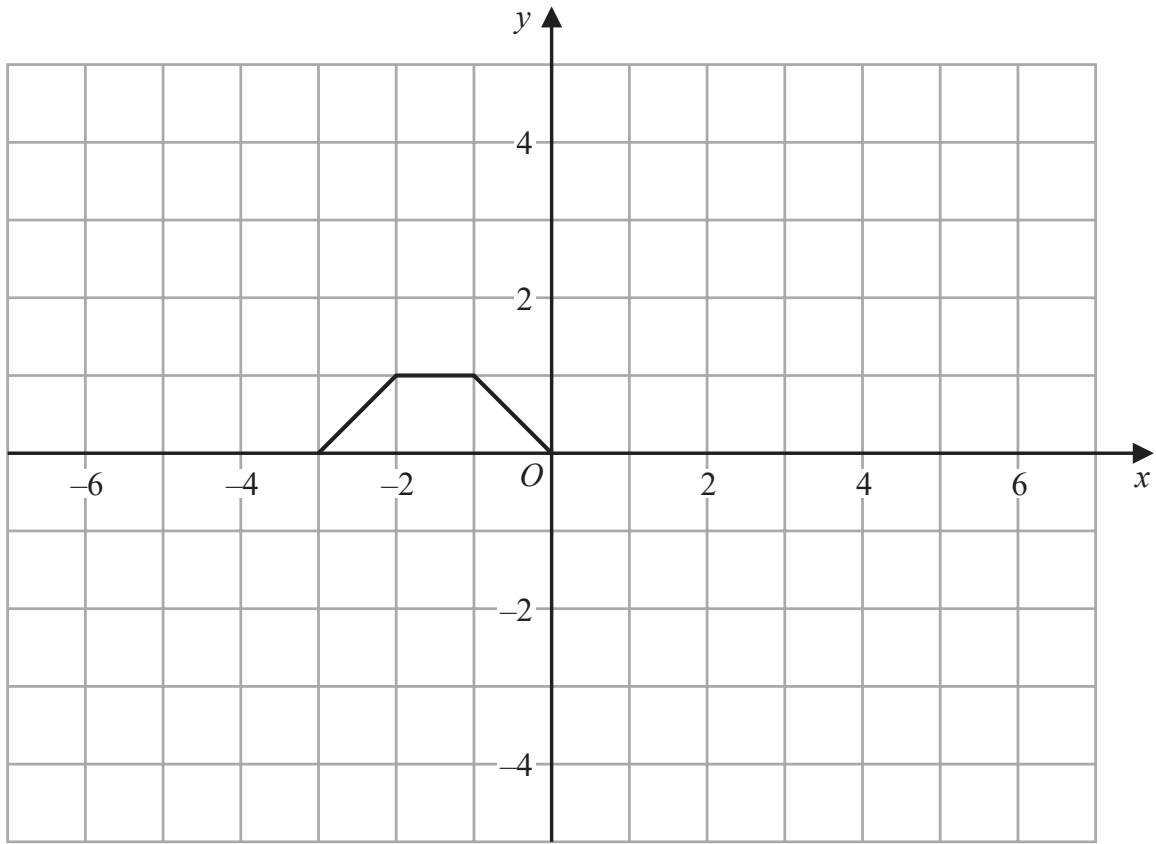
$$= \frac{1}{5}(3\mathbf{a} + 2\mathbf{b})$$

$$\frac{1}{5}(3\mathbf{a} + 2\mathbf{b})$$

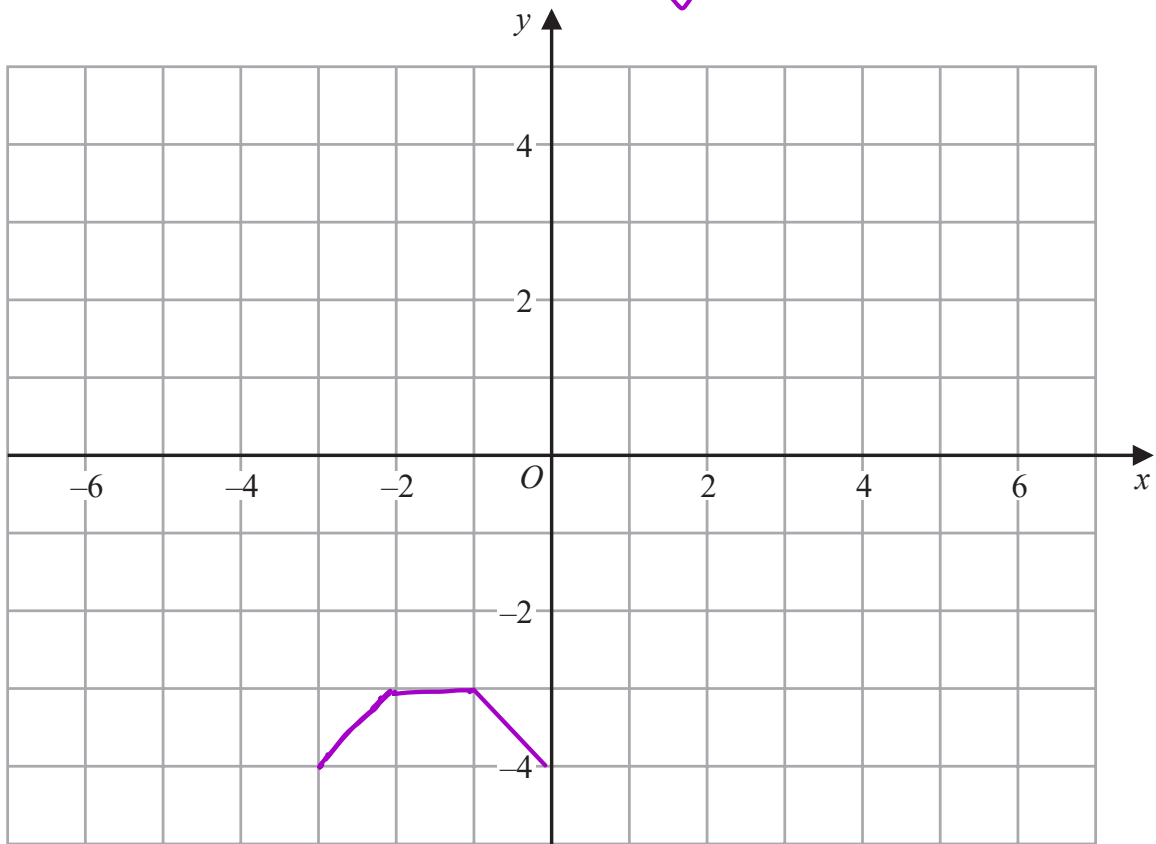
(Total for Question 20 is 4 marks)



21 Here is the graph of $y = f(x)$



(a) On the grid below, draw the graph of $y = f(x) - 4$



(1)

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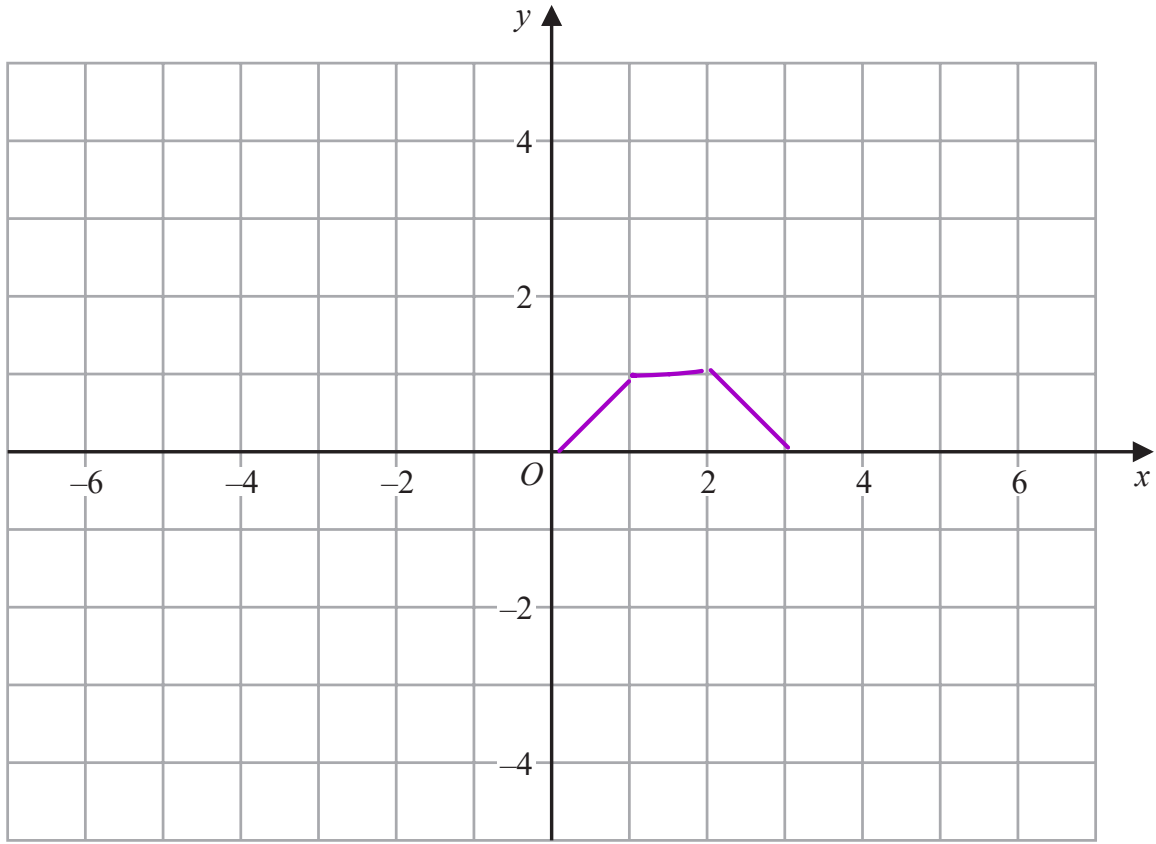


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(b) On the grid below, draw the graph of $y = f(-x)$



(1)

(Total for Question 21 is 2 marks)



22 There are only blue pens and red pens in a box.

The number of blue pens is four times the number of red pens.

Rita takes at random one pen from the box.

She records the colour of the pen and then replaces it in the box.

Rita does this n times, where $n \geq 2$

Write down an expression, in terms of n , for the probability that Rita gets a blue pen at least once and a red pen at least once.

B
4R

R
R

$$P(B) = \frac{4R}{5R} = \frac{4}{5}$$

$$P(R) = \frac{R}{5R} = \frac{1}{5}$$

$$P(\text{all B}) = \left(\frac{4}{5}\right)^n$$

$$P(\text{all R}) = \left(\frac{1}{5}\right)^n$$

$$1 - \left(\frac{4}{5}\right)^n - \left(\frac{1}{5}\right)^n$$

(Total for Question 22 is 2 marks)

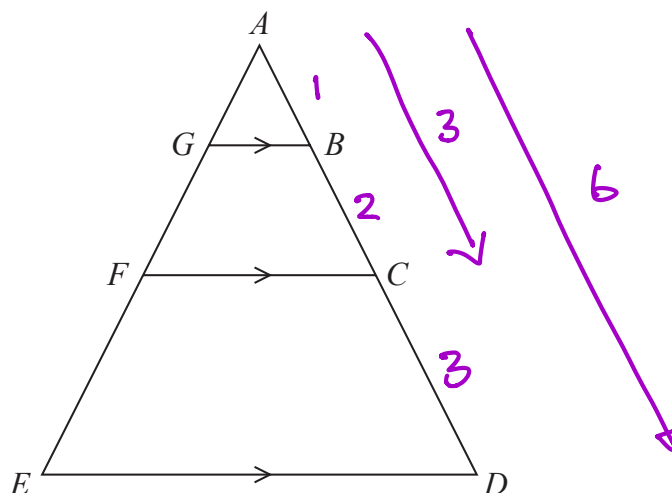


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23 Here are three similar triangles, ABG , ACF and ADE .

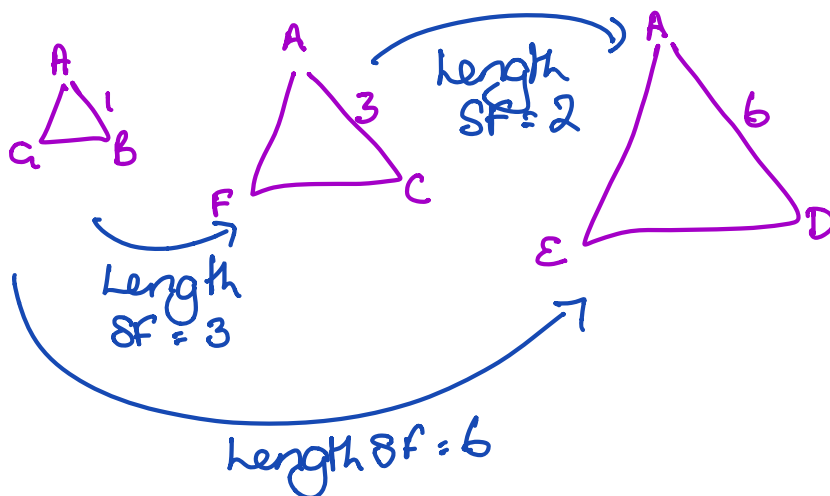


$ABCD$ and $AGFE$ are straight lines.

$$AB:BC:CD = 1:2:3$$

Show that

$$\text{area of } ABG : \text{area of } BCFG : \text{area of } CDEF = 1 : 8 : 27$$

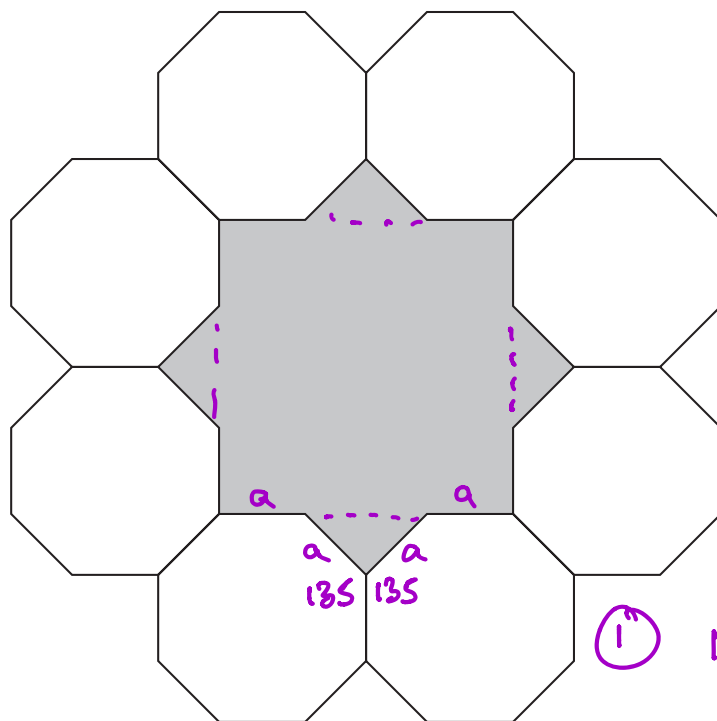


$$\begin{aligned}
 BCFG &= \triangle ACF - \triangle ABG & \left. \begin{aligned} & \\ & \\ & \end{aligned} \right\} CDEF = \triangle ADE - \triangle ACF \\
 \text{area SF} &= 3^2 = 9 & & = 36ABG - 9ABG \\
 &= 9ABG - ABG & & = 27ABG \\
 &= 8ABG & & \\
 \therefore \text{ratio of area} & & & 1 : 8 : 27
 \end{aligned}$$

(Total for Question 23 is 3 marks)



24 The diagram shows 8 identical regular octagons joined to enclose a shaded shape.



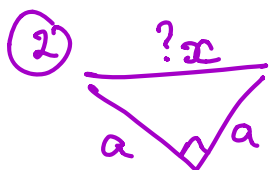
Each octagon has sides of length a .

Find, in terms of a , an expression for the area of the shaded shape.

Give your answer in the form $p(2 + \sqrt{2})a^2$ where p is an integer.

You must show all your working.

① $1080 \div 8 = 135$
 $360 - 270 = 90$
 so right angle \triangle



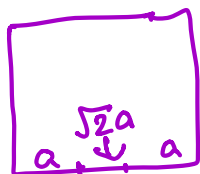
$$x^2 = 2a^2$$

$$x = \sqrt{2}a$$

area of \triangle

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

4 OF THESE! = $2a^2$



area of square

$$= (2a + \sqrt{2}a)(2a + \sqrt{2}a)$$

$$= 4a^2 + 4\sqrt{2}a^2 + 2a^2$$

$$= 6a^2 + 4\sqrt{2}a^2$$

$$\begin{aligned} \text{Total} &= 6a^2 + 4\sqrt{2}a^2 + 2a^2 = 8a^2 + 4\sqrt{2}a^2 \\ &= 4(2 + \sqrt{2})a^2 \text{ as required} \end{aligned}$$



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(Total for Question 24 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS

