

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 $\frac{\sqrt{1577} - 32}{2.3^2 - 5}$

Write down all the figures on your calculator display.

26.59123898

.....
(2)

(b) Work out the value of the reciprocal of 0.8

$$\frac{1}{0.8}$$

1.25

.....
(1)

(Total for Question 1 is 3 marks)

2 Write 84 as a product of its prime factors.

$$\begin{aligned} 84 &= 4 \times 21 \\ &= 2 \times 2 \times 3 \times 7 \end{aligned}$$

$$2^2 \times 3 \times 7$$

(Total for Question 2 is 2 marks)

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

$$\text{number of blue counters} : \text{number of green counters} = 1 : 3$$

Hermione has to work out how many blue counters are in the bag.

She says,

“There are 16 blue counters in the bag because 1 is a third of 3 and 16 is a third of 48”

Is Hermione correct?

You must give a reason for your answer.

$$48 \div 4 = 12 \quad 12 \times 1 = 12 \quad 12 \times 3 = 36$$

She is not correct. There are 12 blue, a quarter of 48 is 12.

(Total for Question 3 is 1 mark)

4 $-3 < n \leq 7$

n is an integer.

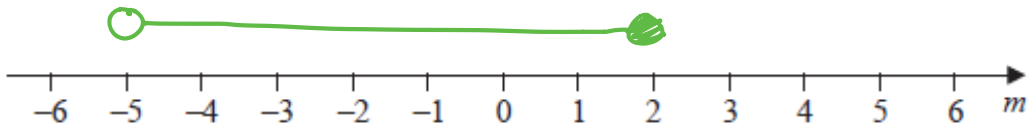
(a) Write down the greatest possible value of n .

~~-3~~, -2, 1, 0, 1, 2, 3, 4, 5, 6, 7 7

greatest value

(1)

(b) On the number line below, show the inequality $-5 < m \leq 2$



(2)

(c) Solve $\frac{4}{5}h - 6 < 10$

$$\frac{4}{5}h - 6 < 10$$
$$\frac{4}{5}h \quad +6 \quad +6$$

$$\frac{4}{5}h < 16$$

$$h < \frac{16 \times 5}{4}$$

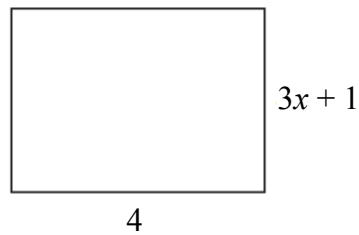
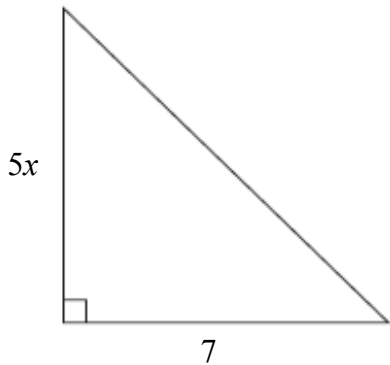
$$h < 20$$

$$h < 20$$

(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 18 cm^2 greater than the area of the rectangle.

Work out the value of x .

$$\begin{aligned} \triangle &= \frac{1}{2} \times 7 \times 5x \\ &= 17.5x \end{aligned}$$

$$\begin{aligned} \square &= 4(3x + 1) \\ &= 12x + 4 \end{aligned}$$

$$17.5x = 12x + 4 + 18$$

$$5.5x = 22$$

$$\begin{aligned} x &= \frac{22}{5.5} \\ &= 4 \end{aligned}$$

$$x = \overset{4}{\dots\dots\dots}$$

(Total for Question 5 is 4 marks)

- 6 Last month a farmer sold 900 kg of vegetables.
65% of these vegetables were turnips and parsnips.

$$\text{weight of turnips} : \text{weight of parsnips} = 9 : 4$$

Calculate the weight of parsnips the farmer sold.

900kg veg.

↙

65% turnips & parsnips

$$0.65 \times 900$$
$$= 585$$

turnips : parsnips

9 : 4

└──────────┘

$$585 \div 13 = 45$$

$$9 \times 45$$
$$= 405$$

$$4 \times 45$$
$$= \underline{180}$$

180

..... kg

(Total for Question 6 is 3 marks)

- 7 A number, d , is rounded to 2 decimal places.
The result is 2.73

Complete the error interval for d .

$$2.72 \quad \uparrow \quad 2.73 \quad \uparrow \quad 2.74$$
$$\dots\dots\dots 2.725 \leq d < 2.735 \dots\dots\dots$$

(Total for Question 7 is 2 marks)

- 8 Ronnie buys a house with a value of £280 000
The value of Ronnie's house increases by 2.5% each year. 1.025

Tom buys a house with a value of £260 000
The value of Tom's house increases by 6% each year. 1.06

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

$$\underline{\text{Ronnie}} \quad 280\,000 \times 1.025^2 = \pounds 294\,175$$

$$\underline{\text{Tom}} \quad 260\,000 \times 1.06^2 = \pounds 292\,136$$

Ronnie's house has the greater value

$$294\,175 > 292\,136$$

(Total for Question 8 is 4 marks)

- 9 The cumulative frequency table gives information about the ages of 78 people going on a cruise.

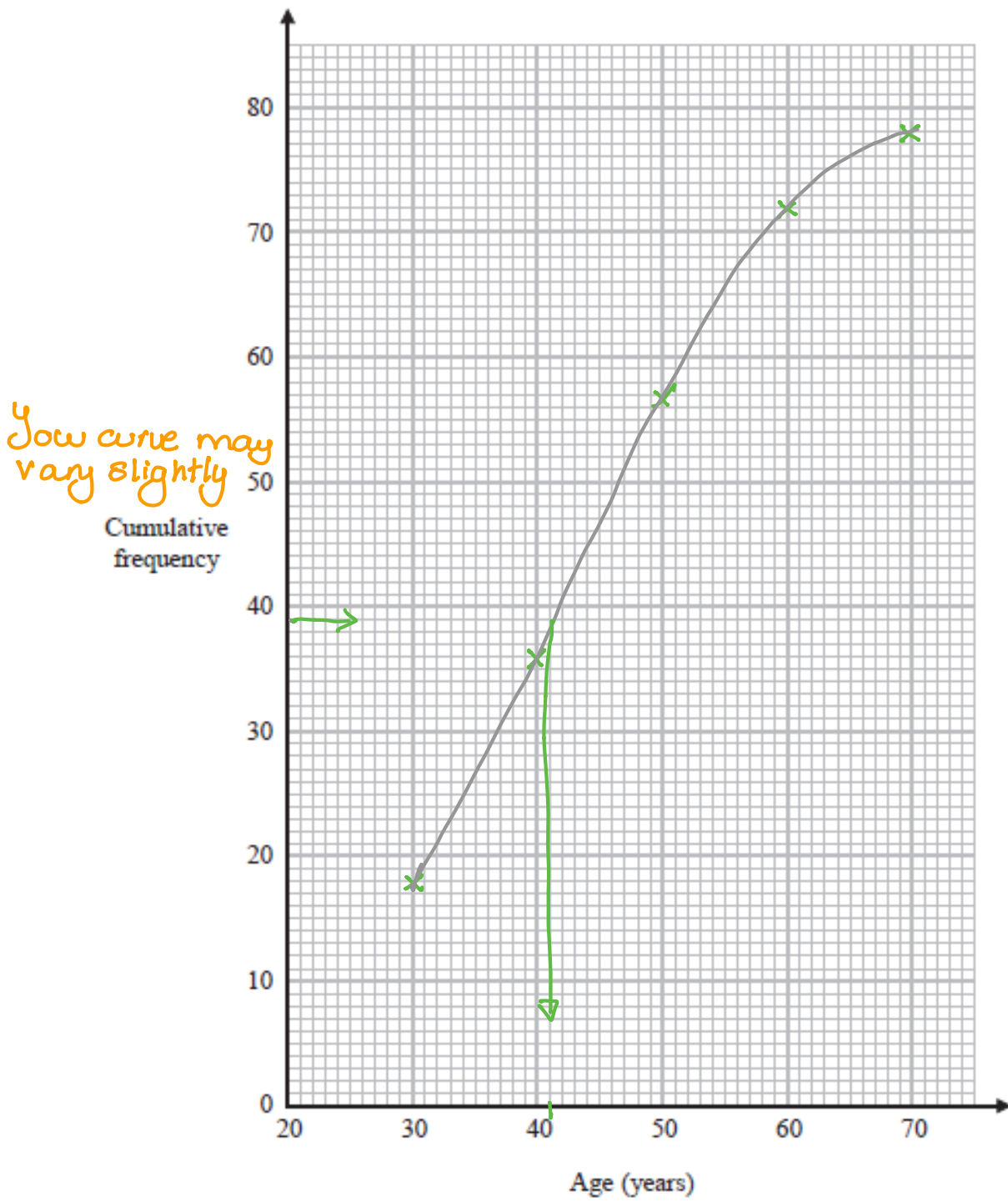
Age (a years)	Cumulative frequency
$20 < a \leq 30$	18
$20 < a \leq 40$	36
$20 < a \leq 50$	57
$20 < a \leq 60$	72
$20 < a \leq 70$	78

(a) On the grid on the next page, draw a cumulative frequency graph for this information.

(2)

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

..... years
(1)



(Total for Question 9 is 3 marks)

10 A biased dice is thrown 80 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	15	9	13	11	8	24

George throws the dice twice.

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

$$P(6) = \frac{24}{80} = \frac{3}{10} \quad \text{so} \quad P(6,6) = \frac{3}{10} \times \frac{3}{10}$$

$$\frac{9}{100}$$

(3)

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

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

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

n would be greater than 80

(1)

(Total for Question 10 is 4 marks)

11 Use algebra to solve the simultaneous equations

$$2x + 6y = 1 \quad \times 2$$

$$5x - 4y = 31 \quad \times 3$$

$$\begin{array}{r} 4x + 12y = 2 \\ 15x - 12y = 93 \\ \hline \end{array}$$

$$+ \quad 19x = 95$$

$$x = 5$$

sub into $2x + 6y = 1$

$$10 + 6y = 1$$

$$6y = -9$$

$$y = -1.5$$

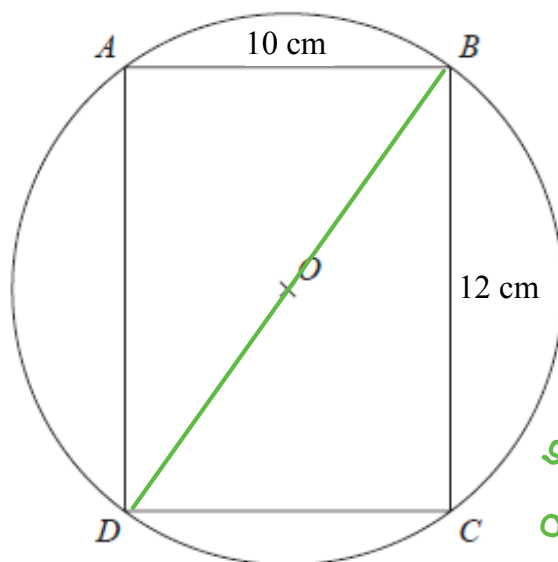
check. $5 \times 5 - 4 \times -1.5$
 $25 + 6 = 31 \checkmark$

$$x = \dots\dots\dots 5 \dots\dots\dots$$

$$y = \dots\dots\dots -1.5 \dots\dots\dots$$

(Total for Question 11 is 4 marks)

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



$$DB^2 = 12^2 + 10^2$$

$$= 144 + 100$$

$$= 244$$

so diameter = $\sqrt{244}$ ✓
 and radius = $\frac{\sqrt{244}}{2}$

$AB = 10 \text{ cm}$ $BC = 12 \text{ cm}$

Work out the circumference of the circle.
 Give your answer correct to 3 significant figures.

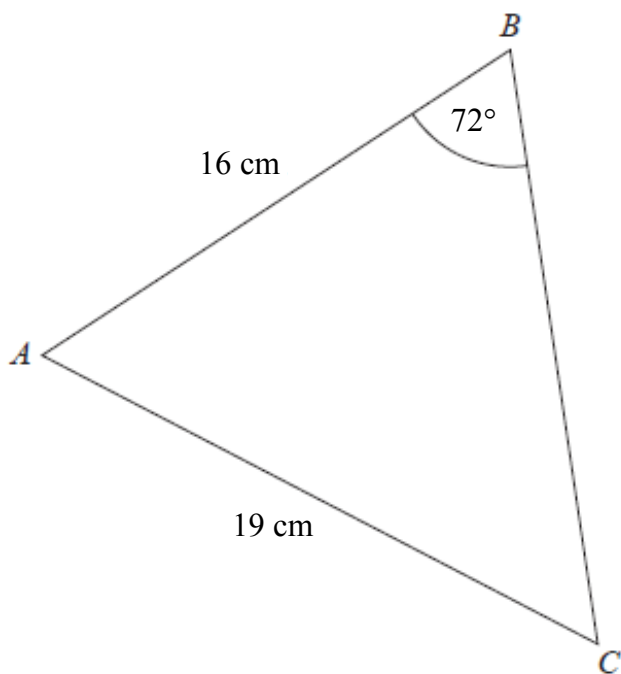
$$C = \pi \times \sqrt{244}$$

$$= 49.073\dots$$

..... 49.1 cm

(Total for Question 12 is 4 marks)

13 ABC is a triangle.



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

$$\frac{\sin 72}{19} = \frac{\sin C}{16}$$

$$\begin{aligned}\sin C &= \frac{16 \times \sin 72}{19} \\ &= 0.80\dots\end{aligned}$$

$$C = 53.21$$

$$\begin{aligned}\text{so } \angle BAC &= 180 - (72 + 53.21\dots) \\ &= 54.784\dots\end{aligned}$$

54.8

.....°
(Total for Question 13 is 4 marks)

14 Show that $\frac{x^2 - x - 12}{2x^2 + 5x - 3}$ can be written in the form $\frac{ax + b}{cx + d}$ where a, b, c and d are integers.

$$x^2 - x - 12 = (x + 3)(x - 4)$$

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

$$\text{so: } \frac{\cancel{(x + 3)}(x + 4)}{\cancel{(x + 3)}(2x - 1)}$$

$$= \frac{x + 4}{2x - 1} \quad \text{where } a = 1 \quad b = 4 \\ c = 2 \quad d = -1$$

(Total for Question 14 is 3 marks)

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

2 3 6 11

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

	1		2		3		4
	2	└─┘	3	└─┘	6	└─┘	11
		└─┘	└─┘	└─┘	└─┘	└─┘	
		2	3	5	8	11	
		└─┘	└─┘	└─┘	└─┘	└─┘	
		1	2	3	4	5	
		└─┘	└─┘	└─┘	└─┘	└─┘	
		1	-1	-3	-5	-7	
		└─┘	└─┘	└─┘	└─┘	└─┘	
		1	-2	-2	-2	-2	

x^2 1 4 9 16

+3 -2 -2 -2 so -2n

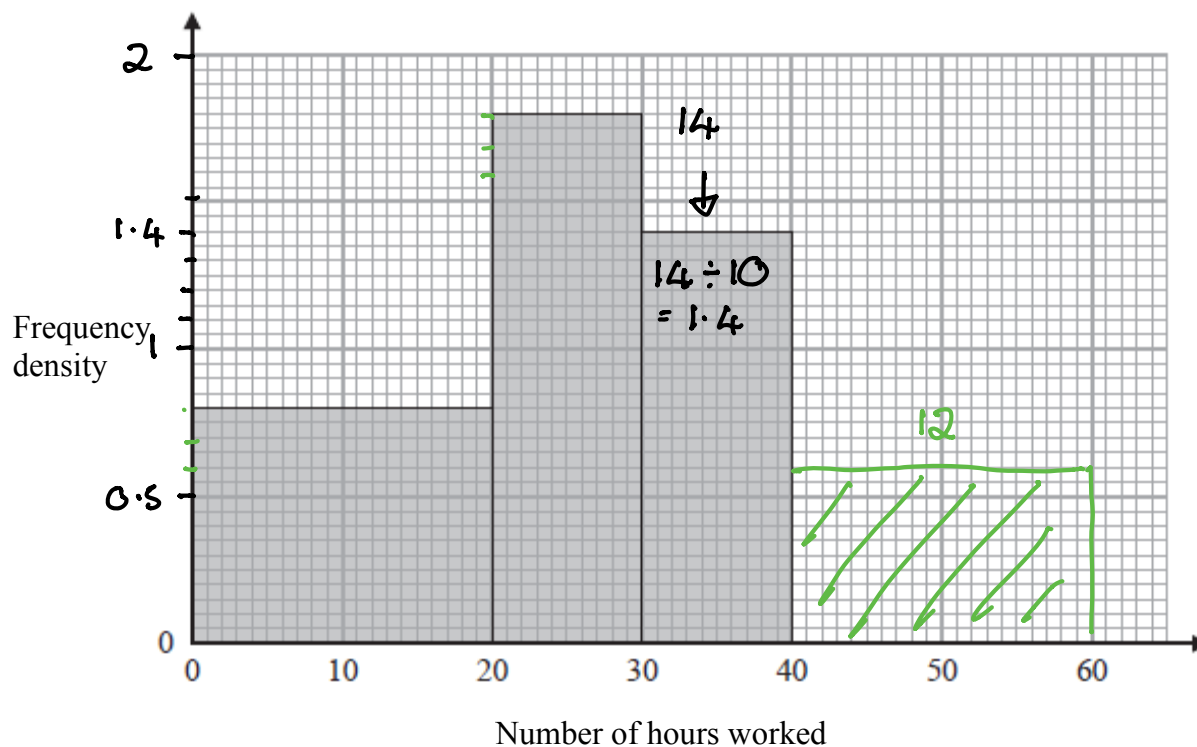
$$x^2 - 2n + 3$$

$$x^2 - 2n + 3$$

(Total for Question 15 is 3 marks)

- 16 The histogram gives information about the number of hours some nurses spent at work last week in a hospital.

The histogram is incomplete.



14 nurses worked between 30 and 40 hours.
 12 nurses worked between 40 and 60 hours. \rightarrow interval = 20

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

$$12 \div 20 = 0.6$$

(2)

No nurse worked for more than 60 hours.

- (b) Work out the total number of nurses in the hospital.

$$0.8 \times 20 = 16$$

$$1.8 \times 10 = 18$$

$$\begin{array}{r} 14 \\ 12 \\ \hline 60 \end{array}$$

60

(2)

(Total for Question 16 is 4 marks)

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

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

(1)

(b) Starting with $x_0 = 1.5$

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

$$x_0 = 1.5$$

$$x_1 = \sqrt[4]{2 \times 1.5^2 + 2} = 1.59671\dots$$

$$x_2 = \sqrt[4]{2 \times 1.59\dots^2 + 2} = 1.632\dots$$

$$x_3 = \sqrt[4]{2 \times 1.63\dots^2 + 2} = 1.64534\dots$$

.....
1.65
(accept 1.64 to 1.65) (3)
(Total for Question 17 is 4 marks)

18 $9a : 7c = 4 : 7$
 $3b : 5c = 5 : 3$

Show that $a + b : b + c = 29 : 34$

$$\frac{9a}{4} : \frac{7c}{7}$$

$$\frac{3b}{5} : \frac{5c}{3}$$

$$\text{or } \frac{9a}{7c} = \frac{4}{7}$$

$$\text{so } \frac{9a}{7c} = \frac{4}{7}$$

$$\frac{3b}{5c} = \frac{5}{3}$$

$$\frac{a}{c} = \frac{28}{63} \div 7 = \frac{4}{9}$$

$$\therefore a : c = 4 : 9$$

$$a = \frac{4 \times \cancel{7}c}{\cancel{7} \times 9}$$

$$b = \frac{5 \times 5c}{3 \times 3}$$

$$= \frac{4c}{9}$$

$$= \frac{25c}{9}$$

$$\frac{3b}{5c} = \frac{5}{3}$$

$$\frac{b}{c} = \frac{25}{9} \quad b : c = 25 : 9$$

$$\therefore \begin{array}{ccc} a & : & b & : & c \\ 4/9c & & 25/9c & & c \end{array}$$

($\times 9$)

$$a : b : c$$

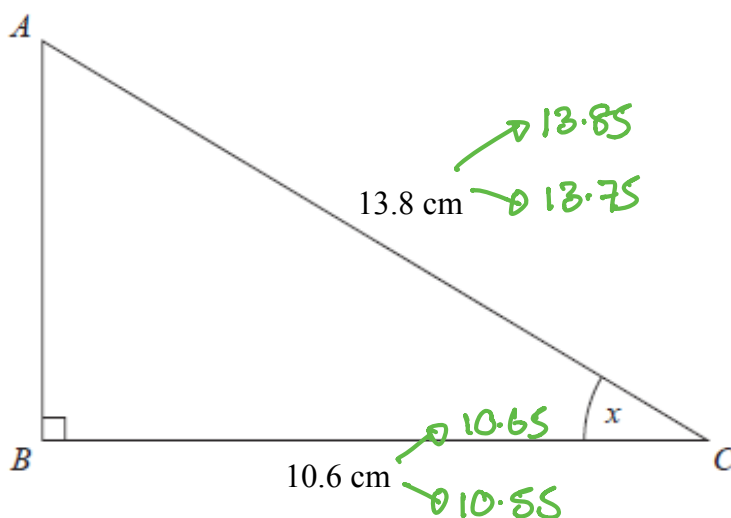
$$4 : 25 : 9$$

$$a + b = 29 \quad : \quad b + c = 34$$

$$\text{so } 29 : 34$$

(Total for Question 18 is 3 marks)

19 ABC is a right-angled triangle.



$AC = 13.8\text{ cm}$ correct to the nearest mm.

$BC = 10.6\text{ cm}$ correct to the nearest mm.

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

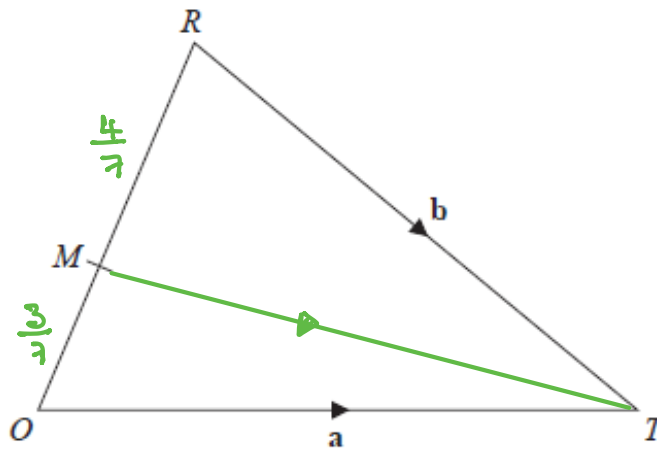
You must show all your working.

$$\cos x_{\text{LB}} = \frac{10.55}{13.85} = 0.761\dots$$

$$x_{\text{UB}} = 40.3827\dots$$

40.4 (1dp) $^\circ$
 (range 40 to 41)
 (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 $OM : MR = 3 : 4$

Express \vec{MT} in terms of \mathbf{a} and \mathbf{b} .
Give your answer in its simplest form.

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

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

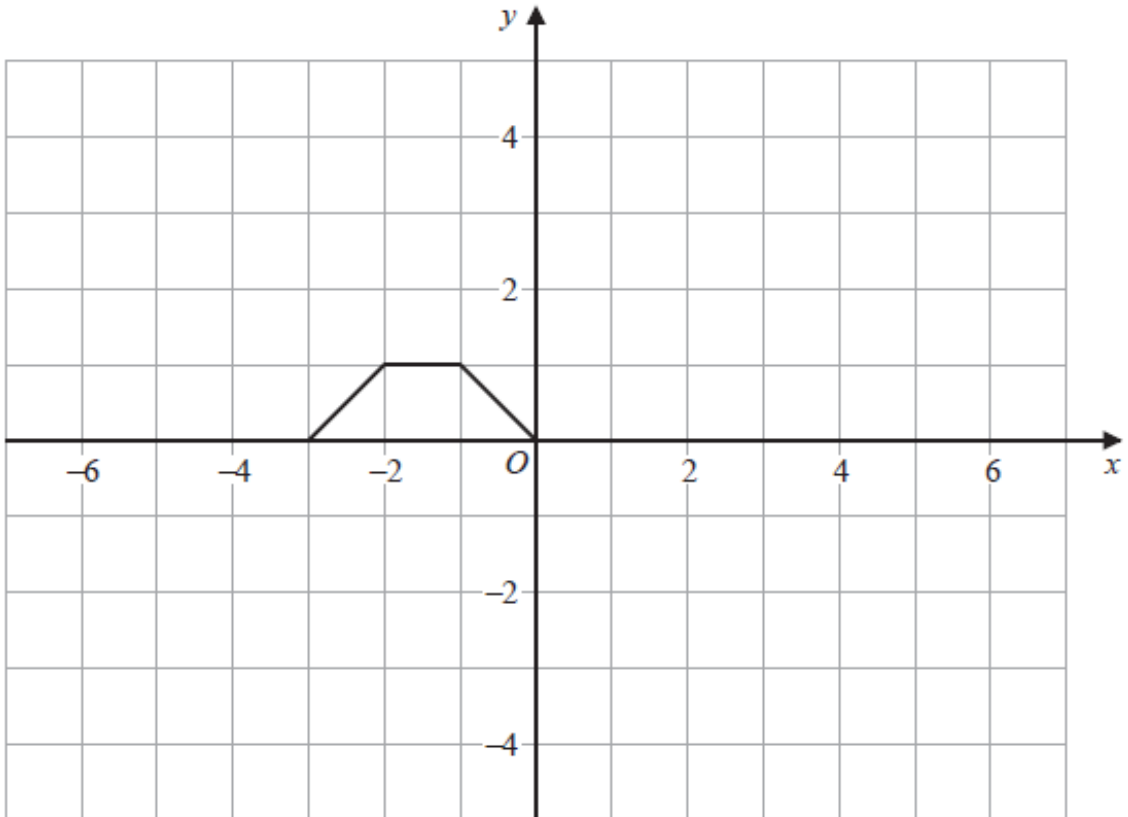
$$= \frac{4}{7}(\mathbf{a} - \mathbf{b}) + \mathbf{b}$$

$$= \frac{4}{7}\mathbf{a} - \frac{4}{7}\mathbf{b} + \frac{7}{7}\mathbf{b}$$

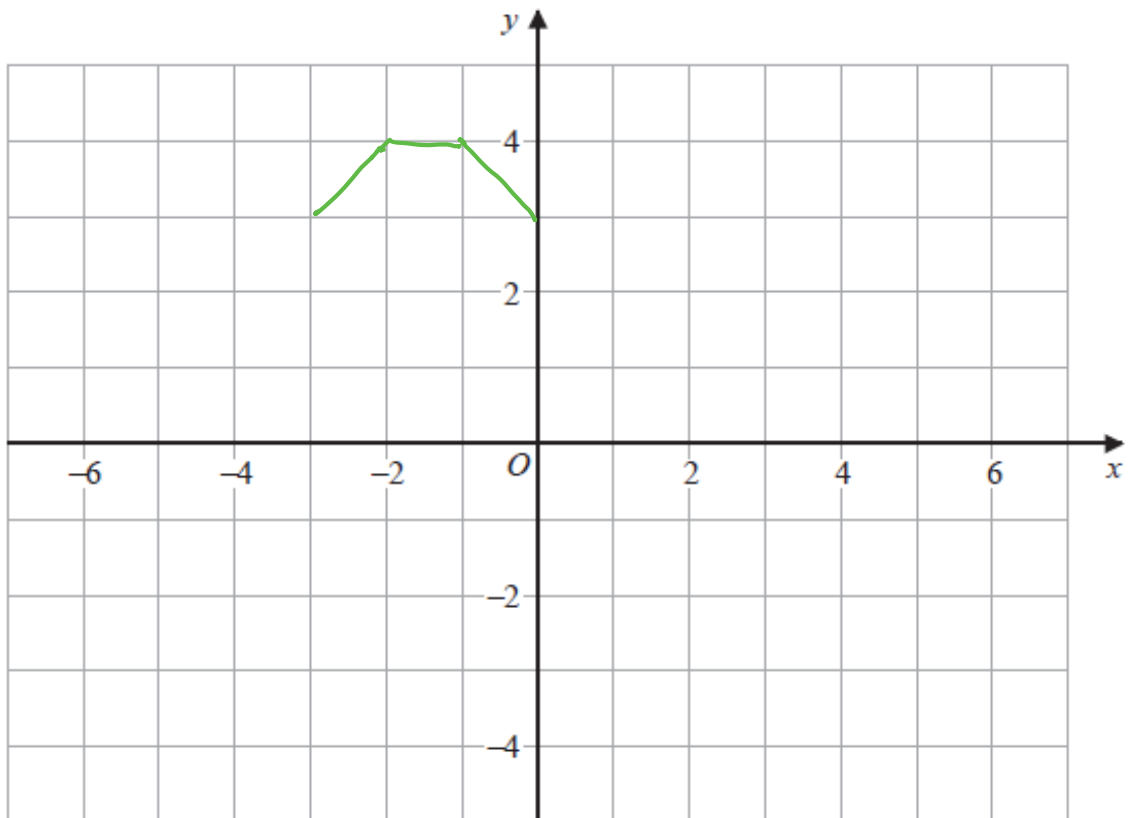
$$= \frac{4}{7}\mathbf{a} + \frac{3}{7}\mathbf{b} = \frac{1}{7}(4\mathbf{a} + 3\mathbf{b})$$

.....
(Total for Question 20 is 4 marks)

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

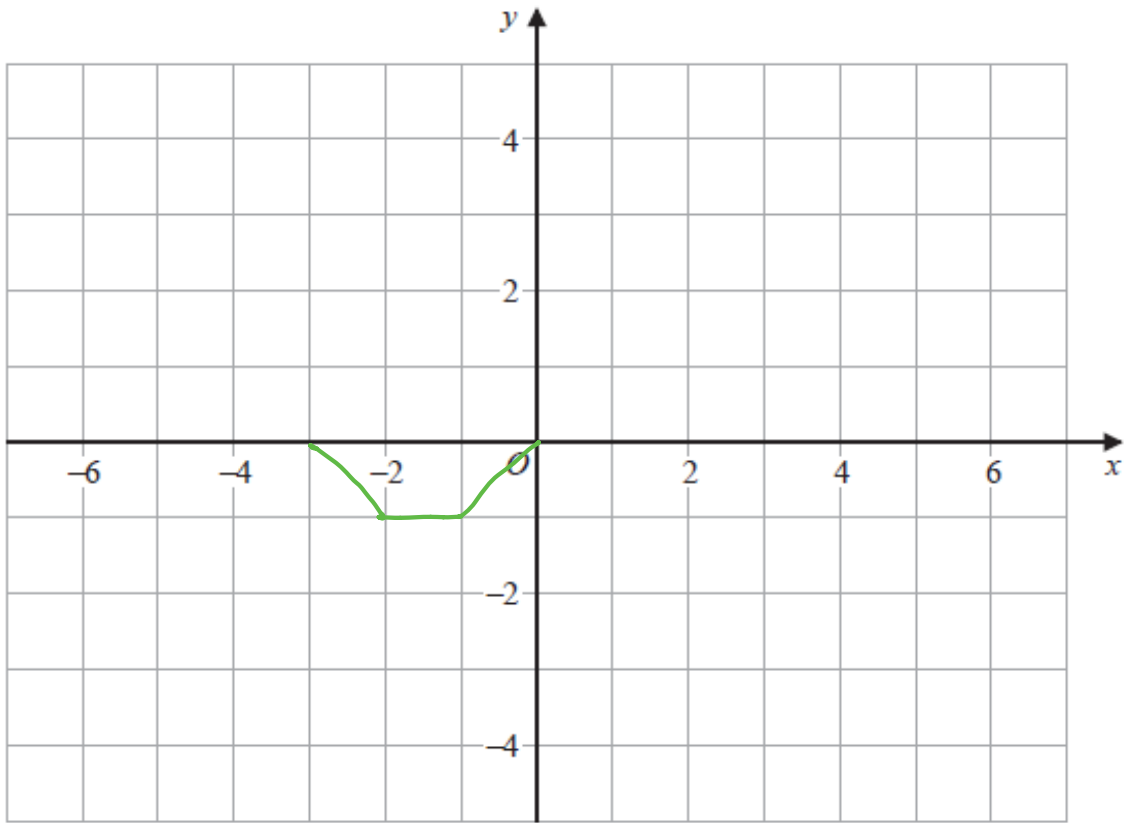


(a) On the grid below, draw the graph of $y = f(x) + 3$



(1)

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



(1)

(Total for Question 21 is 2 marks)

22 There are only white eggs and brown eggs in a box.

The number of white eggs is three times the number of brown eggs.

Rick takes at random one egg from the box.

He records the colour of the egg and then replaces it in the box.

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

Write down an expression, in terms of n , for the probability that Rick gets a white egg at least once and a brown egg at least once.

White
3B

Brown
B

$$P(W) = \frac{3B}{4B} = \frac{3}{4}$$

$$P(B) = \frac{B}{4B} = \frac{1}{4}$$

$$P(\text{all white}) = \left(\frac{3}{4}\right)^n$$

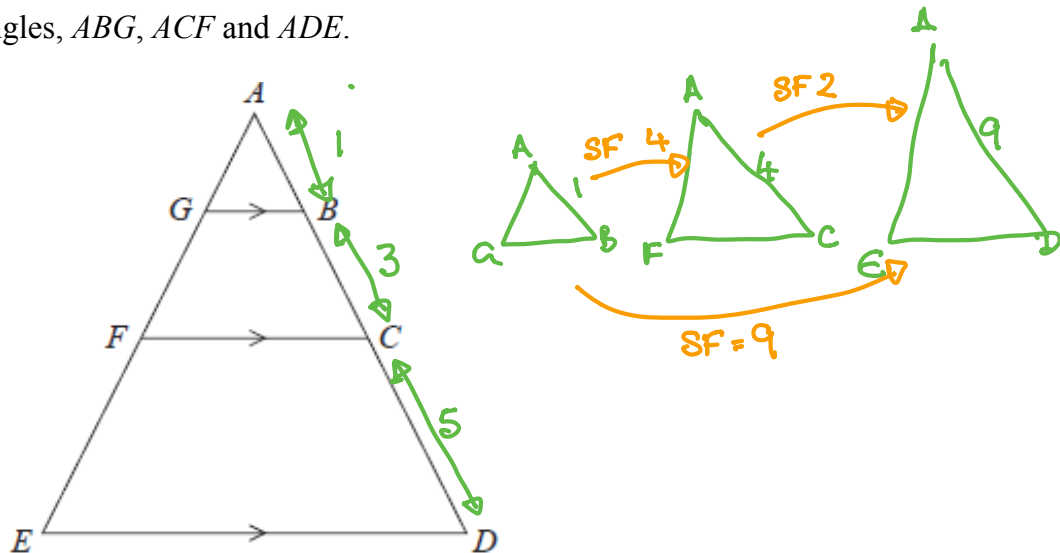
$$P(\text{all brown}) = \left(\frac{1}{4}\right)^n$$

$$\text{so } 1 - \left(\frac{3}{4}\right)^n - \left(\frac{1}{4}\right)^n$$

$$1 - \left(\frac{3}{4}\right)^n - \left(\frac{1}{4}\right)^n$$

(Total for Question 22 is 2 marks)

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



$ABCD$ and $AGFE$ are straight lines.

$$AB : BC : CD = 1 : 3 : 5$$

Show that

$$\text{area of } ABG : \text{area of } BCFG : \text{area of } CDEF = 1 : 15 : 65$$

$$BCFG = \triangle ACF - \triangle ABG$$

$$CDEF = \triangle ADE - \triangle ACF$$

using area SF of $4^2 = 16$

$$= 16ABG - ABG$$

$$= 15ABG$$

$$= 81ABG - 16ABG$$

$$= 65ABG$$

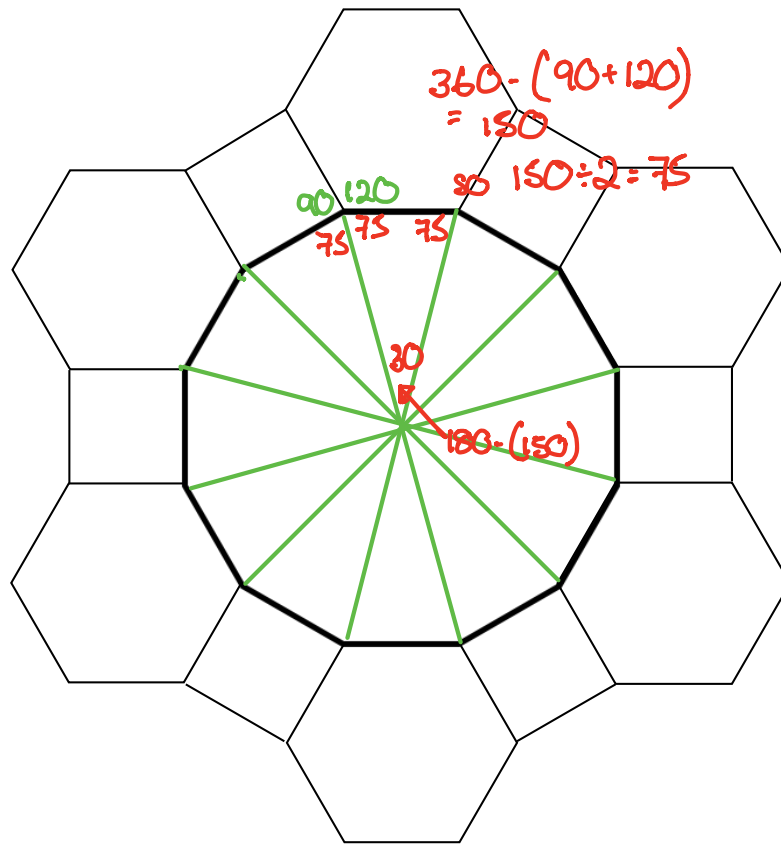
so ratio of area :

$$ABG : BCFG : CDEF$$

$$1 : 15 : 65$$

(Total for Question 23 is 3 marks)

- 24 The diagram shows 6 identical regular hexagons and 6 squares joined to enclose a regular 12-sided dodecagon.



3 sides = 180
 4 sides = 360
 5 sides = 540
 6 sides = 720
 1 angle = $\frac{720}{6}$
 = 120

Each hexagon has sides of length a . Each square has sides of length a .
 Find, in terms of a , an expression for the area of the enclosed dodecagon.

Give your answer in the form $\frac{pa^2}{\tan 15^\circ}$ where p is an integer.

You must show all your working.



$$\tan 15 = \frac{a}{2} \div x$$

$$\tan 15 = \frac{a}{2x} \quad x = \frac{a}{2 \tan 15}$$

$$\begin{aligned} \text{area of 1 triangle} &= \frac{1}{2} \times a \times \frac{a}{2 \tan 15} \\ &= \frac{a^2}{4 \tan 15} \end{aligned}$$

$$\text{Total area} = 12 \times \frac{a^2}{4 \tan 15}$$

$$= \frac{3a^2}{\tan 15} \quad \text{where } p = 3$$

(Total for Question 24 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS