

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

- 1 The table shows the probabilities that a biased dice will land on 2, on 3, on 4, on 5 and on 6

Number on dice	1	2	3	4	5	6
Probability		0.17	0.18	0.09	0.15	0.1

Neymar rolls the biased dice 200 times.

Work out an estimate for the total number of times the dice will land on 1 or on 3

$$0.17 + 0.18 + \dots + 0.1 = 0.69$$

$$\text{so } P(\text{getting 1}) = 1 - 0.69 = 0.31$$

$$P(1 \text{ or } 3) = 0.31 + 0.18 = 0.49$$

$$\text{so number of 1s and 3s} = (200) \times 0.49 = 98$$

98

(Total for Question 1 is 3 marks)

- 2 On Saturday, some adults and some children were in a theatre.  
The ratio of the number of adults to the number of children was 5 : 2

Each person had a seat in the Circle or had a seat in the Stalls.

$\frac{3}{4}$  of the children had seats in the Stalls.

117 children had seats in the Circle.

There are exactly 2600 seats in the theatre.

On this Saturday, were there people on more than 60% of the seats?

You must show how you get your answer.

	circle	stalls
Adults		
Children	117	

$$A : C = 5 : 2$$

of children,  $\frac{3}{4}$  in Stalls so  $\frac{1}{4}$  in circle

$$\begin{aligned} \text{Total number of children} &= 117 \times 4 \\ &= 468 \end{aligned}$$

$$\begin{aligned} \text{Children} &= 2 \text{ parts} = 468 \\ 1 \text{ part} &= 234 \end{aligned}$$

$$\text{Adults} = 5 \text{ parts} = 1170$$

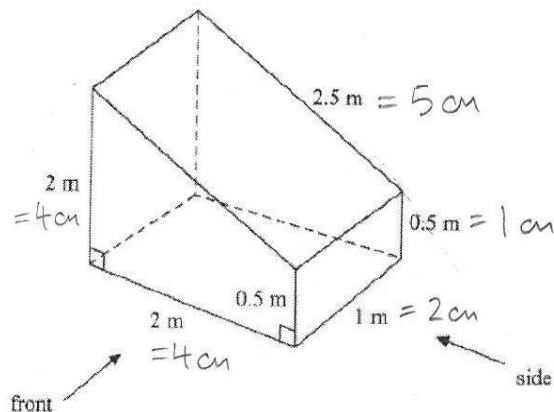
$$\begin{aligned} \text{Total people} &= 468 + 1170 \\ &= 1638 \end{aligned}$$

$$\begin{aligned} \text{Seats taken} &= \frac{1638}{2600} \times 100\% \\ &= 63\% \end{aligned}$$

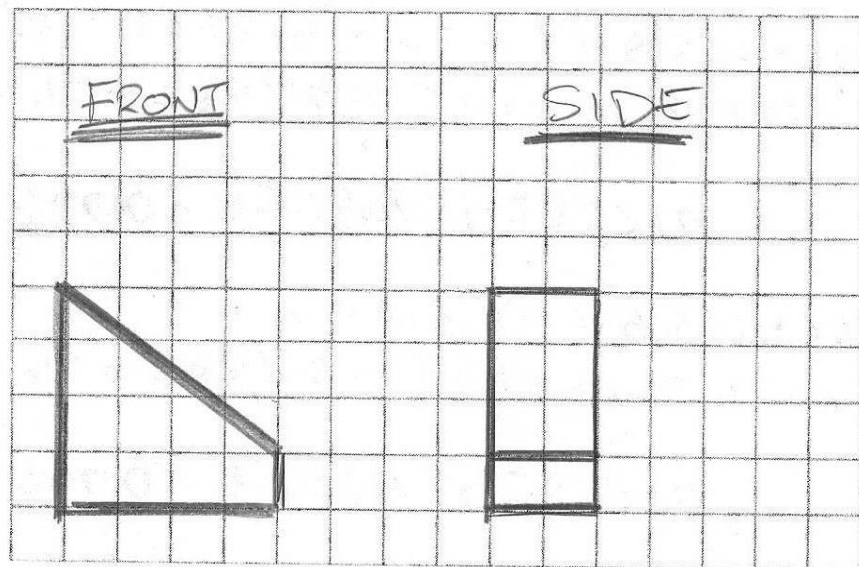
Yes, more than 60% of seats taken

(Total for Question 2 is 5 marks)

- 3 The diagram shows a prism with a cross section in the shape of a trapezium.



On the centimetre grid below, draw the front elevation and the side elevation of the prism. Use a scale of 2 cm to 1 m.



(Total for Question 3 is 4 marks)

Note: Scale is mucked up if exam paper is reduced in size!

- 4 Olly drove 56 km from Liverpool to Manchester. He then drove 61 km from Manchester to Sheffield.

Olly's average speed from Liverpool to Manchester was 70 km/h. Olly took 75 minutes to drive from Manchester to Sheffield.

- (a) Work out Olly's average speed for his total drive from Liverpool to Sheffield.

$$\begin{array}{lcl}
 L \longrightarrow M \longrightarrow Sh. & & \\
 D = 56 \text{ km} & & D = 61 \text{ km} \\
 S = 70 \text{ km/h} & & S = ? \\
 T = ? & & T = 75 \text{ mins} = \frac{75}{60} \text{ h} = 1.25 \text{ h} \\
 T = \frac{D}{S} = \frac{56}{70} = 0.8 \text{ h} & & 
 \end{array}$$

$$\begin{array}{l}
 \text{Overall} \quad Av \text{ Speed} = \frac{\text{Total Distance}}{\text{Total Time}} \\
 S = \frac{D}{T} = \frac{56 + 61}{0.8 + 1.25} = \frac{117}{2.05} = 57.073... \\
 \text{57.1 km/h}
 \end{array}$$

Janie drove from Barnsley to York.

Janie's average speed from Barnsley to Leeds was 80 km/h. Her average speed from Leeds to York was 60 km/h.

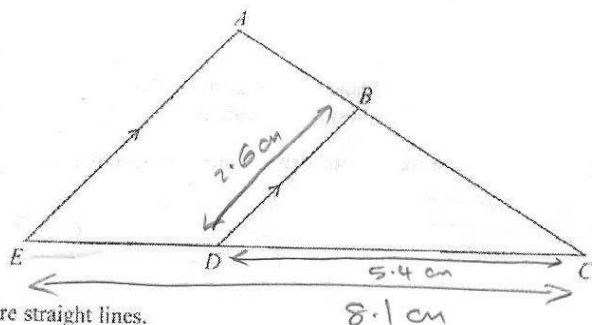
Janie says that the average speed from Barnsley to York can be found by working out the mean of 80 km/h and 60 km/h.

- (b) If Janie is correct, what does this tell you about the two parts of Janie's journey?

If correct, two parts must have taken the same time.

(Total for Question 4 is 5 marks)

For example, B → L was 80 km in 1 hour, L → Y was 60 km in 1 hour, so total was (80 + 60) km in 2 hours, av. speed = 70 km/h



$ABC$  and  $EDC$  are straight lines.  
 $EA$  is parallel to  $DB$ .

$$EC = 8.1 \text{ cm.}$$

$$DC = 5.4 \text{ cm.}$$

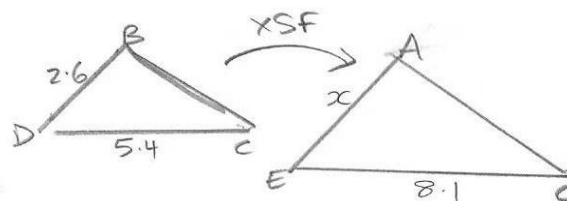
$$DB = 2.6 \text{ cm.}$$

(a) Work out the length of  $AE$ .

$$SF = \frac{\text{new l.}}{\text{old l.}} = \frac{8.1}{5.4} = 1.5$$

$$x = 2.6 \times SF$$

$$x = 2.6 \times 1.5 = 3.9$$



$$\underline{3.9 \text{ cm}} \\ (2)$$

$$AC = 6.15 \text{ cm.}$$

(b) Work out the length of  $AB$ .

$$AC = BC \times 1.5$$

$$6.15 = BC \times 1.5$$

$$BC = \frac{6.15}{1.5} = 4.1$$

$$\therefore AB = 6.15 - 4.1 = 2.05$$

$$\underline{2.05 \text{ cm}} \\ (2)$$

(Total for Question 5 is 4 marks)

6 Anil wants to invest £25 000 for 3 years in a bank.

### Personal Bank

Compound Interest

2% for each year

### Secure Bank

Compound Interest

4.3% for the first year  
 0.9% for each extra year

Which bank will give Anil the most interest at the end of 3 years?  
 You must show all your working.

### Personal Bank

$$\text{Start} = £25,000$$

$$\text{After 3rd year} = £25,000 \times 1.02^3 \\ = £26,530.20$$

$$\text{Interest} = £1530.20$$

### Secure Bank

$$\text{Start} = £25,000$$

$$\text{After 1st year} = £25,000 \times 1.043$$

$$\text{After 3rd year} = £25,000 \times 1.043 \\ \times 1.009^2 \\ = £26,546.46$$

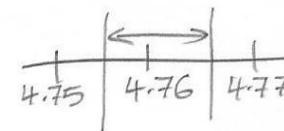
$$\text{Interest} = £1,546.46$$

Secure Bank will give more interest

(Total for Question 6 is 3 marks)

7 A number,  $n$ , is rounded to 2 decimal places.  
 The result is 4.76

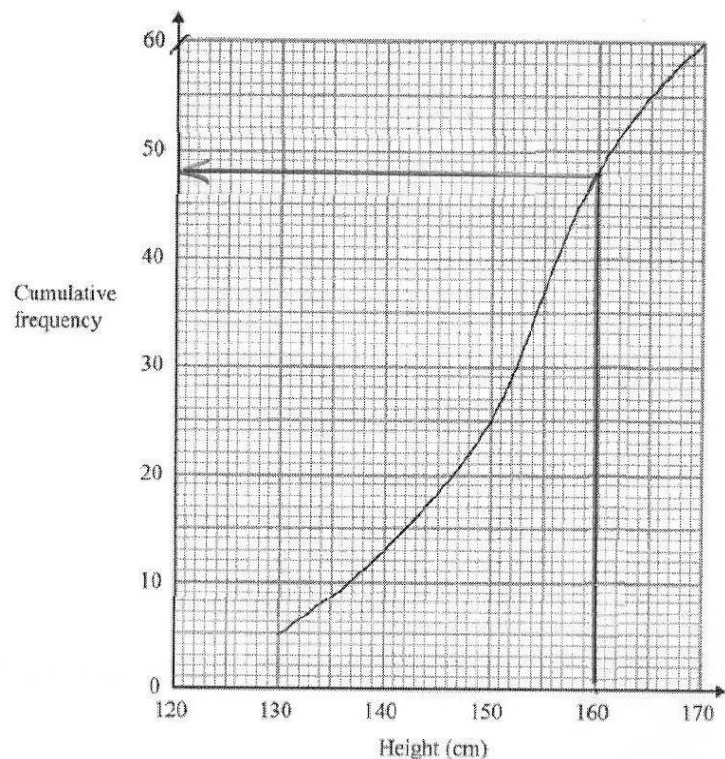
Using inequalities, write down the error interval for  $n$ .



$$\underline{4.755 \leq n < 4.765}$$

(Total for Question 7 is 2 marks)

- 8 The cumulative frequency graph shows some information about the heights, in cm, of 60 students.



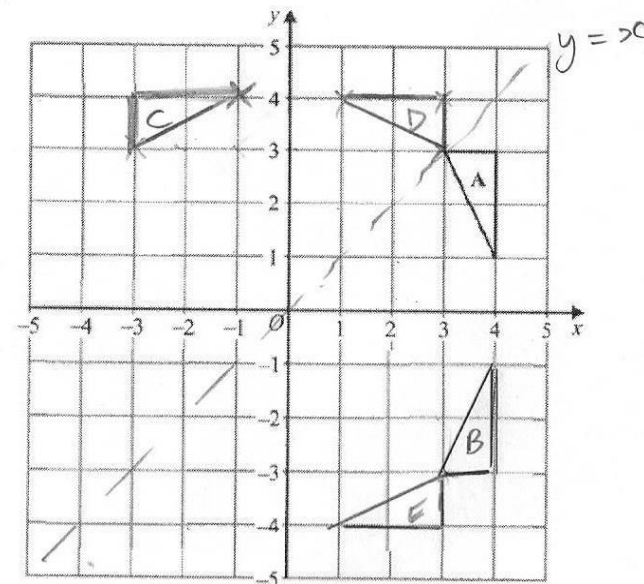
Work out an estimate for the number of these students with a height greater than 160 cm.

48 students shorter than 160 cm  
 $60 - 48 = 12$

12

(Total for Question 8 is 2 marks)

- 9 The diagram shows triangle A drawn on a grid.



Kyle reflects triangle A in the  $x$ -axis to get triangle B.  
 He then reflects triangle B in the line  $y = x$  to get triangle C.

Amy reflects triangle A in the line  $y = x$  to get triangle D.  
 She is then going to reflect triangle D in the  $x$ -axis to get triangle E.

Amy says that triangle E should be in the same position as triangle C.

Is Amy correct?

You must show how you get your answer.

Amy is not correct - see diagram above //

(Total for Question 9 is 3 marks)

10 The table shows some information about eight planets.

Planet	Distance from Earth (km)	Mass (kg)
Earth	0	$5.97 \times 10^{24}$
Jupiter	$6.29 \times 10^8$	$1.898 \times 10^{27}$
Mars	$7.83 \times 10^7$	$6.42 \times 10^{23}$
Mercury	$9.17 \times 10^7$	$3.302 \times 10^{23}$
Neptune	$4.35 \times 10^9$	$1.024 \times 10^{26}$
Saturn	$1.28 \times 10^9$	$5.68 \times 10^{26}$
Uranus	$2.72 \times 10^9$	$8.683 \times 10^{25}$
Venus	$4.14 \times 10^7$	$4.869 \times 10^{24}$

(a) Write down the name of the planet with the greatest mass.

Note: A mass of (something  $\times 10^{27}$ ) is bigger than  $10^{24}$ ,  $10^{25}$  or  $10^{26}$

Jupiter (1)

(b) Find the difference between the mass of Venus and the mass of Mercury.

$$\begin{aligned} \text{mass of Venus} - \text{mass of Mercury} \\ &= 4.869 \times 10^{24} - 3.302 \times 10^{23} \\ &= 4.5388 \times 10^{24} \\ &\approx 4.54 \times 10^{24} \quad (3 \text{ sf.}) \end{aligned}$$

$4.54 \times 10^{24}$  (1)

Nishat says that Neptune is over a hundred times further away from Earth than Venus is.

(c) Is Nishat right?

You must show how you get your answer.

$$\begin{aligned} (\text{Distance Earth to Venus}) \times 100 &= (4.14 \times 10^7) \times 10^2 \\ &= (4.14 \times 10^9) \times 10^2 \\ &= 4.14 \times 10^9 \end{aligned}$$

$$\text{Distance Earth to Neptune} = 4.35 \times 10^9$$

Yes, Nishat is correct //

(2)

(Total for Question 10 is 4 marks)

11 Solve  $\frac{3x-2}{4} - \frac{2x+5}{3} = \frac{1-x}{6}$

$$\left(\frac{3x-2}{4}\right) \times 12^3 - \left(\frac{2x+5}{3}\right) \times 12^4 = \left(\frac{1-x}{6}\right) \times 12^2$$

$$3(3x-2) - 4(2x+5) = 2(1-x)$$

$$9x - 6 - 8x - 20 = 2 - 2x$$

$$9x - 8x + 2x = 2 + 6 + 20$$

take care with sign

$$3x = 28$$

$$x = \frac{28}{3} = 9\frac{1}{3}$$

$$x = 9\frac{1}{3} //$$

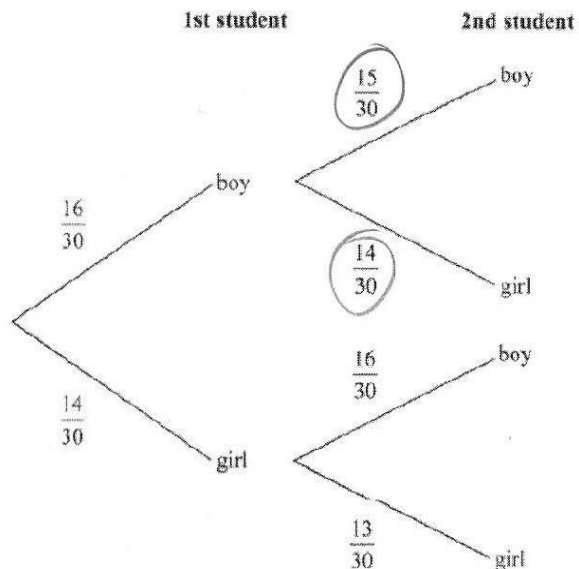
(Total for Question 11 is 4 marks)



- 12 There are 30 students in Mr Lear's class.  
16 of the students are boys.

Two students from the class are chosen at random.

Mr Lear draws this probability tree diagram for this information.



- (a) Write down **one** thing that is wrong with the probabilities in the probability tree diagram.

The circled probabilities should add up to 1.

(1)

Owen and Wasim play for the school football team.

The probability that Owen will score a goal in the next match is 0.4

The probability that Wasim will score a goal in the next match is 0.25

Mr Slater says,

"The probability that both boys will score a goal in the next match is  $0.4 + 0.25$ "

- (b) Is Mr Slater right?

Give a reason for your answer.

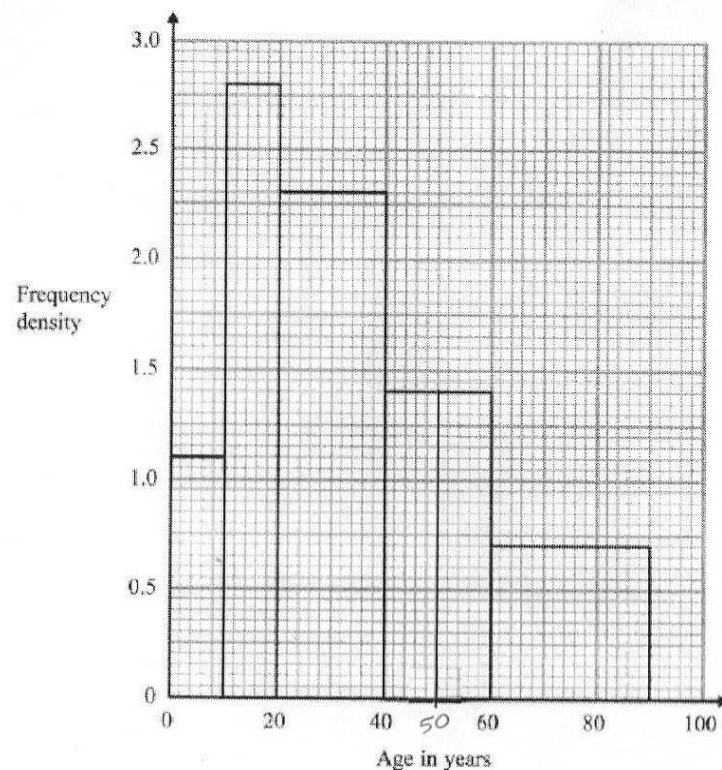
No, the probability is  $0.4 \times 0.25 = 0.1$

(provided that the probabilities are independent)

(1)

(Total for Question 12 is 2 marks)

- 13 The histogram shows some information about the ages of the 134 members of a sports club.



20% of the members of the sports club who are over 50 years of age are female.

Work out an estimate for the number of female members who are over 50 years of age.

Age	Freq	CW	FD
50-60	14	10	1.4
60-90	21	30	0.7

(Members over 50)  $\approx 35$

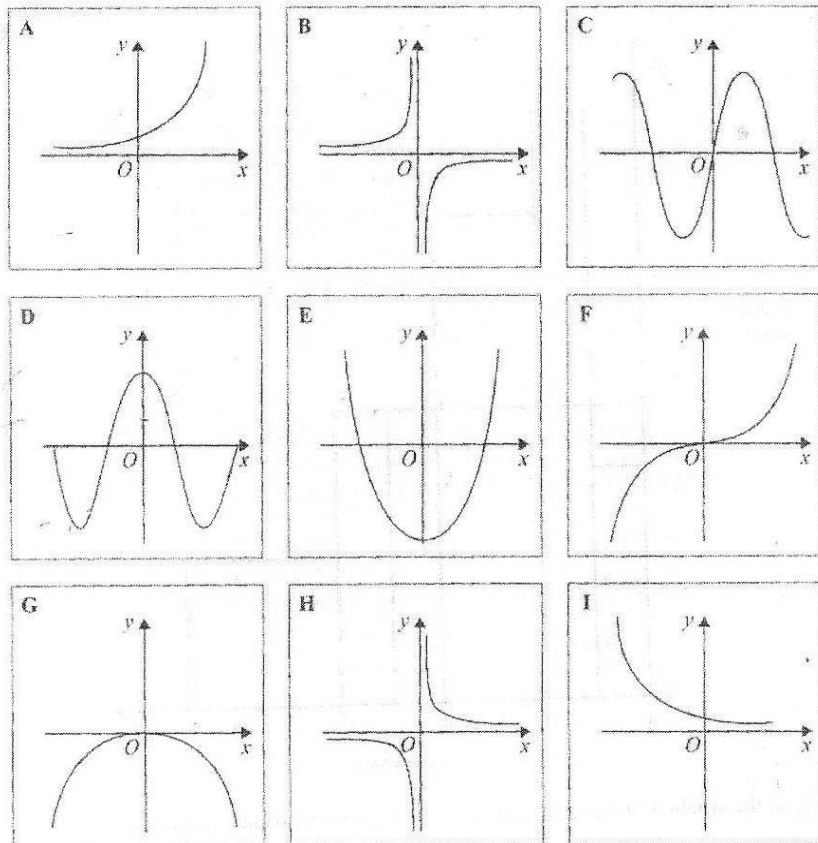
20% of 35 = 7

Ans = 7

↑  
Rearrange  $FD = \frac{\text{Freq}}{CW}$   
to give  $\text{Freq} = FD \times CW$

(Total for Question 13 is 3 marks)

14 Here are some graphs.



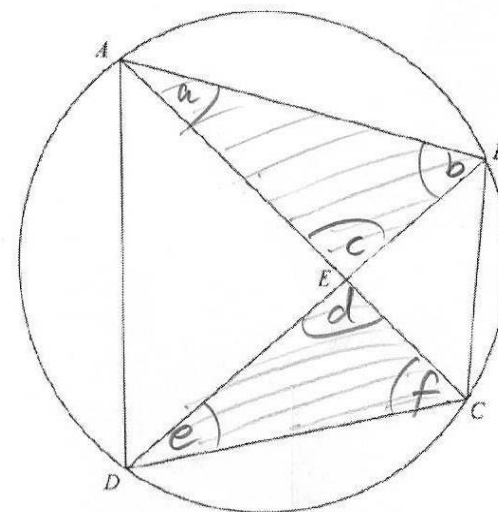
In the table below, match each equation with the letter of its graph.

Equation	Graph
$y = \sin x$	C
$y = x^3 + 4x$	F
$y = 2^x$	A
$y = \frac{4}{x}$	H

If stuck,  
make a  
table of  
values

(Total for Question 14 is 3 marks)

15 A, B, C and D are four points on the circumference of a circle.



AEC and BED are straight lines.

Prove that triangle ABE and triangle DCE are similar.  
You must give reasons for each stage of your working.

$c = d$  (vertically opposite angles)  
 $a = b$  (angles in a segment are equal)  
 $b = f$  (angles in a segment are equal)  
 Therefore triangles ABE and DCE are similar

(Total for Question 15 is 3 marks)

16 Using algebra, prove that  $0.\dot{1}\dot{3}\dot{6} \times 0.\dot{2}$  is equal in value to  $\frac{1}{33}$

$$\text{Let } x = 0.\dot{1}\dot{3}\dot{6}3636\ldots$$

$$10x = 1.3636363\ldots \quad (1)$$

$$100x = 13.6363636\ldots$$

$$1000x = 136.3636363\ldots \quad (2)$$

$$(2) - (1) \quad 990x = 135$$

$$x = \frac{135}{990} = \frac{3}{22}$$

$$\text{Let } y = 0.2222\ldots \quad (3)$$

$$10y = 2.2222\ldots \quad (4)$$

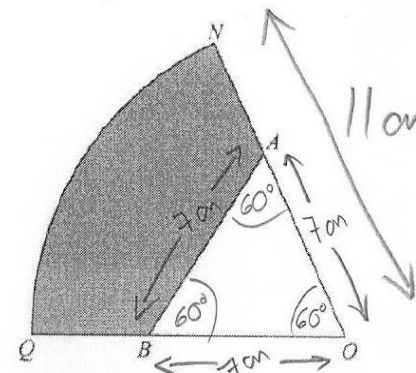
$$(4) - (3) \quad 9y = 2$$

$$y = \frac{2}{9}$$

$$\text{So } x \times y = \frac{3}{22} \times \frac{2}{9} = \frac{1}{33}$$

(Total for Question 16 is 3 marks)

17



ONQ is a sector of a circle with centre O and radius 11 cm.

A is the point on ON and B is the point on OQ such that AOB is an equilateral triangle of side 7 cm.

Calculate the area of the shaded region as a percentage of the area of the sector ONQ. Give your answer correct to 1 decimal place.

$$\begin{aligned} \text{Area of sector} &= \frac{\text{Angle}}{360^\circ} \times \pi r^2 \\ &= \frac{60}{360} \times \pi (11)^2 = 63.35545\ldots \end{aligned}$$

$$\begin{aligned} \text{Area of triangle} &= \frac{1}{2} ab \sin C \\ &= \frac{1}{2} (7)(7) \sin 60 = 21.21762\ldots \end{aligned}$$

$$\begin{aligned} \text{Shaded area} &= 63.35545 - 21.21762 \\ &= 42.13783 \end{aligned}$$

$$\therefore \text{Percentage} = \frac{42.13783}{63.35545} \times 100\% = 66.535\ldots$$

66.5%

(Total for Question 17 is 5 marks)



18  $16^{\frac{1}{5}} \times 2^x = 8^{\frac{3}{4}}$

Work out the exact value of  $x$ .

$$(2^4)^{\frac{1}{5}} \times 2^x = (2^3)^{\frac{3}{4}}$$

$$2^{\frac{4}{5}} \times 2^x = 2^{\frac{9}{4}}$$

$$2^{\frac{4}{5} + x} = 2^{\frac{9}{4}}$$

$$\frac{4}{5} + x = \frac{9}{4}$$

$$x = \frac{9}{4} - \frac{4}{5}$$

$$\frac{29}{20}$$

(Total for Question 18 is 3 marks)

19  $2 - \frac{x+2}{x-3} - \frac{x-6}{x+3}$  can be written as a single fraction in the form  $\frac{ax+b}{x^2-9}$

where  $a$  and  $b$  are integers.

Work out the value of  $a$  and the value of  $b$ .

$$\frac{2(x-3)(x+3) - [(x+2)(x+3)] - [(x-6)(x-3)]}{(x-3)(x+3)}$$

$$= \frac{2(x^2-9) - [x^2+5x+6] - [x^2-9x+18]}{x^2-9}$$

$$= \frac{2x^2-18 - x^2-5x-6 - x^2+9x-18}{x^2-9}$$

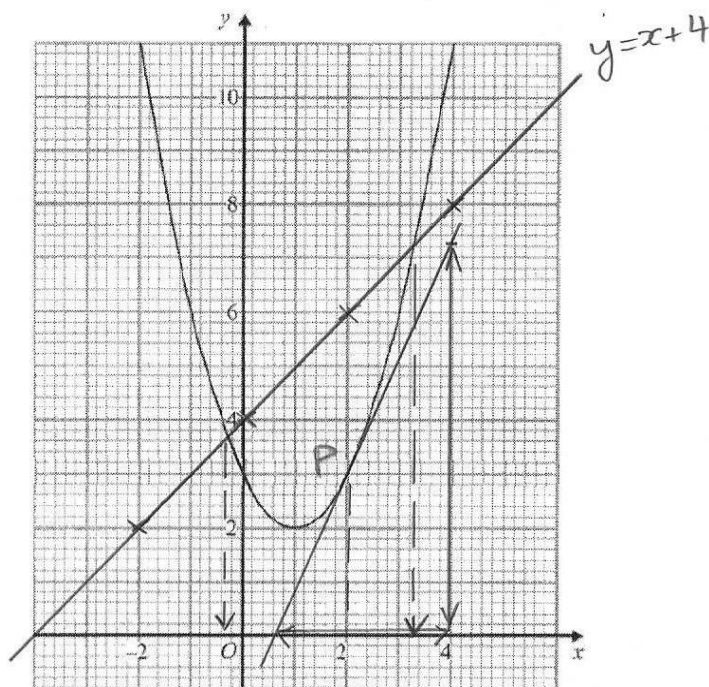
$$= \frac{4x-42}{x^2-9}$$

$$a = 4$$

$$b = -42$$

(Total for Question 19 is 4 marks)

- 20 The diagram shows part of the graph of  $y = x^2 - 2x + 3$



- (a) By drawing a suitable straight line, use your graph to find estimates for the solutions of  $x^2 - 3x - 1 = 0$

$$(x+4)(x+4)$$

$$x^2 - 2x + 3 = x + 4$$

Draw on  $y = x + 4$

$$x = 3.3 \text{ or } -0.3$$

(2)

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

- (b) Calculate an estimate for the gradient of the graph at the point P.

Draw tangent at P

$$\text{Gradient} = \frac{\text{D. up}}{\text{D. ac}} = \frac{7.2}{3.4} = 2.11 \dots \approx 2.1$$

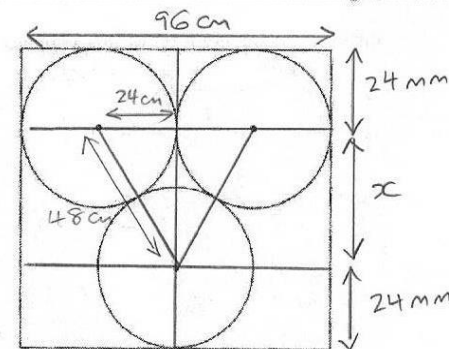
$$2.1$$

(3)

(Total for Question 20 is 5 marks)

- 21 The diagram shows 3 identical circles inside a rectangle.

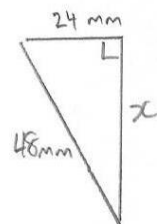
Each circle touches the other two circles and the sides of the rectangle, as shown in the diagram.



The radius of each circle is 24 mm.

Work out the area of the rectangle.

Give your answer correct to 3 significant figures.



$$\begin{aligned} 24^2 + x^2 &= 48^2 \\ 576 + x^2 &= 2304 \\ x^2 &= 1728 \\ x &= 41.569 \dots \end{aligned}$$

$$\begin{aligned} \text{Total height} &= 24 + 41.569 + 24 \\ &= 89.569 \end{aligned}$$

$$\begin{aligned} \therefore \text{Total area} &= 96 \times 89.569 \\ &= 8598.6 \dots \\ &= 8600 \end{aligned}$$

$$8600 \text{ mm}^2$$

(Total for Question 21 is 4 marks)

22 Here are the first five terms of a sequence.

4      11      22      37      56

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

$$\begin{array}{r} \text{Sequence} = 4, 11, 22, 37, 56 \\ \quad \quad \quad \begin{array}{cccc} +4 & +4 & +4 & +4 \\ +7 & +11 & +15 & +19 \end{array} \\ 2n^2 = 2, 8, 18, 32, 50 \\ \hline \text{res} = 2, 3, 4, 5, 6 \\ n = 1, 2, 3, 4, 5 \\ \hline \text{res} = 1, 1, 1, 1, 1 \end{array}$$

$$n\text{th term} = 2n^2 + n + 1$$

$$2n^2 + n + 1$$

(Total for Question 22 is 3 marks)

Check

$$\text{If } n=1, 1^{\text{st}} \text{ term} = 2 + 1 + 1 = 4$$

$$\text{If } n=5, 5^{\text{th}} \text{ term} = 2(25) + 5 + 1 = 50 + 6 = 56$$

It works!

23 L is the circle with equation  $x^2 + y^2 = 4$

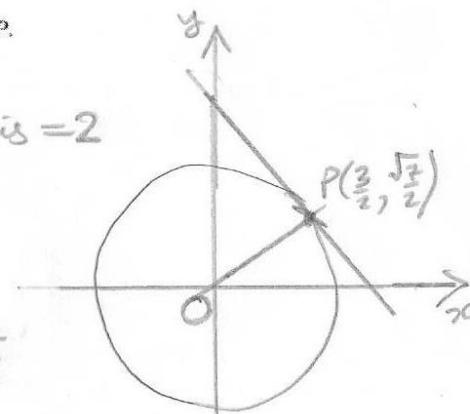
$P\left(\frac{3}{2}, \frac{\sqrt{7}}{2}\right)$  is a point on L.

Find an equation of the tangent to L at the point P.

$$x^2 + y^2 = 4$$

is a circle centre (0,0) radius = 2

$$\begin{aligned} \text{Grad (OP)} &= \frac{\text{diff in } y}{\text{diff in } x} \\ &= \frac{\frac{\sqrt{7}}{2} - 0}{\frac{3}{2} - 0} = \frac{\sqrt{7}}{3} \end{aligned}$$



$$\text{Grad (tangent)} = -\frac{3}{\sqrt{7}} = -\frac{3\sqrt{7}}{7}$$

$$\text{Equation of line is } y = -\frac{3\sqrt{7}}{7}x + c$$

$$\text{Passes through } \left(\frac{3}{2}, \frac{\sqrt{7}}{2}\right) \text{ so } \frac{\sqrt{7}}{2} = -\frac{3\sqrt{7}}{7}\left(\frac{3}{2}\right) + c$$

$$\frac{\sqrt{7}}{2} = -\frac{9\sqrt{7}}{14} + c$$

$$c = \frac{8\sqrt{7}}{7}$$

$$y = -\frac{3\sqrt{7}}{7}x + \frac{8\sqrt{7}}{7}$$

(Total for Question 23 is 3 marks)

TOTAL FOR PAPER IS 80 MARKS