

1 (a) Factorise $y^2 + 27y$

$$y(y + 27)$$

(1)

(b) Simplify $(t^3)^2$

$$t^6$$

(1)

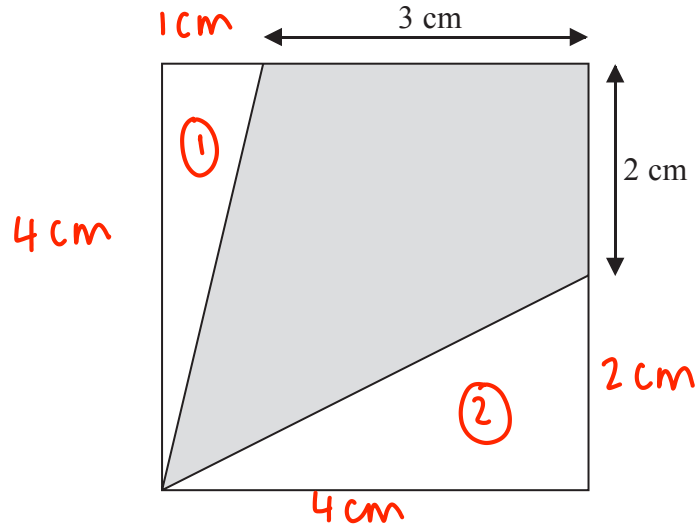
(c) Simplify $\frac{w^9}{w^4}$

$$w^5$$

(1)

(Total for Question 1 is 3 marks)

- 2 The diagram shows a square with perimeter 16 cm.



Work out the proportion of the area inside the square that is shaded.

$$16 \div 4 = 4 \text{ cm}$$

$$\text{Area Square} = 4 \times 4 = 16 \text{ cm}^2$$

$$\text{Area } \textcircled{1} = 4 \times 1 = 4 \div 2 = 2 \text{ cm}^2$$

$$\text{Area } \textcircled{2} = 2 \times 4 = 8 \div 2 = 4 \text{ cm}^2$$

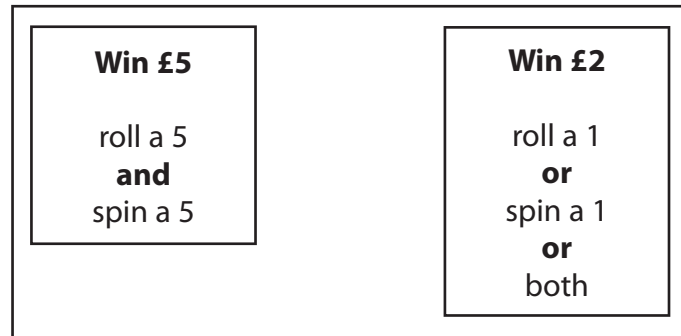
$$\text{Shaded area} = 16 - 2 - 4 = 10 \text{ cm}^2$$

$$10/16$$

(Total for Question 2 is 5 marks)

- 3 David has designed a game.
He uses a fair 6-sided dice and a fair 5-sided spinner.
The dice is numbered 1 to 6
The spinner is numbered 1 to 5

Each player rolls the dice once and spins the spinner once.
A player can win £5 or win £2



David expects 30 people will play his game.
Each person will pay David £1 to play the game.

£30

- (a) Work out how much profit David can expect to make.

Spin

		1	2	3	4	5
1	£2	£2	£2	£2	£2	£2
2	£2					
3	£2					
4	£2					
5	£2					£5
6	£2					

Roll

£25 total

£ 5
(4)

- (b) Give a reason why David's actual profit may be different to the profit he expects to make.

Probabilities are not certain

(1)

(Total for Question 3 is 5 marks)



- 4 Triangle ABC has perimeter 20 cm.

$$AB = 7 \text{ cm.}$$

$$BC = 4 \text{ cm.}$$

$$CA = 20 - 7 - 4 = 9$$

By calculation, deduce whether triangle ABC is a right-angled triangle.

Tip: If it is a right-angled triangle pythagoras will work

$$7^2 + 4^2 = C^2$$

$$49 + 16 = C^2$$

$$65 = C^2$$

$$\begin{array}{r} 49 \\ + 16 \\ \hline 65 \end{array}$$

$$\sqrt{65} \neq 9$$

Not a right-angled triangle

(Total for Question 4 is 4 marks)



- 5 One sheet of A3 card has area $\frac{1}{8} \text{ m}^2$.
The card has a mass of 160 g per m^2 .

Work out the total mass of 25 sheets of A3 card.



$$\begin{array}{rcl}
 \div 8 \swarrow & 160 \text{ g} & = 1 \text{ m}^2 \\
 & \downarrow & \\
 & 20 \text{ g} & = \frac{1}{8} \text{ m}^2 \\
 \swarrow \times 25 & \downarrow & \\
 500 \text{ g} & = &
 \end{array}
 \quad
 \begin{array}{l}
 \searrow \div 8 \text{ (1 sheet)} \\
 \searrow \times 25 \text{ (25 sheets)}
 \end{array}$$

500 g

(Total for Question 5 is 4 marks)



7 A shop has a sale.

Microwave ovens

$\frac{1}{3}$ off normal price

Combination ovens

40% off normal price

A microwave oven has a sale price of £90

A combination oven has a sale price of £84

Which of these ovens has the greater normal price?

You must show all your working.

$$\begin{array}{rcl} \div 2 & \frac{2}{3} = 90 & \div 2 \\ & \downarrow & \downarrow \\ & \frac{1}{3} = 45 & \end{array}$$

original = £135

$$\begin{array}{rcl} \div 6 & 60\% = 84 & \div 6 \\ & \downarrow & \downarrow \\ & 10\% = 14 & \\ \times 10 & \downarrow & \times 10 \\ & 100\% = 140 & \end{array} \quad \begin{array}{r} 14 \\ 6 \overline{)84} \end{array}$$

Combination oven

(Total for Question 7 is 4 marks)

8 Work out an estimate for $\sqrt{4.98 + 2.16 \times 7.35}$

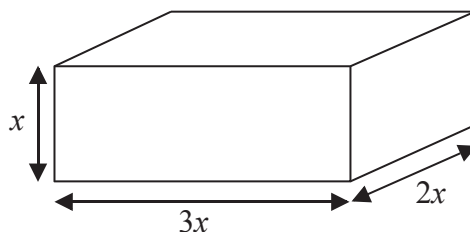
$$\begin{aligned} & \sqrt{5 + 2 \times 7} \\ &= \sqrt{5 + 14} \\ &= \sqrt{19} \end{aligned}$$

$$\sqrt{16} = 4 \quad \sqrt{25} = 5$$

4.3
(4 to 4.5)

(Total for Question 8 is 3 marks)

9 Here is a cuboid.



All measurements are in centimetres.

x is an integer.

The total volume of the cuboid is less than 900 cm^3

Show that $x \leq 5$

$$\begin{array}{rcl}
 x \times 3x \times 2x & < & 900 \\
 6x^3 & < & 900 \\
 \div 6 & & \div 6 \\
 x^3 & < & 150 \\
 \sqrt[3]{} & & \sqrt[3]{} \\
 x & < & \text{Between 5 and 6}
 \end{array}
 \quad \therefore \quad \underline{x \leq 5}$$

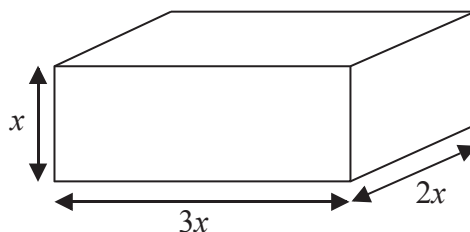
(Total for Question 9 is 3 marks)

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9 Here is a cuboid.



All measurements are in centimetres.

x is an integer.

The total volume of the cuboid is less than 900 cm^3

Show that $x \leq 5$

$$\begin{array}{rcl}
 x \times 3x \times 2x & < & 900 \\
 6x^3 & < & 900 \\
 \div 6 & & \div 6 \\
 x^3 & < & 150 \\
 \sqrt[3]{} & & \sqrt[3]{} \\
 x & < & \text{Between 5 and 6}
 \end{array}
 \quad \therefore \quad \underline{x \leq 5}$$

(Total for Question 9 is 3 marks)

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10 y is inversely proportional to x

When $x = 1.5$, $y = 36$

Find the value of y when $x = 6$

$$y \propto \frac{1}{x}$$

$$\begin{array}{l|l} y & = & \frac{k}{x} \\ 36 & = & \frac{k}{1.5} \\ \times 1.5 & & \times 1.5 \\ 54 & = & k \end{array}$$

$$y = \frac{54}{x}$$

$$y = \frac{54}{6} = 9$$

9

(Total for Question 10 is 3 marks)

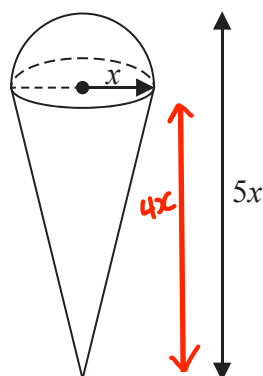
$$\begin{array}{r} \times 36 \\ 15 \\ \hline 180 \\ 360 \\ \hline 540 \end{array}$$

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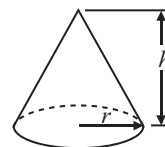
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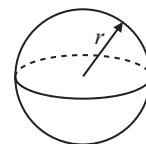
11 A solid is made by putting a hemisphere on top of a cone.



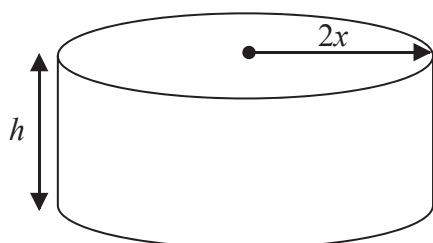
$$\text{Volume of cone} = \frac{1}{3}\pi r^2 h$$



$$\text{Volume of sphere} = \frac{4}{3}\pi r^3$$



The total height of the solid is $5x$
 The radius of the base of the cone is x
 The radius of the hemisphere is x



A cylinder has the same volume as the solid.
 The cylinder has radius $2x$ and height h
 All measurements are in centimetres.

Find a formula for h in terms of x
 Give your answer in its simplest form.

$$\begin{aligned} \text{Volume} &= \frac{1}{3}\pi(x)^2 \times 4x + \frac{1}{2} \times \frac{4}{3}\pi(x)^3 \\ &= \frac{4}{3}\pi x^3 + \frac{4}{6}\pi x^3 \\ &= \frac{8}{6}\pi x^3 + \frac{4}{6}\pi x^3 = \frac{12}{6}\pi x^3 \\ &= 2\pi x^3 \end{aligned}$$

$$\begin{aligned} \text{Volume} &= \pi r^2 h \\ \pi(2x)^2 \times h &= \pi \times 4x^2 \times h \\ &= 4\pi x^2 h \end{aligned}$$

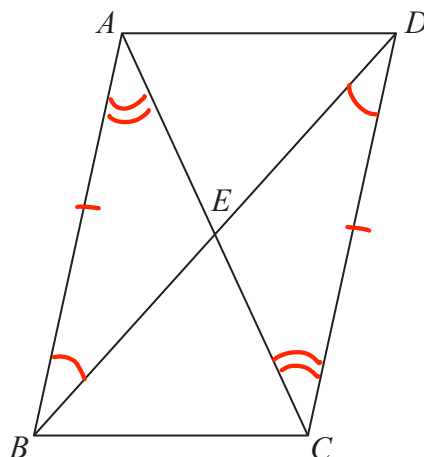
$$\begin{array}{r|l} 4\pi x^2 h & = 2\pi x^3 \\ \div \pi x^2 & \div \pi x^2 \\ 4h & = 2x \\ \div 4 & \div 4 \\ h & = \frac{1}{2}x \end{array}$$

$$h = \frac{1}{2}x$$

(Total for Question 11 is 5 marks)



12 $ABCD$ is a parallelogram.



E is the point where the diagonals AC and BD meet.

Prove that triangle ABE is congruent to triangle CDE .

$AB = DC$ as opposite sides in a parallelogram are equal

$\angle DCE = \angle EAB$ as alternate angles are equal

$\angle ABE = \angle EDC$ as alternate angles are equal

Therefore congruent as ASA proven

(Total for Question 12 is 3 marks)

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13 Mr Brown gives his class a test.

The 10 girls in the class get a mean mark of 70%

The 15 boys in the class get a mean mark of 80%

Nick says that because the mean of 70 and 80 is 75 then the mean mark for the whole class in the test is 75%

Nick is not correct.

Is the correct mean mark less than or greater than 75%?

You must justify your answer.

It will be greater than 75%. There are more boys in the class, so the mean has to be closer to 80% than 70%

(Total for Question 13 is 2 marks)

- 14 Show that $\frac{(4 - \sqrt{3})(4 + \sqrt{3})}{\sqrt{13}}$ simplifies to $\sqrt{13}$

$$\begin{aligned}\frac{16 + 4\sqrt{3} - 4\sqrt{3} - 3}{\sqrt{13}} &= \frac{13}{\sqrt{13}} \times \frac{\sqrt{13}}{\sqrt{13}} \\ &= \frac{13\sqrt{13}}{13} = \sqrt{13}\end{aligned}$$

(Total for Question 14 is 2 marks)

15 (a) Find the value of $\sqrt[3]{8 \times 10^6}$

$$\begin{aligned} & 2 \times 10^2 \\ & = 2 \times 100 \\ & = 200 \end{aligned}$$

200

(1)

(b) Find the value of $144^{\frac{1}{2}} \times 64^{-\frac{1}{3}}$

$$12 \times \frac{1}{4} = 3$$

3

(2)

(c) Solve $3^{2x} = \frac{1}{81}$

$$3^{2x} = \frac{1}{3^4}$$

$$3^{2x} = 3^{-4}$$

$$2x = -4$$

$$x = -2$$

$$x = -2$$

(2)

(Total for Question 15 is 5 marks)

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- 16** The probability that Sanay is late for school tomorrow is 0.05
The probability that Jaden is late for school tomorrow is 0.15

Alfie says that the probability that Sanay and Jaden will both be late for school tomorrow is 0.0075 because $0.05 \times 0.15 = 0.0075$

What assumption has Alfie made?

He has assumed that the events are independent

(Total for Question 16 is 1 mark)

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17 Solve $x^2 - 6x - 8 = 0$

Write your answer in the form $a \pm \sqrt{b}$ where a and b are integers.

Tip: You can use the Quadratic Formula or Complete the Square!

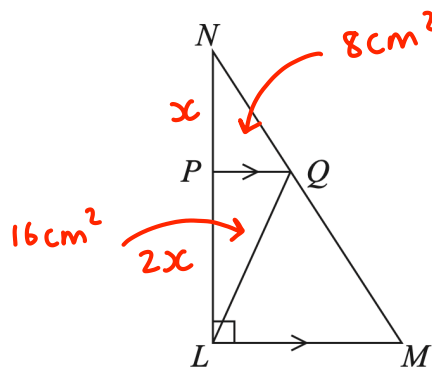
$$\begin{array}{rcl} (x-3)^2 - 17 & = & 0 \\ +17 & & +17 \\ (x-3)^2 & = & 17 \\ \sqrt{} & & \sqrt{} \\ x-3 & = & \pm\sqrt{17} \\ +3 & & +3 \\ x & = & 3 \pm \sqrt{17} \end{array}$$

$$3 \pm \sqrt{17}$$

(Total for Question 17 is 3 marks)



18 LMN is a right-angled triangle.



Angle $NLM = 90^\circ$

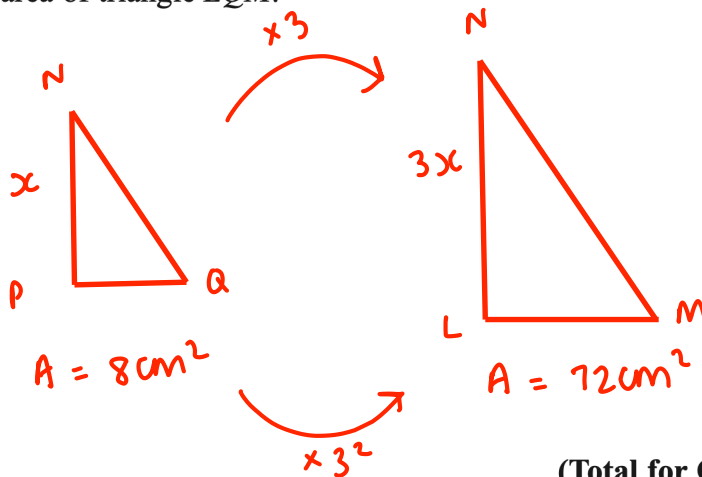
PQ is parallel to LM .

The area of triangle PNQ is 8 cm^2

The area of triangle LPQ is 16 cm^2

Work out the area of triangle LQM .

Length $SF = 3$
Area $SF = 3^2 = 9$



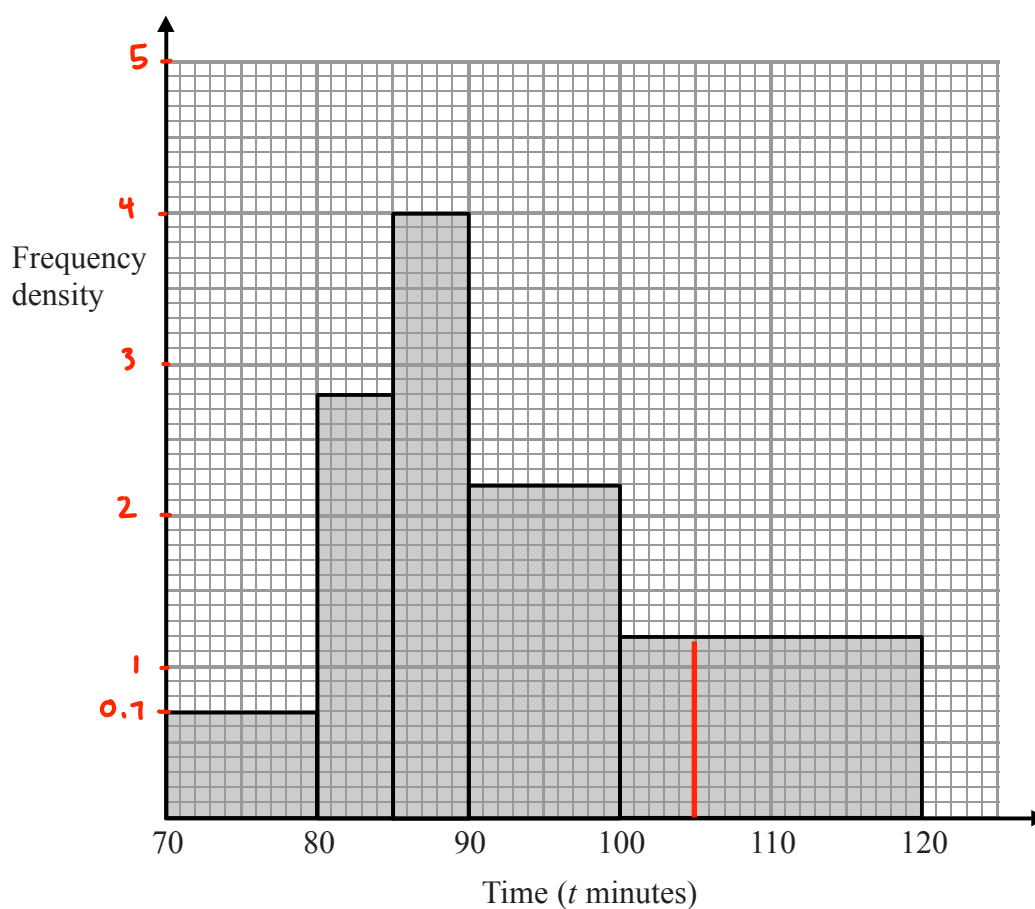
$$16 + 8 = 24$$

$$\begin{array}{r} 6 \\ \times 2 \\ \hline 12 \\ - 24 \\ \hline 48 \end{array}$$

48 cm²

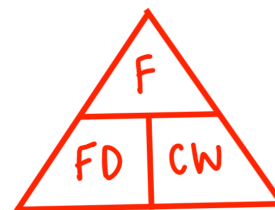
(Total for Question 18 is 4 marks)

- 19 The histogram shows information about the time taken by cyclists to finish a cycle race.



7 cyclists took 80 minutes or less to finish the race.

- (i) Work out an estimate for the number of cyclists who took more than 105 minutes to finish the race.



$$FD = \frac{F}{CW} \quad \frac{7}{10} = 0.7$$

$$20 \times 1.2 = 24$$

$$\frac{3}{4} \times 24 = 18$$

18

- (ii) Explain why your answer to part (i) is only an estimate.

The data is grouped. We only know exactly how many people between 100 and 120.

(Total for Question 19 is 4 marks)



- 20 Show that $\frac{3x+6}{x^2-3x-10} \div \frac{x+5}{x^3-25x}$ simplifies to ax where a is an integer.

$$\frac{3(\cancel{x+2})}{(x-5)(\cancel{x+2})} \div \frac{(\cancel{x+5})}{x(\cancel{x+5})(x-5)}$$

$$\begin{aligned} \frac{3}{(x-5)} \times \frac{x(x-5)}{1} &= \frac{3x(\cancel{x+5})}{(\cancel{x+5})} \\ &= 3x \end{aligned}$$

(Total for Question 20 is 4 marks)

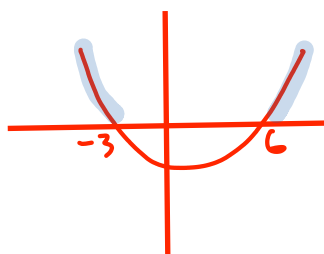
21 Solve the inequality $x^2 > 3(x + 6)$

$$\begin{array}{rcl}
 x^2 & > & 3x + 18 \\
 -3x & & -3x \\
 \hline
 x^2 - 3x & > & 18 \\
 -18 & & -18 \\
 \hline
 x^2 - 3x - 18 & > & 0
 \end{array}$$

$$(x - 6)(x + 3) > 0$$

$$x = 6$$

$$x = -3$$



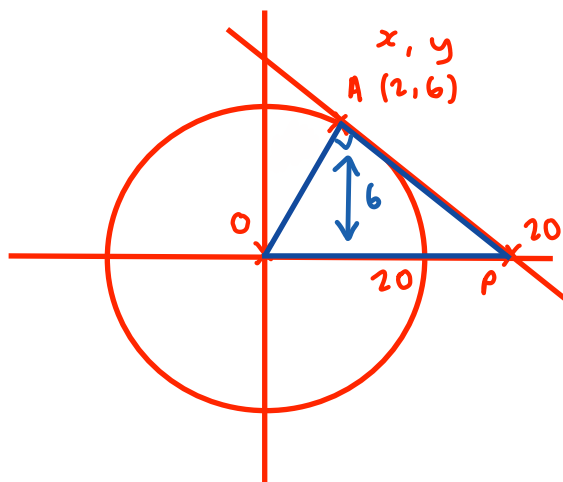
$$x < -3, \quad x > 6$$

(Total for Question 21 is 4 marks)

- 22 The line l is a tangent to the circle $x^2 + y^2 = 40$ at the point A .
 A is the point $(2, 6)$.

The line l crosses the x -axis at the point P .

Work out the area of triangle OAP .



$$\text{Gradient } OP = \frac{6-0}{2-0} = \frac{6}{2} = 3$$

$$\therefore \text{Gradient } AP = -\frac{1}{3}$$

Tip: A tangent to a circle is perpendicular to the radius at the given point

$$y = -\frac{1}{3}x + c$$

$$6 = -\frac{1}{3}(2) + c$$

$$6 = -\frac{2}{3} + c$$

$$+\frac{2}{3} \quad +\frac{2}{3}$$

$$\frac{20}{3} = c$$

$$y = -\frac{1}{3}x + \frac{20}{3}$$

$$\text{At point } P, y = 0$$

$$0 = -\frac{1}{3}x + \frac{20}{3}$$

$$\frac{1}{3}x = \frac{20}{3}$$

$$\times 3 \quad \times 3$$

$$x = 20$$

$$\begin{aligned} \text{Area} &= \frac{1}{2} \times b \times h \\ &= \frac{1}{2} \times 20 \times 6 \\ &= 60 \end{aligned}$$

60

(Total for Question 22 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS