

Please check the examination details below before entering your candidate information

Candidate surname		Other names	
Pearson Edexcel International GCSE		Centre Number 	Candidate Number
Tuesday 21 May 2019			
Morning (Time: 1 hour 30 minutes)		Paper Reference 4MB1/01R	
Mathematics B Paper 1R			
You must have: Ruler graduated in centimetres and millimetres, protractor, compasses, pen, HB pencil, eraser, calculator. Tracing paper may be used.			Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
– *there may be more space than you need.*
- **Calculators may be used.**

Information

- The total mark for this paper is 100.
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Check your answers if you have time at the end.
- Without sufficient working, correct answers may be awarded no marks.

Turn over ►

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Pearson

Answer ALL TWENTY NINE questions.

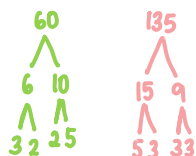
Write your answers in the spaces provided.

You must write down all the stages in your working.

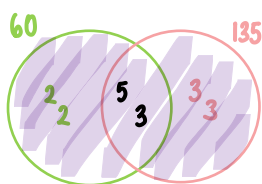
- 1 Find the Lowest Common Multiple (LCM) of 60 and 135

Show your working clearly.

First, draw a factor tree for each number



Place their prime factors in a Venn diagram



The LCM is the product of all prime factors

$$\text{LCM} = 2 \times 2 \times 5 \times 3 \times 3 \times 3$$
$$= 540$$

540

(Total for Question 1 is 2 marks)

- 2 The n th term of a sequence is given by $9n - 7$

Determine whether 214 is a term of this sequence.

Show your working clearly.

If 214 is a term in the sequence, n must be an integer when $9n - 7 = 214$

$$9n - 7 = 214$$

$$9n = 221$$

$$n = 24.5...$$

$\therefore$ 214 is not a term in this sequence

(Total for Question 2 is 2 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



- 3 Here are four numbers written in order of size.

w 7 x 24

The range of the four numbers is 18

The median of the four numbers is 10

Find the value of w and the value of x .

Range: Largest number - Smallest number

Middle: middle value

You can form equations to find w and x using information given.

$$\begin{aligned} 24 - w &= 18 \\ -w &= -6 \\ w &= 6 \end{aligned}$$

$$\begin{aligned} 7 + \frac{x-7}{2} &= 10 \\ \frac{x-7}{2} &= 3 \\ x-7 &= 6 \\ x &= 13 \end{aligned}$$

$$w = 6$$

$$x = 13$$

(Total for Question 3 is 2 marks)

4

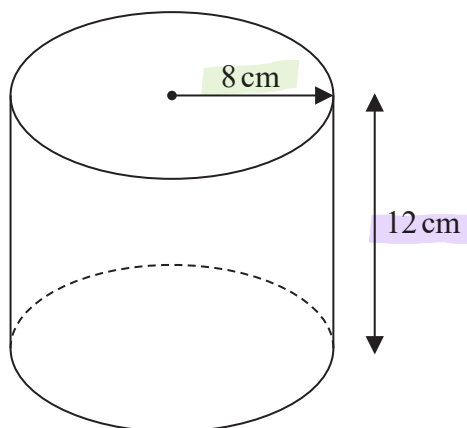


Diagram NOT accurately drawn

The diagram shows a right circular cylinder of radius 8 cm and height 12 cm.

Calculate the volume, in cm^3 to the nearest cm^3 , of the cylinder.

Volume of a cylinder: area of circle $\times$ height

Area of circle: πr^2

$$\pi (8)^2 = 64\pi$$

$$\text{Volume} = 64\pi \times 12$$

$$= 768\pi$$

$$= 2412.7\dots$$

$$\approx 2413 \text{ cm}^3$$

$$2413 \text{ cm}^3$$

(Total for Question 4 is 2 marks)



5 Solve $\frac{2x-3}{5} = 9$

$$\begin{aligned}\frac{2x-3}{5} &= 9 \\ \times 5 & \quad \times 5 \\ 2x-3 &= 45 \\ +3 & \quad +3 \\ 2x &= 48 \\ \div 2 & \quad \div 2 \\ x &= 24\end{aligned}$$

$x = 24$

(Total for Question 5 is 2 marks)

6 $Q = c^2 - 4c$

Work out the value of Q when $c = -6$

Here you simply need to substitute $c = -6$ into the given equation.

$$\begin{aligned}Q &= (-6)^2 - 4(-6) \\ &= 36 + 24 \\ &= 50\end{aligned}$$

$Q = 50$

(Total for Question 6 is 2 marks)

7 Without using a calculator and showing all your working, work out

$$2\frac{3}{4} \div \frac{11}{12}$$

Give your answer in its simplest form.

① Convert into improper fractions

$$\begin{aligned}2\frac{3}{4} &= \frac{(2 \times 4) + 3}{4} \\ &= \frac{8+3}{4} \\ &= \frac{11}{4}\end{aligned}$$

② Flip second fraction and multiply

$$\begin{aligned}\frac{11}{4} \div \frac{11}{12} &= \frac{11}{4} \times \frac{12}{11} \\ &= 3\end{aligned}$$

3

(Total for Question 7 is 2 marks)



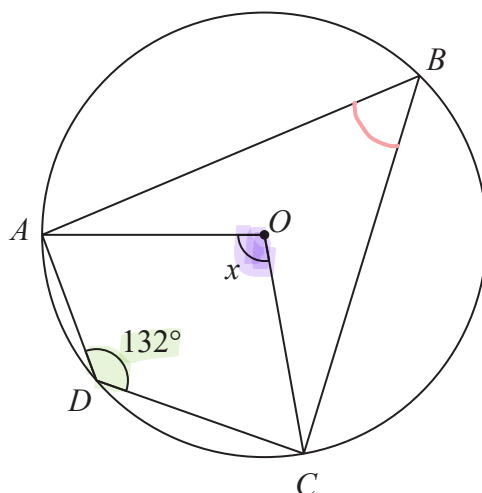


Diagram **NOT**
accurately drawn

A, B, C and D are points on a circle, centre O .

Angle $ADC = 132^\circ$

Calculate, in degrees, the size of angle x .

Opposite angles in a cyclic quadrilateral add to 180° .

$$\angle ADC + \angle ABC = 180$$

$$132 + \angle ABC = 180$$

$$\angle ABC = 48^\circ$$

The angle at the centre is twice the angle at the circumference.

$$\angle AOC = 2 \times \angle ABC$$

$$x = 2 \times 48$$

$$x = 96$$

96

(Total for Question 8 is 2 marks)

9 $y = 4x^3 - \frac{7}{x^2}$

Find $\frac{dy}{dx}$

The general rule for differentiation is 'bring down the power and subtract 1'

① Rewrite y so there are no fractions with an x term

$$y = 4x^3 - 7x^{-2}$$

② Differentiate

$$\frac{dy}{dx} = (2)4x^{2-1} - (-2)7x^{-2-1}$$

$$= 8x + 14x^{-3}$$

$$= 8x + \frac{14}{x^3}$$

$$\frac{dy}{dx} = 8x + \frac{14}{x^3}$$

(Total for Question 9 is 2 marks)



10 Given that a is a positive integer, expand and simplify fully

$$\sqrt{5a}(\sqrt{20a} + a\sqrt{5a})$$

$$\sqrt{a} \times \sqrt{b} = \sqrt{ab}$$

$$\begin{aligned}\sqrt{5a}(\sqrt{20a} + a\sqrt{5a}) &= \sqrt{5a \times 20a} + a\sqrt{5a \times 5a} \\ &= \sqrt{100a^2} + a\sqrt{25a^2} \\ &= 10a + (a \times 5a) \\ &= 10a + 5a^2\end{aligned}$$

$$10a + 5a^2$$

(Total for Question 10 is 2 marks)

11

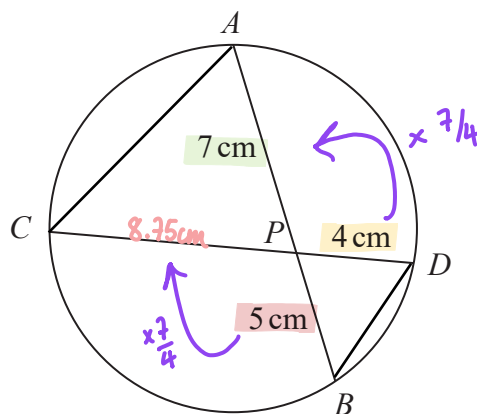


Diagram **NOT** accurately drawn

A , C , B and D are four points on a circle.

The chord AB intersects the chord CD at P .

$$AP = 7 \text{ cm}$$

$$PB = 5 \text{ cm}$$

$$PD = 4 \text{ cm}$$

Calculate, in cm, the length of CP .

The two triangles are similar so have a common scale factor.

$$PD : AP$$

$$4 : 7$$

$$\swarrow \times \frac{7}{4}$$

$$CP : PB$$

$$8.75 : 5$$

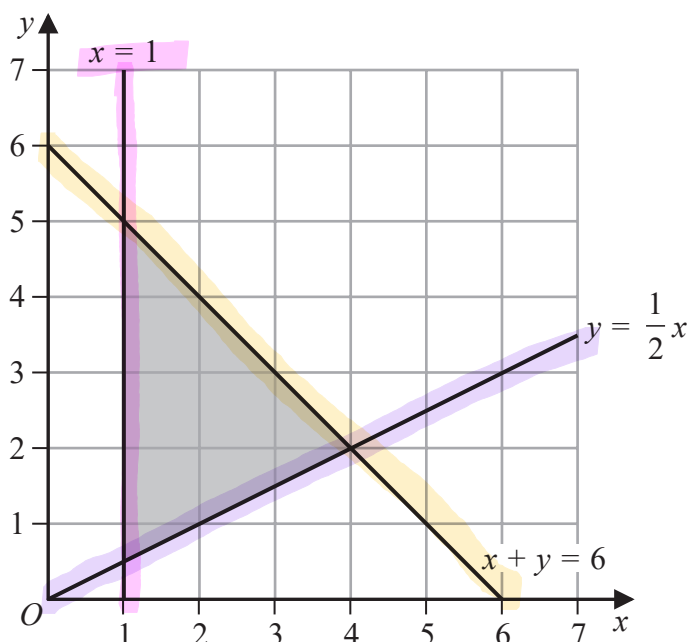
$$\swarrow \times \frac{7}{4}$$

$$8.75 \text{ cm}$$

(Total for Question 11 is 2 marks)



12



Write down the three inequalities that define the shaded region in the diagram above.

All the values of x in the shaded region are greater than 1 and the line is solid

$$\therefore x \geq 1$$

$$x \geq 1$$

If you test (2,2) for $y = \frac{1}{2}x$

$$(2) = \frac{1}{2}(2)$$

$$2 > 1$$

And the line is solid so $y \geq \frac{1}{2}x$

If you test (2,2) for $x + y = 6$

$$(2) + (2) = 6$$

$$4 < 6$$

$$\therefore x + y \leq 6$$

$$y \geq \frac{1}{2}x$$

$$x + y \leq 6$$

(Total for Question 12 is 3 marks)

13 A motorbike was bought for £8600

The motorbike depreciated in value by 20% in the first year after it was bought and by 15% in each of the following years.

Find the value of the motorbike exactly 3 years after it was bought.

If the motorbike's value depreciated by 20%, it only retained 80% of its value.

$$8600 \times 0.8 = 6880$$

Then for the next 2 years it depreciated by 15% so only retained 85% of its value after each year.

$$6880 \times 0.85^2 = 4970.80$$

Find 20% of 8600:

$$8600 \times 0.2 = 1720$$

Subtract:

$$8600 - 1720 = 6880$$

Find 15% of 6880

$$6880 \times 0.15 = 1032$$

Subtract:

$$6880 - 1032 = 5848$$

Find 15% of 5848:

$$5848 \times 0.15 = 877.20$$

$$5848 - 877.20 = 4970.80$$

$$£ 4970.80$$

(Total for Question 13 is 3 marks)



P 6 0 1 9 2 A 0 7 2 4

14

$$A = \begin{pmatrix} 4 & 3 \\ 2 & -1 \end{pmatrix} \quad B = \begin{pmatrix} 4 & x \\ 2y & 7 \end{pmatrix}$$

Given that $5A + nB = \begin{pmatrix} 8 & 27 \\ 1 & -26 \end{pmatrix}$ where n is an integer,

find the value of n , the value of x and the value of y .

$$5A = 5 \begin{pmatrix} 4 & 3 \\ 2 & -1 \end{pmatrix} \quad nB = n \begin{pmatrix} 4 & x \\ 2y & 7 \end{pmatrix}$$

$$= \begin{pmatrix} 20 & 15 \\ 10 & -5 \end{pmatrix} \quad = \begin{pmatrix} 4n & xn \\ 2yn & 7n \end{pmatrix}$$

To add a 2×2 matrix to a 2×2 matrix:

$$\begin{pmatrix} a_1 & b_1 \\ c_1 & d_1 \end{pmatrix} + \begin{pmatrix} a_2 & b_2 \\ c_2 & d_2 \end{pmatrix} = \begin{pmatrix} a_1 + a_2 & b_1 + b_2 \\ c_1 + c_2 & d_1 + d_2 \end{pmatrix}$$

$$\begin{pmatrix} 20 & 15 \\ 10 & -5 \end{pmatrix} + \begin{pmatrix} 4n & xn \\ 2yn & 7n \end{pmatrix} = \begin{pmatrix} 8 & 27 \\ 1 & -26 \end{pmatrix}$$

From here you can form equations to solve for each variable:

$$20 + 4n = 8$$

$$4n = -12$$

$$n = -3$$

$$15 + x(-3) = 27$$

$$-3x = 12$$

$$x = -4$$

$$10 + 2y(-3) = 1$$

$$10 - 6y = 1$$

$$-6y = -9$$

$$y = 3/2$$

$$n = -3$$

$$x = -4$$

$$y = 3/2$$

(Total for Question 14 is 3 marks)



15 (a) $x \times 10^5 + y \times 10^3 = k \times 10^5$

Express k in terms of x and y .

Give your answer in its simplest form.

Here you have to make k the subject

$$x \times 10^5 + y \times 10^3 = k \times 10^5$$

$$\frac{(x \times 10^5 + y \times 10^3)}{10^5} = k$$

$$x^a \div x^b = x^{a-b}$$

$$x + y \times 10^{-2} = k$$

$$k = x + y \times 10^{-2} \quad (2)$$

(b) Calculate $(8.5 \times 10^{64}) \times (4 \times 10^{68})$

Give your answer in standard form.

Here you will have to multiply separately:

Laws of indices:

$$x^a \times x^b = x^{a+b}$$

$$x^a \div x^b = x^{a-b}$$

$$(x^a)^b = x^{ab}$$

$$\begin{aligned} (8.5 \times 10^{64}) \times (4 \times 10^{68}) &= (8.5 \times 4) \times (10^{64} \times 10^{68}) \\ &= 34 \times 10^{64+68} \\ &= 34 \times 10^{132} \\ &= 3.4 \times 10^{133} \end{aligned}$$

$$3.4 \times 10^{133} \quad (2)$$

(Total for Question 15 is 4 marks)



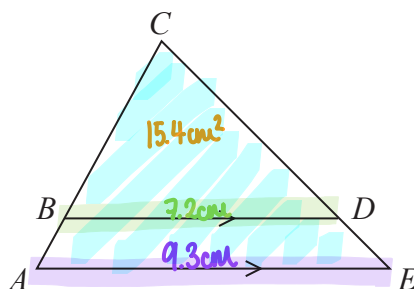


Diagram NOT
accurately drawn

The diagram shows triangle ACE .

The point B on CA and the point D on CE are such that BD is parallel to AE .

$BD = 7.2$ cm to 2 significant figures.

$AE = 9.3$ cm to 2 significant figures.

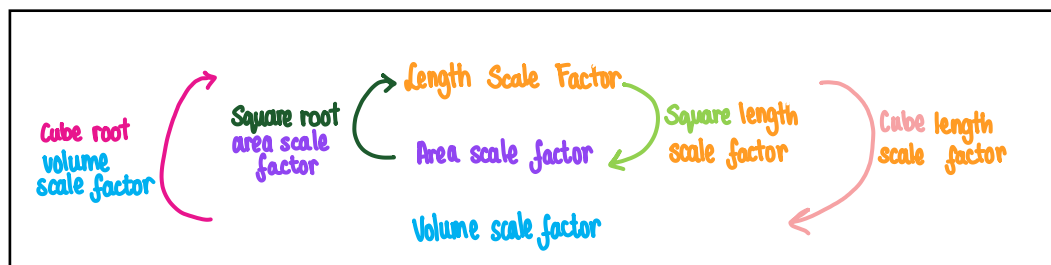
Area of $\triangle BCD = 15.4$ cm² to 3 significant figures.

Calculate the upper bound, to 3 significant figures, for the area of $\triangle ACE$.

This is a scale factor question. You will need to find the scale factor for the upper bound of length and then square this for scale factor of area.

First determine upper bounds:

$$\begin{array}{l} \text{lower bounds} \rightarrow \begin{array}{l} 7.15 \leq BD < 7.25 \\ 9.25 \leq AE < 9.35 \\ 15.35 \leq \triangle BCD < 15.45 \end{array} \leftarrow \text{upper bounds} \end{array}$$



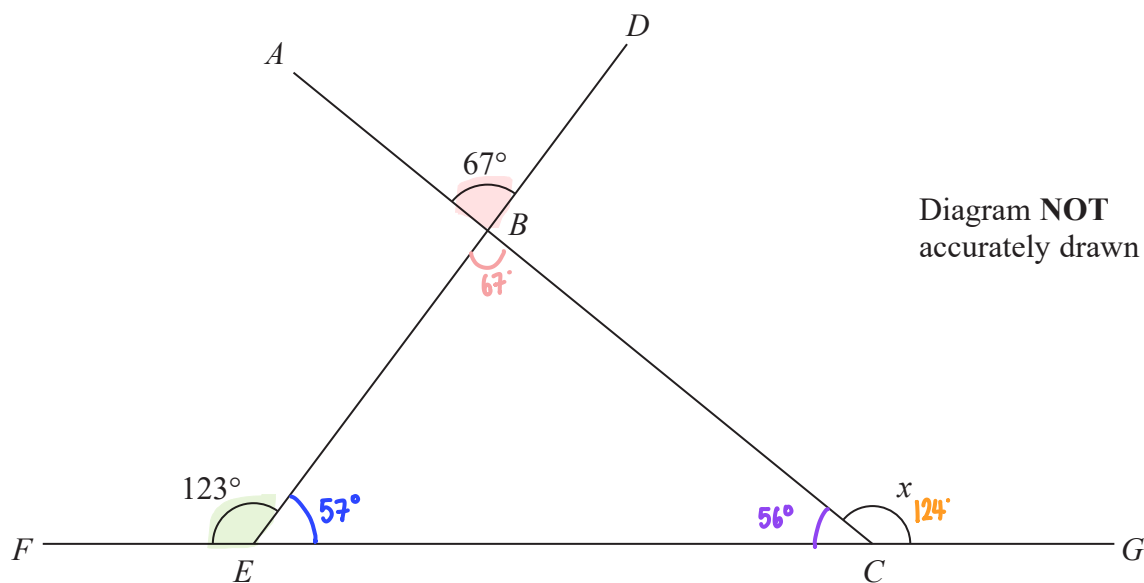
$$\begin{array}{l} BD : AE \\ 7.15 : 9.35 \\ \uparrow \times \frac{9.35}{7.15} \end{array} \rightarrow \begin{array}{l} \text{You should find the biggest possible scale factor} \\ \text{This is the biggest numerator and smallest denominator} \end{array}$$

$$\begin{array}{l} \triangle BCD : \triangle ACE \\ 15.45 : 26.420... \approx 26.4 \text{ (3 s.f.)} \\ \uparrow \left(\frac{9.35}{7.15} \right)^2 \end{array}$$

.....26.4..... cm²

(Total for Question 16 is 3 marks)





The diagram shows three straight lines ABC , DBE and $FECG$.

$\angle ABD = 67^\circ$ and $\angle BEF = 123^\circ$

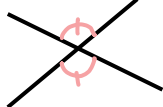
Calculate the size, in degrees, of angle x .

Give a reason for each stage of your working.

For this question, you need to use your angle rules:

① $\angle EBC = \angle ABD$
 $\angle EBC = 67^\circ$

Corresponding angles
are equal.



② $\angle BEC = 180 - \angle BEF$
 $\angle BEC = 180 - 123$
 $\angle BEC = 57^\circ$

Angles on a straight line
add to 180° .

③ $\angle FCB = 180 - \angle EBC - \angle BEC$
 $\angle FCB = 180 - 67 - 57$
 $\angle FCB = 56$

Angles in a
triangle add
up to 180° .

④ $x = 180 - \angle FCB$
 $x = 180 - 56$
 $x = 124^\circ$

Angles on a straight line
add to 180° .

124

(Total for Question 17 is 4 marks)



18 Martin, Jonas and Suzy are three art students.

Martin has x crayons. $M = x$

Jonas has three times as many crayons as Martin. $J = 3x$

Suzy has 7 fewer crayons than Jonas. $S = 3x - 7$

These three students have a total of 56 crayons.

(a) Use all this information to write down an equation in x .

First you need to form an equation for each person then combine them for the total.

$$M = x \quad J = 3x \quad S = 3x - 7$$

$$(x) + (3x) + (3x - 7) = 56$$

$$7x - 7 = 56$$

$$7x - 7 = 56$$

(2)

(b) Find the number of crayons Suzy has.

You need to find the value of x and substitute into Suzy's equation

$$\begin{aligned} 7x - 7 &= 56 \\ +7 & \quad +7 \\ 7x &= 63 \\ \div 7 & \quad \div 7 \\ x &= 9 \end{aligned}$$

$$S = 3x - 7$$

$$S = 3(9) - 7$$

$$S = 27 - 7$$

$$S = 20$$

$$20$$

(2)

(Total for Question 18 is 4 marks)

19 The sum of the interior angles of a regular polygon is 2700°

Calculate the size, in degrees to one decimal place, of each interior angle of the regular polygon.

First, find the number of sides in the polygon:

Sum of the interior angles of a regular polygon: $180(n-2)$

$$\begin{aligned} 180(n-2) &= 2700 \\ \div 180 & \quad \div 180 \\ n-2 &= 15 \\ +2 & \quad +2 \\ n &= 17 \end{aligned}$$

Next divide the sum of angles by the number of sides for each angle:

$$\frac{2700}{17} = 158.823..$$

$$\approx 158.8^\circ$$

$$158.8$$

(Total for Question 19 is 3 marks)



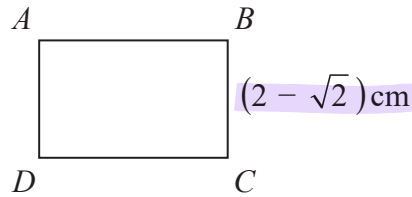


Diagram NOT
accurately drawn

The diagram shows rectangle $ABCD$.

$$AD = BC = (2 - \sqrt{2}) \text{ cm}$$

$$\text{Area of } ABCD = 3(5\sqrt{2} - 2) \text{ cm}^2$$

Show that the length of AB can be written in the form $(a + b\sqrt{2}) \text{ cm}$ where a and b are integers to be found.

Show your working clearly.

In this question you can work backwards from the area equation:

Area of a rectangle = Base $\times$ Height

$$\text{Area of } ABCD = AD \times AB$$

$$3(5\sqrt{2} - 2) = (2 - \sqrt{2}) \times AB$$

$$15\sqrt{2} - 6 = (2 - \sqrt{2}) \times AB$$

$$\div (2 - \sqrt{2}) \quad \frac{15\sqrt{2} - 6}{2 - \sqrt{2}} = AB \quad \div (2 - \sqrt{2})$$

$$\frac{15\sqrt{2} - 6}{2 - \sqrt{2}} \times \frac{(2 + \sqrt{2})}{(2 + \sqrt{2})} = AB \quad \left| \begin{array}{l} \text{Rationalise denominator} \end{array} \right.$$

$$\frac{30\sqrt{2} + 30 - 12 - 6\sqrt{2}}{4 - 2} = AB$$

$$\frac{24\sqrt{2} + 18}{2} = AB$$

$$\div 2 \rightarrow \frac{2(12\sqrt{2} + 9)}{2} = AB$$

$$\underline{\underline{12\sqrt{2} + 9 = AB}}$$

(Total for Question 20 is 3 marks)



21 Solve the simultaneous equations

$$3x + 4y = 4.5$$

$$2x - 3y = 11.5$$

Show clear algebraic working.

There are 2 ways to solve simultaneous equations:

① Elimination

- ① Make the multiplier of x or y equal regardless of negative or positive sign.

If making x equal:

$$\begin{array}{l} 3x + 4y = 4.5 \\ \times 2 \rightarrow 6x + 8y = 9 \end{array}$$

$$\begin{array}{l} 2x - 3y = 11.5 \\ \times 3 \rightarrow 6x - 9y = 34.5 \end{array}$$

- ② Since the signs in front of x are the same, subtract.

$$\begin{array}{r} 6x + 8y = 9 \\ - 6x - 9y = 34.5 \\ \hline 17y = -25.5 \\ \div 17 \rightarrow y = -1.5 \end{array}$$

- ③ Substitute your value of y to find x .

$$\begin{array}{l} 3x + 4(-1.5) = 4.5 \\ 3x + (-6) = 4.5 \\ +6 \rightarrow 3x = 10.5 \\ \div 3 \rightarrow x = 3.5 \end{array}$$

② Substitution

- ① Rearrange an equation so that you have x as the subject

$$\begin{array}{l} 3x + 4y = 4.5 \\ -4y \rightarrow 3x = 4.5 - 4y \\ \div 3 \rightarrow x = \frac{4.5 - 4y}{3} \end{array}$$

- ② Substitute x into the other equation

$$\begin{array}{l} 2\left(\frac{4.5 - 4y}{3}\right) - 3y = 11.5 \\ \text{Expand} \rightarrow \frac{9 - 8y}{3} - 3y = 11.5 \\ \times 3 \rightarrow 9 - 8y - 9y = 34.5 \\ \text{Simplify} \rightarrow 9 - 17y = 34.5 \\ -9 \rightarrow -17y = 25.5 \\ \div -17 \rightarrow y = -1.5 \end{array}$$

- ③ Substitute your value of y to find x .

$$\begin{array}{l} 3x + 4(-1.5) = 4.5 \\ 3x + (-6) = 4.5 \\ +6 \rightarrow 3x = 10.5 \\ \div 3 \rightarrow x = 3.5 \end{array}$$

$$x = 3.5$$

$$y = -1.5$$

(Total for Question 21 is 4 marks)



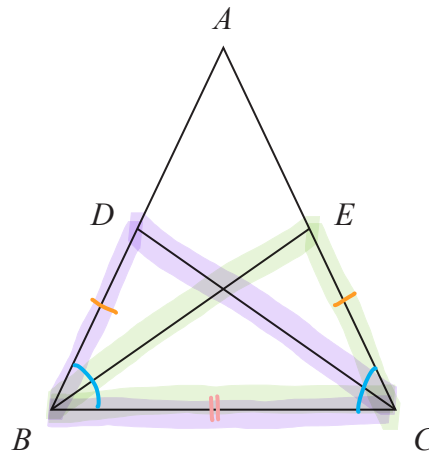


Diagram NOT
accurately drawn

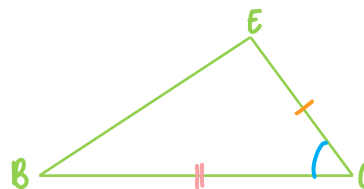
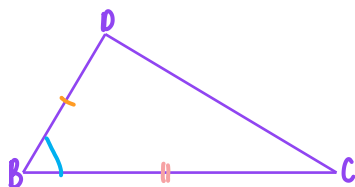
ABC is an isosceles triangle with $AB = AC$.

D and E are the midpoints of the sides AB and AC respectively.

Prove that triangles EBC and DCB are congruent.

There are 4 conditions to prove congruency in triangles:

1. Side - Side - Side (SSS) - all sides are equal.
2. Side - Angle - Side (SAS) - two sides and an angle are equal.
3. Angle - Side - Angle (ASA) - two angles and a side are equal.
4. Right Angle - Hypotenuse - Side (RHS) - Right Angle, hypotenuse and side are equal.



① Sides DB and EC are equal since they are half of AB and AC which are equal
 $DB = EC$

② Opposite angles of an isosceles triangle are equal
 $\angle DBC = \angle ECB$

③ BC is shared
 $BC = BC$

$\therefore EBC$ and DCB are congruent by SAS.

(Total for Question 22 is 4 marks)



23 Given that $\frac{27^{3x}}{9^y} = 3^{2x} \times 3^{x+1}$

find an expression for y in terms of x .
Give your answer in its simplest form.

Laws of indices:

$$x^a \times x^b = x^{a+b}$$

$$x^a \div x^b = x^{a-b}$$

$$(x^a)^b = x^{ab}$$

First, you need to make all of your values have the same base, 3.

$$\frac{27^{3x}}{(3^2)^y} = 3^{2x} \times 3^{x+1}$$

Next, ensure you have one base on either side

$$\frac{3^{9x}}{3^{2y}} = 3^{2x} \times 3^{x+1}$$

$$x^a \div x^b = x^{a-b} \quad \left| \quad \frac{3^{9x}}{3^{2y}} = 3^{2x} \times 3^{x+1} \right| \quad x^a \times x^b = x^{a+b}$$

$$3^{9x-2y} = 3^{2x+(x+1)}$$

Make your power equal and rearrange for y .

$$9x - 2y = 2x + (x+1)$$

$$9x - 2y = 3x + 1 \quad \leftarrow \text{Simplify}$$

$$-9x \quad \leftarrow -9x$$

$$-2y = -6x + 1 \quad \leftarrow -9x$$

$$\div 2 \quad \leftarrow \div 2$$

$$y = \frac{-6x + 1}{-2}$$

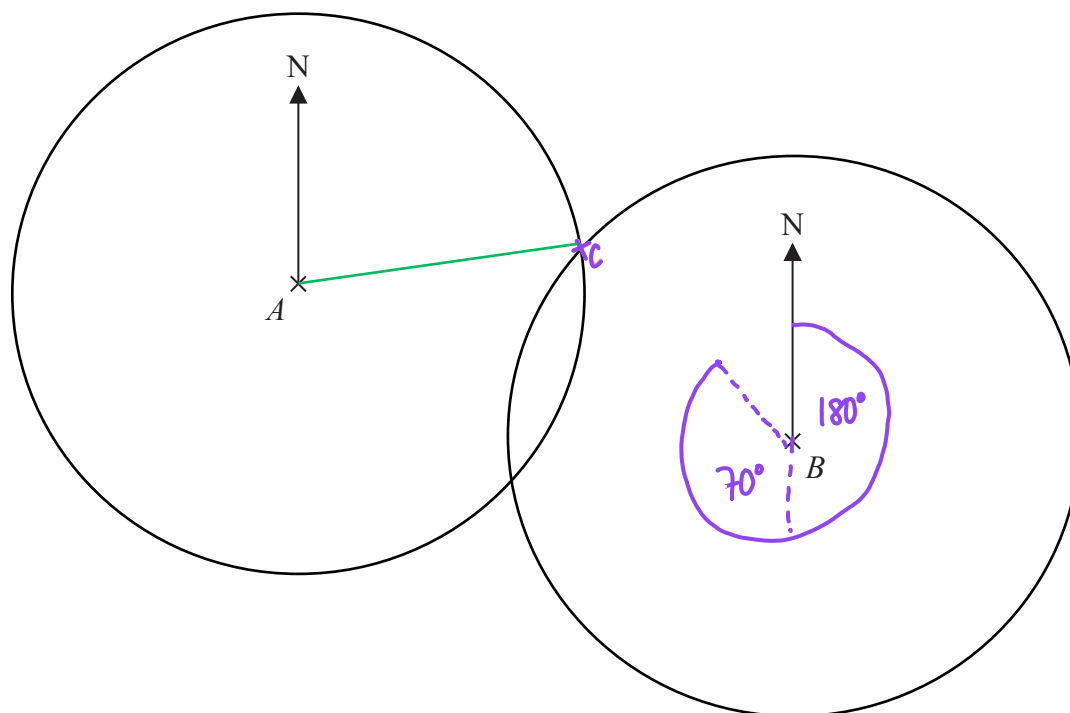
$$y = 3x - \frac{1}{2} \quad \leftarrow \text{Simplify}$$

$$y = 3x - \frac{1}{2}$$

(Total for Question 23 is 4 marks)



24 The scale drawing shows the positions of two posts, A and B .



Scale: 1 cm represents 50 metres

A third post, C , is equidistant from A and B .

- (a) Using ruler and compasses only, construct the locus of points that are equidistant from A and B .

Draw arcs of equal radius and find intersection.

(2)

Given that C is also on a bearing of 250° from B ,

- (b) find and mark the position of C on the scale drawing with a cross ($\times$).
Label the cross C .

Measure 70° from the right of B to locate C .

(2)

- (c) Find by measurement from the scale drawing, the distance, in metres to the nearest metre, of C from A .

Measure length AC .

..... **210 - 230** m

(1)

(Total for Question 24 is 5 marks)



25 The line L_1 has equation $5x + 4y = 16$

The line L_2 is parallel to L_1 and passes through the point with coordinates $(8, 15)$
 L_2 crosses the x -axis at the point A and the y -axis at the point B .

Calculate the length, to the nearest whole number, of AB .

Since L_1 and L_2 are parallel, they must have the same gradient.

① Rearrange L_1 into the form $y = mx + c$ for the gradient

$$\begin{aligned} 5x + 4y &= 16 \\ 4y &= 16 - 5x \\ y &= 4 - \frac{5}{4}x \\ y &= -\frac{5}{4}x + 4 \end{aligned}$$

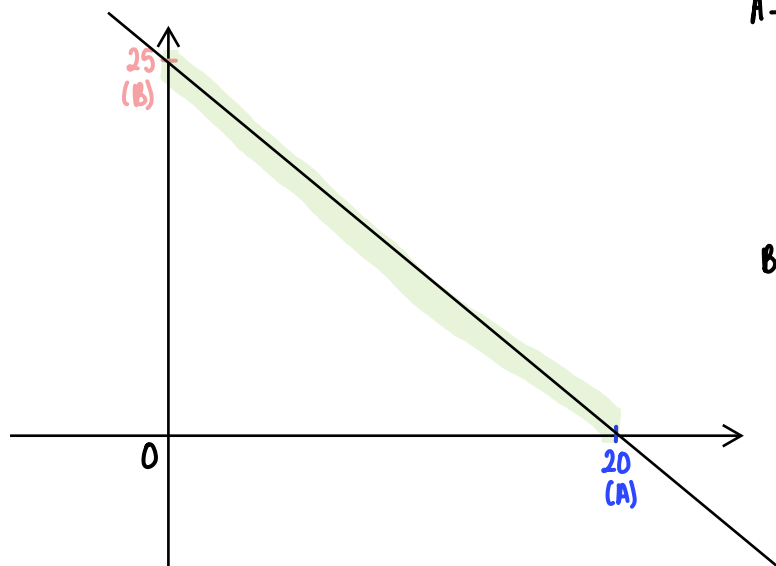
The gradient of L_2 is $-\frac{5}{4}$

② Substitute the gradient and co-ordinates for L_2 to find the equation of L_2 .

$$\begin{aligned} y &= mx + c \\ (15) &= \left(-\frac{5}{4}\right)(8) + c \\ 15 &= -10 + c \\ 25 &= c \end{aligned}$$

$$\therefore L_2 \Rightarrow y = -\frac{5}{4}x + 25$$

③ Find the y -intercept and x -intercept of L_2 for A and B .



$$A \rightarrow 0 = -\frac{5}{4}x + 25$$

$$-25 = -\frac{5}{4}x$$

$$100 = 5x$$

$$20 = x$$

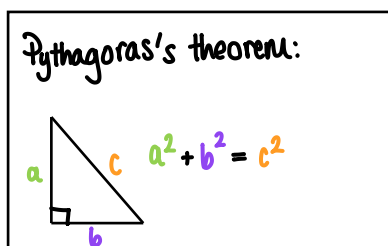
$$\therefore A \rightarrow (20, 0)$$

$$B \rightarrow y = -\frac{5}{4}(0) + 25$$

$$y = 25$$

$$\therefore B \rightarrow (0, 25)$$

④ You can use Pythagoras to find AB



$$AB^2 = OB^2 + OA^2$$

$$AB = \sqrt{(25)^2 + (20)^2}$$

$$\begin{aligned} AB &= 5\sqrt{41} \\ &= 32.01... \end{aligned}$$

$$\approx 32$$

32

(Total for Question 25 is 5 marks)



26 (a) Use the factor theorem to show that $(2x - 1)$ is a factor of $6x^3 + 23x^2 - 5x - 4$

Make $(2x-1)$ equal 0 and rearrange for x

$$\begin{aligned} 2x-1 &= 0 \\ 2x &= 1 \\ x &= \frac{1}{2} \end{aligned}$$

Substitute into cubic and ensure it equals 0.

$$\begin{aligned} 6\left(\frac{1}{2}\right)^3 + 23\left(\frac{1}{2}\right)^2 - 5\left(\frac{1}{2}\right) - 4 &= 0 \\ 0 &= 0 \end{aligned}$$

(2)

(b) Hence, solve $\frac{6x^3 + 23x^2 - 5x - 4}{2x - 1} = 0$

Show clear algebraic working.

There are 2 methods for this:

① Long division

$$\begin{array}{r} 3x^2 + 13x + 4 \\ 2x-1 \overline{) 6x^3 + 23x^2 - 5x - 4} \\ \underline{-6x^3 - 3x^2} \\ 26x^2 - 5x \\ \underline{-26x^2 - 13x} \\ 8x - 4 \\ \underline{-8x + 4} \\ 0 \end{array}$$

② Synthetic division

$$\begin{array}{r} 2x-1=0 \leftarrow \frac{1}{2} \\ x=\frac{1}{2} \end{array} \quad \begin{array}{rrrr} 6 & 23 & -5 & -4 \\ & 3 & 13 & 4 \\ \hline 6 & 26 & 8 & 0 \\ & 3 & 13 & 4 \\ \hline \therefore 3x^2 + 13x + 4 \end{array}$$

$$3x^2 + 13x + 4$$

(4)

(Total for Question 26 is 6 marks)



27 The diagram shows quadrilateral $ABCD$.

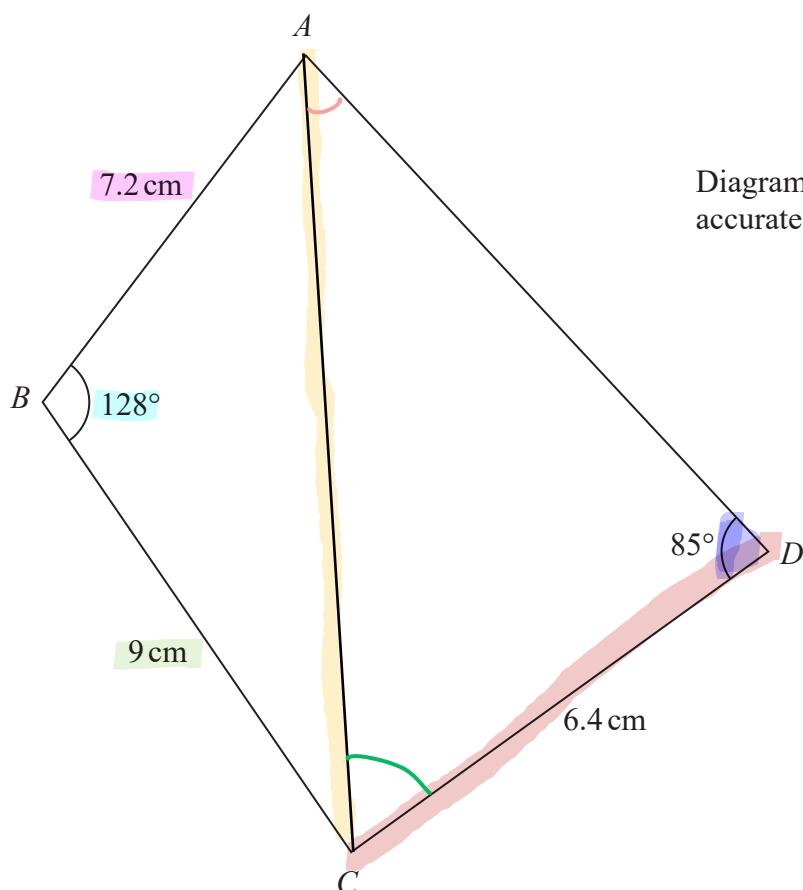


Diagram **NOT**
accurately drawn

$$AB = 7.2 \text{ cm}$$

$$BC = 9 \text{ cm}$$

$$CD = 6.4 \text{ cm}$$

$$\angle ABC = 128^\circ$$

$$\angle ADC = 85^\circ$$

Calculate the area, in cm^2 to 3 significant figures, of quadrilateral $ABCD$.

To find the area of $ABCD$, you need to separate it into triangles ABC and ADC .

ABC :

You can use $\frac{1}{2}ab\sin C$ to find the area of ABC .

where $a = 7.2$

$b = 9$

$C = 128$

$$ABC = \frac{1}{2} \times (7.2) \times (9) \times \sin 128$$

$$ABC = 25.531\dots \text{ (do not round yet)}$$

ADC :

Since we do not know the value of DC , we must first use cosine to find AC and sin to find $\angle CAD$.

$$a^2 = b^2 + c^2 - 2bc \cos A$$

To find AC :

$a = AC$

$b = 7.2$

$c = 9$

$A = 128$

$$(AC)^2 = (7.2)^2 + (9)^2 - 2(7.2)(9) \cos(128)$$

$$AC = \sqrt{(7.2)^2 + (9)^2 - 2(7.2)(9) \cos(128)}$$

$$AC = 14.58182\dots$$



Sine rule for finding an angle:

$$\frac{\sin A}{a} = \frac{\sin B}{b}$$

where $A = CAD$
 $a = 6.4$
 $B = 85$
 $b = 14.58...$

$$\frac{\sin CAD}{6.4} = \frac{\sin 85}{14.58...}$$

$$\sin CAD = \frac{\sin 85}{14.58...} \times 6.4$$

$$CAD = \sin^{-1}\left(\frac{\sin 85}{14.58...} \times 6.4\right)$$

$$CAD = 25.927...$$

Now you can find $\angle ACD$ and use $\frac{1}{2}ab\sin C$ to find area of ADC .

The sum of angles in a triangle is 180° .

$$\angle ACD + 85 + 25.92... = 180$$

$$\angle ACD = 69.07...$$

Area of ADC :

$$a = 14.58... \quad ADC = \frac{1}{2} \times (14.58...) \times (6.4) \times \sin(69.07...)$$

$$b = 6.4$$

$$ADC = 43.58...$$

$$C = 69.07...$$

Now you can add the areas of ABC and ADC :

$$25.531... + 43.58... = 69.11...$$

$$\approx 69.1 \text{ cm}^2$$

69.1 cm²

(Total for Question 27 is 6 marks)



- 28 The table below gives information about the lengths of time, in minutes, that 75 cars were parked in a car park on Sunday.

Time (t minutes)	Frequency
$0 < \overset{2.5}{t} \leq 5$	8
$5 < \overset{12.5}{t} \leq 20$	10
$20 < \overset{25}{t} \leq 30$	15
$30 < \overset{35}{t} \leq 40$	17
$40 < \overset{50}{t} \leq 60$	25

- (a) Calculate an estimate for the mean length of time, in minutes to one decimal place, that the 75 cars were parked in the car park on Sunday.

To find an estimate of mean you must multiply each frequency by the midpoint of the time interval and then divide by the total frequency.

$$\frac{(2.5 \times 8) + (12.5 \times 10) + (25 \times 15) + (35 \times 17) + (50 \times 25)}{75} = \frac{2365}{75}$$

$$= 31.53 \dots$$

$$\approx 31.5$$

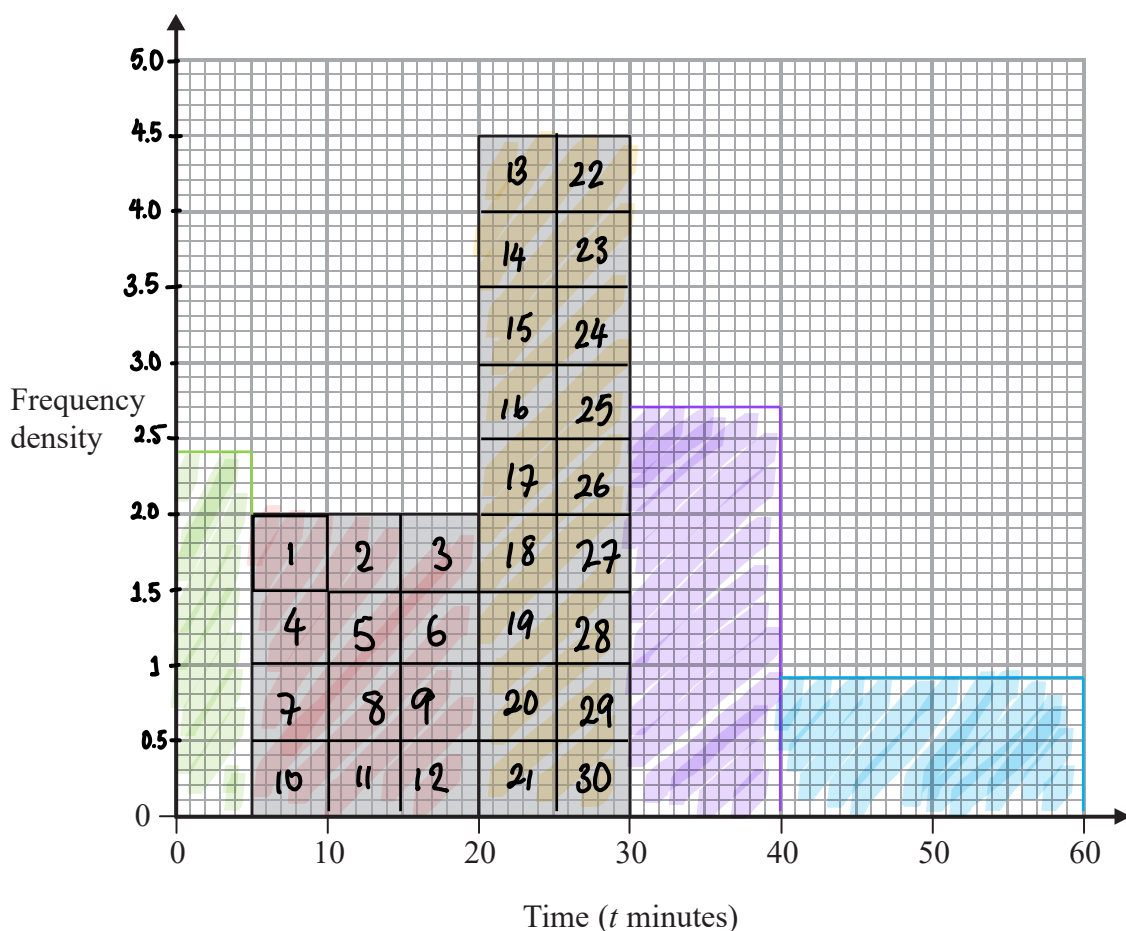
..... 31.5 minutes
(4)



The incomplete table and incomplete histogram give information about the lengths of time, in minutes, that 132 cars were parked in the car park on Monday.

Time (t minutes)	Frequency	Class Width	frequency density
$0 < t \leq 5$	12	5	$(12 \div 5) = 2.4$
$5 < t \leq 20$	$(15 \times 2) = 30$	15	2
$20 < t \leq 30$	$(10 \times 4.5) = 45$	10	4.5
$30 < t \leq 40$	27	10	$(27 \div 10) = 2.7$
$40 < t \leq 60$	18	20	$(18 \div 20) = 0.9$

(b) Complete the histogram and the table. $\text{frequency density} = \text{frequency} \div \text{class width}$



(4)

Since there are a total of 132 cars and we have 57 of them in the frequency table, there must be 75 cars in the two empty boxes.

There are 30 small squares so each square must represent $\frac{75}{30} = 2.5$ cars.

Each square is 5×5 so the height of each is $\frac{2.5}{5} = 0.5$.

(Total for Question 28 is 8 marks)



29 Given that P is inversely proportional to the square of w and that $P = 16$ when $w = 5$

(a) find the value of P when $w = 12.5$

$$\begin{aligned}
 P &\propto \frac{1}{w^2} & P &= \frac{400}{w^2} \\
 P &= \frac{k}{w^2} & P &= \frac{400}{(12.5)^2} \\
 (16) &= \frac{k}{(5)^2} & P &= 2.56 \\
 16 \times 5^2 &= k \\
 400 &= k
 \end{aligned}$$

$$P = 2.56 \dots\dots\dots (3)$$

Given also that P is inversely proportional to y and that $P = 75$ when $y = 4$

(b) find the value of y when $w = 2$

First find P when $w=2$

$$P = \frac{400}{(2)^2}$$

$$P = 100$$

then form an equation for P and y

$$P \propto y$$

$$P = ay$$

$$(75) = a(4)$$

$$25 = a$$

$$\therefore P = 25y$$

Find y when $P=100$

$$\begin{aligned}
 (100) &= 25y \\
 4 &= y
 \end{aligned}$$

$$y = 4 \dots\dots\dots (3)$$

(Total for Question 29 is 6 marks)

(TOTAL FOR PAPER IS 100 MARKS)

