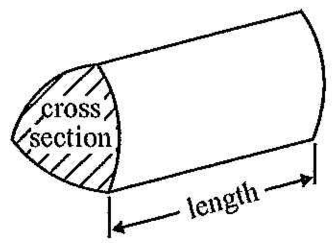
GCSE Mathematics 1MA0

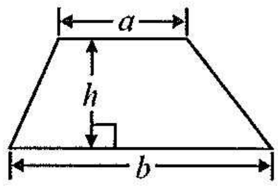
Formulae: Higher Tier

You must not write on this formulae page.
Anything you write on this formulae page will gain NO credit.

Volume of prism = area of cross section × length

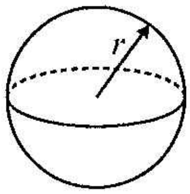


Area of trapezium = $\frac{1}{2}(a + b)h$



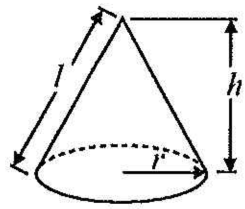
Volume of sphere = $\frac{4}{3}\pi r^3$

Surface area of sphere = $4\pi r^2$

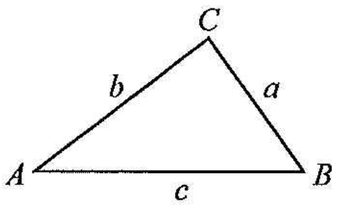


Volume of cone = $\frac{1}{3}\pi r^2 h$

Curved surface area of cone = $\pi r l$



In any triangle ***ABC***



The Quadratic Equation
The solutions of $ax^2 + bx + c = 0$
where $a \neq 0$, are given by

$$x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$$

Sine Rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

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

Area of triangle = $\frac{1}{2} ab \sin C$

P 4 0 6 4 7 A 0 2 2 4

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all stages in your working.

1

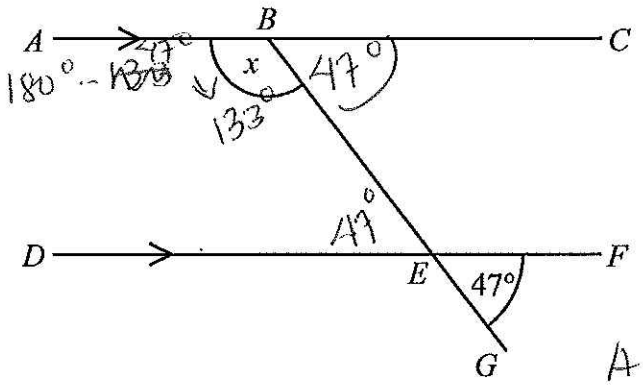


Diagram **NOT** accurately drawn

ABC and *DEF* are parallel lines.
BEG is a straight line.
Angle *GEF* = 47°.

Work out the size of the angle marked *x*.
Give reasons for your answer.

Alternate angles are equal.

Angles on a straight line,

133°

(Total for Question 1 is 3 marks)

2 (a) Use your calculator to work out $\dfrac{38.5 \times 14.2}{18.4 - 5.9}$

Write down all the figures on your calculator display.
You must give your answer as a decimal.

$\dfrac{546.7}{12.5} = 43.736$

.....

(2)

(b) Write your answer to part (a) correct to 1 significant figure.

40.

.....

(1)

(Total for Question 2 is 3 marks)

3 Pradeep wants to find out how much time people spend playing sport.

He uses this question on a questionnaire.

How much time do you spend playing sport?

☐ 0 – 1 hours ☐ 1 – 2 hours ☐ 3 – 4 hours

(a) Write down **two** things wrong with this question.

1 Overlapping boxes.

2 no time frame.

(2)

(b) Design a better question for Pradeep's questionnaire to find out how much time people spend playing sport.

How much time do you spend playing sport each week?

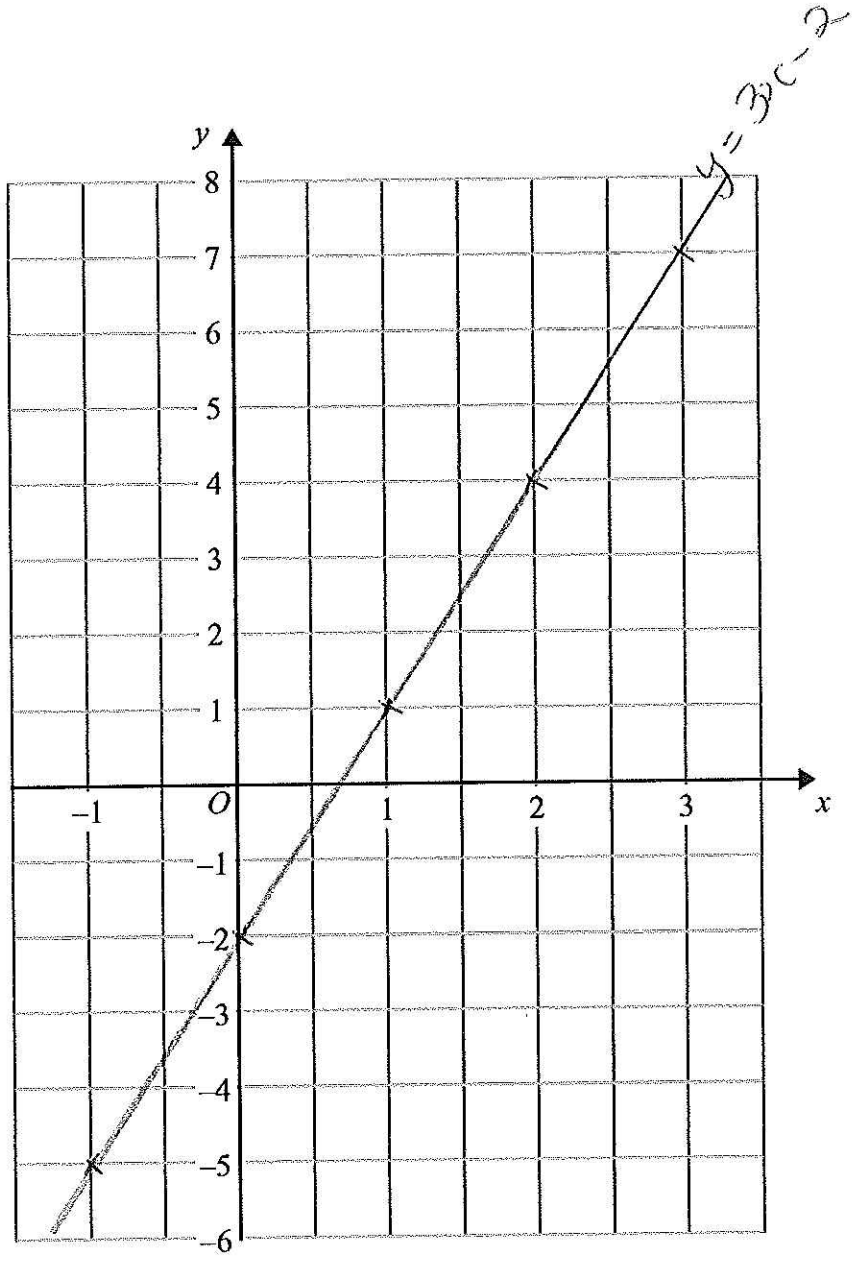
☐ None ☐ 1hr - 2hrs ☐ 3hrs - 5hrs ☐ more than 5 hrs

(2)

(Total for Question 3 is 4 marks)

4 On the grid, draw the graph of $y = 3x - 2$ for values of x from -1 to 3

x	-1	0	1	2	3
y	-5	-2	1	4	7



(Total for Question 4 is 3 marks)

*5 Mr Weaver's garden is in the shape of a rectangle.

In the garden

there is a patio in the shape of a rectangle
and two ponds in the shape of circles with diameter 3.8 m.

The rest of the garden is grass.

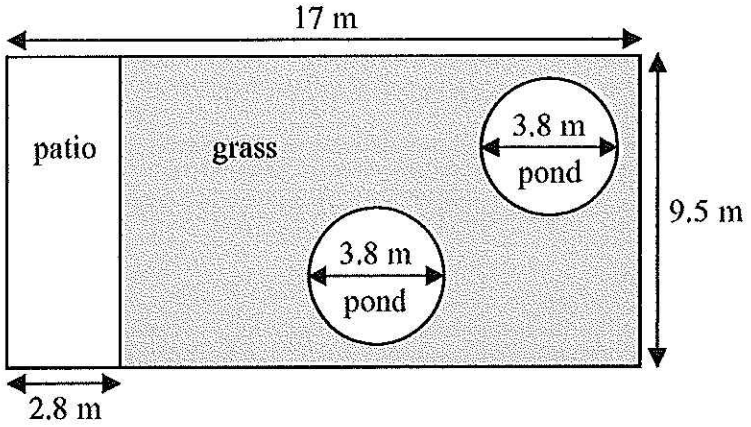


Diagram **NOT** accurately drawn

Mr Weaver is going to spread fertiliser over all the grass.
One box of fertiliser will cover 25 m^2 of grass.

How many boxes of fertiliser does Mr Weaver need?
You must show your working.

$(17 - 2.8) \times 9.5 = 134.9 m^2$

$\pi \times (3.8 \div 2)^2 \times 2 = 11.34$

$134.9 - (2 \times 11.34) = 112.21 m^2$

$112.21 \div 25 = 4.488$

Mr. Weaver needs 5 boxes of fertiliser.

(Total for Question 5 is 5 marks)

*6 Potatoes cost £9 for a 12.5 kg bag at a farm shop.
The same type of potatoes cost £1.83 for a 2.5 kg bag at a supermarket.

Where are the potatoes the better value, at the farm shop or at the supermarket?
You must show your working.

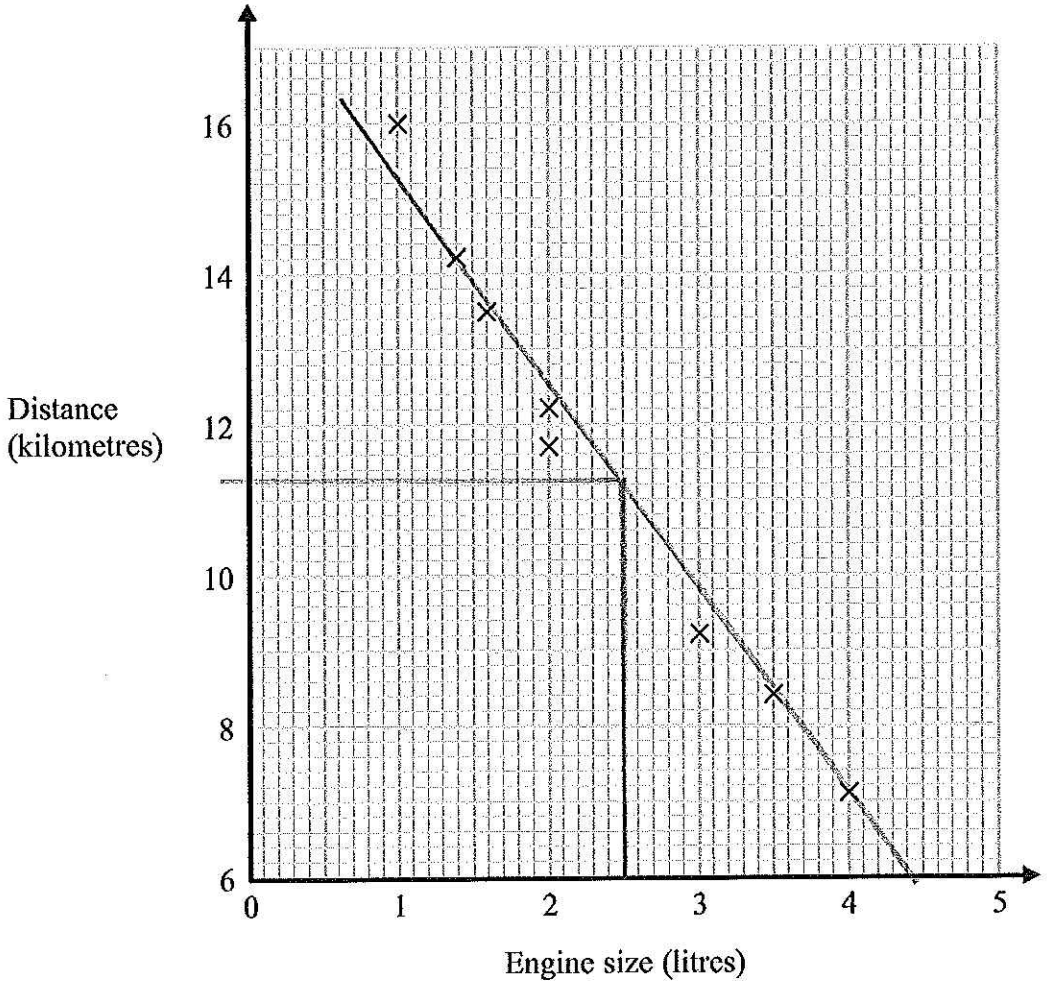
farm shop ~~£9 ÷ 2.5 =~~ 12.5 ÷ 5 = 2.5 kg

£9 ÷ 5 = £1.80.

for the same 2.5 kg bag, the farm shop is cheaper by 3 pence.

(Total for Question 6 is 4 marks)

7 The scatter graph shows some information about 8 cars.
For each car it shows the engine size, in litres, and the distance, in kilometres, the car travels on one litre of petrol.



(a) What type of correlation does the scatter graph show?

Negative correlation

(1)

A different car of the same type has an engine size of 2.5 litres.

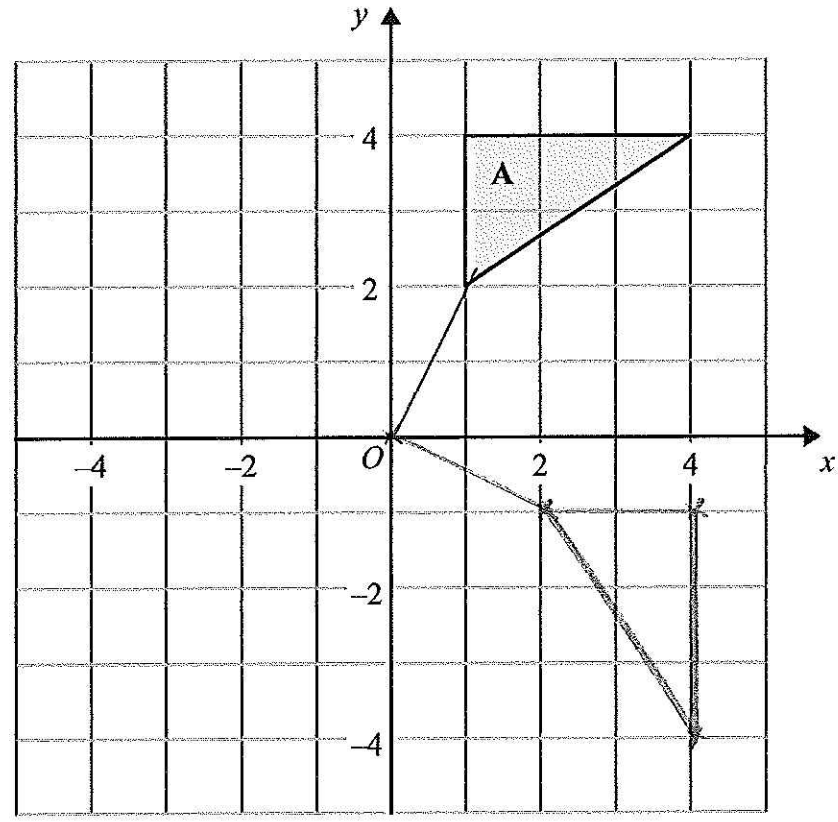
(b) Estimate the distance travelled on one litre of petrol by this car.

11.2 kilometres

(2)

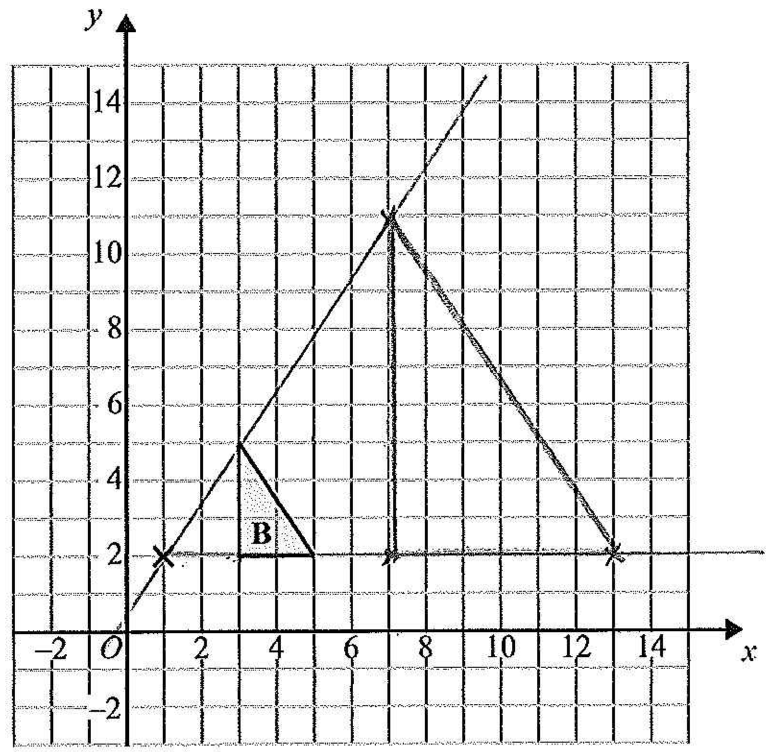
(Total for Question 7 is 3 marks)

8



(a) Rotate triangle **A** 90° clockwise, centre O.

(2)



(b) Enlarge triangle **B** by scale factor 3, centre (1, 2).

(3)

(Total for Question 8 is 5 marks)

P 4 0 6 4 7 A 0 1 0 2 4

9 Linda is going on holiday to the Czech Republic.
She needs to change some money into koruna.

She can only change her money into 100 koruna notes.

Linda only wants to change up to £200 into koruna.
She wants as many 100 koruna notes as possible.

The exchange rate is £1 = 25.82 koruna.

How many 100 koruna notes should she get?

200 × 25·82 = 5164

$\frac{5164}{100}$ = 51·64.

51

(Total for Question 9 is 3 marks)

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10 m is an integer such that $-2 < m \leqslant 3$

(a) Write down all the possible values of m.

$m > -2$
$m \leq 3$

−1, 0, 1, 2, 3

(2)

(b) Solve $7x - 9 < 3x + 4$

$7x - 9 < 3x + 4$
$-3x \quad -3x$
$4x - 9 < 4$
$+9 \quad +9$
$4x < 13 \div 4$
$\div 4$
$x < 3{\cdot}25$

$x < 3{\cdot}25$

(2)

(Total for Question 10 is 4 marks)

11 The equation

$$x^3 - 6x = 72$$

has a solution between 4 and 5

Use a trial and improvement method to find this solution.
Give your answer correct to one decimal place.
You must show **all** your working.

x	$x^3 - 6x = 72$	Comment
4	$4^3 - 24 = 40$	too small
5	$5^3 - 30 = 95$	too big
4.1	$4.1^3 - 24.6 = 44.321$	too small
4.2	$4.2^3 - 25.2 = 48.888$	too small
4.3	$4.3^3 - 25.8 = 53.707$	too small
4.4	$4.4^3 - 26.4 = 58.784$	too small
4.5	$4.5^3 - 27 = 64.125$	too small
4.6	$4.6^3 - 27.6 = 69.736$	too small
4.7	$4.7^3 - 28.2 = 75.623$	too big
4.8	$4.8^3 - 28.8 = 81.792$	too big
4.9	$4.9^3 - 29.4 = 88.249$	too big
4.61	$4.61^3 - 27.66 = 70.312$	too small
4.62	$4.62^3 - 27.72 = 70.891$	too small
4.63	$4.63^3 - 27.78 = 71.472$	too small
4.65	$4.65^3 - 27.9 = 72.644$	too big
(4.64)	$4.64^3 - 27.84 = 72.057$	correct

$x =$ 4.6

(Total for Question 11 is 4 marks)

12 The probability that a biased dice will land on a five is 0.3

Megan is going to roll the dice 400 times.

Work out an estimate for the number of times the dice will land on a five.

$0.3 \times 400 = 120$

120

(Total for Question 12 is 2 marks)

13 Bob asked each of 40 friends how many minutes they took to get to work.

The table shows some information about his results.

Time taken (*m* minutes)	**Frequency**	mid-point	freq x midpt
$0 < m \leqslant 10$	3	5	5x3 = 15
$10 < m \leqslant 20$	8	15	15 x 8 = 120
$20 < m \leqslant 30$	11	25	11 x 25 = 275
$30 < m \leqslant 40$	9	35	9 x 35 = 315
$40 < m \leqslant 50$	9	45	9 x 45 = 405
	total 40		total = 1130

Work out an estimate for the mean time taken.

mean $= \frac{1130}{40} = 28.25$

28.25 minutes

(Total for Question 13 is 4 marks)

P 4 0 6 4 7 A 0 1 3 2 4

Turn over ▷

14 (a) Expand and simplify $(p + 9)(p - 4)$

$p^2 + 9p - 4p - 36$

$p^2 + 5p - 36$

.....

(2)

(b) Solve $\frac{5w - 8}{3} = 4w + 2$

multiply both sides by 3

$5w - 8 = 3(4w + 2)$

$5w - 8 = 12w + 6$

$-5w \quad -5w$

$-8 = 7w + 6$

$-6 \quad -6$

$-14 = 7w$

$\div 7 \quad \div 7$

$-2 = w$

$w =$ -2

(3)

(c) Factorise $x^2 - 49$

difference of 2 squares

$(x + 7)(x - 7)$

.....

(1)

(d) Simplify $(9x^8y^3)^{\frac{1}{2}}$

$= \sqrt{9x^8y^3}$

$= 3x^{(8 \times \frac{1}{2})} y^{(3 \times \frac{1}{2})}$

$3x^4y^{3/2}$

(2)

(Total for Question 14 is 8 marks)

*15 Henry is thinking about having a water meter.

These are the two ways he can pay for the water he uses.

Water Meter	No Water Meter
A charge of £28.20 per year **plus** 91.22p for every cubic metre of water used **1 cubic metre = 1000 litres**	A charge of £107 per year

Henry uses an average of 180 litres of water each day.

Henry wants to pay as little as possible for the water he uses.
Should Henry have a water meter?

Water meter.
~~28.20 + (91.22 x 180,000)~~ ~~365~~
180 x 365 = 65700 litres a year.
65700 ÷ 1000 = 65.7 cubic metres
65.7 x 91.22 = 5993.154 pence.
5993.154 / 100 + 28.20 = £ 88.13
(convert into pounds)

Yes; it is cheaper for him to have a water meter.

(Total for Question 15 is 5 marks)

P 4 0 6 4 7 A 0 1 5 2 4

Turn over ▷

16

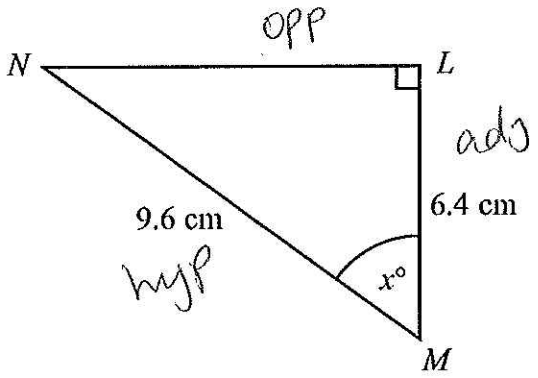

Diagram **NOT** accurately drawn

LMN is a right-angled triangle.
MN = 9.6 cm.
LM = 6.4 cm.

SOH CAH TOA

Calculate the size of the angle marked $x°$.
Give your answer correct to 1 decimal place.

$$\frac{6.4}{9.6} = \cos x^\circ$$

$$x^\circ = 48.189$$

$$= 48.2^\circ$$

48.2° °

(Total for Question 16 is 3 marks)

17 Liam invests £6200 for 3 years in a savings account.
He gets 2.5% per annum compound interest.

How much money will Liam have in his savings account at the end of 3 years?

1st year = $\frac{6200 \times 2.5}{100}$ = £155 interest.

£6200 + 155 = £6355

2nd year $\frac{6355 \times 2.5}{100}$ = £158.875 interest

£6355 + 158.875 = £6513.875

= £6513.88

3rd year. $\frac{6513.88 \times 2.5}{100}$ = £162.85

£6513.88 + 162.85 = £6676.73

£ 6676.73

(Total for Question 17 is 3 marks)

18 The diagram shows a quadrilateral *ABCD*.

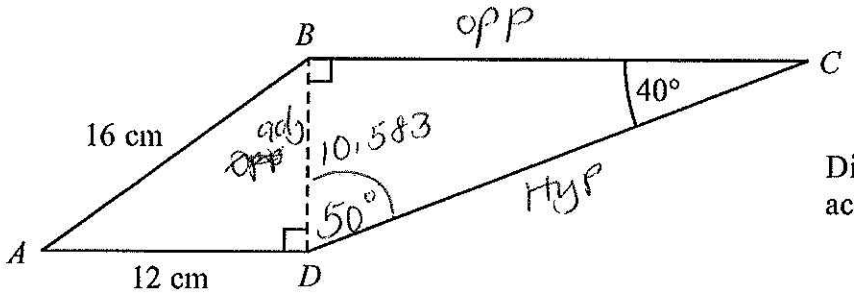

Diagram **NOT** accurately drawn

AB = 16 cm.
AD = 12 cm.
Angle *BCD* = 40°.
Angle *ADB* = angle *CBD* = 90°.

Calculate the length of *CD*.
Give your answer correct to 3 significant figures.

Pythagoras' theorem.

$BD^2 = BA^2 - AD^2$

$BD^2 = 16^2 - 12^2$

$BD^2 = 256 - 144 = 112$

$BD = 10.583\text{ cm}$.

SOH CAH TOA

$\frac{10.583}{CD} = \cos 50^\circ$

$10.583 = CD \cos 50^\circ$

$\frac{10.583}{\cos 50^\circ} = CD$

$16.459 = CD$

16.5cm cm

(Total for Question 18 is 5 marks)

21 Prove that

$(2n + 3)^2 - (2n - 3)^2$ is a multiple of 8

for all positive integer values of n.

$(2n+3)(2n+3) = 4n^2 + 6n + 6n + 9$

$= 4n^2 + 12n + 9$

$(2n-3)(2n-3) = 4n^2 - 6n - 6n + 9$

$= 4n^2 - 12n + 9.$

$4n^2 + 12n + 9 - (4n^2 - 12n + 9)$

$= 4n^2 + 12n + 9 - 4n^2 + 12n - 9$

$= 24n = 8(3n)$ (all the other values cancel out)

Proof it is a multiple of 8.

(Total for Question 21 is 3 marks)

22 Solve $3x^2 - 4x - 2 = 0$

Give your solutions correct to 3 significant figures.

$a = 3$

$b = -4$

$c = -2$

using the quadratic formula.

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$= \frac{4 \pm \sqrt{16 - (4 \times 3 \times -2)}}{6}$

$= \frac{4 \pm \sqrt{16 + 24}}{6}$

$= \frac{4 \pm \sqrt{40}}{6}$

$= \frac{4 \pm 6.3245}{6}$

$x = \frac{10.3245}{6}$ or $\frac{-2.3245}{6}$

$x = 1.72$ or -0.387

(Total for Question 22 is 3 marks)

23 (a) Max wants to take a random sample of students from his year group.

(i) Explain what is meant by a random sample.

Every member of the population has an equal chance of being selected

(ii) Describe a method Max could use to take his random sample.

Number each student and randomly select them

(2)

(b) The table below shows the numbers of students in 5 year groups at a school.

Year	Number of students
9	239
10	257
11	248
12	190
13	206

Lisa takes a stratified sample of 100 students by year group.

Work out the number of students from Year 9 she has in her sample.

$\frac{239}{1140} \times 100 = 21$

(20.9649)

21

(2)

(Total for Question 23 is 4 marks)

P 4 0 6 4 7 A 0 2 0 2 4

24

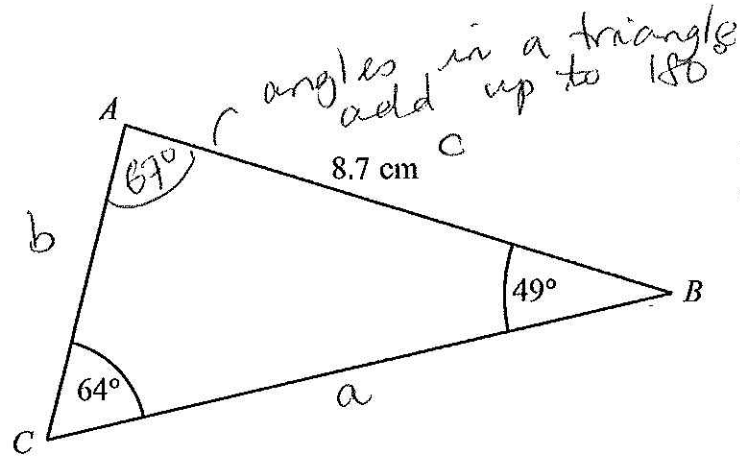

Diagram **NOT** accurately drawn

ABC is a triangle.

AB = 8.7 cm.
Angle *ABC* = 49°.
Angle *ACB* = 64°.

Calculate the area of triangle *ABC*.
Give your answer correct to 3 significant figures.

using the sine rule.

$\frac{b}{\sin B} = \frac{c}{\sin C}$

$\frac{b}{\sin 49°} = \frac{8.7}{\sin 64°}$

$b \sin 64° = 8.7 \sin 49°$

$b = 7.305$ cm.

Area of $ABC = \frac{1}{2} ab \sin C$

$= \frac{1}{2} \times 8.7 \times 7.31 \sin 67°$

$= 29.27 \text{ cm}^2$

$= 29.3 \text{ cm}^2$

29.3 .... cm^2

(Total for Question 24 is 5 marks)

P 4 0 6 4 7 A 0 2 1 2 4

Turn over ▷

25 Carolyn has 20 biscuits in a tin.

She has

12 plain biscuits
5 chocolate biscuits
3 ginger biscuits

Carolyn takes at random two biscuits from the tin.

Work out the probability that the two biscuits were **not** the same type.

Probability of the same type.

$\left(\frac{12}{20} \times \frac{11}{19}\right) + \left(\frac{5}{20} \times \frac{4}{19}\right) + \left(\frac{3}{20} \times \frac{2}{19}\right)$

Plain Chocolate Ginger

$= \frac{222}{380} \quad \frac{158}{380}$

$\frac{380}{380} - \frac{158}{380} = \frac{222}{380}$

All probabilities add up to 1

.....

(Total for Question 25 is 4 marks)

26

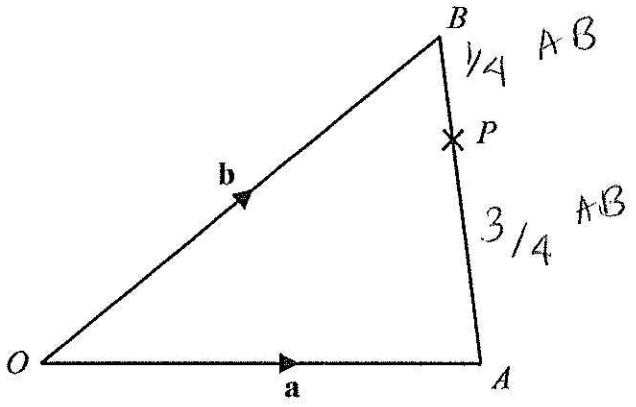

Diagram **NOT** accurately drawn

OAB is a triangle.

$\overrightarrow{OA} = \mathbf{a}$

$\overrightarrow{OB} = \mathbf{b}$

(a) Find $\overrightarrow{AB}$ in terms of **a** and **b**.

$\overrightarrow{AB} = \overrightarrow{AO} + \overrightarrow{OB}$

$= -a + b$

$= b - a$

.....

(1)

P is the point on AB such that $AP : PB = 3 : 1$

(b) Find $\overrightarrow{OP}$ in terms of **a** and **b**.
Give your answer in its simplest form.

$\overrightarrow{OP} = \overrightarrow{OB} + \frac{1}{4}\overrightarrow{BA}$

$= b + \frac{1}{4}(a - b)$

$= b + \frac{1}{4}a - \frac{1}{4}b$

$= \frac{3}{4}b + \frac{1}{4}a$

$\overrightarrow{OP} = \frac{1}{4}(a + 3b)$

.....

(3)

(Total for Question 26 is 4 marks)

TOTAL FOR PAPER IS 100 MARKS

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