Write your name here

Surname

Other names

Centre Number

Candidate Number

**Edexcel GCSE**

# Mathematics B
## Unit 3: Number, Algebra, Geometry 2 (Calculator)

### Higher Tier

Tuesday 13 November 2012 – Morning
Time: 1 hour 45 minutes

Paper Reference
**5MB3H/01**

**You must have:** Ruler graduated in centimetres and millimetres, protractor, pair of 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.**
- If your calculator does not have a $\pi$ button, take the value of $\pi$ to be 3.142 unless the question instructs otherwise.

## Information

- The total mark for this paper is 80
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed.
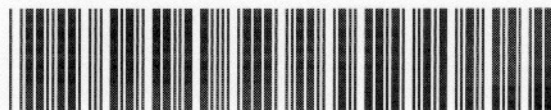
## Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

*Turn over*

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**PEARSON**

**1**  $3x + 5 > 16$

$x$ is an integer.

Find the smallest value of $x$.

$3x > 16 - 5$

$3x > 11$

$x > \dfrac{11}{3}$

$x > 3\,{}^{2}\!/_{3}$

4

**(Total for Question 1 is 3 marks)**

**2**  Brian is $x$ years old.
Peter is 4 years older than Brian.
Amy is 2 years younger than Brian.

The total of their ages is 26 years.

Work out the value of $x$.

$x + (x + 4) + (x - 2) = 26$

$3x + 2 = 26$

$3x = 24$
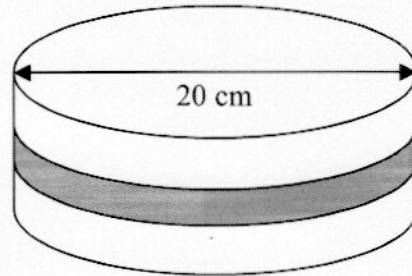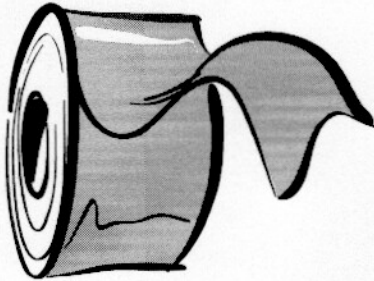
$x = 8$

$x = 8$

**(Total for Question 2 is 4 marks)**

**3** Susan has a round cake.
The cake has a diameter of 20 cm.

Diagram **NOT**
accurately drawn

20 cm

Susan wants to put a ribbon round the cake.
What is the least length of ribbon she can use?

Circumference = $\pi D$

$= 20 \times \pi = 62.83$ cm

62.8 cm

**(Total for Question 3 is 3 marks)**

1 mark for units

*4  Gordon owns a shop.

Here are the prices of three items in Gordon's shop and in a Supermarket.

| Gordon's Shop | |
| --- | --- |
| 400 g loaf of bread | £1.22 |
| 1 litre of milk | £0.96 |
| 40 tea bags | £2.42 |

| Supermarket | |
| --- | --- |
| 400 g loaf of bread | £1.15 |
| 1 litre of milk | £0.86 |
| 40 tea bags | £2.28 |

Gordon reduces his prices by 5%.
Will the total cost of these three items be cheaper in Gordon's shop than in the Supermarket?

Gordon's current total: $1.22 + 0.96 + 2.42 = £4.60$

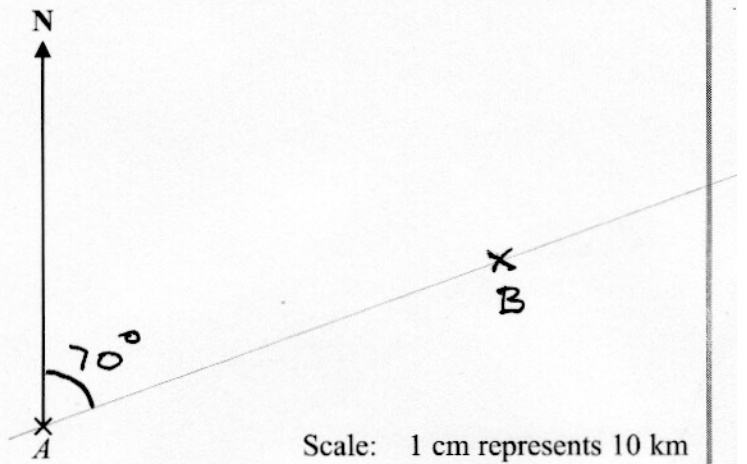Gordon's total after discount: $4.6 \times 0.95 = £4.37$

Supermarket total: $1.15 + 0.86 + 2.28 = £4.29$

No, even with the discount they are more expensive in Gordon's shop, than in the supermarket.

(Total for Question 4 is 3 marks)

**5** The diagram shows the position of town *A*.

N

70°

×
A

×
B

Scale:   1 cm represents 10 km

Town *B* is 64 km from town *A* on a bearing of 070°.

Mark the position of town *B*, with a cross (×).
Use a scale of 1 cm represents 10 km.

**(Total for Question 5 is 2 marks)**

6  (a) Solve  $3(2p - 5) = 21$

$\div 3$  $2p - 5 = 7$

$2p = 7 + 5 = 12$

$p = 6$

(check: $2p - 5 = 12 - 5 = 7$,
$3 \times 7 = 21$ ✓).

$p = \underline{\hphantom{xx} 6 \hphantom{xx}}$

(3)

(b) Solve  $9x - 11 = 5x + 7$

$-5x$  $4x - 11 = 7$

$+11$  $4x = 7 + 11 = 18$

$x = \dfrac{18}{4} = 4\tfrac{1}{2}$

$x = \underline{\hphantom{xx} 4\tfrac{1}{2} \hphantom{xx}}$

(3)

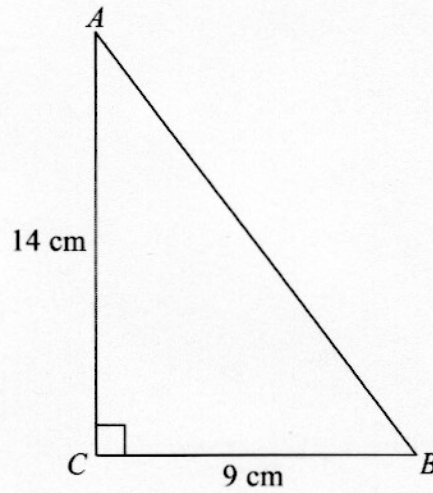**(Total for Question 6 is 6 marks)**

7



Diagram **NOT**
accurately drawn

14 cm

9 cm

Calculate the length of *AB*.
Give your answer correct to 1 decimal place.

$$AB^2 = 9^2 + 14^2 = 277$$

$$AB = \sqrt{277} = 16.6433$$

$$= 16.6 \text{ cm to 1 decimal place}$$

.........16.6......... cm

**(Total for Question 7 is 3 marks)**

*8  Sam is going to paint his garden shed.

The paint is sold in two different shops.

**Paint For You**

2.5 litres

£8.35 plus VAT at 20%

**Paul's Paints**

0.75 litres

£3.15

Sam needs **7.5 litres** of paint.

Sam wants to buy the cheapest paint.
He is going to buy the paint from one of these shops.

Which shop should he buy the paint from?
You must show your working.

Paint for you :

7.5 litres = 3 × 2.5 litres

3 × £8.35 × 1.2 = £26.25

Paul's Paints :

7.5 litres = 10 × 0.75 litres

10 × £3.15 = £31.50

The paint will be cheaper from Paint For You.

(Total for Question 8 is 4 marks)

**9** The diagram shows an L-shaped prism.

2 cm

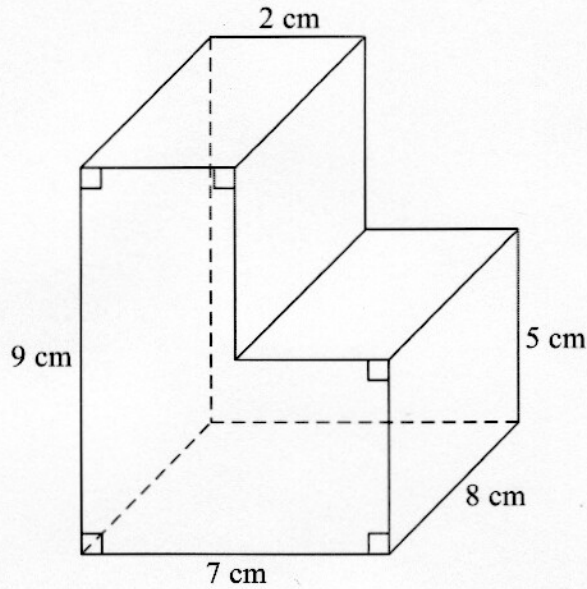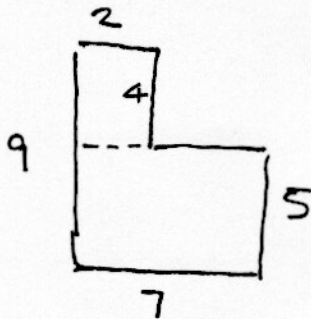Diagram **NOT**
accurately drawn

9 cm

5 cm

8 cm

7 cm

Calculate the volume of the prism.

Volume = (cross-section area) × length.

2

4

9

5

7

Cross-sectional area = 2 × 4 + 7 × 5

= 8 + 35 = 43 cm²

length = 8 cm.

∴ Volume = 43 cm² × 8 cm = 344 cm³

___3 4 4___ cm³

**(Total for Question 9 is 3 marks)**

10



$x=3$
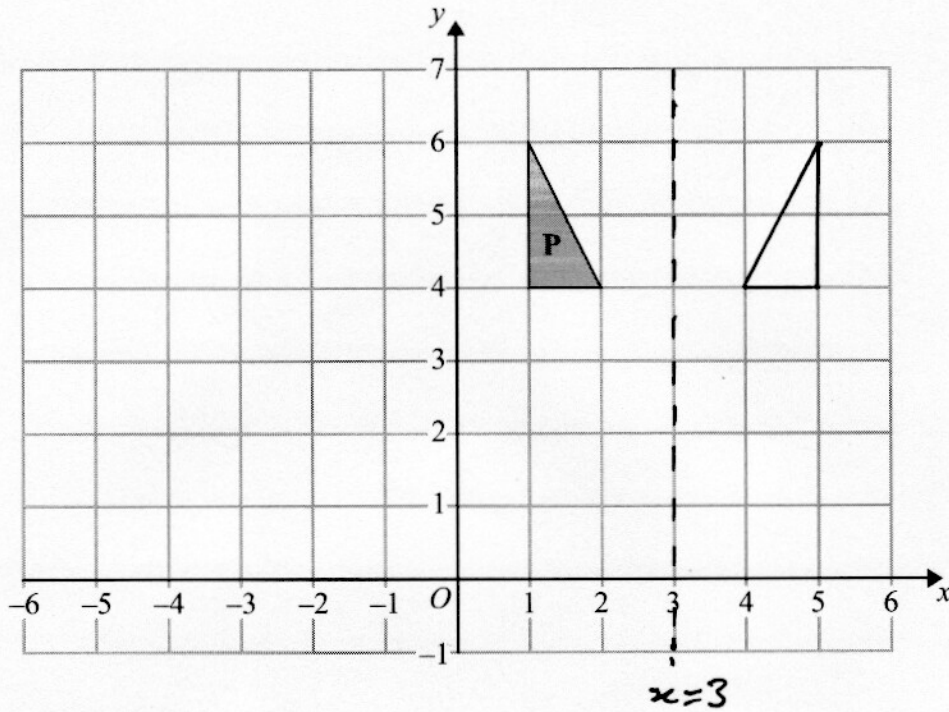
(a) Reflect shape **P** in the line $x = 3$

(2)



(b) Describe fully the single transformation that maps shape **A** onto shape **B**.

Rotation, anti clockwise through 90° about centre of rotation (0,1)

(3)

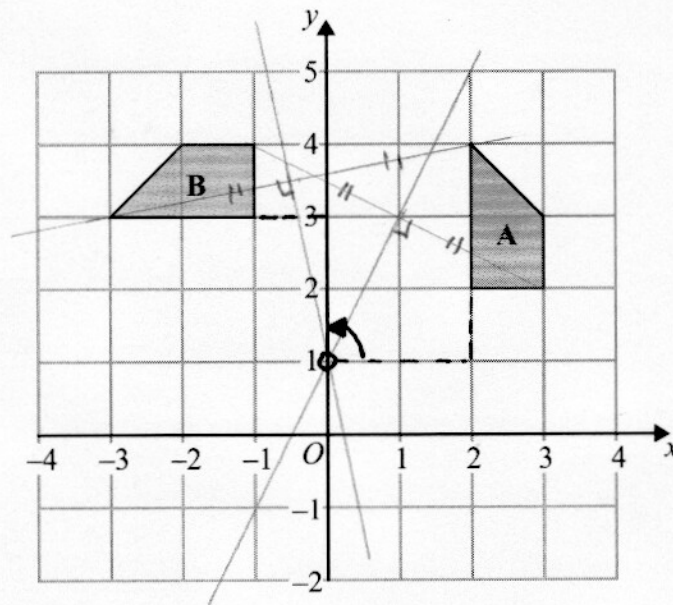**(Total for Question 10 is 5 marks)**

**11** The equation

$$x^3 - x = 32$$

has a solution between 3 and 4

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

| $x$ | $x^3 - x$ | |
|-----|-----------|---|
| 3 | 24 | too small |
| 3.5 | 39.375 | too big |
| 3.3 | 32.637 | too big |
| 3.25 | 31.078 | too small |
| 3.28 | 32.0076 | |

The exact answer is just less than 3.28.
It is > 3.25 so rounds to 3.3 to 1 decimal place
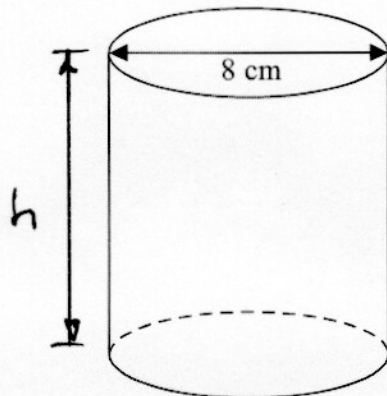
$x = $ 3.3

**(Total for Question 11 is 4 marks)**

**12** Ella is designing a glass in the shape of a cylinder.

The glass must hold a minimum of $\frac{1}{2}$ litre of liquid.

The glass must have a diameter of 8 cm.

Calculate the minimum height of the glass.

$D = 8\,cm,$

$r = 4\,cm$

Diagram **NOT** accurately drawn

$1\ \text{litre} = 1000\,cm^3,\quad \frac{1}{2}\ \text{litre} = 500\,cm^3$

$V = (\text{base area}) \times \text{height} = \pi r^2 h = 500$

$\therefore h = \dfrac{500}{\pi r^2} = \dfrac{500}{16\pi} = 9.947\,cm$

$= 9.95\,cm$ to 3 s. figs

Mark scheme allows 9.9, 9.95 or 10

DON'T do:

"$500 \div 16\pi$", this is $\dfrac{500}{16} \times \pi = 98.2$ !!

use $\dfrac{\square}{\square}$ or $500 \div (16\pi) =$

10 cm is a sensible height, 98 cm is not!

9.95 ......................... cm

**(Total for Question 12 is 5 marks)**

13  Mr and Mrs Adams sold their house for £168 000
They made a profit of 12% on the price they paid for the house.

Calculate how much they paid for the house.

£168 000 = purchase price × 1.12

∴ Purchase price = $\frac{168000}{1.12}$ = £150 000

£ 150 000

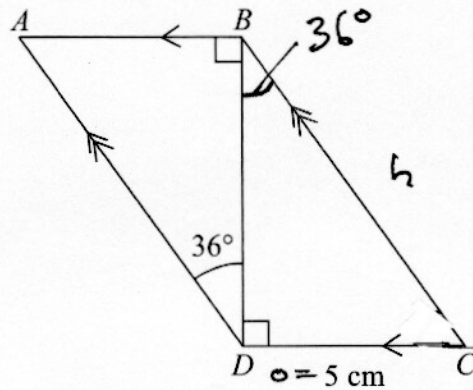**(Total for Question 13 is 3 marks)**

14



Diagram **NOT** accurately drawn

*ABCD* is a parallelogram.

*DC* = 5 cm
Angle *ADB* = 36°

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

Alternate angles → $\angle CBD = 36°$

$\sin(36) = \dfrac{o}{h} = \dfrac{5}{h}$,

$h\sin(36) = 5$, $h = \dfrac{5}{\sin(36)} = 8.5065\ \text{cm}$.

Parallelogram ∴ $AD = BC = 8.5065$

$= 8.51\ \text{cm}$ to 3 sig. figs

8.51 ............................ cm

**(Total for Question 14 is 4 marks)**

**15** Make $m$ the subject of the formula $\quad 6m^2 = k$

$$m^2 = \frac{k}{6}$$

$$m = \sqrt{\frac{k}{6}}$$

$$m = \sqrt{\frac{k}{6}}$$

**(Total for Question 15 is 2 marks)**

**16** Neil invested £500 on 1st January 2000 at a fixed compound interest rate of $R\%$ each year.

The value $V$, in pounds, of this investment after $n$ years is given by the formula

$$V = 500 \times (1.025)^n$$

(a) Write down the value of $R$.

2·5

(1)

(b) Use your calculator to find the value of Neil's investment at the end of 12 years.

$$500 \times 1.025^{12} = 672.44$$

£ 672.44

(2)

**(Total for Question 16 is 3 marks)**

**17** (a) Write 55 000 in standard form.

$$5.5 \times 10^4$$

(1)

(b) Work out $(3.6 \times 10^9) \times (5 \times 10^{-4})$

Write your answer as an ordinary number.

$$3.6 \times 5 = 1.8 \times 10$$

$$10^9 \times 10^{-4} = 10^{9-4} = 10^5$$

$$1.8 \times 10 \times 10^5 = 1.8 \times 10^6 = 1\,800\,000$$
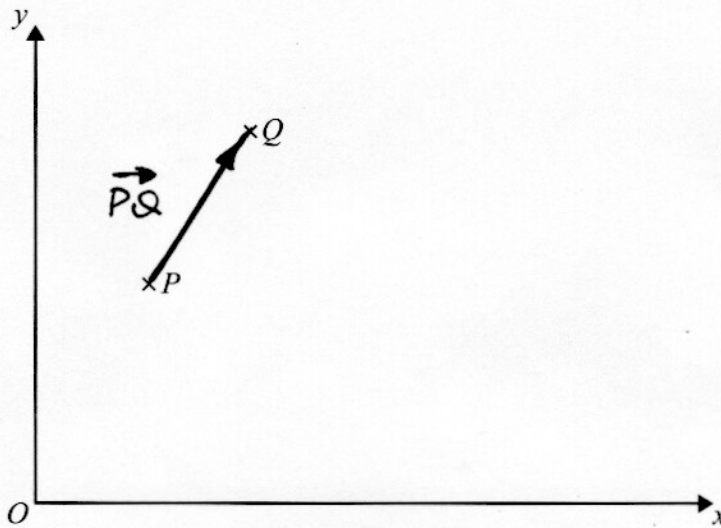
$$1\,800\,000$$

(2)

**(Total for Question 17 is 3 marks)**

Diagram **NOT**
accurately drawn

The diagram is a sketch.

*P* is the point (2, 4)
*Q* is the point (4, 8)

} A vector $\binom{2}{4}$ would translate P to Q

(a) Find the vector $\vec{PQ}$

Give your answer as a column vector $\binom{x}{y}$

Think: $\vec{OQ} = \vec{OP} + \vec{PQ}$

$\vec{PQ} = \vec{OQ} - \vec{OP}$

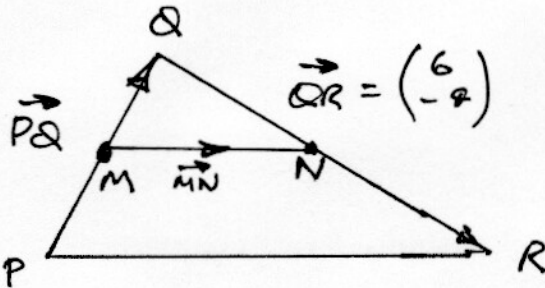$= \binom{4}{8} - \binom{2}{4} = \binom{2}{4}$

$\binom{2}{4}$

(2)

$\overrightarrow{QR} = \begin{pmatrix} 6 \\ -4 \end{pmatrix}$

$M$ is the midpoint of $PQ$.
$N$ is the midpoint of $QR$.

(b) Find the vector $\overrightarrow{MN}$

Give your answer as a column vector $\begin{pmatrix} x \\ y \end{pmatrix}$



$\overrightarrow{QR} = \begin{pmatrix} 6 \\ -4 \end{pmatrix}$

By similar triangles, $\overrightarrow{MN} = \frac{1}{2} \overrightarrow{PR}$
(since $MQ = \frac{1}{2} PQ$, $QN = \frac{1}{2} QR$ and $\angle PQR$ is constant).

$\overrightarrow{PR} = \overrightarrow{PQ} + \overrightarrow{QR} = \begin{pmatrix} 2 \\ 4 \end{pmatrix} + \begin{pmatrix} 6 \\ -4 \end{pmatrix} = \begin{pmatrix} 8 \\ 0 \end{pmatrix}$

$\therefore \overrightarrow{MN} = \begin{pmatrix} 4 \\ 0 \end{pmatrix}$

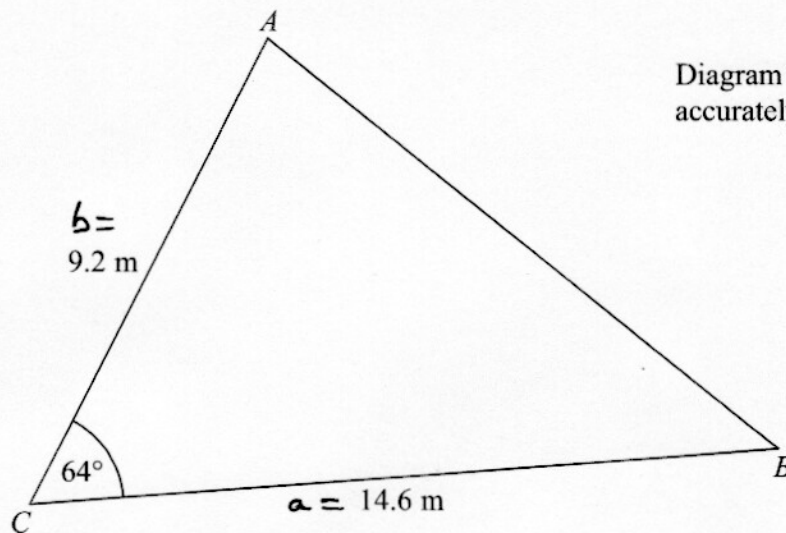$\begin{pmatrix} 4 \\ 0 \end{pmatrix}$

(3)

**(Total for Question 18 is 5 marks)**

Diagram **NOT**
accurately drawn

$b =$
9.2 m

64°

C

$a =$ 14.6 m

B

A

$AC$ = 9.2 m
$BC$ = 14.6 m
Angle $ACB$ = 64°

(a) Calculate the area of the triangle $ABC$.
   Give your answer correct to 3 significant figures.

$$\text{Area} = \tfrac{1}{2} \, ab \sin C = \tfrac{1}{2} \times 14.6 \times 9.2 \times \sin(64)$$

$$= 60.363 \, m^2$$
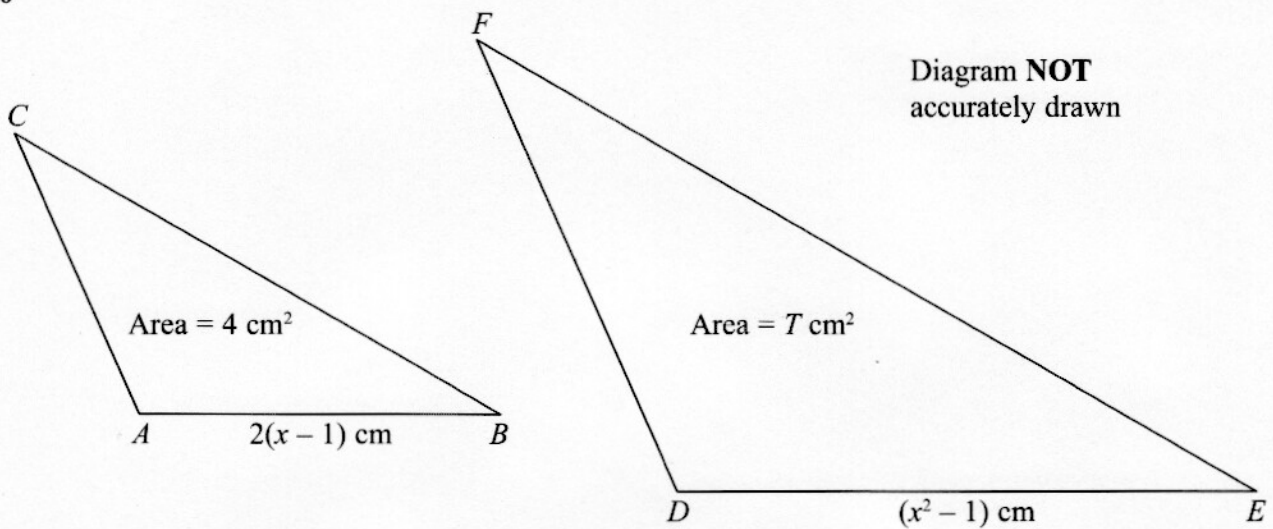
$$= 60.4 \, m^2 \text{ to 3 sig. figs}$$

............60.4............ m²

(2)

(b) Calculate the length of $AB$.
   Give your answer correct to 3 significant figures.

Cosine rule : $c^2 = a^2 + b^2 - 2ab \cos C$

$$= 14.6^2 + 9.2^2 - 2 \times 14.6 \times 9.2 \times \cos 64$$

$$= 180.04$$

$$c = \sqrt{ANS} = 13.4177$$

$$= 13.4 \, m$$

(3 sig. figs)

............13.4............ m

(3)

**(Total for Question 19 is 5 marks)**

**20**



Diagram **NOT** accurately drawn

Area = 4 cm$^2$

$A$    $2(x-1)$ cm    $B$

Area = $T$ cm$^2$

$D$    $(x^2-1)$ cm    $E$

Triangles $ABC$ and $DEF$ are mathematically similar.

The base, $AB$, of triangle $ABC$ has length $2(x-1)$ cm
The base, $DE$, of triangle $DEF$ has length $(x^2-1)$ cm

The area of triangle $ABC$ is 4 cm$^2$
The area of triangle $DEF$ is $T$ cm$^2$

Prove that

$$T = x^2 + 2x + 1$$

Geometrically similar $\therefore$ area $\propto$ length$^2$

$$\therefore T = \left[ \frac{x^2-1}{2(x-1)} \right]^2 \times 4 \text{ cm}^2$$

$$x^2-1 = (x+1)(x-1) \quad \therefore \frac{x^2-1}{x-1} = x+1$$

$$T = \left( \frac{x+1}{2} \right)^2 \times 4 = \left( \frac{x^2+2x+1}{4} \right) \times 4$$

$$\therefore T = x^2 + 2x + 1$$

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

**21** Solve the simultaneous equations

$$x^2 + y^2 = 25$$
$$y = 2x + 5$$

$$x^2 + (2x+5)^2 = 25$$

$$x^2 + (4x^2 + 20x + 25) = 25$$

$$5x^2 + 20x = 0$$

$\div 5$

$$x^2 + 4x = 0$$

$$x(x+4) = 0$$

$$\therefore x = 0, \quad y = 2x + 5 = 5$$

or

$$x + 4 = 0, \quad x = -4, \quad y = 2x + 5 = -3$$

$x = \underline{\quad 0 \quad}$ and $y = \underline{\quad 5 \quad}$

or

$x = \underline{\quad -4 \quad}$ and $y = \underline{\quad -3 \quad}$

**(Total for Question 21 is 6 marks)**

**TOTAL FOR PAPER IS 80 MARKS**