Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Pages	Mark
3	
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22 – 23	
TOTAL	

AQA

General Certificate of Secondary Education
Higher Tier
November 2012

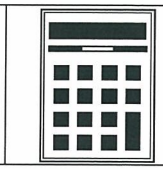
Mathematics 43603H

Unit 3

Monday 12 November 2012 9.00 am to 10.30 am

H

For this paper you must have:
- a calculator
- mathematical instruments.



Time allowed
- 1 hour 30 minutes

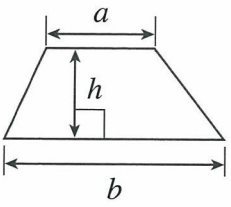
Instructions
- Use black ink or black ball-point pen. Draw diagrams in pencil.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book.
- If your calculator does not have a π button, take the value of π to be 3.14 unless another value is given in the question.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.
- The quality of your written communication is specifically assessed in Questions 3 and 16. These questions are indicated with an asterisk (*).
- You may ask for more answer paper, graph paper and tracing paper. These must be tagged securely to this answer booklet.

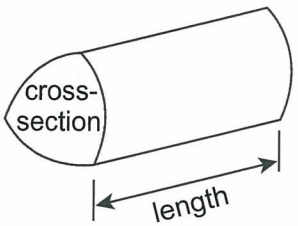
Advice
- In all calculations, show clearly how you work out your answer.

Formulae Sheet: Higher Tier

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

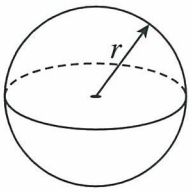


Volume of prism = area of cross-section × length



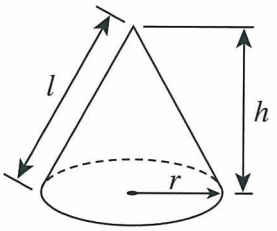
Volume of sphere = $\frac{4}{3}\pi r^3$

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



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

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

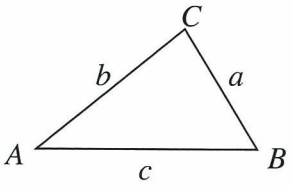


In any triangle ABC

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

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

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



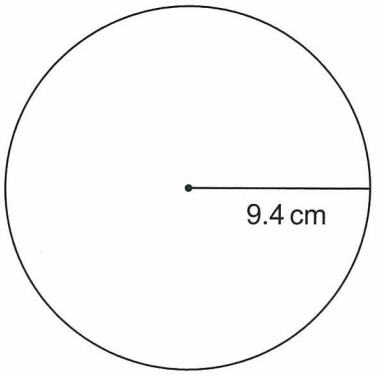
The Quadratic Equation

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

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

Answer **all** questions in the spaces provided.

1 A circle has radius 9.4 cm.



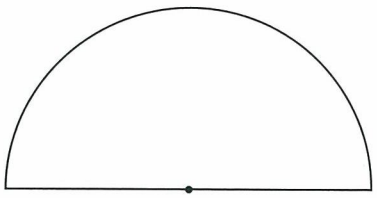
Not drawn accurately

1 (a) Work out the circumference of the circle.

$C = 2\pi r = 2\pi(9.4) = 59.1 \text{ cm}$ (3 s.f.).

Answer 59.1 cm (3 s.f.) *(2 marks)*

1 (b) A semicircle has radius 9.4 cm.



Not drawn accurately

Use your answer to part (a) to work out the perimeter of the semicircle.

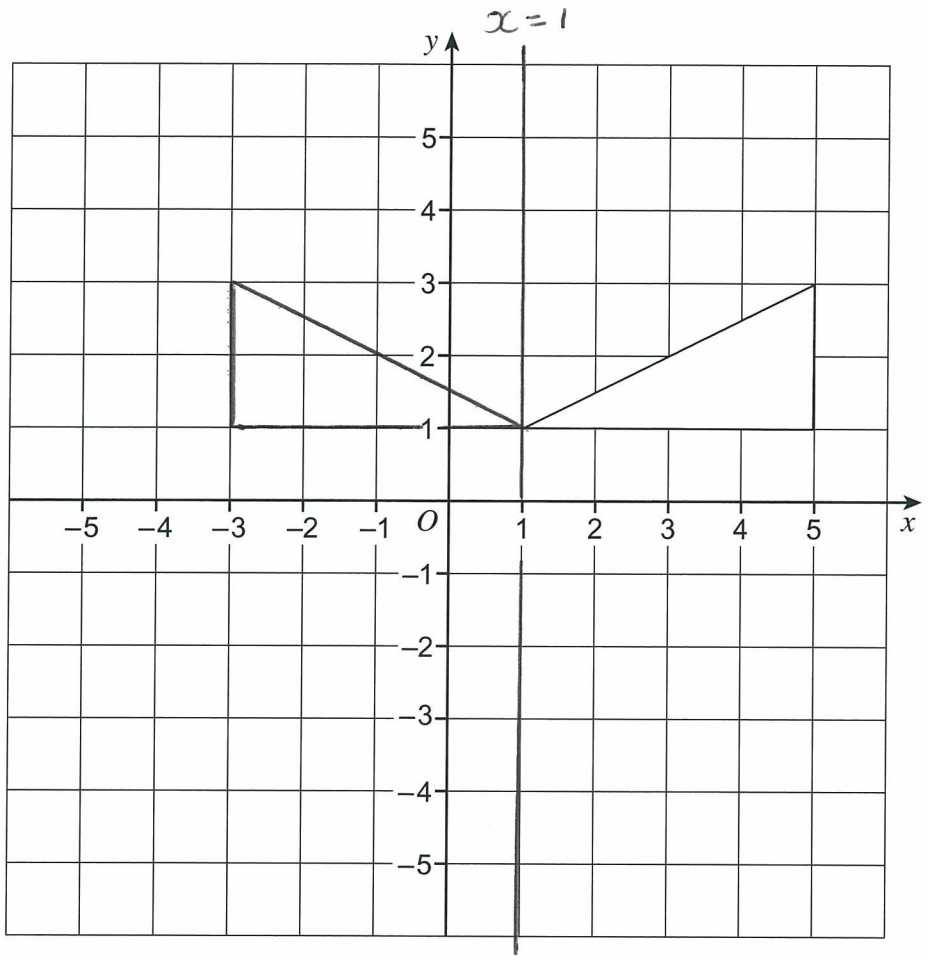
Perimeter $= \frac{2\pi r}{2} + 2r = \pi r + 2r = \pi(9.4) + 2(9.4)$

$= 48.3 \text{ cm}$ (3 s.f.).

Answer 48.3 cm (3 s.f.) *(2 marks)*

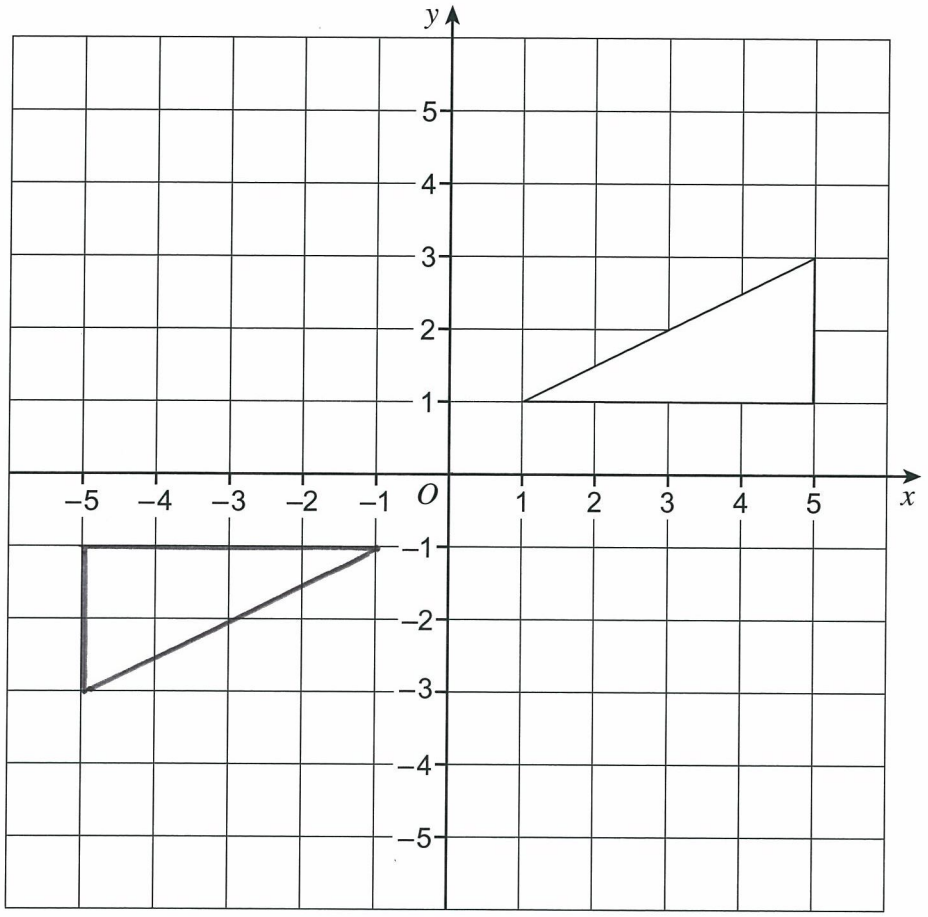
4

2 (a) Reflect the triangle in the line $x = 1$



(2 marks)

2 (b) Rotate the triangle through 180° about the origin.

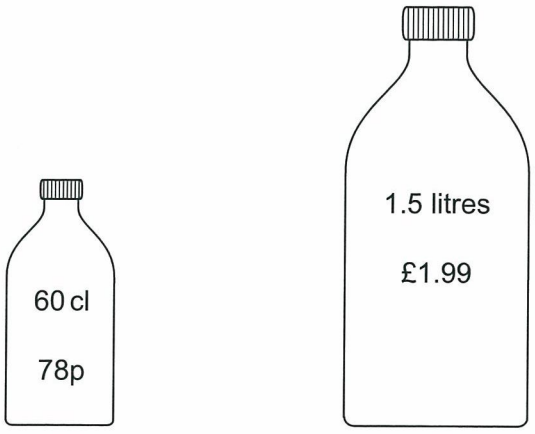


(2 marks)

Turn over for the next question

4

***3** The diagram shows two bottles of the same drink.



Small Large

You are given that 1 litre = 100 cl

Which bottle is better value for money?
You **must** show your working.

1L = 1000ml $\Rightarrow$ 1cl = $\frac{1000}{100}$ = 10ml.

60cl = 600ml and 1.5L = 1500ml

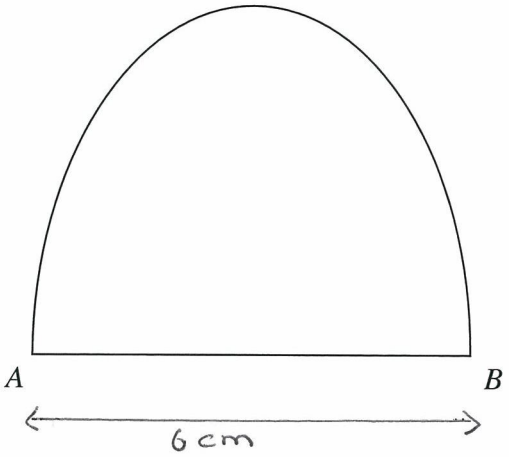
Price per litre of small bottle is given by $\frac{100}{60} \times 78p = 130p$ and price per litre of large bottle is given by $\frac{199p}{1.5} = 132\frac{2}{3}p$

Answer Small bottle *(4 marks)*

N.B: Even quicker would be to scale up the volume of the small bottle to the volume of the larger (or vice versa) and then compare the prices.

e.g. $\frac{1.5}{0.6} \times 78 = \frac{5}{2} \times 78 = 195p$ compared with the larger bottle @ 199p

4 Here is a scale drawing of a play area.



Scale 1 : 800

A straight wall is to be built from A to B.
250 bricks are needed for each metre of wall.

Work out the total number of bricks needed to build the wall.

$\frac{6 \times 800}{100} \times 250 = 12{,}000$ bricks

Answer 12,000 *(4 marks)*

8

5 (a) The diagram shows a square piece of card.

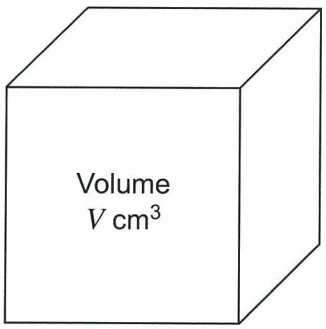
Width, w cm

Write down a formula connecting A and w.

.....

Answer $A = w^2$ *(1 mark)*

5 (b) This diagram shows a cube.



Width, w cm

Write down a formula connecting V and w.

.....

Answer $V = w^3$ *(1 mark)*

5 (c) The area of one face of a cube is 20 cm^2.

Work out the volume of the cube.

For the cube above with length, l, width, w, and depth, d, $l = w = d = \sqrt{20}$ cm and volume = $l \times w \times d = (\sqrt{20})^3 = 89.4 cm^3$ (3s.f.).

Answer 89.4 cm^3 (3s.f.) *(3 marks)*

Turn over for the next question

5

6 (a) Three angles are in the ratio 2 : 3 : 7
The smallest angle is 60°.

Show that these three angles will fit together at a point with no gaps.

2 : 3 : 7 = 60 : 90 : 210

i.e. the three angles in ascending order are 60°, 90° and 210°. Since angles around a point add to 360° and 60° + 90° + 210° = 360°, these three angles will fit together at a point with no gaps.

(3 marks)

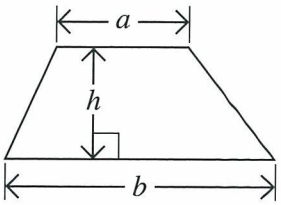
6 (b) Two angles form a straight line.
One of the angles is $(x + 30)$ degrees.

Write down an expression for the size of the other angle.
Give your answer in its simplest form.

$180 - (x + 30) = 180 - x - 30 = 150 - x$

Answer $150 - x$ degrees *(2 marks)*

7 In the trapezium, a = 6.5 m, b = 8.3 m and h = 3.2 m



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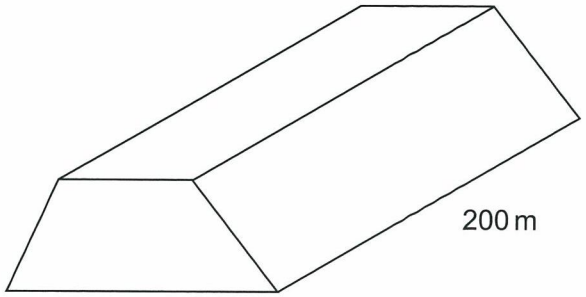
The trapezium is the cross-section of a tunnel.
The tunnel is 200 metres long.



Work out the volume of the tunnel.

Volume = Cross-sectional area x length

$= \frac{1}{2}(a+b)h \times l$

$= \frac{1}{2}(6.5 + 8.3)(3.2)(200)$

$= 4736\ m^3$

Answer 4736 m^3 *(4 marks)*

9

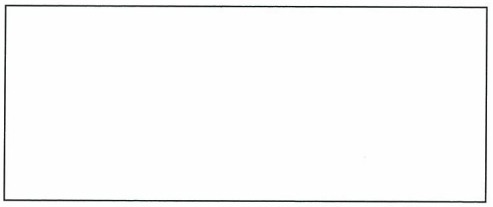
8 Solve the equation $x^2 - 5 = 0$

Give your answers to 1 decimal place.

$x = \pm\sqrt{0+5} = \pm\sqrt{5} = \pm 2.2$ (1 d.p.).

Answer 2.2 and -2.2 *(2 marks)*

9 The diagram shows a rectangle.



$(x - 5)$ cm

$(x + 4)$ cm

The area of the rectangle is 90 cm^2.

Set up and solve a quadratic equation to work out the value of x.

$(x+4)(x-5) = 90$

$\Rightarrow x^2 - x - 20 = 90$

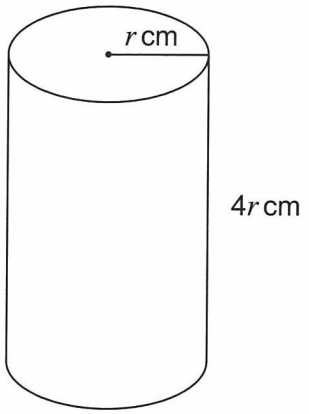
$\Rightarrow x^2 - x - 110 = 0$

$\Rightarrow (x-11)(x+10) = 0$

$\Rightarrow x = 11$ or -10 of which we only require the positive solution for a spatial dimension.

$x =$ 11 cm *(5 marks)*

10 The diagram shows a cylinder of radius r cm and height $4r$ cm.



10 (a) Work out a formula for the volume, V of the cylinder in terms of π and r.
Simplify your answer.

$V = \pi r^2 (4r) = 4\pi r^3$

Answer $4\pi r^3$ *(2 marks)*

10 (b) Work out the volume of the cylinder when $r = 8$

$V = 4\pi(8^3) = 6433.98 \text{ cm}^3$ (2 d.p.)

Answer 6433.98 cm^3 (2 d.p.) *(2 marks)*

11

11 This is a formula for the time to cook a turkey.

$T = 15 + 20m$

This is a formula for the time to cook a goose.

$T = 40 + 15m$

m is the mass in kilograms.
T is the time in minutes.

A turkey and a goose have the same mass and take the same time to cook.

Work out this time.

$15 + 20m = 40 + 15m$

$\Rightarrow \quad 5m = 25$

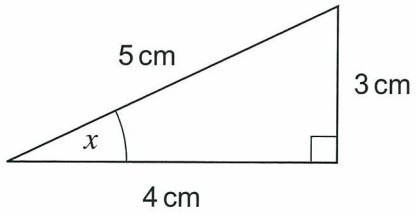
$\Rightarrow \quad m = \frac{25}{5} = 5\text{kg}.$

$T = 15 + 20(5) = 15 + 100 = 115$ minutes.

CHECK: $T = 40 + 15(5) = 40 + 75 = 115$ mins.

Answer 115 minutes *(4 marks)*

12 (a) The diagram shows a right-angled triangle.



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Write down the value of sin x.

Answer $\sin x = \frac{3}{5}$ or 0.6 *(1 mark)*

12 (b) In a different right-angled triangle, tan $y = 0.7$

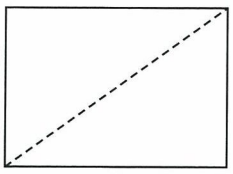
Work out the value of y.

Answer $y = \tan^{-1} 0.7 = 35.0°$ (3 s.f.) degrees *(1 mark)*

Turn over for the next question

6

13 (a) The diagram shows a rectangle.



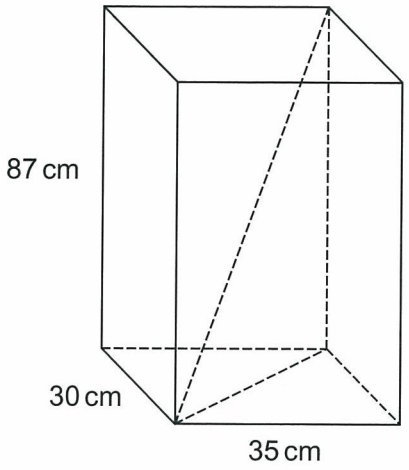
Not drawn accurately

Work out the length of the diagonal.

$\sqrt{35^2 + 30^2} = \sqrt{2125} = 46.1$ cm (3 s.f.).

Answer 46.1 cm (3 s.f.). *(3 marks)*

13 (b) The rectangle in part (a) is the base of this box.
The box is a cuboid.



Will a straight rod of length 1 metre fit in the box?
You **must** show your working.

Let x = length of diagonal of cuboid.

Then $x^2 = (\sqrt{2125})^2 + 87^2$

$\Rightarrow x = \sqrt{9694} = 98.5$ cm (3 s.f.)

or 0.985 m (3 s.f.)

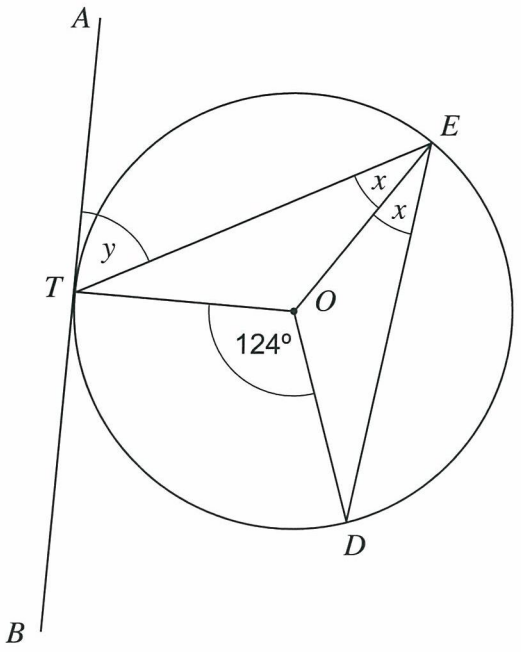
∴ A straight rod of length 1m WILL NOT fit in the box.

(3 marks)

Turn over for the next question

6

14 The diagram shows a circle, centre O.
ATB is a tangent at T.



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14 (a) Work out the value of x.

$2x = \frac{1}{2}(124) = 62$ as per 'The Double Angle Theorem'

$\Rightarrow x = \frac{62}{2} = 31°$

Answer 31 degrees *(2 marks)*

14 (b) Work out the value of y.

ATO = 90° since a tangent and a radius form a right-angle where they meet.

ETO = TEO = x = 31° since base angles of an isosceles triangle are equal. $\therefore y = 90 - 31 = 59°$

Answer 59 degrees *(3 marks)*

15 W is inversely proportional to x.
When $W = 6$, $x = 20$

Work out the value of W when $x = 24$

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

$\Rightarrow W = \frac{k}{x}$

$6 = \frac{k}{20}$

$\Rightarrow k = 6 \times 20 = 120.$

$\therefore W = \frac{120}{x}$ and when $x = 24$, $W = \frac{120}{24} = 5$

Answer 5 *(4 marks)*

Turn over for the next question

9

16 (a) You are given that 1 mile = 1.6 kilometres

Convert $6\frac{1}{2}$ miles into kilometres.

$6\frac{1}{2} = \frac{13}{2}$ and $1.6 = \frac{16}{10} = \frac{8}{5}$

$\frac{13}{2} \times \frac{8}{5} = \frac{104}{10} = 10.4$ km

Answer 104 km *(2 marks)*

***16 (b)** A manufacturer claims a car like mine uses 5.5 litres per 100 km.

My car does 50 miles per gallon.

Is my car using more or less fuel than the manufacturer claims?
You **must** show your working.

1 gallon = 4.54609 litres

50 × 1.6 = 80 km

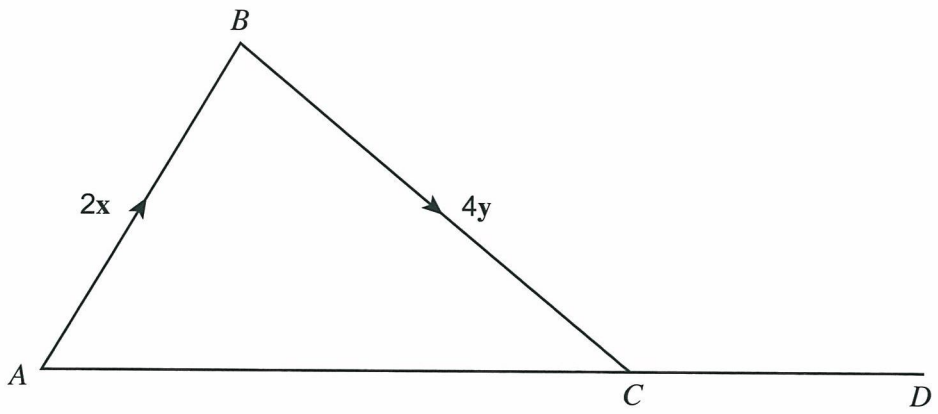
Manufacturer's claimed consumption rate per is given by $\frac{5.5}{100} = 0.055$ L/km

Actual consumption rate = $\frac{4.54609}{80} = 0.057$ L/km (3d.p.).

∴ Car is using more fuel than the manufacturer claims.

(5 marks)

17 $\overrightarrow{AB} = 2\mathbf{x}$ and $\overrightarrow{BC} = 4\mathbf{y}$
ACD is a straight line.



17 (a) Write down the vector $\overrightarrow{AC}$ in terms of $\mathbf{x}$ and $\mathbf{y}$.

Answer 2x + 4y or 2(x + 2y) *(1 mark)*

17 (b) $AC : CD = 2 : 1$

Work out the vector $\overrightarrow{AD}$ in terms of $\mathbf{x}$ and $\mathbf{y}$.
Give your answer as simply as possible.

$\overrightarrow{AC} = \frac{2}{3}\overrightarrow{AD} \Rightarrow \overrightarrow{AD} = \frac{3}{2}\overrightarrow{AC} = \frac{3}{2}(2x + 4y)$

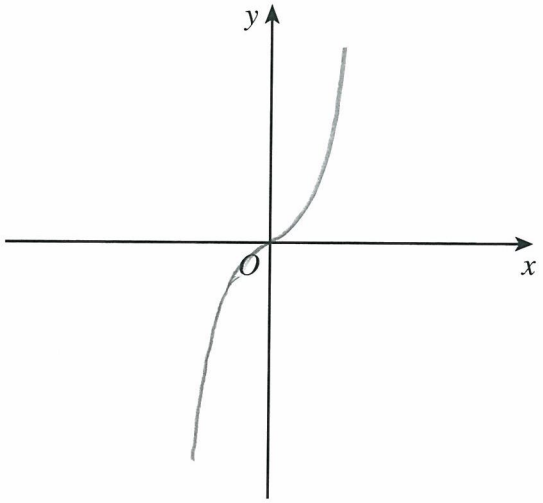
$= 3x + 6y = 3(x + 2y)$

Answer 3(x + 2y) *(2 marks)*

Turn over for the next question

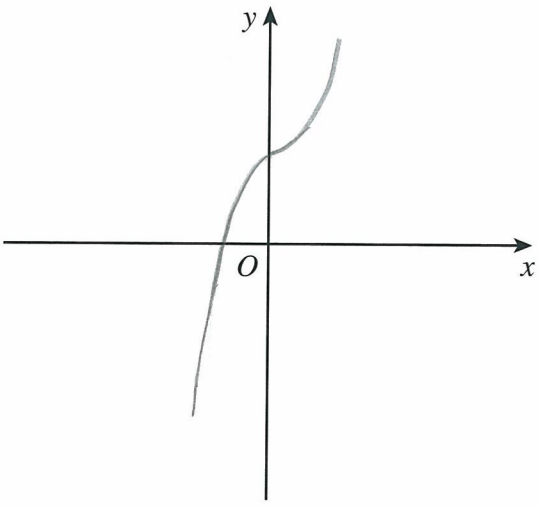
10

18 (a) On the axes below sketch the graph of $y = x^3$



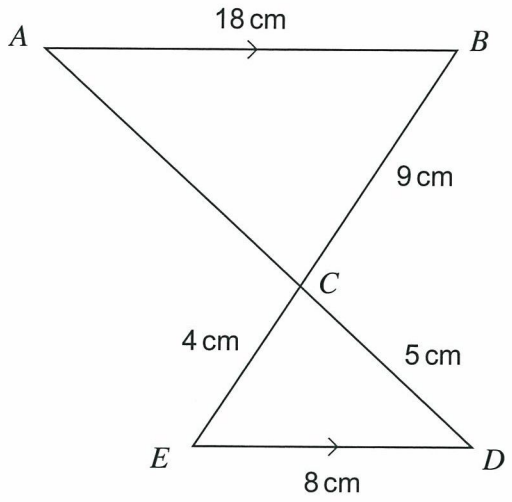
(1 mark)

18 (b) On the axes below sketch the graph of $y = x^3 + 8$



(1 mark)

19 ACD and BCE are straight lines.
Triangle ABC is similar to triangle DEC.
AB is parallel to ED.



Not drawn accurately

Work out the area of triangle ABC.

$\frac{AC}{CD} = \frac{AB}{ED} \Rightarrow \frac{AC}{5} = \frac{18}{8} = \frac{9}{4}$

$\Rightarrow AC = \frac{9}{4} \times 5 = \frac{45}{4} = 11.25$ cm.

From the cosine rule, $11.25^2 = 18^2 + 9^2 - 2(18)(9)\cos x$

where x is the angle ABC.

$x = \cos^{-1}\left[\frac{18^2+9^2-11.25^2}{2(18)(9)}\right] = 30.8^\circ$ (3s.f.).

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

$= \frac{1}{2}(18)(9)\sin x = 41.4$ cm^2 (3s.f.).

Answer 41.4 cm^2 (3s.f.). *(6 marks)*

END OF QUESTIONS

8

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