In the style of:
Pearson Edexcel
Level 1/Level 2 GCSE (9 - 1)

Centre Number

Candidate Number

Mathematics
Grade 9 type questions

MODEL ANSWERS

Higher Tier

GCSE style questions arranged by topic

Paper Reference
1MA1/1H

You must have: Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser.

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 not be used.**
- Diagrams are **NOT** accurately drawn, unless otherwise indicated.
- You must **show all your working out**.

Information

- The total mark for this paper is
- 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.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

1 Solve the equation $\dfrac{x}{2} - \dfrac{2}{x+1} = 1$

$\times 2$ $\qquad$ $x - \dfrac{4}{x+1} = 2$

$\times (x+1)$ $\qquad$ $x(x+1) - 4 = 2(x+1)$

Brackets $\qquad$ $x^2 + x - 4 = 2x + 2$

$-2x$ $\qquad$ $x^2 - x - 4 = 2$

-2 $\qquad$ $x^2 - x - 6 = 0$

factorise $\qquad$ $(x + 2)(x - 3) = 0$

$\qquad$ $x = -2$ or $x = 3$

$\underline{x = -2 \text{ or } x = 3}$

(Total for Question 1 is 4 marks)

2 The diagram shows a solid wax cylinder.
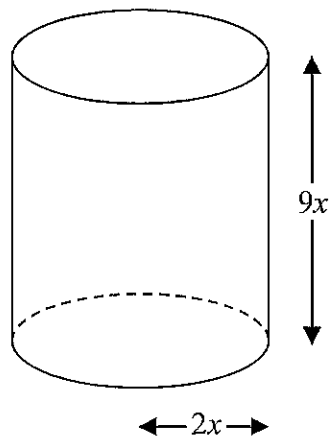
Diagram **NOT** accurately drawn

$9x$

$\leftarrow 2x \rightarrow$

The cylinder has base radius $2x$ and height $9x$.

The cylinder is melted down and made into a sphere of radius r.

Find an expression for r in terms of x.

Volume Cylinder	$\pi r^2 \times h$

$\pi (2x)^2 \times 9x = 4\pi x^2 \times 9x$

$= 36\pi x^3$

Volume of Sphere

$\frac{4}{3}\pi r^3$

Sphere = Cylinder

$\frac{4}{3}\pi r^3 = 36\pi x^3$

$\div \pi$

$\frac{4r^3}{3} = 36 x^3$

$\times 3$

$4r^3 = 108 x^3$

$\div 4$

$r^3 = 27x^3$

$\sqrt[3]{}$
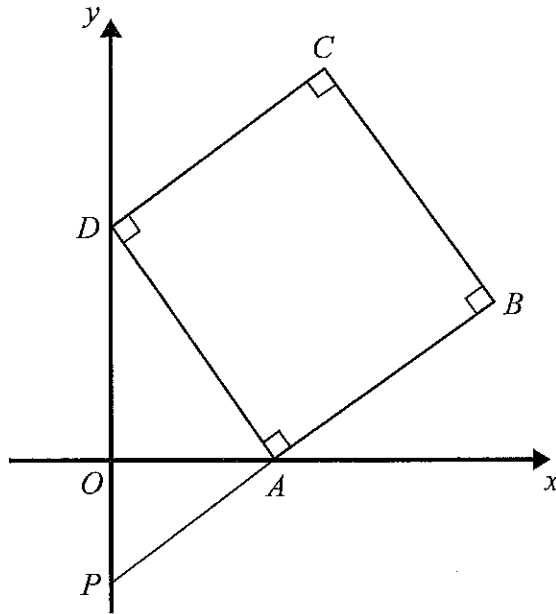
$r = 3x$

$r = 3x$

(Total for Question 2 is 3 marks)

y

C

Diagram **NOT**
accurately drawn

D

B

O   A   x

P

ABCD is a square.
P and *D* are points on the *y*-axis.
A is a point on the *x*-axis.
PAB is a straight line.

The equation of the line that passes through the points *A* and *D* is $y = -2x + 5$

Find the length of *PD*.

Coordinate at
A
$y = 0$

AB perpendicular to
AD

Equation of AB

use $M = \frac{1}{2}$ $(x_1, y_1) = (\frac{5}{2}, 0)$

$P = -\frac{5}{4}$

$D = 5$

$0 = -2x + 5$

$x = \frac{5}{2} = 2.5$ $(2.5, 0)$
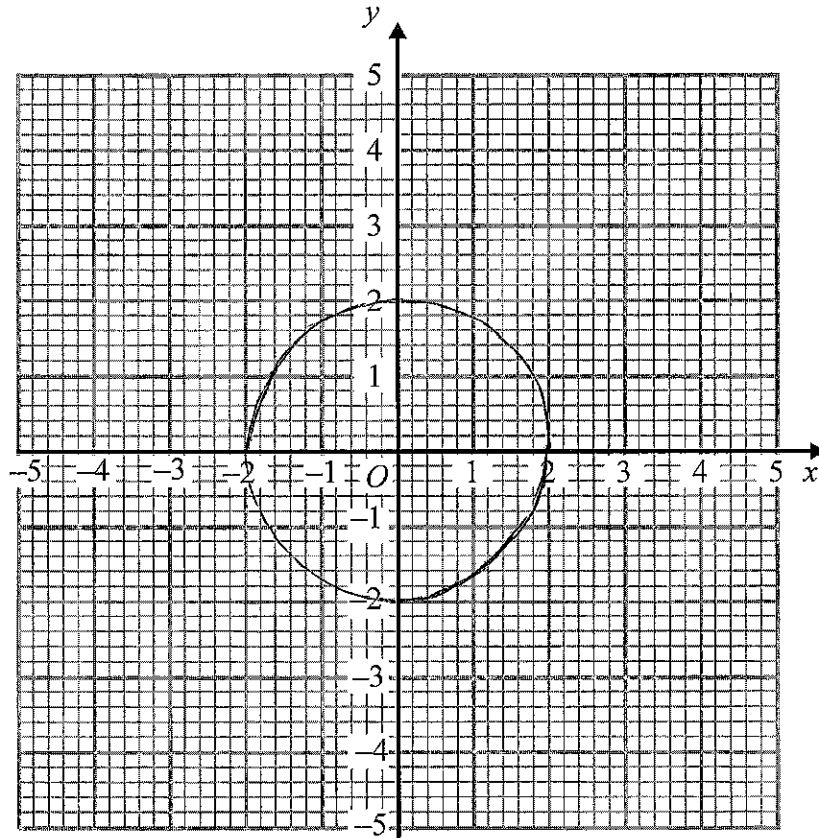
gradient $= \frac{1}{2}$ $(\frac{1}{2} \times -2 = -1)$

$y - y_1 = M(x - x_1)$

$y - 0 = \frac{1}{2}(x - \frac{5}{2})$

$y = \frac{1}{2}x - \frac{5}{4}$

$PD = 5 + \frac{5}{4} = 6.25$

....
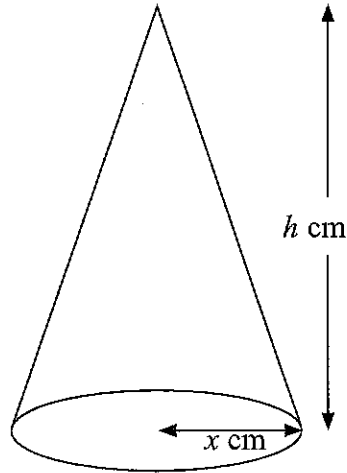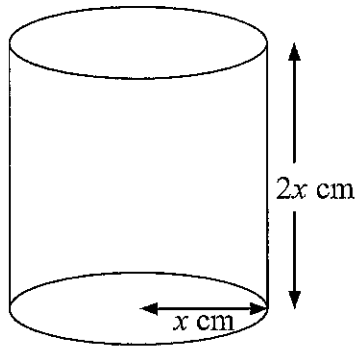
(Total for Question 3 is 4 marks)

4

(a) On the grid, draw the graph of $x^2 + y^2 = 4$ ← radius = $\sqrt{4}$ = 2

circle.

(2)
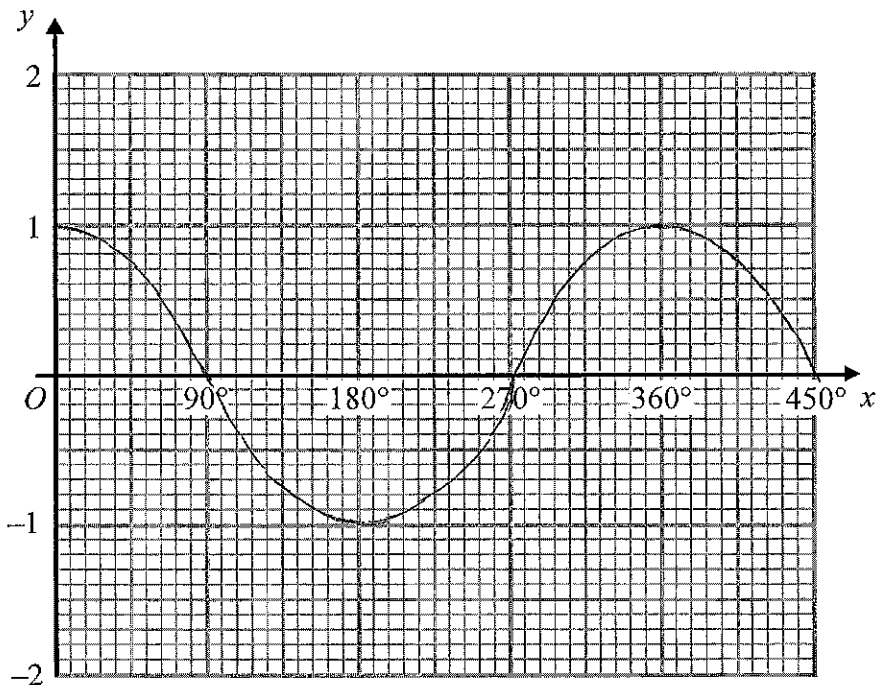
(b) On the grid, sketch the graph of $y = \cos x$ for $0° \leqslant x \leqslant 360°$

(Total for Question 4 is 4 marks)

Diagrams **NOT** accurately drawn

$2x$ cm

x cm

h cm

x cm

A cylinder has base radius x cm and height $2x$ cm.

A cone has base radius x cm and height h cm.

The volume of the cylinder and the volume of the cone are equal.

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

x $2x$

Volume Cylinder

$\pi r^2 \times h = \pi \times x^2 \times 2x$

$= 2\pi x^3$

Volume Pyramid

$\frac{1}{3} \times \pi r^2 \times h = \frac{1}{3} \times \pi \times x^2 \times h$

$= \frac{1}{3} \pi x^2 h.$

Volume Cylinder = Volume Pyramid

$2\pi x^3 = \frac{1}{3} \pi x^2 h.$

$\div \pi$

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

$\div x^2$

$2x = \frac{1}{3} h.$

$\times 3$

$h = 6x$

$h = \underline{\;\;6x\;\;}$

(Total for Question 5 is 3 marks)

6

$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$

$$u = 2\frac{1}{2}, \ v = 3\frac{1}{3}$$

$u = \frac{5}{2} \qquad v = \frac{10}{3}$

(a) Find the value of f.

$\frac{1}{u} = \frac{2}{5} \qquad \frac{1}{v} = \frac{3}{10}$

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v} = \frac{2}{5} + \frac{3}{10} = \frac{4+3}{10} = \frac{7}{10}$$

$$\frac{1}{f} = \frac{7}{10} \qquad f = \frac{10}{7}$$

$f = \frac{10}{7}$

....

(3)

(b) Rearrange $\quad \dfrac{1}{u} + \dfrac{1}{v} = \dfrac{1}{f}$

to make u the subject of the formula.

Give your answer in its simplest form.

$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$

$\times u \qquad 1 + \dfrac{u}{v} = \dfrac{u}{f}$

$\times v \qquad v + u = \dfrac{uv}{f}$

$\times f \qquad vf + uf = uv$

$- uf \qquad vf = uv - uf$

factorise $\quad vf = u(v-f)$

$\div (v-f) \qquad \dfrac{vf}{v-f} = u$

$u = \dfrac{vf}{v-f}$

....

(2)

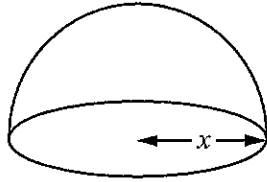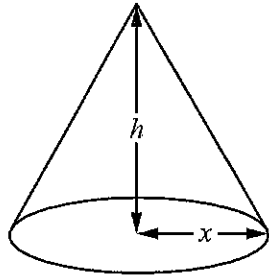**(Total for Question 6 is 5 marks)**

Diagram **NOT** accurately drawn

The diagram shows a solid cone and a solid hemisphere.

The cone has a base of radius x cm and a height of h cm.
The hemisphere has a base of radius x cm.
The surface area of the cone is equal to the surface area of the hemisphere.

Find an expression for h in terms of x.

SA Cone

By Pythagoras :

$\pi r^2 + \pi r L$

$L = \sqrt{x^2 + h^2}$

$\pi x^2 + \pi x \sqrt{x^2 + h^2}$

SA Hemisphere

$\pi r^2 + 2\pi r^2$

$\pi x^2 + 2\pi x^2$

SA Cone = SA Hemisphere

$\pi x^2 + \pi x \sqrt{x^2 + h^2} = \pi x^2 + 2\pi x^2$

$-\pi x^2$

$\pi x \sqrt{x^2 + h^2} = 2\pi x^2$

$\div \pi x$

$\sqrt{x^2 + h^2} = 2x$

Square

$x^2 + h^2 = 4x^2$

$-x^2$

$h^2 = 3x^2$

$\sqrt{}$

$h = x\sqrt{3}$

$x\sqrt{3}$

....

(Total for Question 7 is 4 marks)

8

A

B

C

D

E

F
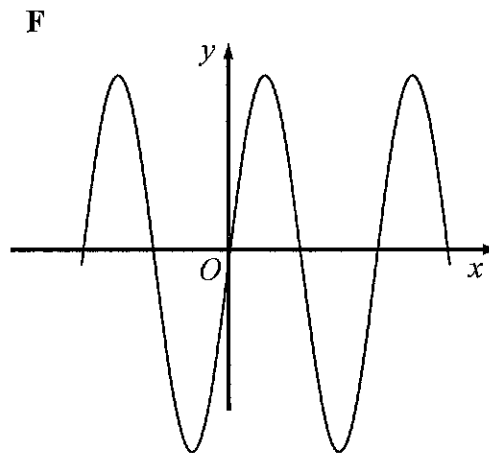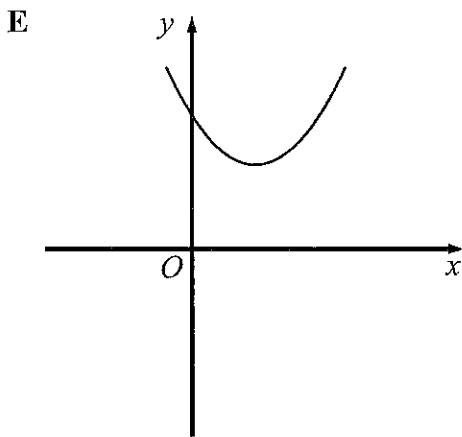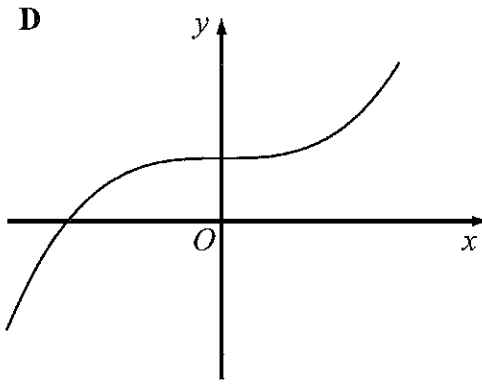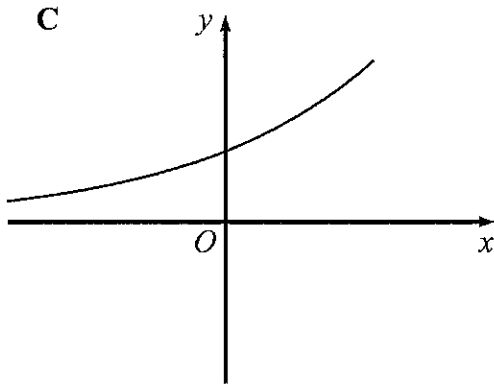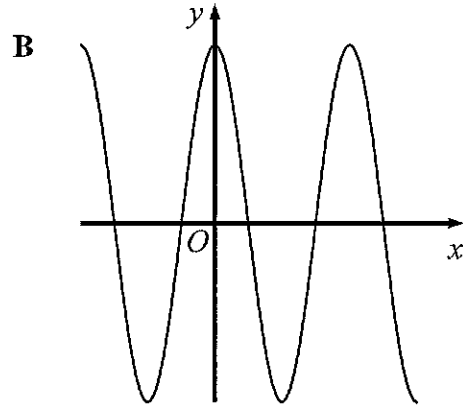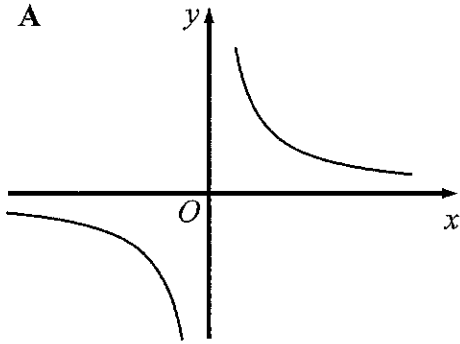
Each equation in the table represents one of the graphs **A** to **F**.

Write the letter of each graph in the correct place in the table.

Equation	Graph
$y = 4 \sin x°$	F
$y = 4 \cos x°$	B
$y = x^2 - 4x + 5$	E
$y = 4 \times 2^x$	C
$y = x^3 + 4$	D
$y = \dfrac{4}{x}$	A

(Total for Question 8 is 3 marks)
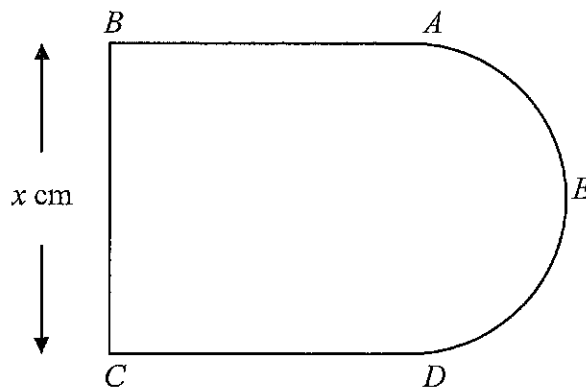
9 Here is a shape *ABCDE*.

Diagram **NOT** accurately drawn

AB, *BC* and *CD* are three sides of a square.
BC = *x* cm.
AED is a semicircle with diameter *AD*.

The perimeter, *P* cm, of the shape *ABCDE* is given by the formula

$$P = 3x + \frac{\pi x}{2}$$

(a) Rearrange this formula to make *x* the subject.

$$P = 3x + \frac{\pi x}{2}$$

×2 $\qquad 2P = 6x + \pi x$

factorise $\qquad 2P = x(6 + \pi)$

÷ (6 + π) $\qquad x = \dfrac{2P}{6 + \pi}$

$$x = \frac{2P}{6 + \pi}$$

....

(2)

The area, A cm^2, of this shape is given by $A = kx^2$ where k is a constant.

(b) Find the exact value of k.
Give your answer in its simplest form.

$A = $ Area Square $+$ Area Semicircle

$= x^2 + \frac{1}{2}\pi\left(\frac{x}{2}\right)^2$

$= x^2 + \frac{\pi x^2}{8}$

Factorise

$A = x^2\left(1 + \frac{\pi}{8}\right)$

$k = \frac{1 + \pi}{8}$

....

(3)

(Total for Question 9 is 5 marks)

10 Express the recurring decimal $0.2\dot{1}\dot{3}$ as a fraction.

$$x = 0.2\dot{1}\dot{3}$$
$$10x = 2.13\dot{1}$$
$$100x = 21.3\dot{1}\dot{3}$$

$$100x - x = 21.3\dot{1}\dot{3} - 0.2\dot{1}\dot{3}$$

$$99x = 21.1$$

$$x = \frac{21.1}{99} = \frac{211}{990}.$$

....

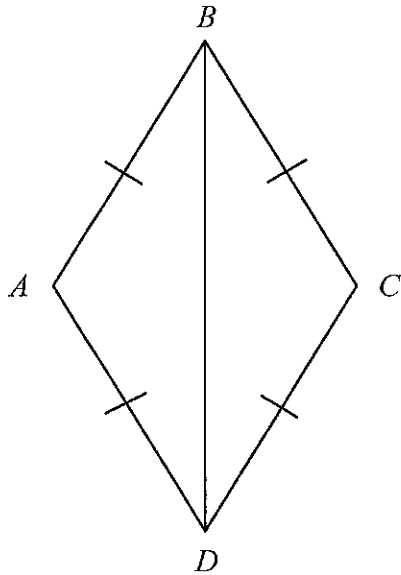**(Total for Question 10 is 3 marks)**

B

Diagram **NOT**
accurately drawn

A   C

PROVE SSS

D

In the diagram, *AB* = *BC* = *CD* = *DA*.

Prove that triangle *ADB* is congruent to triangle *CDB*.

(Total for Question 11 is 3 marks)

12 Prove, using algebra, that the sum of two consecutive whole numbers is always an odd number.

2 consecutive numbers.

n and $n+1$

Sum

$n + n + 1 = 2n + 1$

$2n$ is always even

So $2n + 1$ must be odd!

(Total for Question 12 is 3 marks)

13 The table shows information about the ages, in years, of 1000 teenagers.

Age (years)	13	14	15	16	17	18	19
Number of teenagers	158	180	165	141	131	115	110

Sophie takes a sample of 50 of these teenagers, stratified by age.

Calculate the number of 14 year olds she should have in her sample.

Sample of 14 year old $= 180 \times \dfrac{50}{1000} = 9$

.... 9

(Total for Question 13 is 2 marks)

14 P is inversely proportional to V.

When $V = 8$, $P = 5$

(a) Find a formula for P in terms of V.

① $P \propto \dfrac{1}{V}$

② $P = \dfrac{k}{V}$

③ $5 = \dfrac{k}{8}$ $\qquad k = 40$

$P = \dfrac{40}{V}$

$P = \dfrac{40}{V}$

P = ... $P = \dfrac{40}{V}$ ....

(3)

(b) Calculate the value of P when $V = 2$

$P = \dfrac{40}{V} = \dfrac{40}{2} = 20$

.... 20 ....

(1)

(Total for Question 14 is 4 marks)
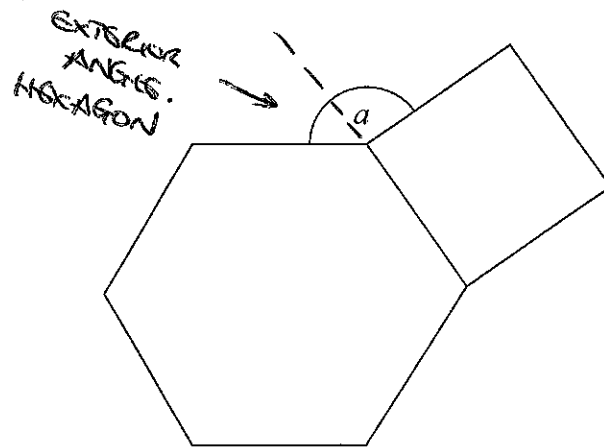
EXTERIOR ANGLE. HEXAGON

a

Diagram **NOT** accurately drawn

The diagram shows a regular hexagon and a square.

Calculate the size of the angle *a*.

External Angle of Regular Hexagon
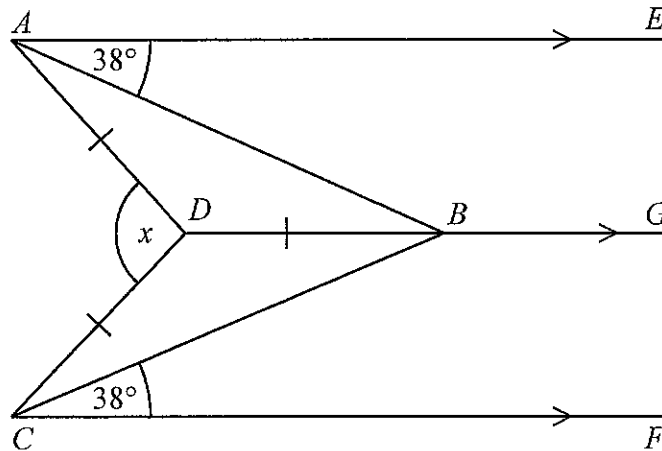
Exterior Angle of Square

$$\frac{360}{6} = 60°$$

$$\frac{360}{4} = 90°$$

$$A = 60 + 90$$
$$= 150°$$

150 °

(Total for Question 15 is 4 marks)

AE, *DBG* and *CF* are parallel.
DA = *DB* = *DC*.
Angle *EAB* = angle *BCF* = 38°

Work out the size of the angle marked *x*.
You must show your working.

Reason	Angle
Alternating Angles	$BAE = ABD = 38°$
Base angles in Isoceles.	$BAD = ABD = 38°$
Angles in triangle $= 180°$	$ADB = 180 - 88 - 38°$ $= 104°$
Congruent triangles	$CDB = ADB = 104°$
Angles at Point	$x = 360 - 104 - 104 = 152$

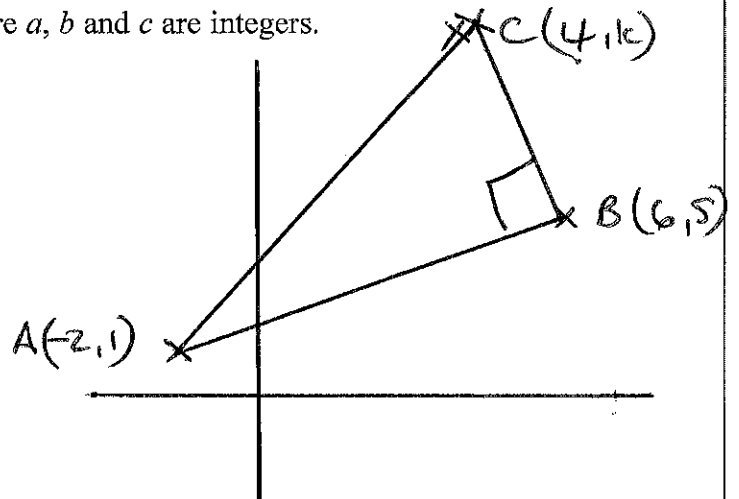...............................°

(Total for Question 16 is 3 marks)

17 $A(-2, 1)$, $B(6, 5)$ and $C(4, k)$ are the vertices of a right-angled triangle ABC.
Angle ABC is the right angle.

Find an equation of the line that passes through A and C.
Give your answer in the form $ay + bx = c$ where a, b and c are integers.

Sketch

A(-2,1)   C(4,k)   B(6,5)

grad AB

$$\frac{\text{diff in } y}{\text{diff in } x} = \frac{5-1}{6-2} = \frac{4}{8} = \frac{1}{2}$$

grad CB (perpendicular)

$$= -2 \qquad \left(\tfrac{1}{2} \times -2 = -1\right)$$

grad CB

$$\frac{\text{diff in } y}{\text{diff in } x} = \frac{5-k}{6-4} = \frac{5-k}{2}$$

so

$$\frac{5-k}{2} = -2$$

×2

$$5 - k = -4 \qquad k = 9.$$

grad AC

$$\frac{\text{diff in } y}{\text{diff in } x} = \frac{9-1}{4-2} = \frac{8}{6} = \frac{4}{3}$$

equation AC

$M = \frac{4}{3}$ $(x_1, y_1) = (4, 9)$
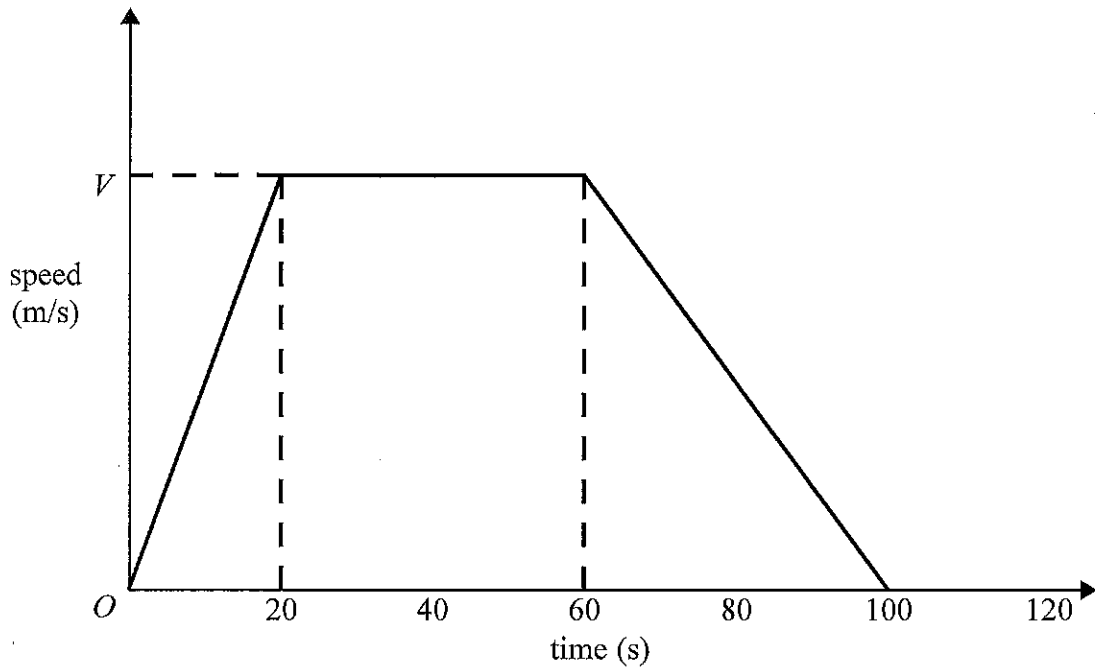
$$y - y_1 = M(x - x_1)$$

$$y - 9 = \frac{4}{3}(x - 4)$$

....

(Total for Question 17 is 5 marks)

×3

$$3y - 27 = 4x - 16$$

$$3y - 4x = 11.$$

18 Here is a speed-time graph for a car journey.
The journey took 100 seconds.

The car travelled 1.75 km in the 100 seconds.

Area = 1·75km = 1750 m

(a) Work out the value of V.

Area Trapezium

$A = 1750$ $a = 100$ $b = 40$
$h = V$

$A = \left(\dfrac{a+b}{2}\right) \times h$

$1750 = \left(\dfrac{100+40}{2}\right) \times V$

$V = \dfrac{1750}{70}$ .... 25 m/s.

(3)

(b) Describe the acceleration of the car for each part of this journey.

0 - 20s constant acceleration

20-60s constant velocity (acceleration = 0)
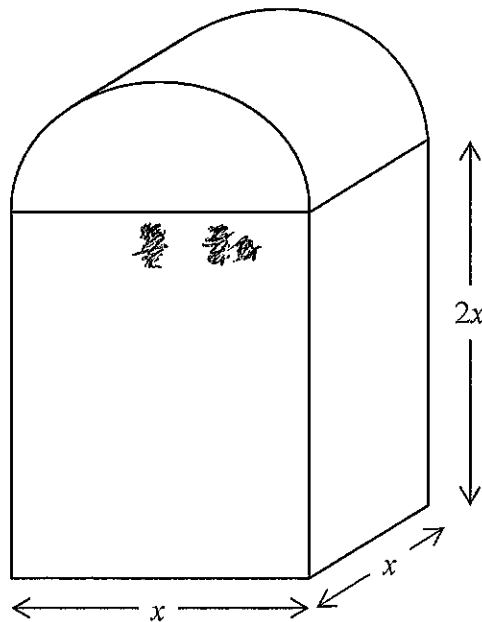
60 - 100s constant deceleration.

(2)

(Total for Question 18 is 5 marks)

19   In this question all dimensions are in centimetres.

A solid has uniform cross section.

The cross section is a rectangle and a semicircle joined together.

$2x$

x

x

Work out an expression, in cm^3, for the **total** volume of the solid.

Write your expression in the form $ax^3 + \dfrac{1}{b}\pi x^3$ where a and b are integers.

Volume of solid
= Volume + Volume
of cuboid semicircle
prism

$= x \times x \times 2x + \pi \times \left(\dfrac{x}{2}\right)^2 \times x$

$= 2x^3 + \dfrac{1}{4}\pi x^3$

$a = 2 \quad b = 4$

.... cm^3

(Total for Question 19 is 4 marks)

20 $f(x) = 2x + c$

$g(x) = cx + 5$

$fg(x) = 6x + d$

c and d are constants.

Work out the value of d.

$$fg(x) = 6x + d$$

$$fg(x) = 2(cx + 5) + c$$

$$= 2cx + 10 + c$$

comparing x terms $2cx = 6x$ $c = 3$

comparing number terms $d = 10 + c$

$$d = 10 + 3 = 13$$

$$\underline{d = 13} \, .$$

(Total for Question 20 is 3 marks)