Write your name here

Surname	Other names

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 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.*

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

$$\frac{x}{2} - \frac{2}{x+1} - 1 = 0$$

Both sides × 2

$$x - \frac{4}{x+1} - 2 = 0$$

Both sides × $(x + 1)$

$$x(x + 1) - 4 - 2(x + 1) = 0$$

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

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

$$(x + 2)(x - 3) = 0$$

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

$x = -2$ or 3

(Total for Question 1 is 4 marks)

2 The diagram shows a solid wax cylinder.

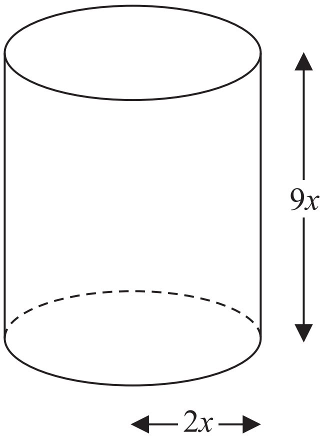


Diagram **NOT** accurately drawn

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 of a cylinder $= \pi r^2 h$

$$= \pi (2x)^2\, 9x$$

$$= \pi\, 4x^2 9x$$

$$= 36\pi x^3$$

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

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

$$4\pi r^3 = 108 \pi x^3$$

$$r^3 = 27x^3$$

$$r = 3x$$

$r = 3x$

(Total for Question 2 is 3 marks)

3

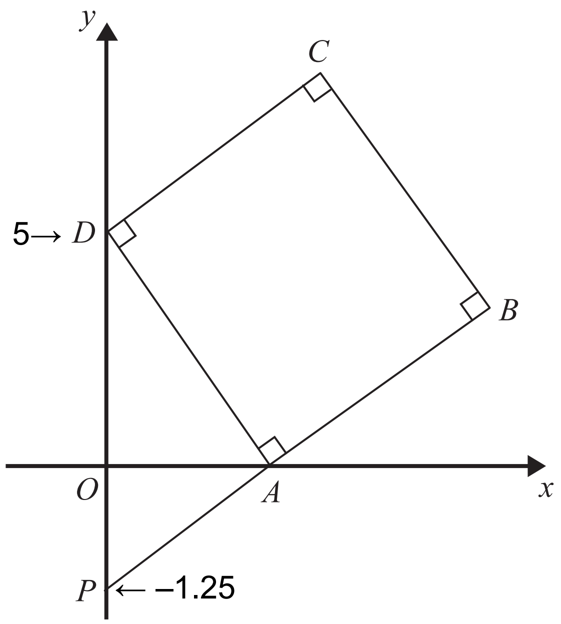


Diagram **NOT** accurately drawn

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*.

The line *AB* is perpendicular to the line for the equation $y = -2x + 5$.

This means its equation will be $y = \frac{1}{2}x + c$

When $y = -2x + 5$ is at *A*. $y = 0$:

$0 = -2x + 5$

$2x = 5$

$x = 2.5$

It passes through the point (2.5, 0), which is substituted in the equation to find *c*.

$0 = 1.25 + c$

$c = -1.25$. This is the *y* intercept.

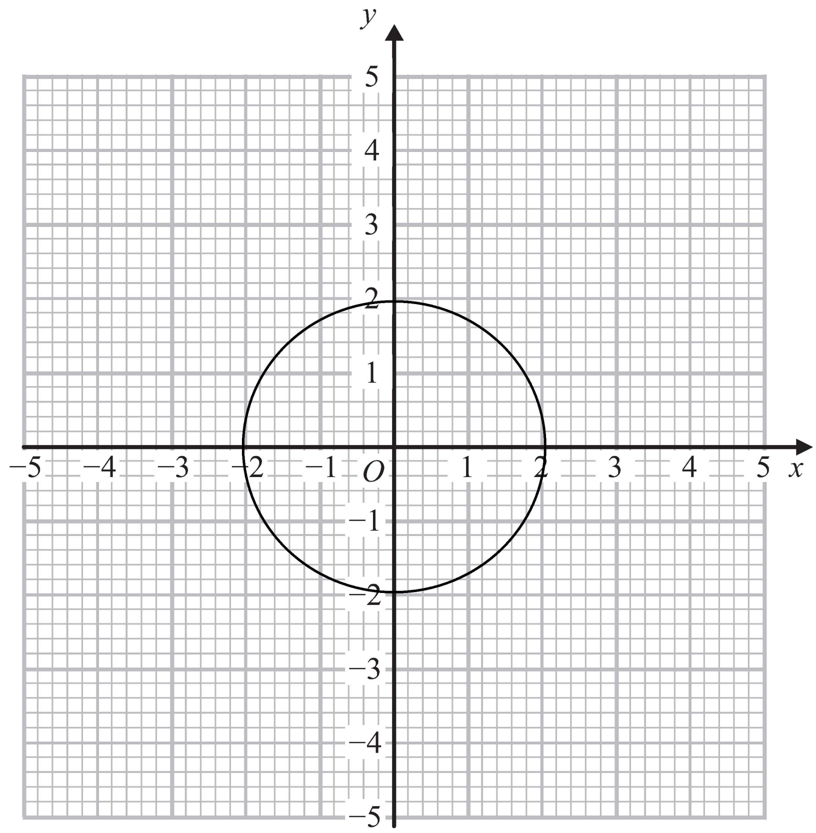
The equation for the line *AB* is $y = \frac{1}{2}x - 1.25$

The distance between *P* and *D* is 5 + 1.25

6.25

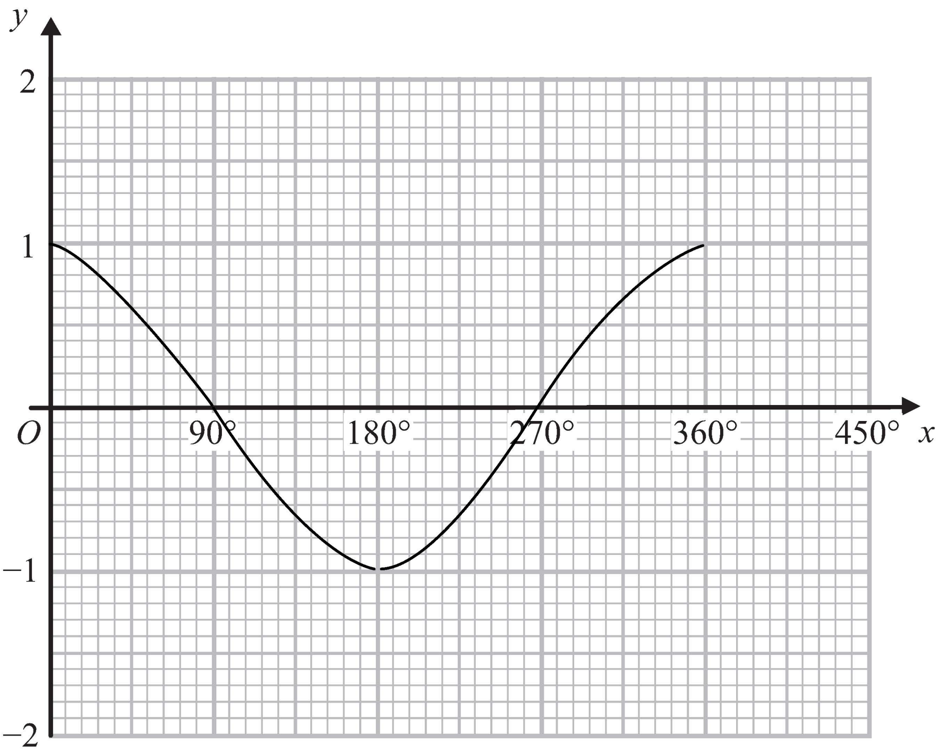
(Total for Question 3 is 4 marks)

4



(a) On the grid, draw the graph of $x^2 + y^2 = 4$

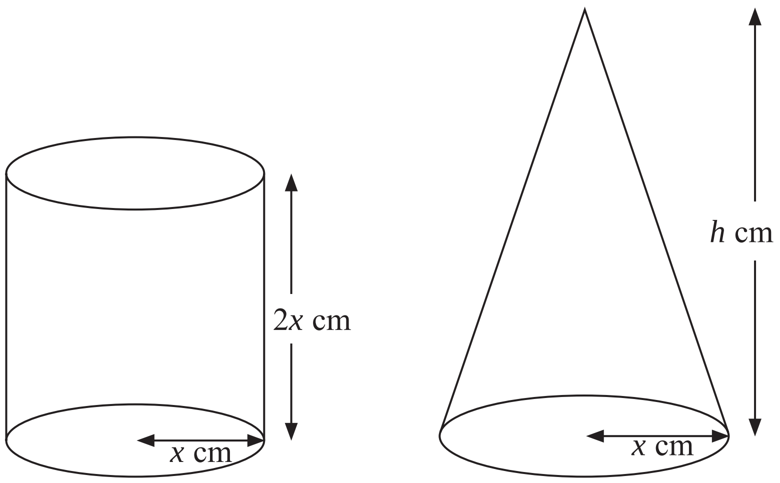
(2)



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

(Total for Question 4 is 4 marks)

5



Diagrams **NOT** accurately drawn

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

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.

Volume of cylinder $= \pi r^2 h$

$= \pi x^2 2x$

$= 2\pi x^3$

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

Volume of cone = Volume of cylinder

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

$\pi x^2 h = 6\pi x^3$

Both sides $\div \pi$, $\div x^2$

$h = 6x$

$h =$ ....6x....................

(Total for Question 5 is 3 marks)

6

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

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

(a) Find the value of f.

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

$$\frac{1}{f} = \frac{2}{5} + \frac{3}{10}$$

$$\frac{1}{f} = \frac{4}{10} + \frac{3}{10}$$

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

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

$f = 1\frac{3}{7}$

(3)

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

to make u the subject of the formula.

Give your answer in its simplest form.

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

$$\frac{1}{u} = \frac{v-f}{fv}$$

$$u = \frac{fv}{v-f}$$

$u = \frac{fv}{v-f}$

(2)

(Total for Question 6 is 5 marks)

7

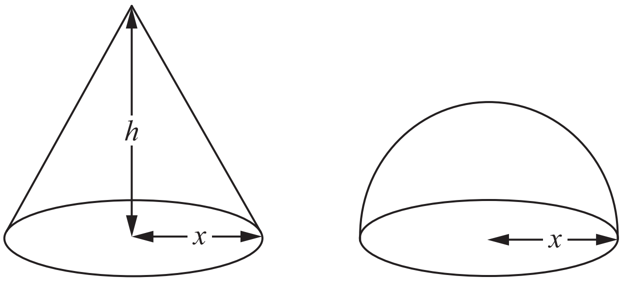


Diagram **NOT** accurately drawn

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.

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

Surface area of hemisphere $= 2\pi r^2 + \pi r^2$

$= 3\pi r^2$

Surface area of cone $= \pi rl + \pi r^2$

$\pi xl + \pi x^2 = 3\pi x^2$

$xl = 2x^2$

$l = 2x$

Pythagoras

$h^2 = 4x^2 - x^2$

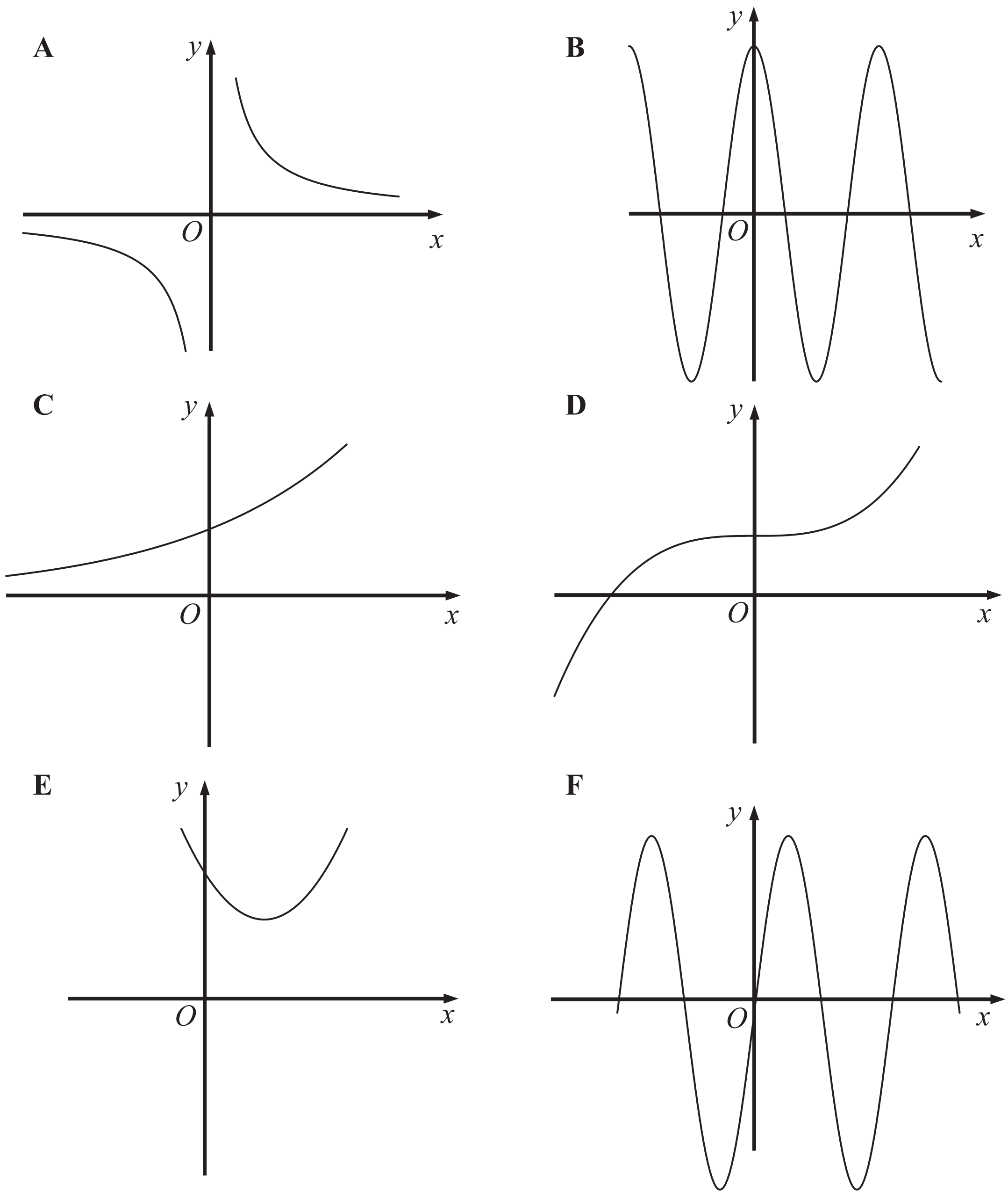
$h^2 = 3x^2$

$h = \sqrt{3}x$

............$h = \sqrt{3}x$............

(Total for Question 7 is 4 marks)

8



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
$y = \frac{4}{x}$	A

(Total for Question 8 is 3 marks)

9 Here is a shape *ABCDE*.

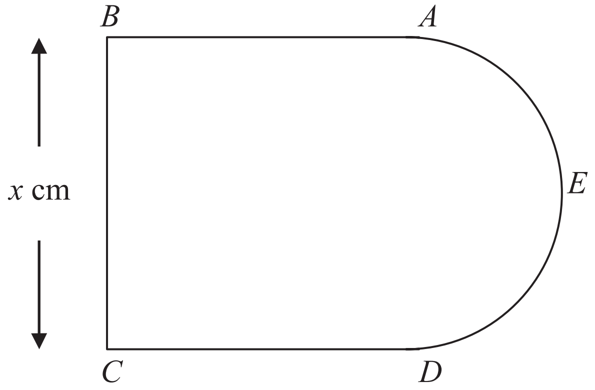


Diagram **NOT** accurately drawn

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.

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

Both sides × 2

$6x + \pi x = 2P$

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

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

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

(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.

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

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

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

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

$k = 1 + \frac{\pi}{8}$ **(3)**

(Total for Question 9 is 5 marks)

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

Multiply by 1000

$$1000r = 213.131313$$
$$10r = 2.131313$$
$$1000r - 10r = 990r$$
$$990r = 213.1313 - 2.1313$$
$$990r = 211$$
$$r = \frac{211}{990}$$

$\frac{211}{990}$

(Total for Question 10 is 3 marks)

11

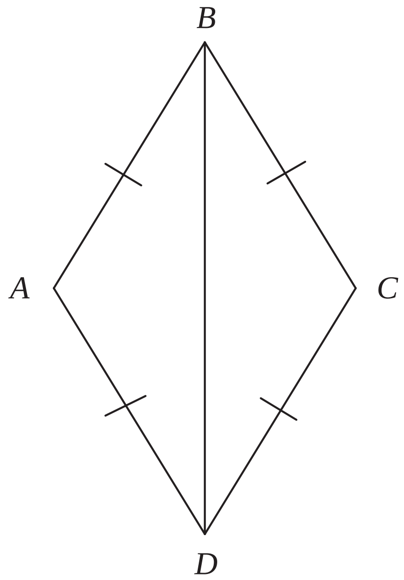


Diagram **NOT** accurately drawn

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

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

AB = *CB* equal sides
AD = *CD* equal sides
BD is common
ADB is congruent to *CDB* (SSS)

(Total for Question 11 is 3 marks)

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

Let n be any integer.

A pair of consecutive numbers would be n and $n + 1$

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

$2n$ is a multiple of 2 so is even.

An even number + 1 is 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.

The proportion of 14 year olds is $\frac{180}{1000}$

The sample size would be:

$$\frac{180}{1000} \times 50 = \frac{90}{10}$$
$$= 9$$

..........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*.

$$P \,\alpha\, \frac{1}{V}$$

$$P = \frac{k}{V}$$

Substitute $V = 8$, $P = 5$

$$5 = \frac{k}{8}$$

$k = 40$

Substitute $k = 40$ in $P = \frac{k}{V}$

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

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

(3)

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

..........20..........

(1)

(Total for Question 14 is 4 marks)

15

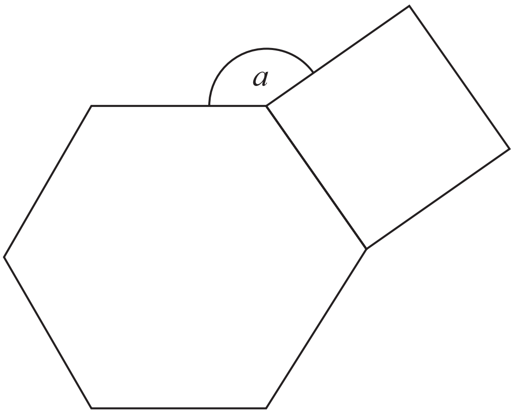


Diagram **NOT** accurately drawn

The diagram shows a regular hexagon and a square.

Calculate the size of the angle *a*.

Sum of interior angles of a regular polygon is

$2n - 4$ right angles, where n is the number of sides.

Substitute $n = 6$ into $2n - 4$ right angles.

$12 - 4 = 8$ right angles

$= 720°$

$720 \div 6 = 120°$

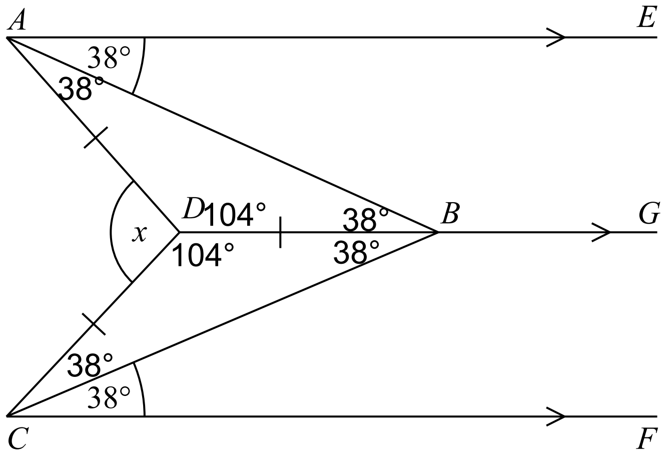
Angle $a = 360 - 120 - 90$

$= 150°$

..................150.................. °

(Total for Question 15 is 4 marks)

16



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.

Angle *ABD* = 38° Alternate angle to angle *EAB*

Angle *DAB* = 38° Triangle *BDA* is isosceles

Angle *DCB* = 38° Triangle *BDC* is isosceles

Angle *ADB* = angle *CDB* = 104° 180 – 38 – 38 (Angles in a triangle add up to 180°)

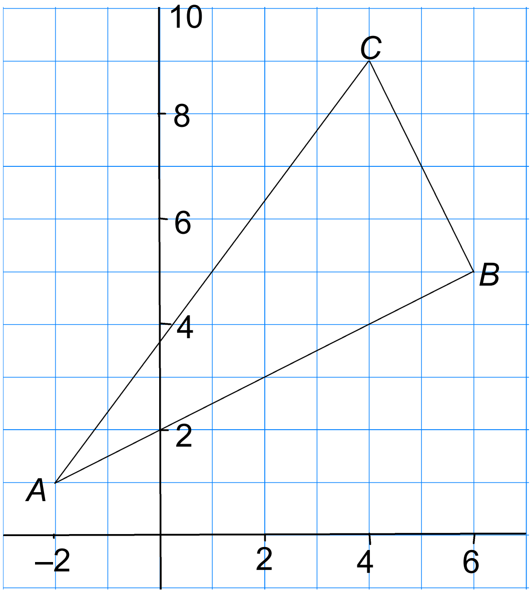
Angle *x* = 152° 360 – 104 – 104

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.



Gradient of $AB = \frac{4}{8}$

$= \frac{1}{2}$

Equation of AB

$y = \frac{1}{2}x + c$

B is at (6, 5)

$5 = (\frac{1}{2} \times 6) + c$

$c = 2$

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

The graph of the equation of CB is perpendicular to that of AB.

Therefore it is the inverse of AB.

$y = -2x + c$

Substitute B coordinates (6, 5) to find c.

$5 = -12 + c$

$c = 17$

Equation of CD

$y = -2x + 17$

y coordinate of C

$x = 4$

$y = -8 + 17$

$y = 9$

Gradient of $AC = \frac{8}{6}$

$= \frac{4}{3}$

Equation of AC

$y = \frac{4}{3}x + c$

Substitute C coordinates (4, 9) to find c.

$9 = \frac{16}{3} + c$

$c = 9 - \frac{16}{3}$

$c = \frac{11}{3}$

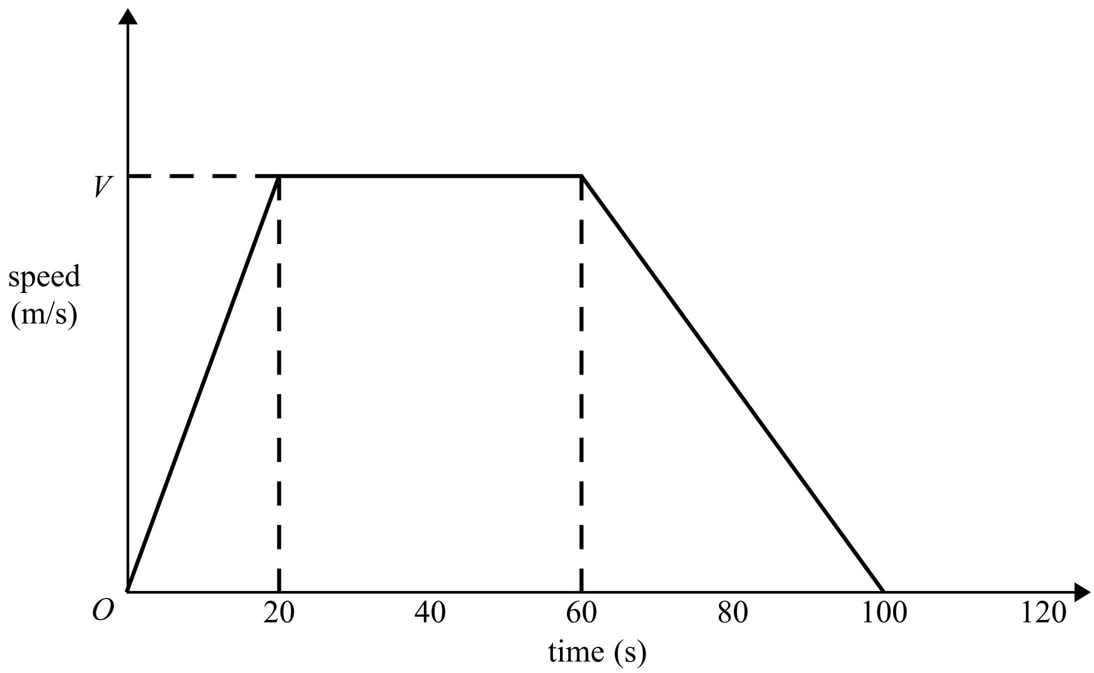
$y = \frac{4}{3}x + \frac{11}{3}$

$3y = 4x + 11$

$3y - 4x = 11$

(Total for Question 17 is 5 marks)

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.

(a) Work out the value of V.

Change km to m. 1750 m in 100 sec

The area under the graph is the distance travelled. The graph forms a trapezium.

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

$$1750 = \frac{1}{2}(40 + 100)V$$

$$70V = 1750$$

$$V = 25$$

.......................25.......................

(3)

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

The gradient of the graph is the acceleration. Acceleration $= \dfrac{\text{change in velocity}}{\text{time}}$

First stage: $\frac{25}{20} = 1.25$ m/s^2

Second stage: $\frac{25}{0} = 0$ m/s^2

Third stage: $\frac{25}{-40} = -0.625$ m/s^2

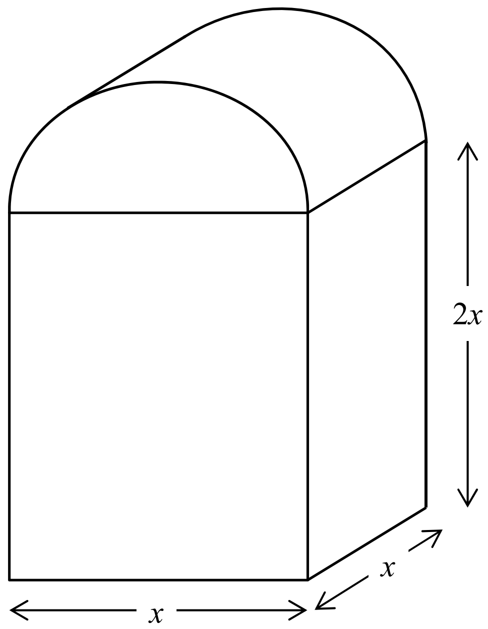
(2)

(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.



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

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

Cross section area:

Rectangle $= x2x^2$

$= 2x^2$

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

$= \frac{1}{2}\pi\frac{x^2}{4}$

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

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

$= 2x^3 + \pi\frac{x^3}{8}$

$= 2x^3 + \frac{1}{8}\pi x^3$

$2x^3 + \frac{1}{8}\pi x^3$ 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.

To find fg(x) in terms of c substitute g(x) for x in f(x)

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

$= 2cx + 10 + c$

$6x + d = 2cx + 10 + c$

c and d are constants

$\therefore d = 10 + c$

$6x = 2cx$

$c = 3$

$6x + d = 2(3x) + 10 + 3$

$6x + d = 6x + 13$

$d = 13$

$d = 13$

(Total for Question 20 is 3 marks)

BLANK PAGE