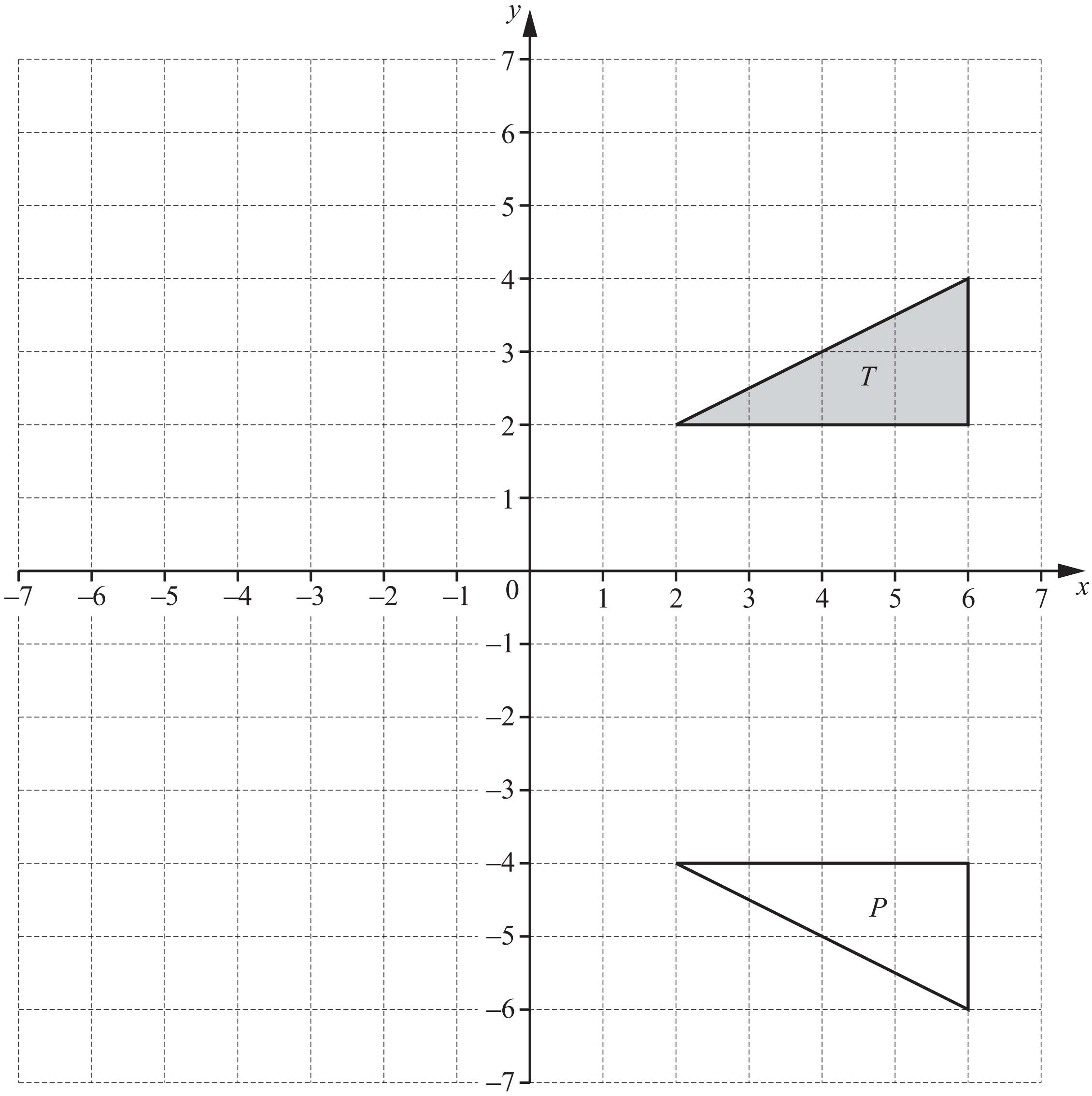
1 (a)



(i) Describe fully the **single** transformation that maps triangle T onto triangle P.

....

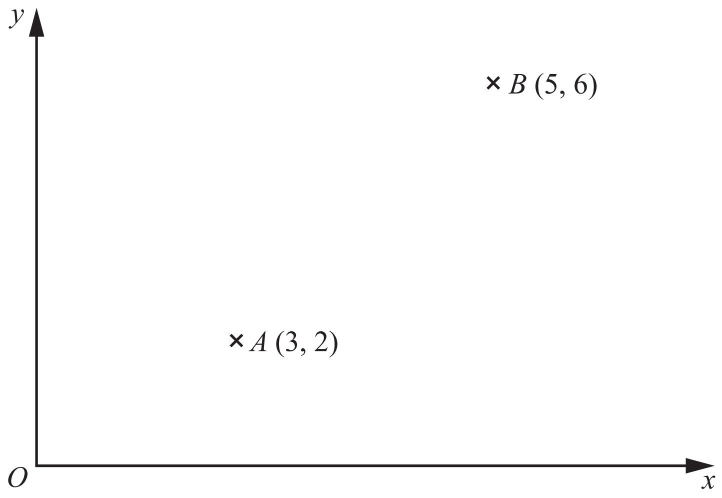
.... [2]

(ii) Translate triangle T by the vector $\begin{pmatrix}-2\\-5\end{pmatrix}$. [2]

(iii) Rotate triangle T through 90° anticlockwise about (0, 0). [2]

(iv) Enlarge triangle T by scale factor $-\frac{1}{2}$ with centre (0, 0). [2]

(b)



NOT TO SCALE

(i) Find the column vector $\overrightarrow{AB}$.

$\overrightarrow{AB} = \begin{pmatrix} \\ \end{pmatrix}$ [1]

(ii) Find $|\overrightarrow{AB}|$.

$|\overrightarrow{AB}|$ = ... [2]

(iii) *B* is the mid-point of the line *AC*.

Find the co-ordinates of *C*.

(....................... , ...) [2]

(iv) Find the equation of the straight line that passes through *A* and *B*.

.... [3]

(v) The straight line that passes through *A* and *B* cuts the *y*-axis at *D*.

Write down the co-ordinates of *D*.

(....................... , ...) [1]

2 **(a)** A school has 240 students.
The ratio girls : boys = 25 : 23.

(i) Show that the number of boys is 115.

[1]

(ii) One day, there are 15 girls absent and 15 boys absent.

Find the ratio girls : boys in school on this day.
Give your answer in its simplest form.

.... : .... [2]

(iii) Next year, the number of students will increase by 15%.

Calculate the number of students next year.

.... [2]

(iv) Since the school was opened, the number of students has increased by 60%.
There are now 240 students.

Calculate the number of students when the school was opened.

.... [3]

(b) The population of a city is increasing exponentially at a rate of 2% each year.
The population now is 256 000.

Calculate the population after 30 years.
Give your answer correct to the nearest thousand.

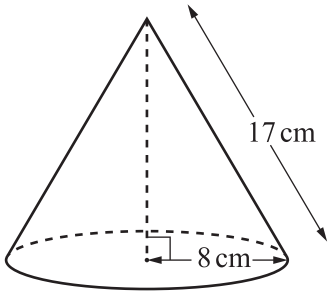
.... [3]

(c) A bacteria population increases exponentially at a rate of r% each day.
After 32 days, the population has increased by 309%.

Find the value of r.

r = ... [3]

3 **(a)**



NOT TO SCALE

The diagram shows a solid cone.
The radius is 8 cm and the slant height is 17 cm.

(i) Calculate the curved surface area of the cone.

[The curved surface area, A, of a cone with radius r and slant height l is $A = \pi r l$.]

.... cm^2 [2]

(ii) Calculate the volume of the cone.

[The volume, V, of a cone with radius r and height h is $V = \frac{1}{3}\pi r^2 h$.]

.... cm^3 [4]

(iii) The cone is made of wood and 1 cm^3 of the wood has a mass of 0.8 g.

Calculate the mass of the cone.

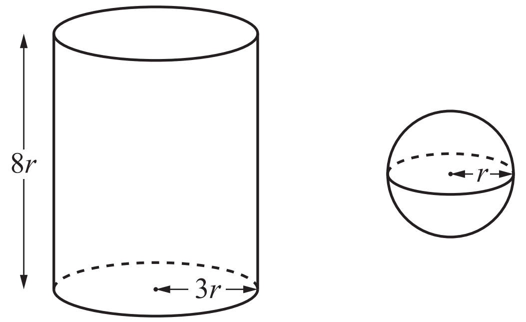
.... g [1]

(iv) The cone is placed in a box.
The total mass of the cone and the box is 1.2 kg.

Calculate the mass of the box.
Give your answer in grams.

.... g [1]

(b)



NOT TO SCALE

The diagram shows a solid cylinder and a solid sphere.
The cylinder has radius $3r$ and height $8r$.
The sphere has radius r.

(i) Find the volume of the sphere as a fraction of the volume of the cylinder.
Give your answer in its lowest terms.

[The volume, V, of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

.... [4]

(ii) The surface area of the sphere is $81\pi\,\text{cm}^2$.

Find the **curved** surface area of the cylinder.
Give your answer in terms of π.

[The surface area, A, of a sphere with radius r is $A = 4\pi r^2$.]

.... cm^2 [4]

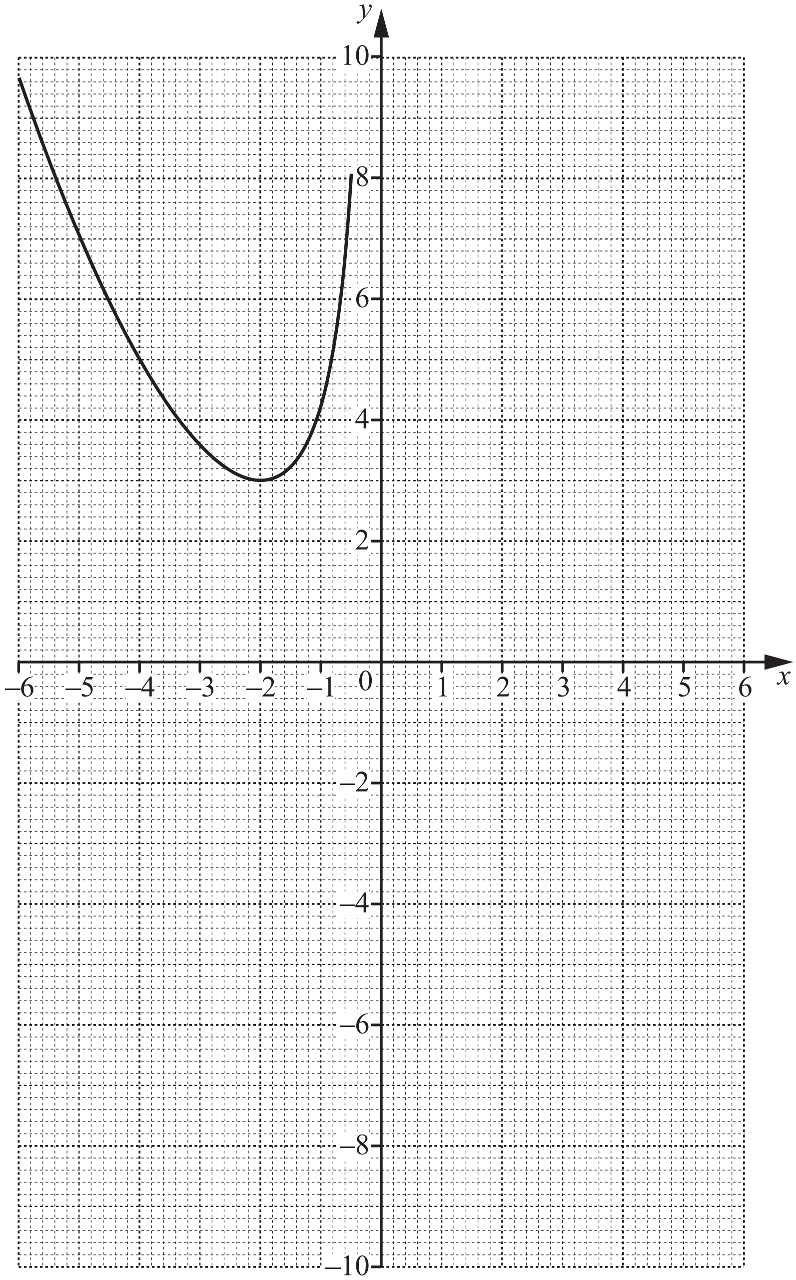
4 $f(x) = \frac{x^2}{4} - \frac{4}{x}$, $x \neq 0$

(a) Complete the table for $f(x)$.

x	0.5	1	2	3	4	5	6
$f(x)$	–7.9	–3.8		0.9		5.5	8.3

[2]

(b) The graph of $y = f(x)$ for $-6 \leqslant x \leqslant -0.5$ is drawn on the grid.



On the same grid, draw the graph of $y = f(x)$ for $0.5 \leqslant x \leqslant 6$. [3]

(c) By drawing a suitable tangent, estimate the gradient of the graph of $y = f(x)$ at the point (–4, 5).

.... [3]

(d) $g(x) = \frac{9}{x}$, $x \neq 0$

Complete the table for $g(x)$.

x	–4	–3	–2	–1		1	2	3	4
$g(x)$	–2.3		–4.5	–9		9	4.5		2.3

[1]

(e) On the same grid, draw the graph of $y = g(x)$ for $-4 \leqslant x \leqslant -1$ and $1 \leqslant x \leqslant 4$. [4]

(f) **(i)** Use your graphs to find the value of x when $f(x) = g(x)$.

x = ... [1]

(ii) Write down an inequality to show the **positive** values of x for which $f(x) > g(x)$.

.... [1]

(g) The exact answer to **part (f)(i)** is $\sqrt[3]{k}$.

Use algebra to find the value of k.

k = ... [2]

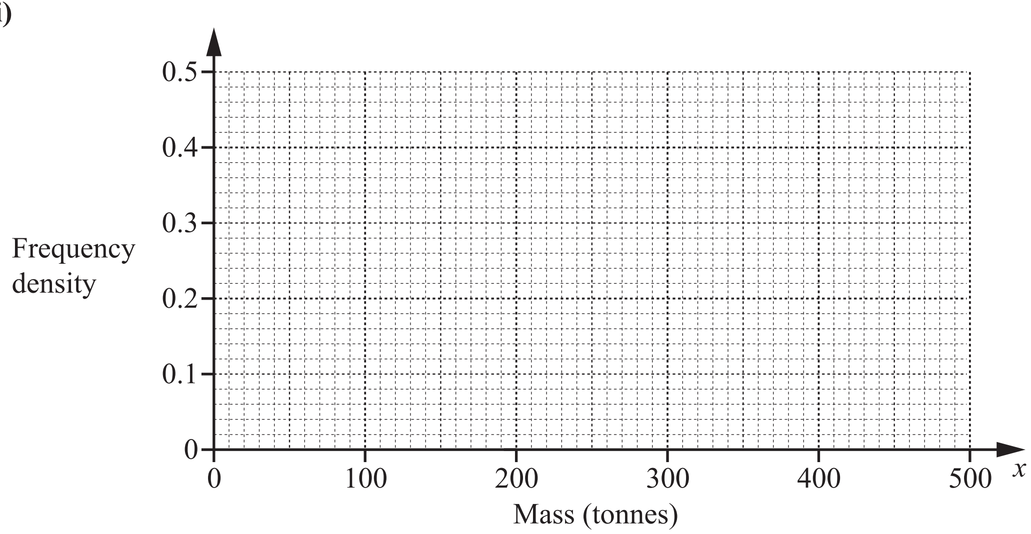
5 **(a)** A factory recycles metal.
The mass, x tonnes, of metal is measured each week.
The table shows the results for 52 weeks.

Mass (x tonnes)	$100 < x \leqslant 200$	$200 < x \leqslant 250$	$250 < x \leqslant 300$	$300 < x \leqslant 500$
Frequency	8	20	12	12

(i) Calculate an estimate of the mean.

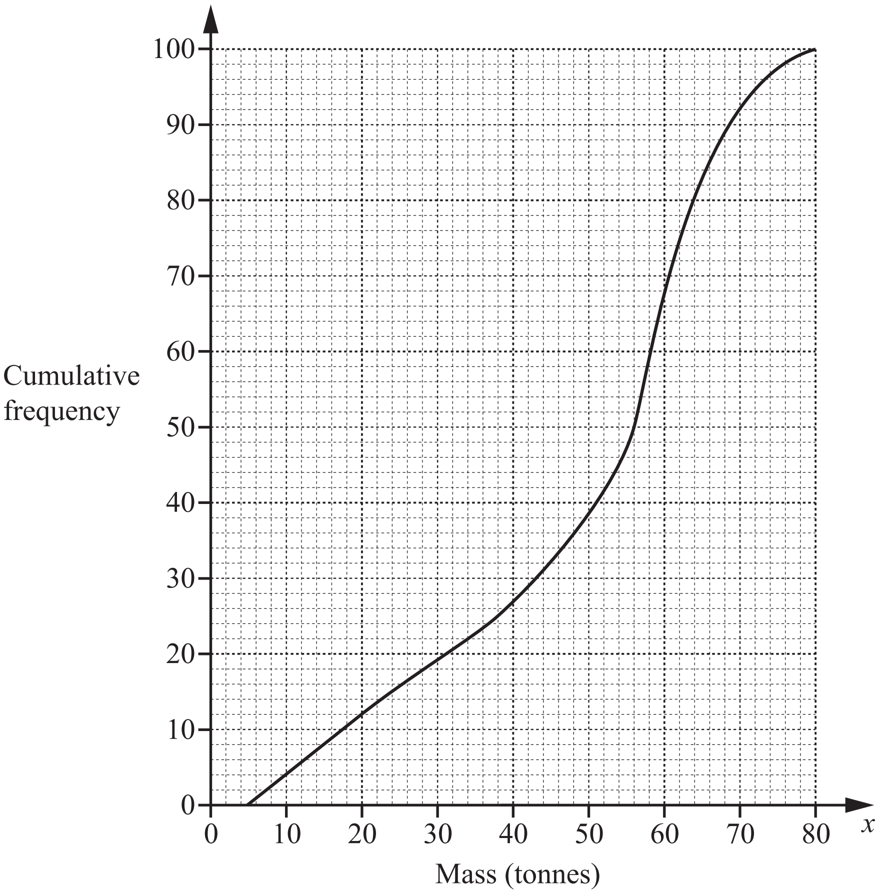
.... tonnes [4]

(ii)



On the grid, draw a histogram to show the information in the table. [4]

(b) Another factory also recycles metal.
The mass, x tonnes, of metal is measured each day for a number of days.
The cumulative frequency diagram shows the results.



(i) For how many days was the mass measured?

.... [1]

(ii) Find an estimate of the median.

.... tonnes [1]

(iii) Find an estimate of the upper quartile.

.... tonnes [1]

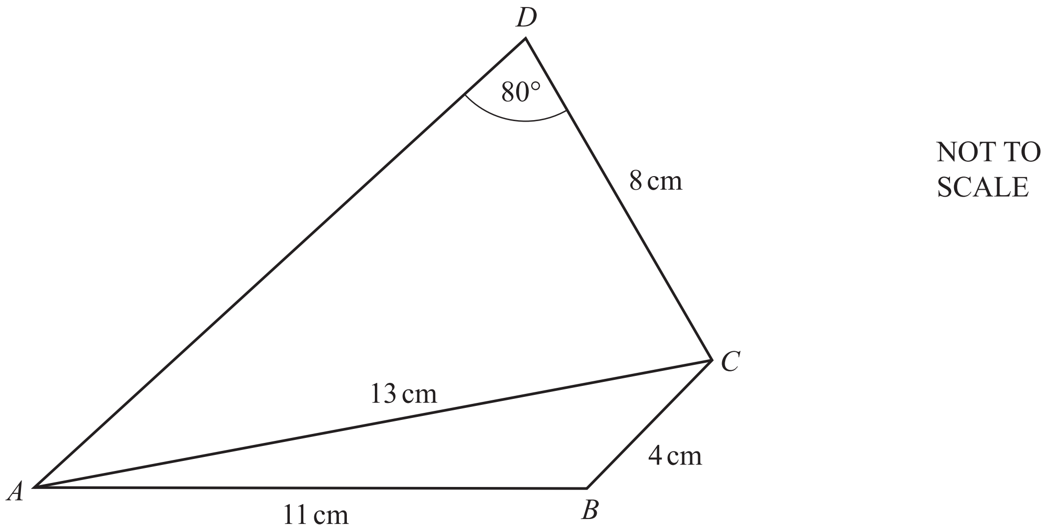
(iv) Find an estimate of the interquartile range.

......................................tonnes [1]

(v) Find an estimate of the number of days when the mass was greater than 20 tonnes.

.... [2]

6



(a) Calculate angle *ACB*.

Angle *ACB* = ... [4]

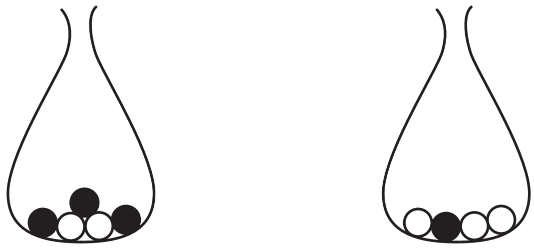
(b) Calculate angle *ACD*.

Angle *ACD* = ... [4]

(c) Calculate the area of the quadrilateral *ABCD*.

.... cm^2 [3]

7



Bag *A* contains 3 black balls and 2 white balls.
Bag *B* contains 1 black ball and 3 white balls.

(a) A ball is taken at random from each bag.

(i) Show that a black ball is more likely to be taken from bag *A* than from bag *B*.

[1]

(ii) Find the probability that the two balls have different colours.

.... [3]

(b) The balls are returned to their original bags.
Three balls are taken at random from bag A, without replacement.

Find the probability that

(i) they are all black,

.... [2]

(ii) they are all white.

.... [1]

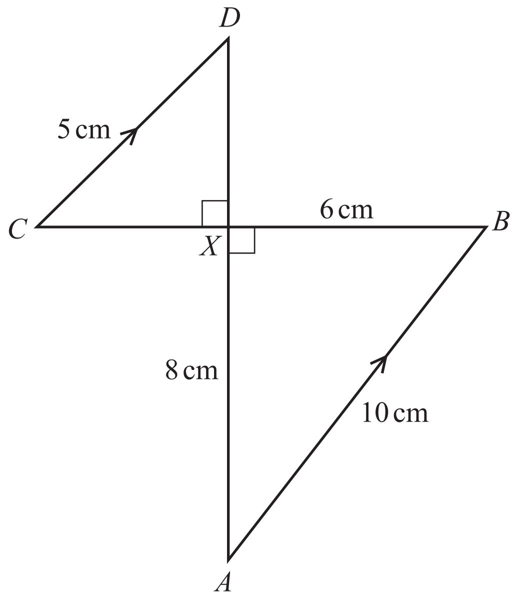
(c) The balls are returned to their original bags.

A ball is taken at random from bag A and its colour is recorded.
This ball is then placed in bag B.
A ball is then taken at random from bag B.

Find the probability that the ball taken from bag B has a different colour to the ball taken from bag A.

.... [3]

8 **(a)**



NOT TO SCALE

In the diagram, AB and CD are parallel.
AD and BC intersect at right angles at the point X.
$AB = 10$ cm, $CD = 5$ cm, $AX = 8$ cm and $BX = 6$ cm.

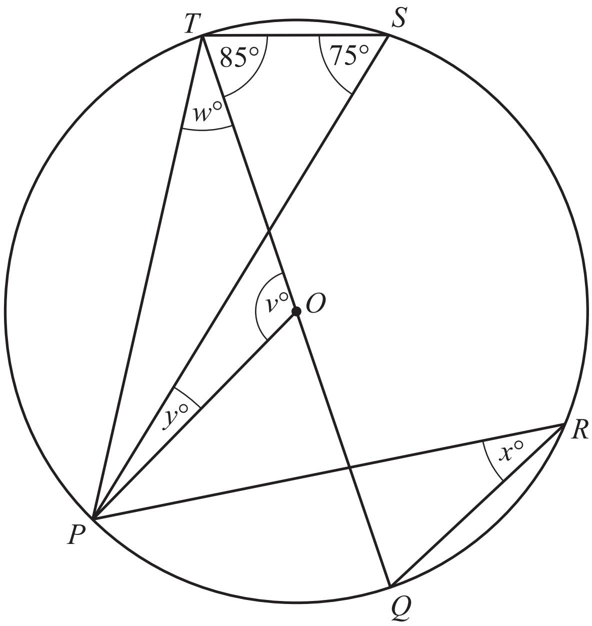
(i) Use similar triangles to calculate DX.

$DX =$ .... cm [2]

(ii) Calculate angle XAB.

Angle $XAB =$ .... [2]

(b)



NOT TO SCALE

P, Q, R, S and T lie on the circle, centre O.
Angle $PST = 75°$ and angle $QTS = 85°$.

Find the values of v, w, x and y.

v = ...

w = ...

x = ...

y = ... [6]

(c) Two containers are mathematically similar.
The surface area of the larger container is $226\,\text{cm}^2$ and the surface area of the smaller container is $94\,\text{cm}^2$.
The volume of the larger container is $680\,\text{cm}^3$.

Find the volume of the smaller container.

.... cm^3 [3]

9 $\quad f(x) = 3x + 4 \qquad g(x) = 2x - 1 \qquad h(x) = 3^x$

(a) Find $g\left(\frac{1}{2}\right)$.

.... [1]

(b) Find $fh(-1)$.

.... [2]

(c) Find $g^{-1}(x)$.

$g^{-1}(x) =$ .... [2]

(d) Find $ff(x)$ in its simplest form.

.... [2]

(e) Find $(f(x))^2$ in the form $ax^2 + bx + c$.

.... [2]

(f) Find x when $h^{-1}(x) = g(2)$.

$x =$ .... [2]

10 (a) Find the next term and the *n*th term of this sequence.

$$\frac{3}{5}, \quad \frac{4}{7}, \quad \frac{5}{9}, \quad \frac{6}{11}, \quad \frac{7}{13}, \quad \ldots$$

Next term = ...

*n*th term = ... [3]

(b) Find the *n*th term of each sequence.

(i) –1, –3, –5, –7, –9, …

.... [2]

(ii) 2, 9, 28, 65, 126, …

.... [2]