



1 (a) Kristian and Stephanie share some money in the ratio 3 : 2.  
Kristian receives \$72.

(i) Work out how much Stephanie receives.

\$ ..... [2]

(ii) Kristian spends 45% of his \$72 on a computer game.

Calculate the price of the computer game.

\$ ..... [1]

(iii) Kristian also buys a meal for \$8.40 .

Calculate the fraction of the \$72 Kristian has left after buying the computer game and the meal.  
Give your answer in its lowest terms.

..... [2]

(iv) Stephanie buys a book in a sale for \$19.20 .  
This sale price is after a reduction of 20%.

Calculate the original price of the book.

\$ ..... [3]

- (b) Boris invests \$550 at a rate of 2% per year simple interest.

Calculate the amount Boris has after 10 years.

\$ ..... [3]

- (c) Marlene invests \$550 at a rate of 1.9% per year compound interest.

Calculate the amount Marlene has after 10 years.

\$ ..... [2]

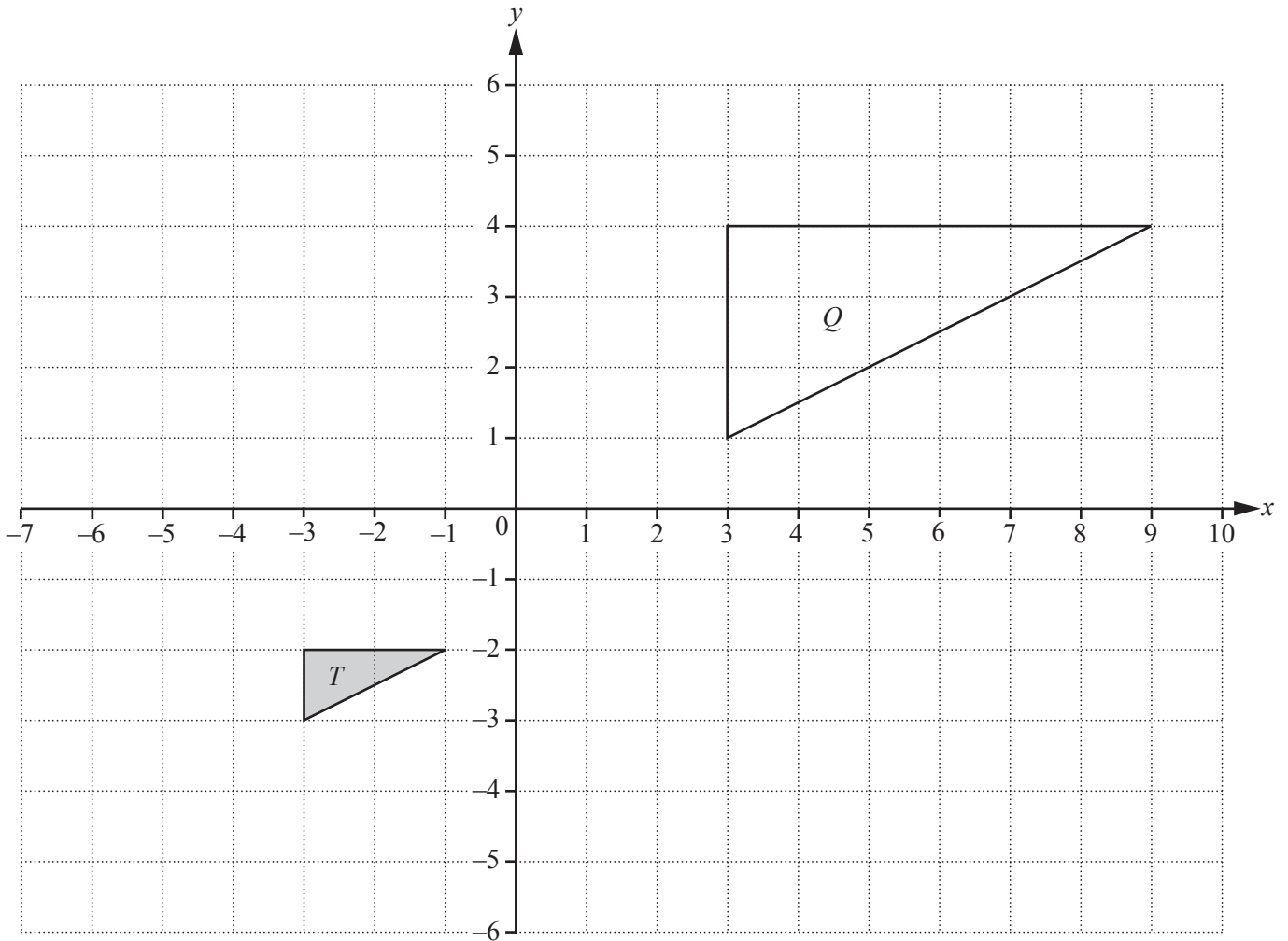
- (d) Hans invests \$550 at a rate of  $x\%$  per year compound interest.

At the end of 10 years he has a total amount of \$638.30, correct to the nearest cent.

Find the value of  $x$ .

$x =$  ..... [3]

2 (a)



(i) Draw the image of triangle *T* after a translation by the vector  $\begin{pmatrix} 5 \\ -2 \end{pmatrix}$ . [2]

(ii) Draw the image of triangle *T* after a reflection in the line  $y = 1$ . [2]

(iii) Describe fully the **single** transformation that maps triangle *T* onto triangle *Q*.

.....  
 ..... [3]

(b)  $\mathbf{M} = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$        $\mathbf{N} = \begin{pmatrix} 4 & 3 \\ 1 & k \end{pmatrix}$        $\mathbf{P} = \begin{pmatrix} 1 & 3 \\ 0 & 6 \end{pmatrix}$

(i) Work out  $\mathbf{M} + \mathbf{P}$ .

$$\begin{pmatrix} & \\ & \end{pmatrix} \quad [1]$$

(ii) Work out  $\mathbf{PM}$ .

$$\begin{pmatrix} & \\ & \end{pmatrix} \quad [2]$$

(iii)  $|\mathbf{M}| = |\mathbf{N}|$

Find the value of  $k$ .

$$k = \dots\dots\dots [3]$$

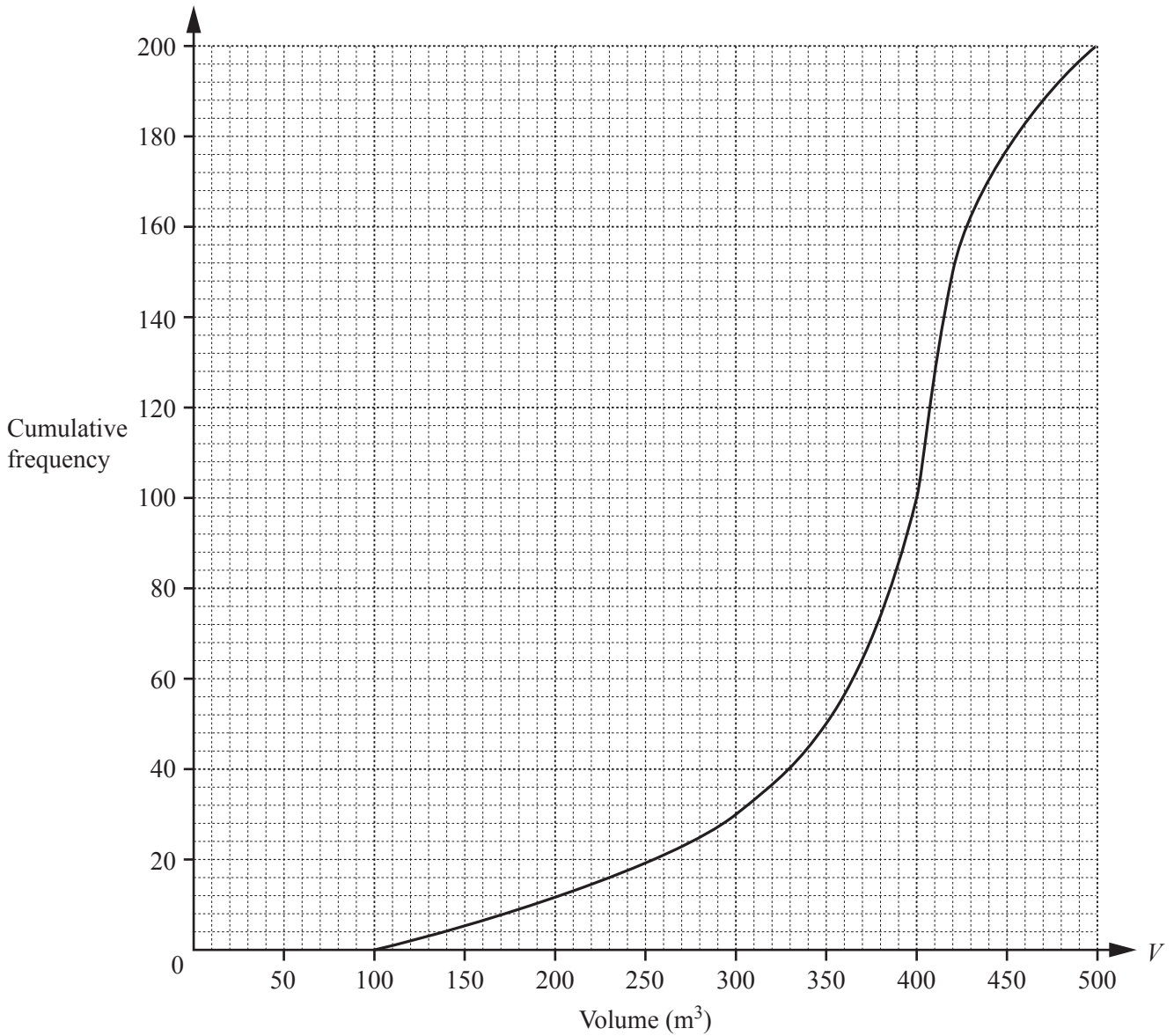
(c) (i) Describe fully the **single** transformation represented by the matrix  $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$ .

.....  
 ..... [3]

(ii) Find the matrix which represents a reflection in the line  $y = x$ .

$$\begin{pmatrix} & \\ & \end{pmatrix} \quad [2]$$

- 3 (a) 200 students estimate the volume,  $V \text{ m}^3$ , of a classroom. The cumulative frequency diagram shows their results.



Find

- (i) the median,

.....  $\text{m}^3$  [1]

- (ii) the lower quartile,

.....  $\text{m}^3$  [1]

- (iii) the inter-quartile range,

.....  $\text{m}^3$  [1]

- (iv) the number of students who estimate that the volume is greater than  $300 \text{ m}^3$ .

..... [2]

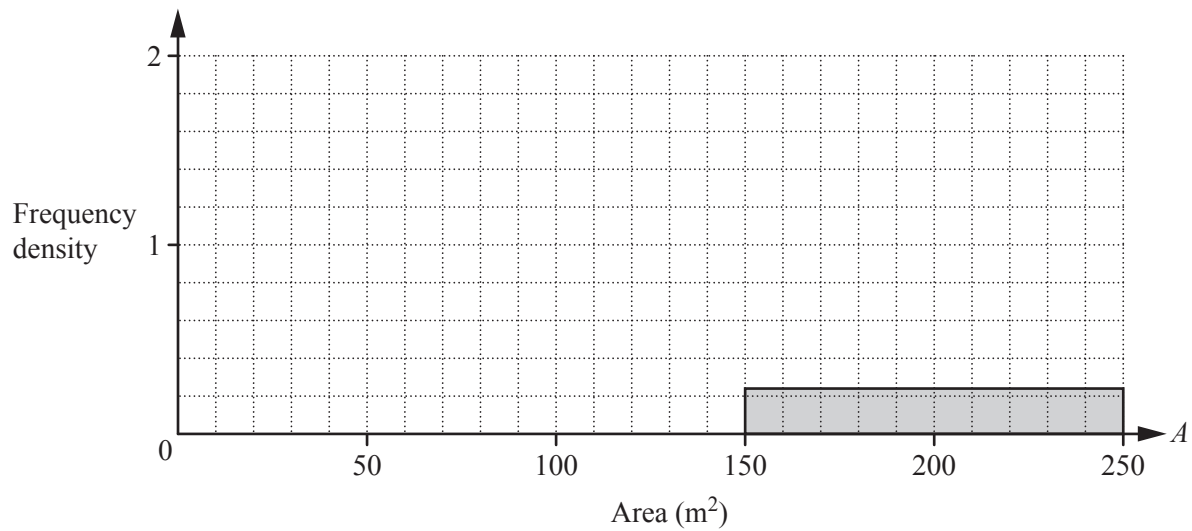
- (b) The 200 students also estimate the total area,  $A \text{ m}^2$ , of the windows in the classroom. The results are shown in the table.

Area ( $A \text{ m}^2$ )	$20 < A \leq 60$	$60 < A \leq 100$	$100 < A \leq 150$	$150 < A \leq 250$
Frequency	32	64	80	24

- (i) Calculate an estimate of the mean.  
Show all your working.

.....  $\text{m}^2$  [4]

- (ii) Complete the histogram to show the information in the table.



[4]

- (iii) Two of the 200 students are chosen at random.

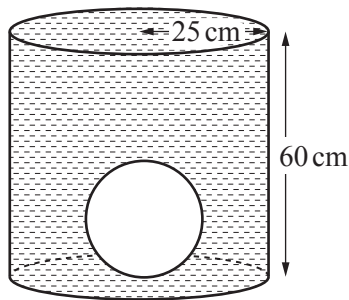
Find the probability that they both estimate that the area is greater than  $100 \text{ m}^2$ .

..... [2]

- 4 (a) Calculate the volume of a metal sphere of radius 15 cm and show that it rounds to  $14\,140\text{ cm}^3$ , correct to 4 significant figures.  
 [The volume,  $V$ , of a sphere with radius  $r$  is  $V = \frac{4}{3}\pi r^3$ .]

[2]

- (b) (i) The sphere is placed inside an empty cylindrical tank of radius 25 cm and height 60 cm. The tank is filled with water.

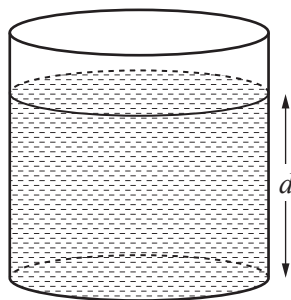


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Calculate the volume of water required to fill the tank.

.....  $\text{cm}^3$  [3]

- (ii) The sphere is removed from the tank.



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Calculate the depth,  $d$ , of water in the tank.

$d =$  ..... cm [2]



(c) The sphere is melted down and the metal is made into a solid cone of height 54 cm.

(i) Calculate the radius 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]

(ii) Calculate the **total** 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<sup>2</sup> [4]

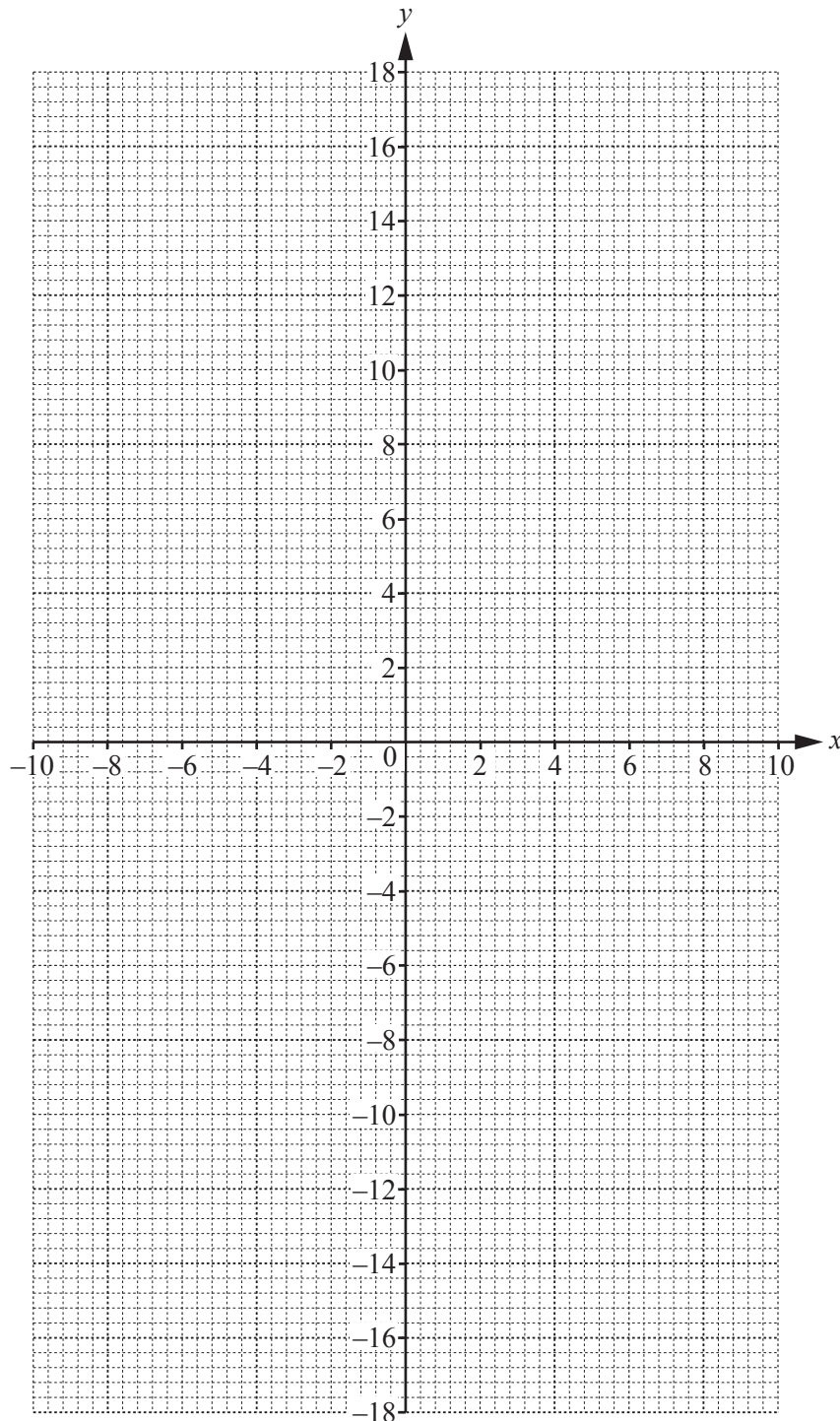
5  $f(x) = \frac{20}{x} + x, \quad x \neq 0$

(a) Complete the table.

$x$	-10	-8	-5	-2	-1.6		1.6	2	5	8	10
$f(x)$	-12	-10.5	-9	-12	-14.1		14.1	12			12

[2]

(b) On the grid, draw the graph of  $y = f(x)$  for  $-10 \leq x \leq -1.6$  and  $1.6 \leq x \leq 10$ .



[5]

(c) Using your graph, solve the equation  $f(x) = 11$ .

$x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [2]

(d)  $k$  is a prime number and  $f(x) = k$  has no solutions.

Find the possible values of  $k$ .

$\dots\dots\dots$  [2]

(e) The gradient of the graph of  $y = f(x)$  at the point  $(2, 12)$  is  $-4$ .

Write down the co-ordinates of the other point on the graph of  $y = f(x)$  where the gradient is  $-4$ .

$(\dots\dots\dots, \dots\dots\dots)$  [1]

(f) (i) The equation  $f(x) = x^2$  can be written as  $x^3 + px^2 + q = 0$ .

Show that  $p = -1$  and  $q = -20$ .

[2]

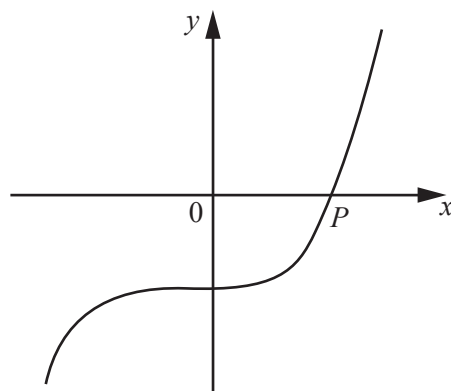
(ii) On the grid opposite, draw the graph of  $y = x^2$  for  $-4 \leq x \leq 4$ .

[2]

(iii) Using your graphs, solve the equation  $x^3 - x^2 - 20 = 0$ .

$x = \dots\dots\dots$  [1]

(iv)



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The diagram shows a **sketch** of the graph of  $y = x^3 - x^2 - 20$ .  
 $P$  is the point  $(n, 0)$ .

Write down the value of  $n$ .

$n = \dots\dots\dots$  [1]

6 (a)

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The perimeter of the rectangle is 80 cm.  
The area of the rectangle is  $A \text{ cm}^2$ .

(i) Show that  $x^2 - 40x + A = 0$ .

[3]

(ii) When  $A = 300$ , solve, by factorising, the equation  $x^2 - 40x + A = 0$ .

$x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [3]

(iii) When  $A = 200$ , solve, by using the quadratic formula, the equation  $x^2 - 40x + A = 0$ .  
Show all your working and give your answers correct to 2 decimal places.

$x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [4]

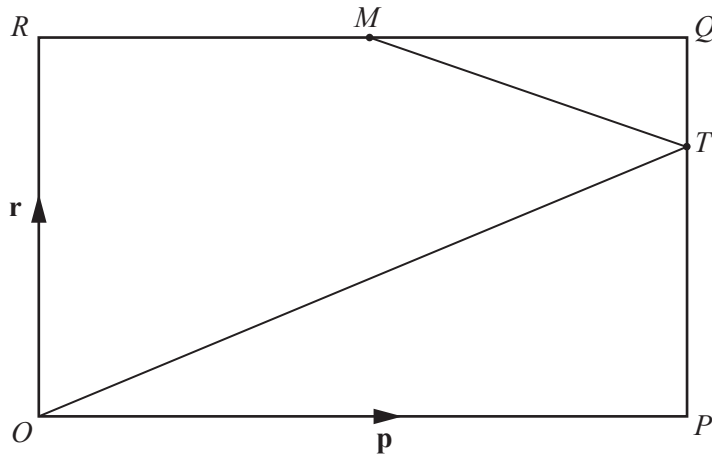
- (b) A car completes a 200 km journey with an average speed of  $x$  km/h.  
The car completes the return journey of 200 km with an average speed of  $(x + 10)$  km/h.
- (i) Show that the difference between the time taken for each of the two journeys is  $\frac{2000}{x(x+10)}$  hours.

[3]

- (ii) Find the difference between the time taken for each of the two journeys when  $x = 80$ .  
Give your answer in **minutes** and **seconds**.

..... min ..... s [3]

7



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$OPQR$  is a rectangle and  $O$  is the origin.  
 $M$  is the midpoint of  $RQ$  and  $PT : TQ = 2 : 1$ .  
 $\overrightarrow{OP} = \mathbf{p}$  and  $\overrightarrow{OR} = \mathbf{r}$ .

(a) Find, in terms of  $\mathbf{p}$  and/or  $\mathbf{r}$ , in its simplest form

(i)  $\overrightarrow{MQ}$ ,

$\overrightarrow{MQ} = \dots\dots\dots [1]$

(ii)  $\overrightarrow{MT}$ ,

$\overrightarrow{MT} = \dots\dots\dots [1]$

(iii)  $\overrightarrow{OT}$ .

$\overrightarrow{OT} = \dots\dots\dots [1]$

(b)  $RQ$  and  $OT$  are extended to meet at  $U$ .

Find the position vector of  $U$  in terms of  $\mathbf{p}$  and  $\mathbf{r}$ .  
 Give your answer in its simplest form.

$\dots\dots\dots [2]$

(c)  $\overrightarrow{MT} = \begin{pmatrix} 2k \\ -k \end{pmatrix}$  and  $|\overrightarrow{MT}| = \sqrt{180}$ .

Find the positive value of  $k$ .

$k = \dots\dots\dots [3]$

8

$$f(x) = 2x + 1$$

$$g(x) = x^2 + 4$$

$$h(x) = 2^x$$

(a) Solve the equation  $f(x) = g(1)$ .

$$x = \dots\dots\dots [2]$$

(b) Find the value of  $fh(3)$ .

$$\dots\dots\dots [2]$$

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

$$f^{-1}(x) = \dots\dots\dots [2]$$

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

$$\dots\dots\dots [3]$$



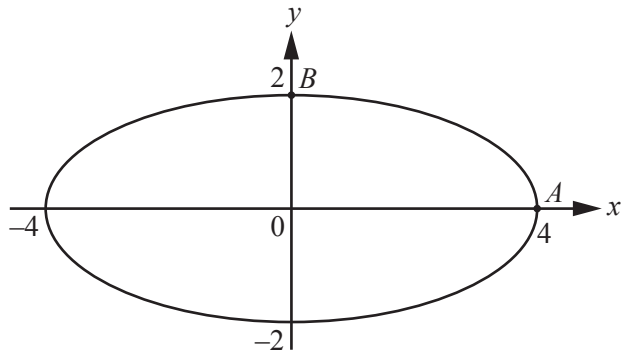
(e) Solve the equation  $h^{-1}(x) = 0.5$ .

$x = \dots\dots\dots$  [1]

(f)  $\frac{1}{h(x)} = 2^{kx}$

Write down the value of  $k$ .

$k = \dots\dots\dots$  [1]



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The diagram shows a curve with equation  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ .

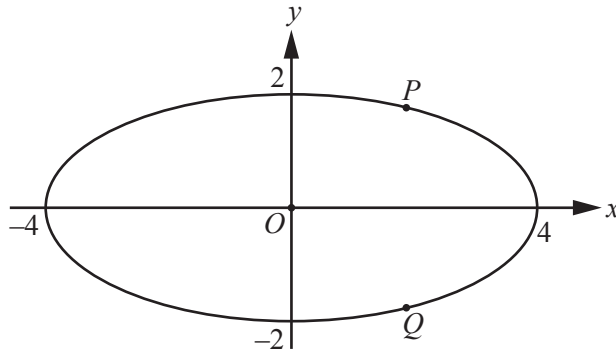
- (a)  $A$  is the point  $(4, 0)$  and  $B$  is the point  $(0, 2)$ .
  - (i) Find the equation of the straight line that passes through  $A$  and  $B$ .  
Give your answer in the form  $y = mx + c$ .

$y = \dots\dots\dots$  [3]

- (ii) Show that  $a^2 = 16$  and  $b^2 = 4$ .

[2]

(b)



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$P(2, k)$  and  $Q(2, -k)$  are points on the curve  $\frac{x^2}{16} + \frac{y^2}{4} = 1$ .

(i) Find the value of  $k$ .

$k = \dots\dots\dots [3]$

(ii) Calculate angle  $POQ$ .

Angle  $POQ = \dots\dots\dots [3]$

(c) The area enclosed by a curve with equation  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$  is  $\pi ab$ .

(i) Find the area enclosed by the curve  $\frac{x^2}{16} + \frac{y^2}{4} = 1$ .

Give your answer as a multiple of  $\pi$ .

$\dots\dots\dots [1]$

(ii) A curve, mathematically similar to the one in the diagrams, intersects the  $x$ -axis at  $(12, 0)$  and  $(-12, 0)$ .

Work out the area enclosed by this curve, giving your answer as a multiple of  $\pi$ .

$\dots\dots\dots [2]$

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