

$$1 \quad \mathbf{A} = \begin{pmatrix} 3 & 2 \\ -1 & 1 \end{pmatrix} \quad \mathbf{B} = \begin{pmatrix} -2 & 5 \end{pmatrix} \quad \mathbf{C} = \begin{pmatrix} -2 \\ 5 \end{pmatrix} \quad \mathbf{D} = \begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix}$$

- (a) Work out, when possible, each of the following.
If it is not possible, write 'not possible' in the answer space.

(i) $2\mathbf{A}$

Answer(a)(i) [1]

(ii) $\mathbf{B} + \mathbf{C}$

Answer(a)(ii) [1]

(iii) \mathbf{AD}

Answer(a)(iii) [2]

(iv) \mathbf{A}^{-1} , the inverse of \mathbf{A} .

Answer(a)(iv) [2]

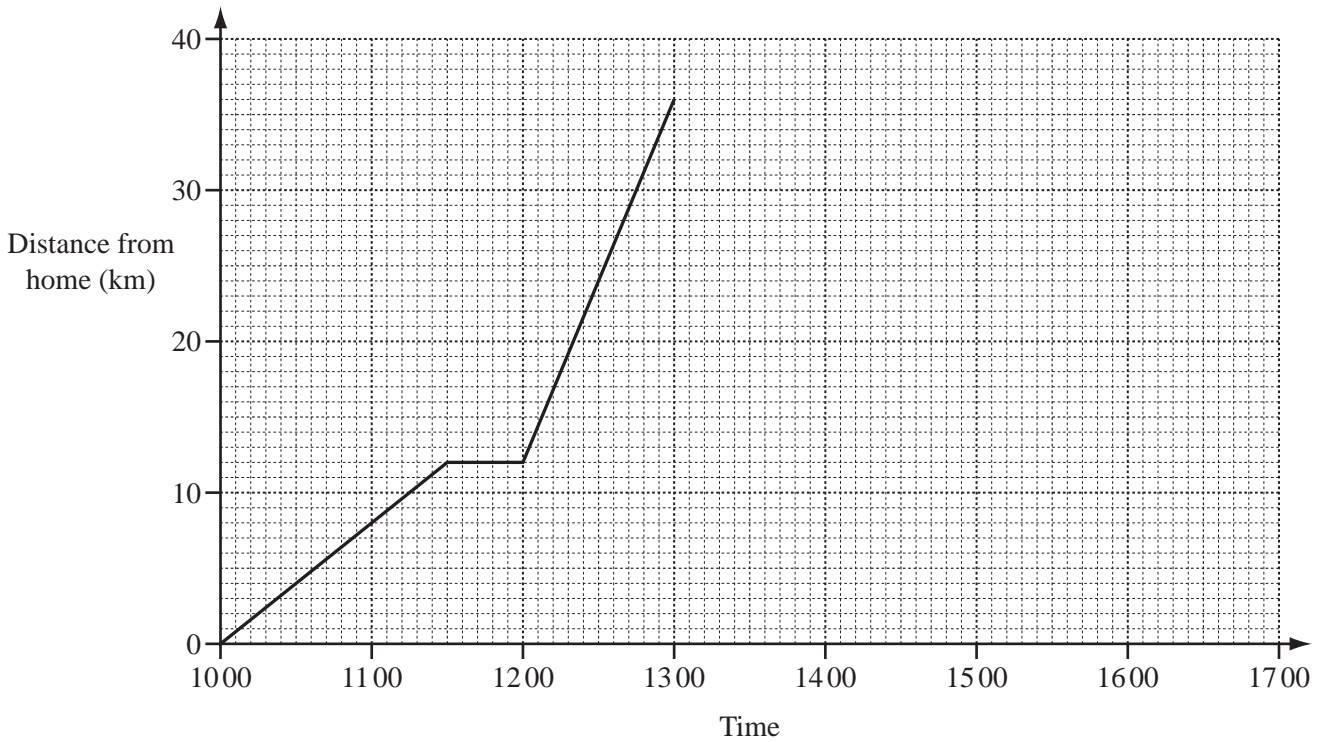
- (b) Explain why it is not possible to work out \mathbf{CD} .

Answer(b) [1]

- (c) Describe fully the **single** transformation represented by the matrix \mathbf{D} .

Answer(c)
..... [3]

- 2 Ali leaves home at 1000 to cycle to his grandmother’s house. He arrives at 1300. The distance-time graph represents his journey.



- (a) Calculate Ali’s speed between 1000 and 11 30. Give your answer in kilometres per hour.

Answer(a) km/h [2]

- (b) Show that Ali’s average speed for the whole journey to his grandmother’s house is 12 km/h.

Answer(b)

[2]

- (c) Change 12 kilometres per hour into metres per minute.

Answer(c) m/min [2]

- (d) Ali stays for 45 minutes at his grandmother’s house and then returns home. He arrives home at 1642.

Complete the distance-time graph.

[2]

- 3 (a) The running costs for a papermill are \$75 246.
This amount is divided in the ratio labour costs : materials = 5 : 1.
Calculate the labour costs.

Answer(a) \$ [2]

- (b) In 2012 the company made a profit of \$135 890.
In 2013 the profit was \$150 675.

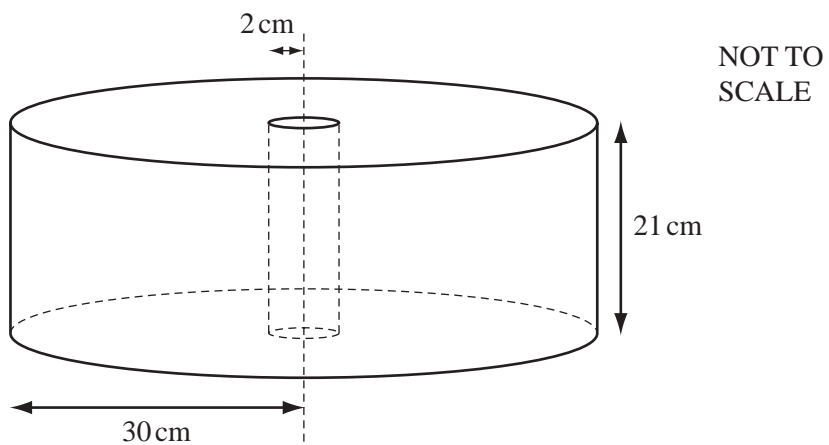
Calculate the percentage increase in the profit from 2012 to 2013.

Answer(b) % [3]

- (c) The profit of \$135 890 in 2012 was an increase of 7% on the profit in 2011.
Calculate the profit in 2011.

Answer(c) \$ [3]

- (d)



Paper is sold in cylindrical rolls.
There is a wooden cylinder of radius 2 cm and height 21 cm in the centre of each roll.
The outer radius of a roll of paper is 30 cm.

- (i) Calculate the volume of paper in a roll.

Answer(d)(i) cm^3 [3]

(ii) The paper is cut into sheets which measure 21 cm by 29.7 cm.
The thickness of each sheet is 0.125 mm.

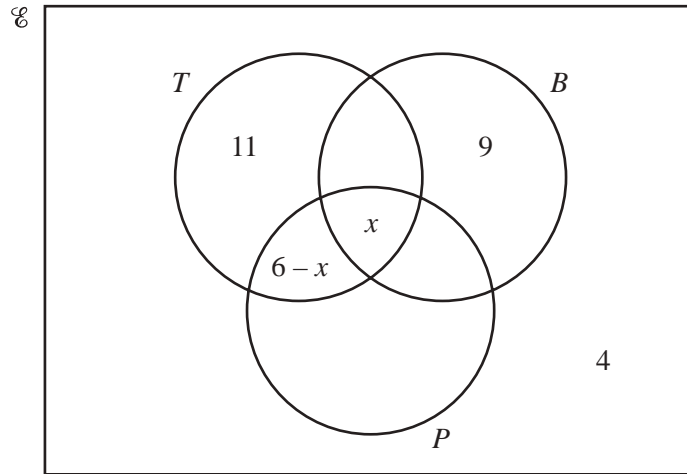
(a) Change 0.125 millimetres into centimetres.

Answer(d)(ii)(a) cm [1]

(b) Work out how many whole sheets of paper can be cut from a roll.

Answer(d)(ii)(b) [4]

4



In the Venn diagram, $\mathcal{E} = \{\text{children in a nursery}\}$

- $B = \{\text{children who received a book for their birthday}\}$
 $T = \{\text{children who received a toy for their birthday}\}$
 $P = \{\text{children who received a puzzle for their birthday}\}$

x children received a book and a toy and a puzzle.
 6 children received a toy and a puzzle.

- (a) 4 children received a book and a toy.
 5 children received a book and a puzzle.
 7 children received a puzzle but not a book and not a toy.

Complete the Venn diagram above.

[3]

- (b) There are 40 children in the nursery.

Using the Venn diagram, write down and solve an equation in x .

Answer(b)

[3]

(c) Work out

(i) the probability that a child, chosen at random, received a book but not a toy and not a puzzle,

Answer(c)(i) [1]

(ii) the number of children who received a book and a puzzle but not a toy,

Answer(c)(ii) [1]

(iii) $n(B)$,

Answer(c)(iii) [1]

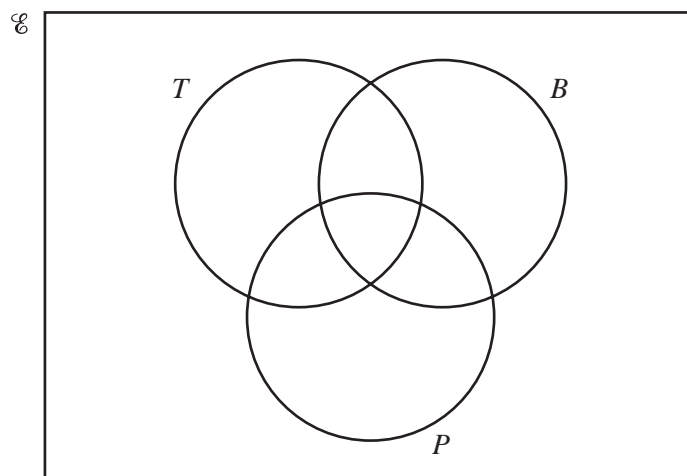
(iv) $n(B \cup P)$,

Answer(c)(iv) [1]

(v) $n(B \cup T \cup P)'$.

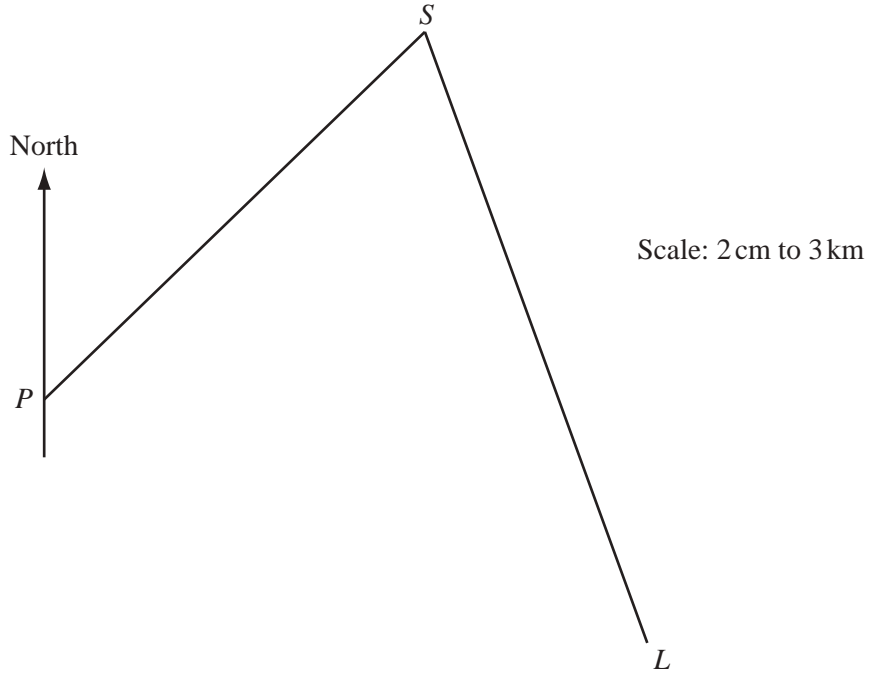
Answer(c)(v) [1]

(d)



Shade the region $B \cap (T \cup P)'$.

[1]



In the scale drawing, P is a port, L is a lighthouse and S is a ship.
 The scale is 2 centimetres represents 3 kilometres.

(a) Measure the bearing of S from P .

Answer(a) [1]

(b) Find the actual distance of S from L .

Answer(b) km [2]

(c) The bearing of L from S is 160° .

Calculate the bearing of S from L .

Answer(c) [1]

(d) Work out the scale of the map in the form $1 : n$.

Answer(d) 1: [2]

(e) A boat B is

- equidistant from S and L
- and
- equidistant from the lines PS and SL .

On the diagram, **using a straight edge and compasses only**, construct the position of B . [5]

(f) The lighthouse stands on an island of area 1.5 cm^2 on the scale drawing.

Work out the actual area of the island.

Answer(f) km^2 [2]

- 6 (a) A square spinner is biased.
The probabilities of obtaining the scores 1, 2, 3 and 4 when it is spun are given in the table.

Score	1	2	3	4
Probability	0.1	0.2	0.4	0.3

- (i) Work out the probability that on one spin the score is 2 or 3.

Answer(a)(i) [2]

- (ii) In 5000 spins, how many times would you expect to score 4 with this spinner?

Answer(a)(ii) [1]

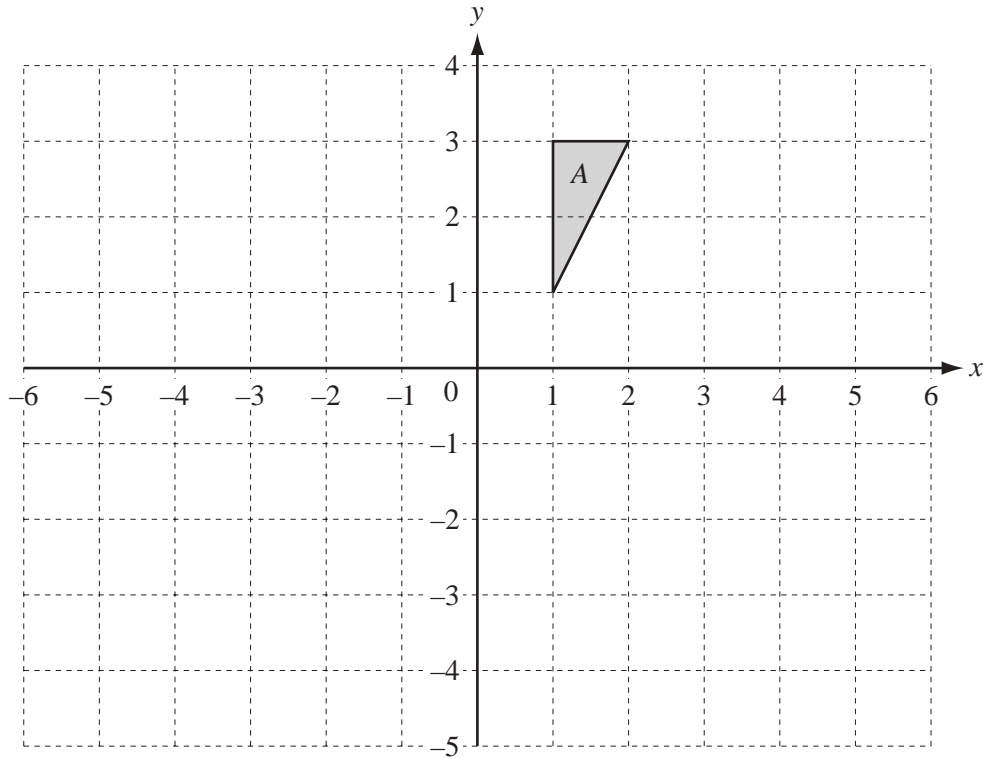
- (iii) Work out the probability of scoring 1 on the first spin and 4 on the second spin.

Answer(a)(iii) [2]

- (b) In a bag there are 7 red discs and 5 blue discs.
From the bag a disc is chosen at random and not replaced.
A second disc is then chosen at random.

Work out the probability that at least one of the discs is red.
Give your answer as a fraction.

Answer(b) [3]



(a) On the grid,

(i) draw the image of shape A after a translation by the vector $\begin{pmatrix} -5 \\ -4 \end{pmatrix}$, [2]

(ii) draw the image of shape A after a rotation through 90° clockwise about the origin. [2]

(b) (i) On the grid, draw the image of shape A after the transformation represented by the matrix $\begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}$. [3]

(ii) Describe fully the **single** transformation represented by the matrix $\begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}$. [3]

Answer(b)(ii)

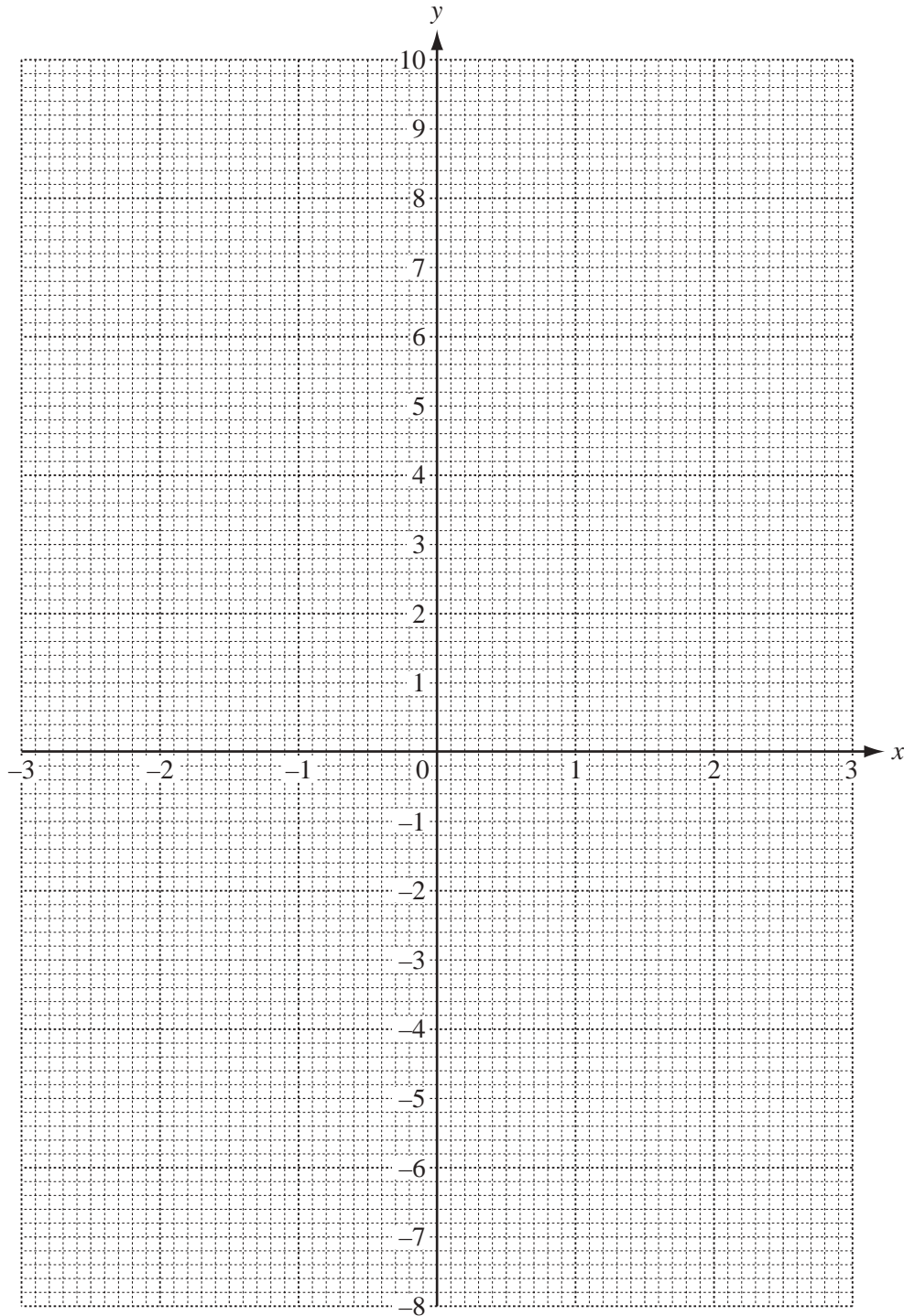
..... [3]

- 8 (a) Complete the table of values for $y = x^3 - 3x + 1$.

x	-2.5	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2	2.5
y	-7.125	-1		3		1	-0.375	-1	-0.125	3	9.125

[2]

- (b) Draw the graph of $y = x^3 - 3x + 1$ for $-2.5 \leq x \leq 2.5$.



[4]

(c) By drawing a suitable tangent, estimate the gradient of the curve at the point where $x = 2$.

Answer(c) [3]

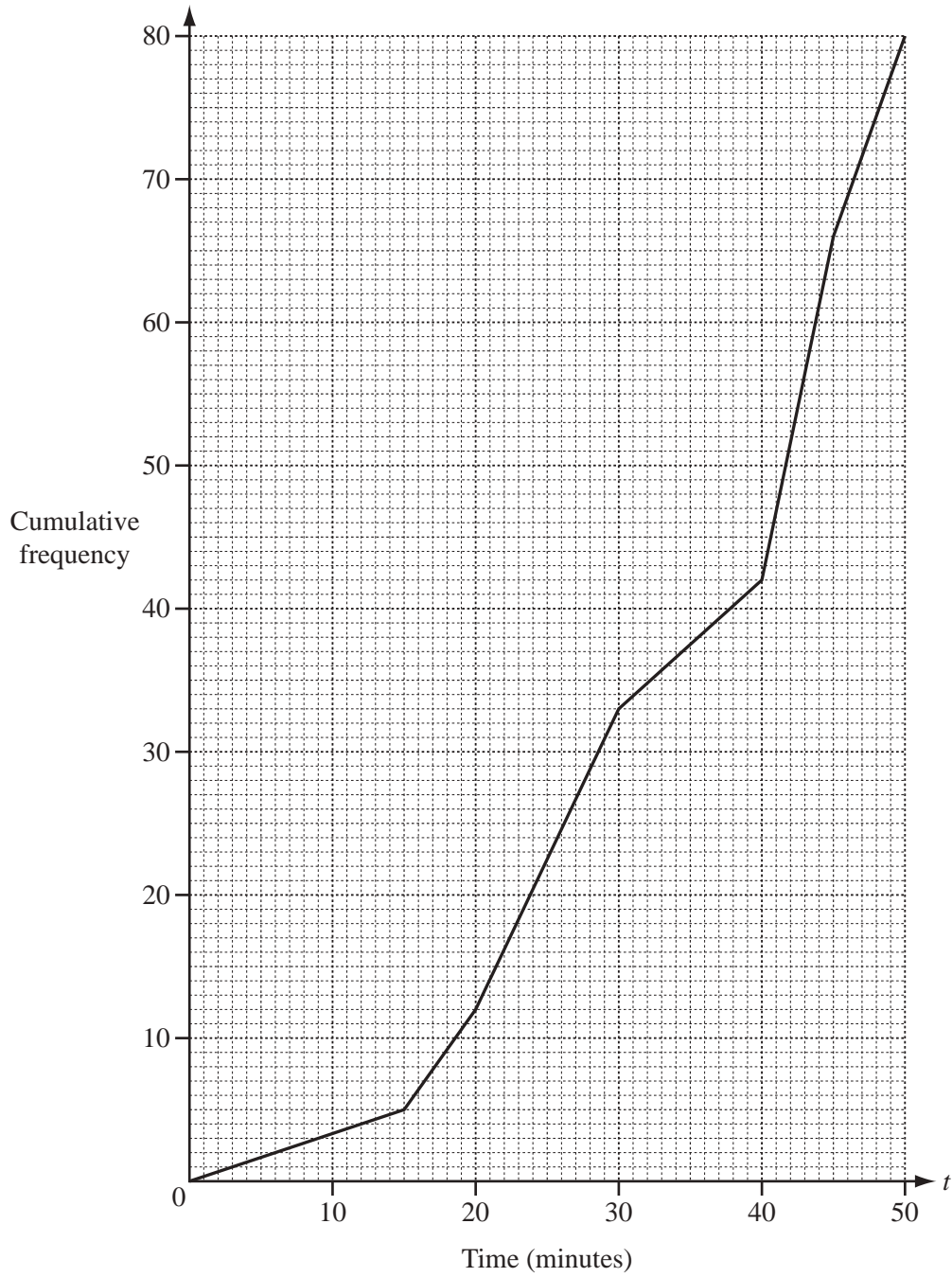
(d) Use your graph to solve the equation $x^3 - 3x + 1 = 1$.

Answer(d) $x =$ or $x =$ or $x =$ [2]

(e) Use your graph to complete the inequality in k for which the equation

$x^3 - 3x + 1 = k$ has three different solutions.

Answer(e) $< k <$ [2]



The times (t minutes) taken by 80 people to complete a charity swim were recorded. The results are shown in the cumulative frequency diagram above.

(a) Find

(i) the median,

Answer(a)(i) min [1]

(ii) the inter-quartile range,

Answer(a)(ii) min [2]

(iii) the 70th percentile.

Answer(a)(iii) min [2]

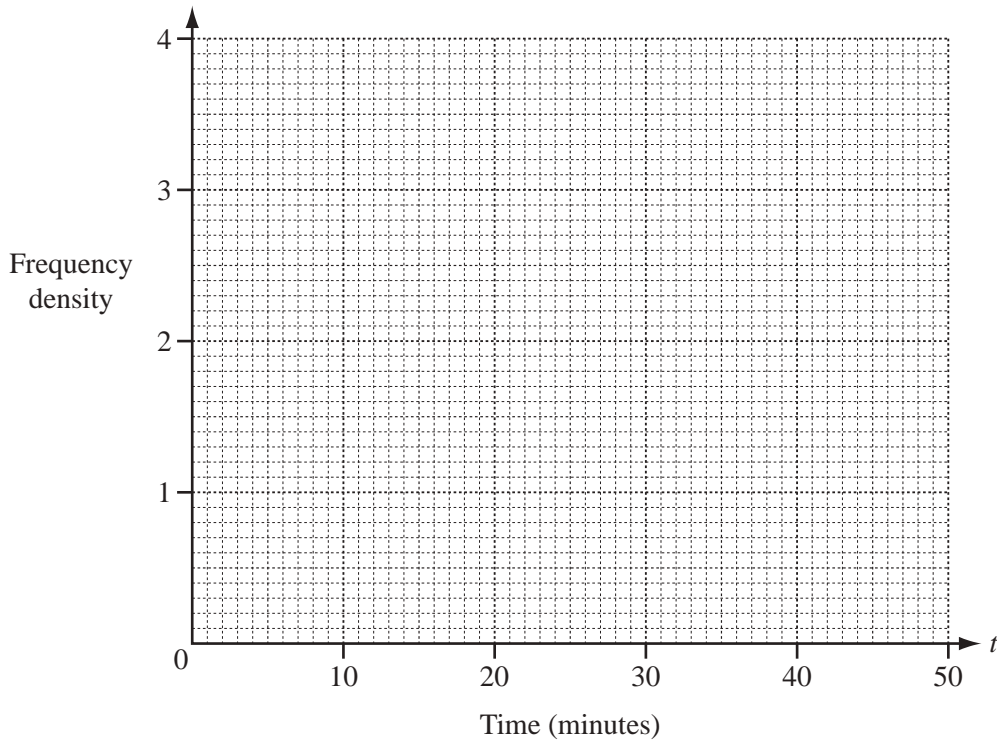
(b) The times taken by the 80 people are shown in this grouped frequency table.

Time (t minutes)	$0 < t \leq 20$	$20 < t \leq 30$	$30 < t \leq 45$	$45 < t \leq 50$
Frequency	12	21	33	14

(i) Calculate an estimate of the mean time.

Answer(b)(i) min [4]

(ii) Draw a histogram to represent the grouped frequency table.



[4]

10 (a)

$f(x) = 2x - 3$

$g(x) = \frac{1}{x+1} + 2$

$h(x) = 3^x$

(i) Work out $f(4)$.*Answer(a)(i)* [1](ii) Work out $fh(-1)$.*Answer(a)(ii)* [2](iii) Find $f^{-1}(x)$, the inverse of $f(x)$.*Answer(a)(iii)* $f^{-1}(x) =$ [2](iv) Find $ff(x)$ in its simplest form.*Answer(a)(iv)* $ff(x) =$ [2]

(v) Show that the equation $f(x) = g(x)$ simplifies to $2x^2 - 3x - 6 = 0$.

Answer(a)(v)

[3]

(vi) Solve the equation $2x^2 - 3x - 6 = 0$.

Give your answers correct to 2 decimal places.
Show all your working.

Answer(a)(vi) $x = \dots\dots\dots$ or $x = \dots\dots\dots$ [4]

(b) Simplify $\frac{x^2 - 3x + 2}{x^2 + 3x - 10}$.

Answer(b) $\dots\dots\dots$ [4]

11 (a) $\vec{PQ} = \begin{pmatrix} -3 \\ 4 \end{pmatrix}$

(i) P is the point $(-2, 3)$.

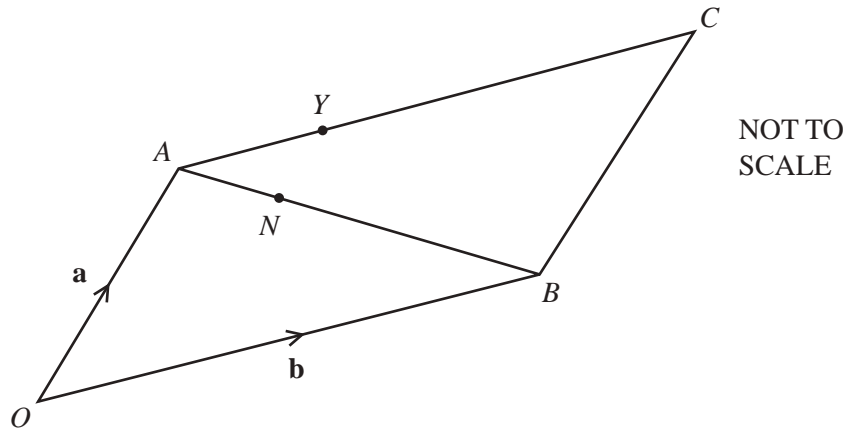
Work out the co-ordinates of Q .

Answer(a)(i) (..... ,) [1]

(ii) Work out $|\vec{PQ}|$, the magnitude of \vec{PQ} .

Answer(a)(ii) [2]

(b)



$OACB$ is a parallelogram.

$\vec{OA} = \mathbf{a}$ and $\vec{OB} = \mathbf{b}$.

$AN:NB = 2:3$ and $AY = \frac{2}{5}AC$.

(i) Write each of the following in terms of \mathbf{a} and/or \mathbf{b} .
Give your answers in their simplest form.

(a) \vec{ON}

Answer(b)(i)(a) $\vec{ON} = \dots\dots\dots$ [2]

(b) \vec{NY}

Answer(b)(i)(b) $\vec{NY} = \dots\dots\dots$ [2]

(ii) Write down two conclusions you can make about the line segments NY and BC .

Answer(b)(ii) $\dots\dots\dots$

$\dots\dots\dots$ [2]

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