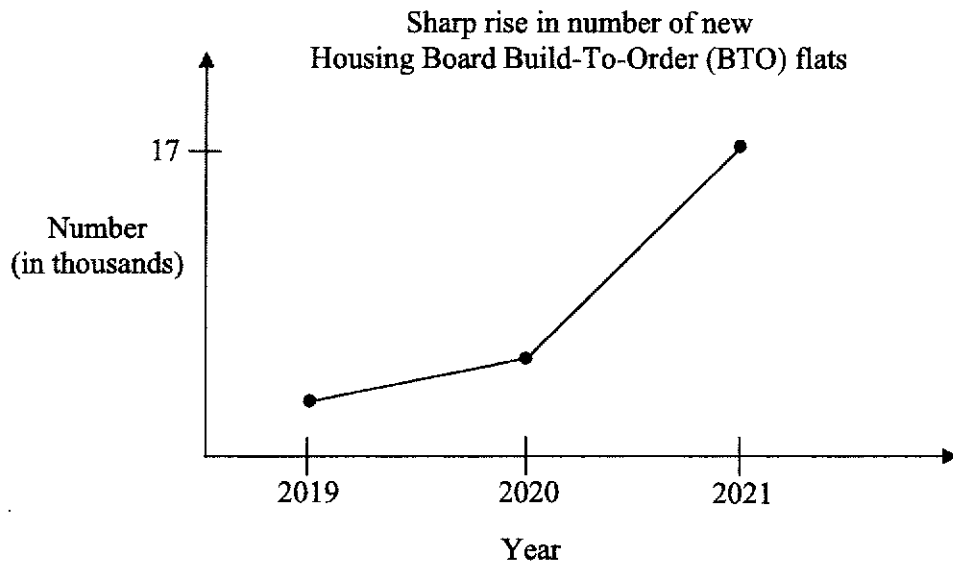


- 1 Elly's height is 1.61 m and Adela's height is 1.73 m, measured correct to three significant figures.

Find the greatest possible difference in their heights in metres, correct to three significant figures.

Answer m [1]

2



Explain how the line graph above may be misleading.

Answer

.....
.....
.....

[1]

- 3 Simplify $(2x^2)^3 \div 4\sqrt{x}$, giving your answer in the form of ax^n , where a and n are rational numbers.

Answer [2]

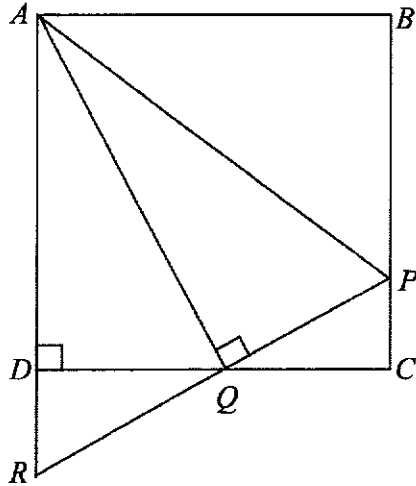
- 4 Given that $9172.05 = (9 \times 10^3) + (1 \times 10^2) + (7 \times 10) + (2 \times 10^a) + (5 \times 10^b)$, write down the values of a and of b .

Answer $a = \dots\dots\dots b = \dots\dots\dots$ [2]

- 5 Write as a single fraction in its simplest form $\frac{3}{1-x^2} - \frac{2}{x+1}$.

Answer [2]

6



$ABCD$ is a square and AQ is perpendicular to PR .
 PQR and ADR are straight lines.
 $DQ : DC = 1 : 2$.

Show that triangle DQR is congruent to triangle CQP .
 Give a reason for each statement you make.

Answer

[2]

- 7 Use **factorisation** to solve the equation.

$$2h^2 - 11h - 21 = 0$$

Answer $h = \dots\dots\dots$ or $\dots\dots\dots$ [2]

- 8 A map is drawn to a scale of $1:n$.
The actual distance between two points X and Y is 2.8 km.
On the map, they are 4 cm apart.

Find the value of n .

Answer $n = \dots\dots\dots$ [2]

- 9 Solve the inequalities $x \leq \frac{x+4}{3} \leq 2x-1$.

Answer [3]

- 10 The acceleration, $a \text{ m/s}^2$, of a particle is inversely proportional to the square of its distance x metres from a fixed point.
The distance of the particle is reduced to $0.5x$.

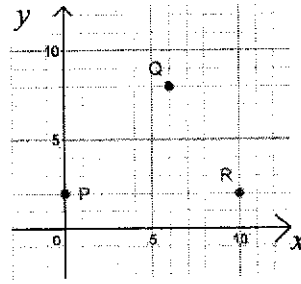
Find the ratio of the acceleration to the original acceleration.

Answer : [3]

11 $PQSR$ is a parallelogram.

The coordinates of P , Q and R are $(0,2)$, $(6,8)$ and $(10,2)$ respectively.

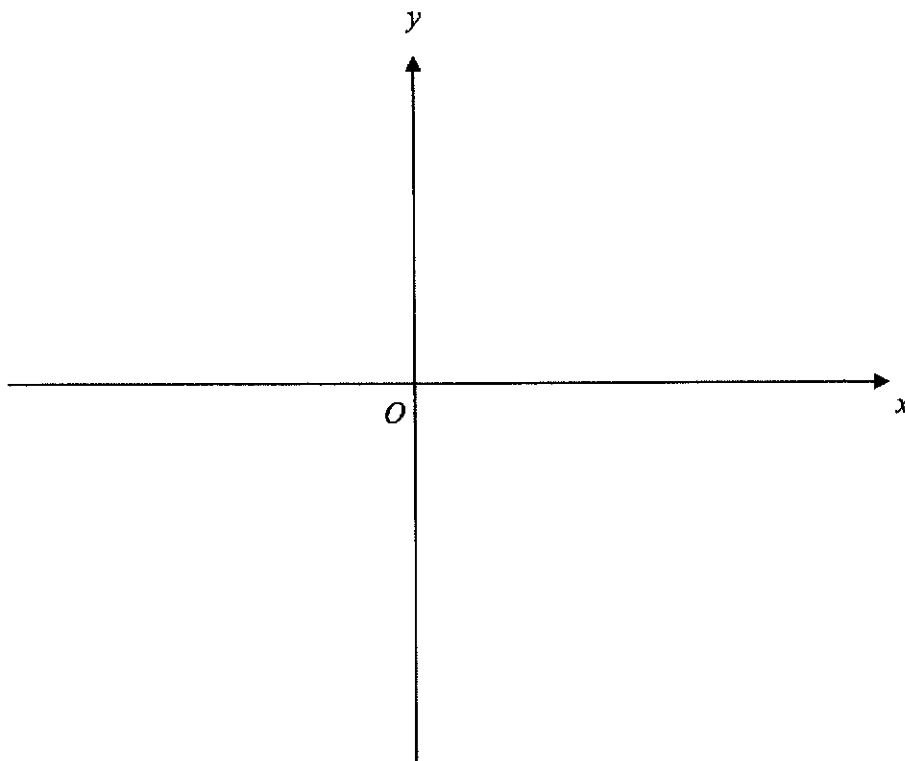
Find area of the parallelogram $PQSR$.



Answer units² [3]

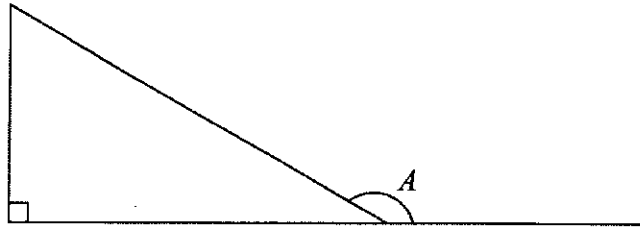
12 Sketch the graph of $y = (x+4)(10-x)$ on the axes below.

Indicate clearly the coordinates of the points where the graph crosses the axes and the maximum point on the curve.



[3]

- 13 In the diagram, A is an obtuse angle such that $\sin A = \frac{5}{13}$.



Leaving your answer as a fraction, find the value of

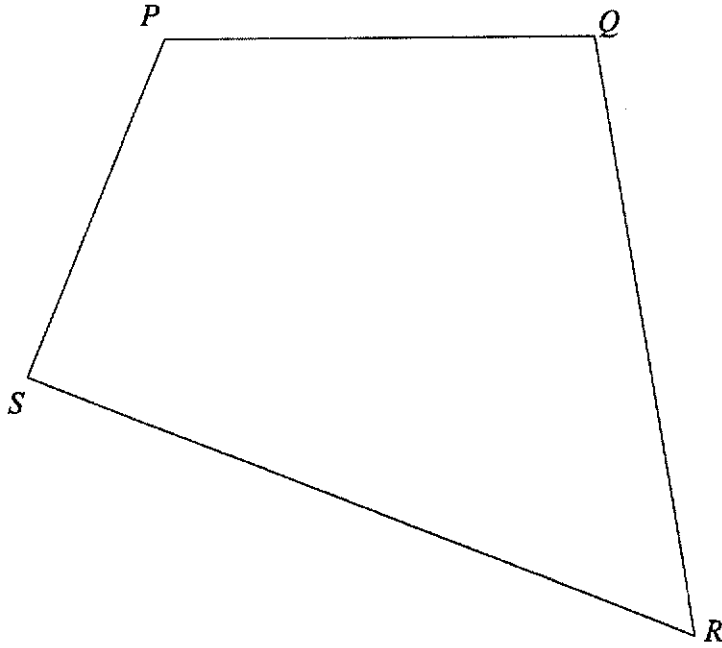
(a) $\sin(180^\circ - A)$,

Answer [1]

(b) $\cos A$.

Answer [2]

14 The diagram shows a quadrilateral $PQRS$.



On the diagram,

- (a) construct the perpendicular bisector of SR such that it meets PQ at point Z .
Mark and label Z . [2]
- (b) measure and write down the size of angle PZS .

Answer° [1]

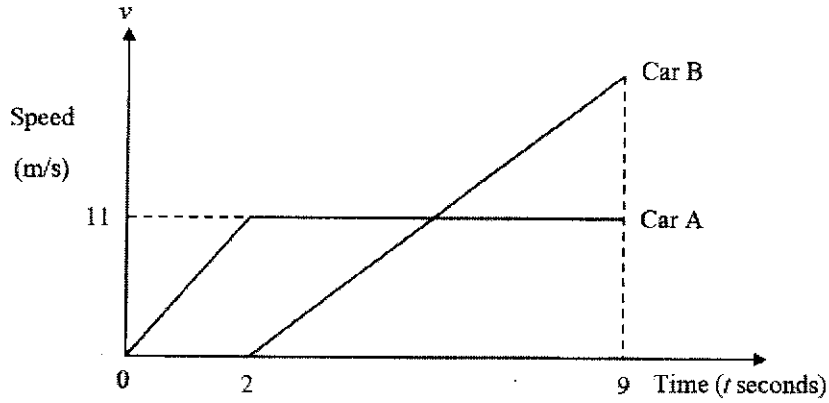
15 (a) Factorise completely $5pr - 2ps - 5qr + 2qs$.

Answer [2]

(b) Given that $p \neq q$, find the value of $\frac{r}{s}$ when $5pr - 2ps - 5qr + 2qs = 0$.

Answer [2]

17



The diagram shows the speed-time graph of two cars, A and B.
 Car A, starting from rest, accelerates uniformly for 2 seconds until it reaches a speed of 11 m/s.
 It then continues to travel at constant speed.
 2 seconds later, Car B starts from the same point as Car A.

- (a) Find
 (i) the acceleration of Car A when $t = 1$,

Answer m/s^2 [1]

- (ii) the distance travelled by Car A for the first 2 seconds.

Answer m [1]

- (b) Car B accelerates uniformly from rest.
 It overtakes Car A when $t=9$ seconds.
 Find v , the speed of Car B when it overtakes Car A.

Answer $v =$ [2]

- 18 $\varepsilon = \{ \text{integers } x: 2 \leq x \leq 13 \}$
 $A = \{ \text{prime numbers} \}$
 $B = \{ \text{multiples of } 4 \}$
 $C = \{ \text{factors of } 12 \}$

List the elements in

(a) B' ,

Answer [1]

(b) $A \cap B'$,

Answer [1]

(c) $(A \cup B)'$,

Answer [1]

(d) $B \cap C$.

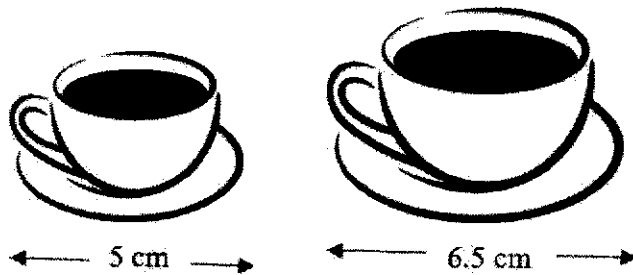
Answer [1]

- 19 The number of blue, white and black masks Julian has is in the ratio 3 : 4 : 5. After exchanging 30 black masks for blue ones, the ratio becomes 9 : 10 : 11.

Find the number of blue masks Julian has now.

Answer masks [4]

20



The diagram shows two geometrically similar cup and saucer sets.
The diameter of the smaller saucer is 5 cm.
The diameter of the larger saucer is 6.5 cm.
A coffee shop sells the smaller cup of coffee at \$1 and the larger cup at \$2.

Calculate which is a better buy.
Explain your answer.

Answer
.....
.....
.....

[4]

21 The matrix below shows the results of three baseball teams in a series of competition.

	Win	Draw	Lose	
$\mathbf{R} =$	12	5	3	Gratitude
	3	8	7	Respect
	9	4	4	Compassion

- (a) A win gains 3 points, a draw 1 point and a loss 0 point.
 Represent this information with a 3×1 column matrix \mathbf{P} .

Answer $\mathbf{P} = \dots\dots\dots$ [1]

- (b) Evaluate the matrix \mathbf{RP} .

Answer $\mathbf{RP} = \dots\dots\dots$ [2]

- (c) Explain what your answer to (b) represents and state the name of the winning baseball team.

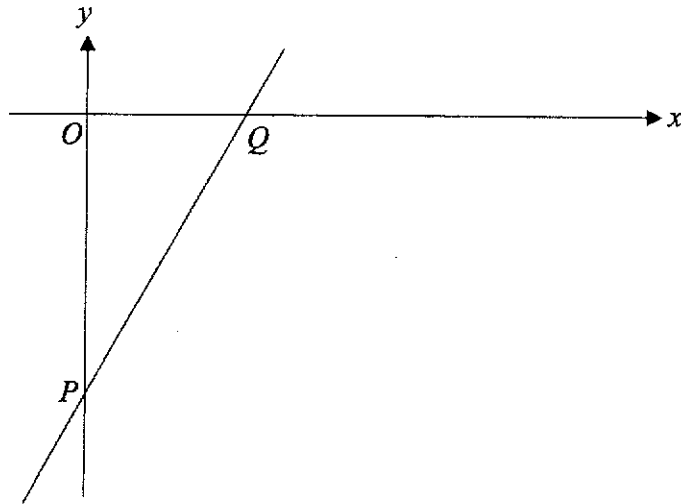
Answer

.....

.....

[1]

- 22 The diagram shows a sketch of the graph of $y = -10 + 2x$.
The line crosses the axes at P and Q .



- (a) Find the coordinates of P and Q .

Answer $P(\dots\dots\dots, \dots\dots\dots)$.

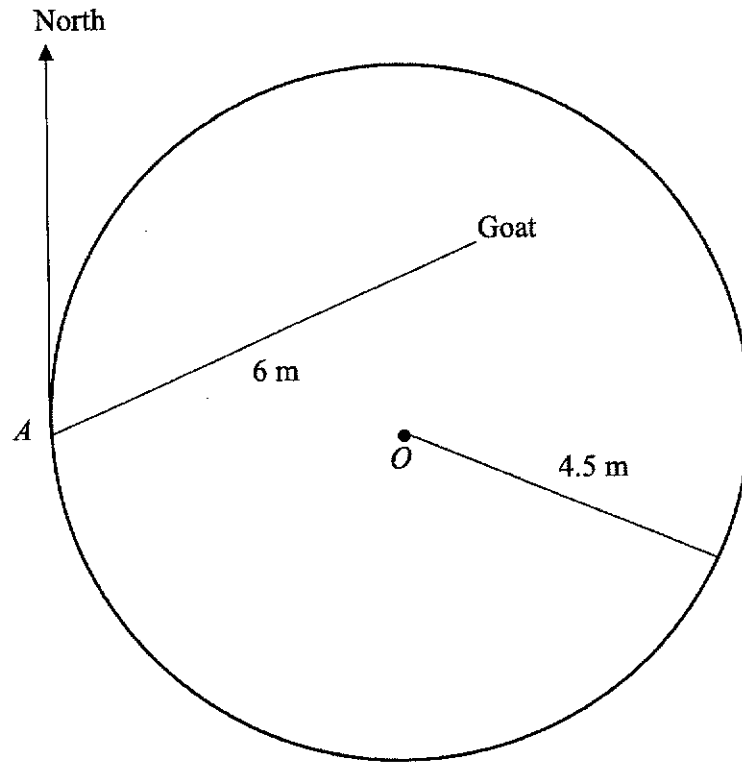
$Q(\dots\dots\dots, \dots\dots\dots)$ [2]

- (b) Calculate the length of the line joining P to Q .

Answer $\dots\dots\dots$ units [2]

⋮

23



The diagram shows a goat tied to a pole at A .
 The length of the rope attached to the goat is 6 m.
 A is due west of the centre of the circle, O .

- (a) Measure the bearing of the goat from A .

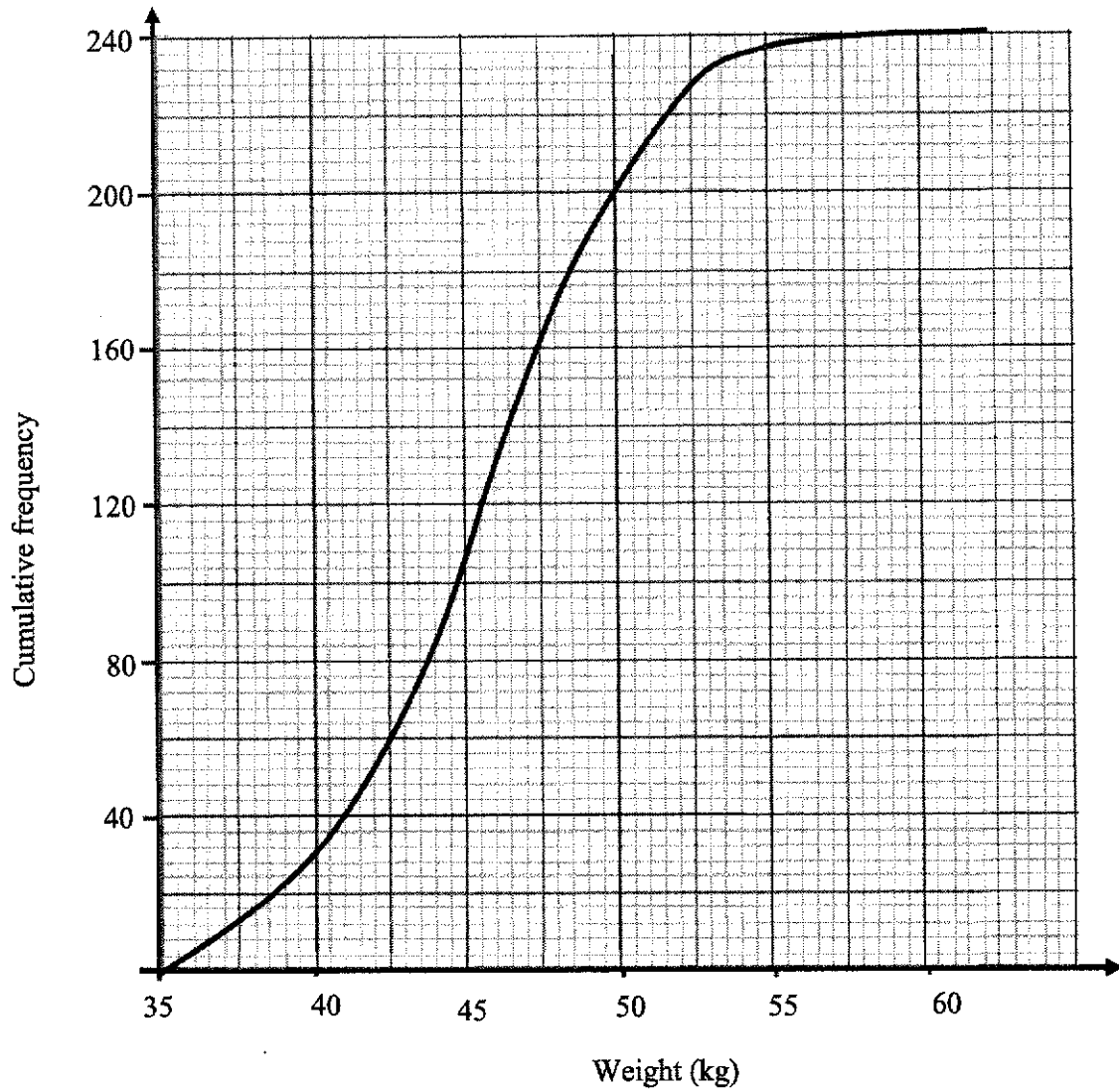
Answer ° [1]

- (b) The circle represents a grass patch of radius 4.5 m.
Find the probability that the goat is in the grass patch.

Answer [3]

⋮

24 The cumulative frequency graph below shows the weight of 240 students in a school.



Use the graph to find

- (a) the number of students with a weight greater than 55 kg,

Answer [1]

(b) the interquartile range,

Answer kg [2]

(c) the median.

Answer kg [1]

It was discovered that the weighing machine used to measure the weight of the students was faulty.

The weight of each of the students was supposed to be 5 kg more than their recorded weights.

(d) Explain how the cumulative frequency curve of the corrected weights will differ from the given curve.

Answer
.....
.....
.....
.....

[2]

25 The first four terms of a sequence are 5, 9, 13 and 17.

(a) Write down the 8th term of the sequence.

Answer [1]

(b) Find an expression, in terms of n , for the n th term of the sequence.

Answer [2]

(c) One term of the sequence is 205.
Find the value of n for this term.

Answer $n =$ [1]

(d) Explain why 50 is not part of the sequence.

Answer
.....
.....
..... [2]

1 (a) Simplify $\frac{16a^4b^2}{5} \div \frac{8a^3}{25ab^3}$.

Answer _____ [2]

- (b) (i) Express $-4x + x^2 - 6$ in the form $a + (x + b)^2$, where a and b are integers.

Answer _____ [2]

- (ii) Write down the coordinates of the minimum point of the graph of $y = -4x + x^2 - 6$.

Answer (_____ , _____) [1]

(c) $l = \frac{1}{2}(m^2 - n)$

(i) Evaluate l when $m = 4$ and $n = -5$.

Answer $l =$ _____ [1]

(ii) Express n in terms of l and m .

Answer _____ [2]

(d) Solve $\frac{x+1}{2x+3} + \frac{3x}{4x^2-9} = 2$.

Answer $x =$ _____ or _____ [4]

- 2 (a) A children indoor playground can accommodate 160 people in a session. Ticket price for an accompanying adult and a child is \$9 and \$32.50 respectively.

- (i) On a particular weekend afternoon, the playground is 60% full. 75% of the patrons are children.

Calculate the total amount collected from the sales of tickets.

Answer \$ _____ [3]

- (ii) On that same particular weekend evening, \$3900 was collected from the sales of tickets for children.

Calculate the percentage increase in the number of children who patronized the playground on the weekend evening compared to the afternoon.

Answer _____ % [3]

- (b) Arielle plans to invest \$25 000 over a period of 2 years.
Plan *A* offers simple interest of 6.2% per annum.
Plan *B* offers 6% per annum interest compounded quarterly.

Determine which plan offers a better return for her.
Justify your answer.

Answer

[5]

- 3 (a) Students in a class were asked how many siblings they have. The results are shown in the table.

Number of sibling	0	1	2	3	4
Number of students	5	18	10	x	2

- (i) The modal number of siblings is 1.
Calculate the greatest possible number of students in the class.

Answer _____ [2]

- (ii) The median number of siblings is 2.
Calculate the smallest possible value of x .

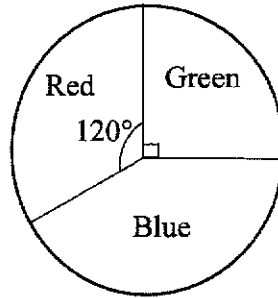
Answer $x =$ _____ [1]

- (iii) The mean number of siblings is 1.525.
Calculate the value of x .

Answer $x =$ _____ [2]

- (b) A dart board comprises of 3 colours as shown below.

[Turn Over



A pouch contains six 10 cents coins, three 20 cents coins and one 50 cents coin.

Tim throws a dart first then picks a coin from the pouch.

- (i) Draw a tree diagram to show the probabilities of the possible outcomes.

Answer

[2]

- (ii) Calculate the probability that the dart hits the red region and a 20 cent coin is picked.

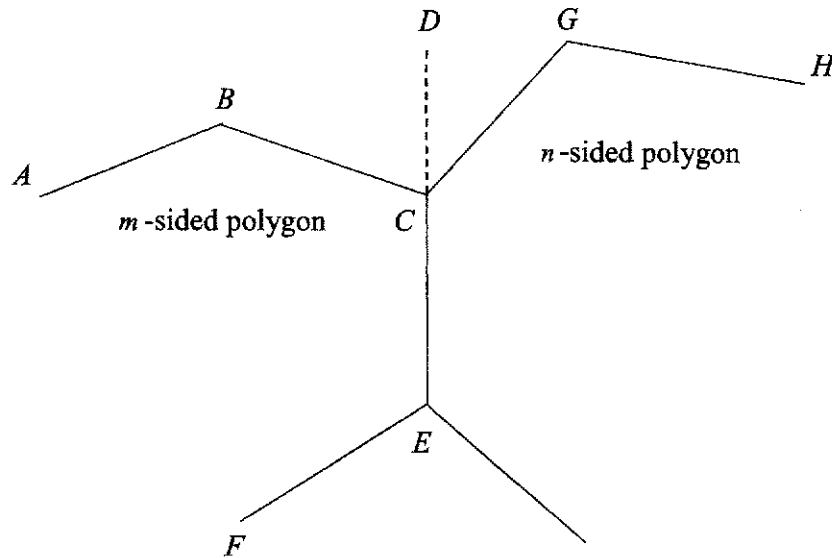
Answer _____ [2]

- (iii) State one assumption made.

Answer _____

_____ [1]

- 4 (a) A regular m -sided polygon and a regular n -sided polygon are joined together.
Part of the polygons are shown below.
 $\angle BCD : \angle DCG = 5 : 3$



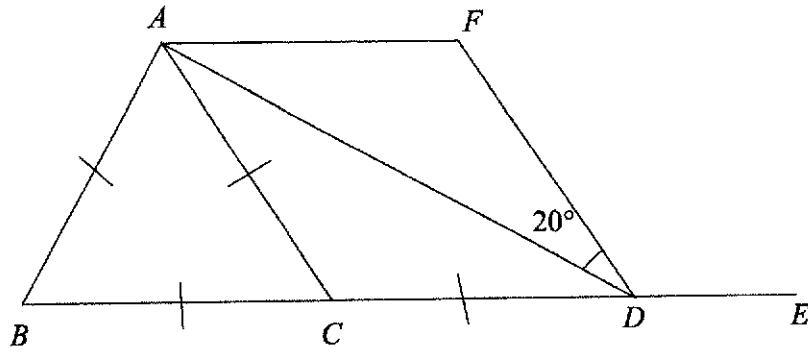
Mike made some calculations and claimed that $m = 6$ and $n = 10$.

Determine if Mike's claim is accurate.
Justify your answer.

Answer

[4]

(b)



Triangle ABC is an equilateral triangle.

$AC = CD$.

$\angle ADF = 20^\circ$

AD bisects $\angle CAF$.

- (i) Show that AF is parallel to CD .
State your reasons.

Answer

[2]

Calculate

- (ii) reflex $\angle BAF$,

Answer _____ $^\circ$ [1]

- (iii) $\angle FDE$.

_____ $^\circ$ [1]

- 5 (a) Complete the table of values for $y = 2x^3 - x^2 - 10x$.

x	-2	-1.5	-1	-0.5	0	1	1.5	2
y	0	6	7	4.5	0	-9	-10.5	

[1]

- (b) On the grid opposite, draw the graph of $y = 2x^3 - x^2 - 10x$ for $-2 \leq x \leq 2$.

[3]

- (c) The equation $2x^3 - x^2 - 5x = -8$ only has one solution.

- (i) Explain how this can be seen from your graph.

Answer

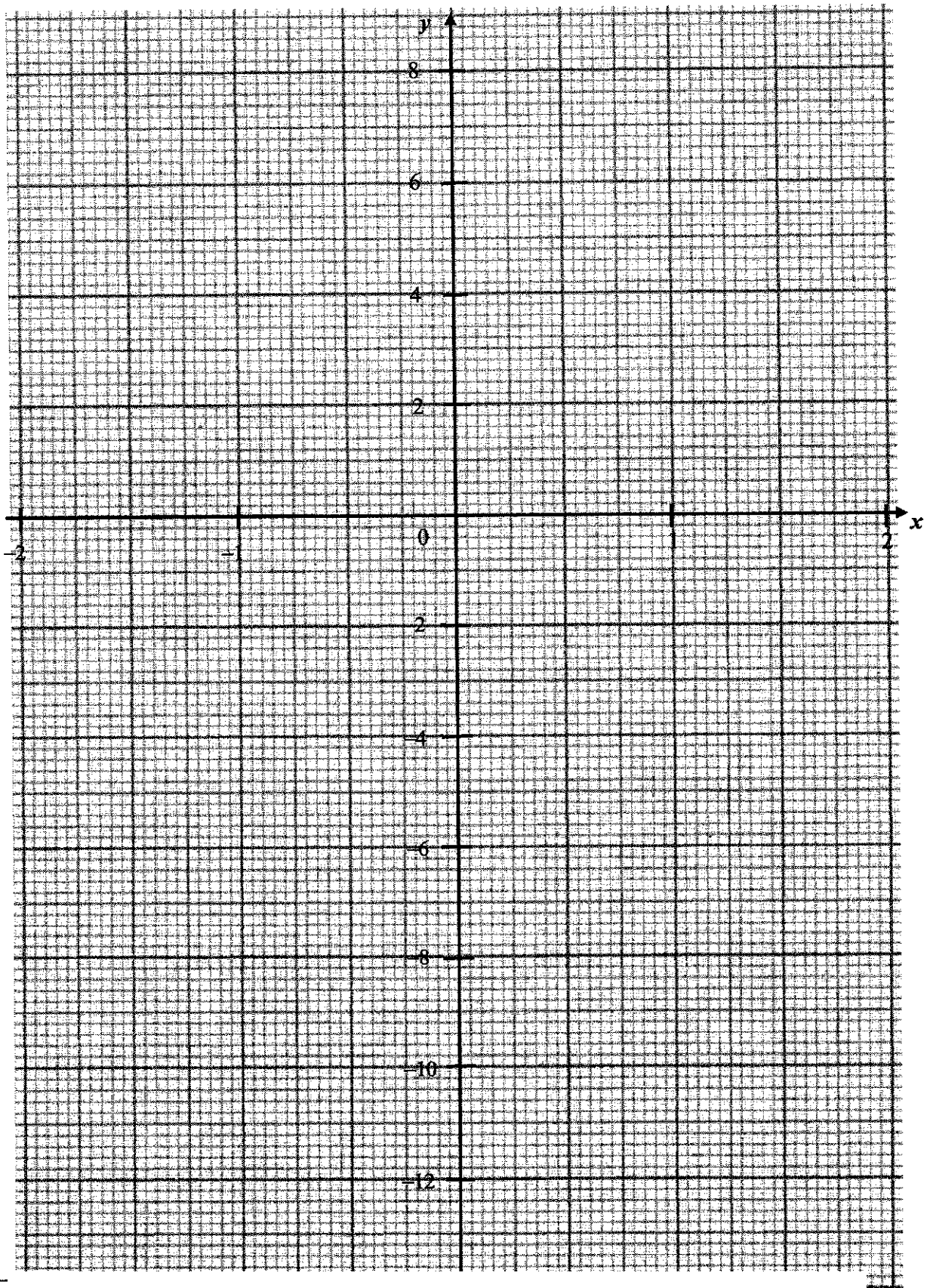
[3]

- (ii) Use your graph to find the solution of the equation $2x^3 - x^2 - 5x = -8$.

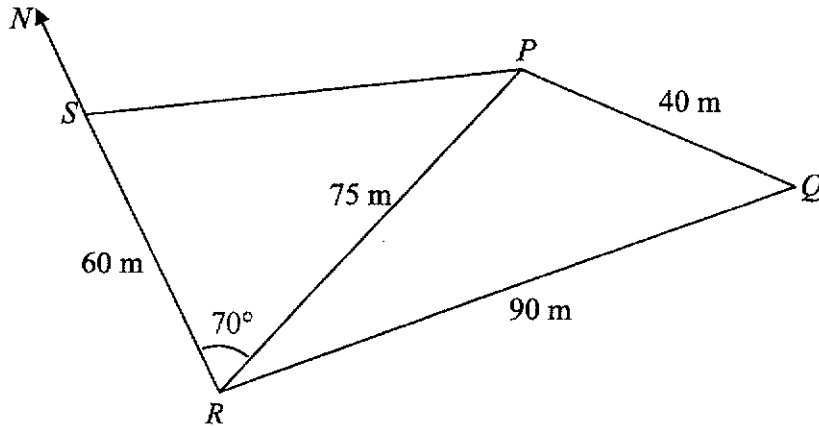
Answer _____ [1]

- (d) Use your graph to find the x -coordinate of the maximum point.

Answer _____ [1]



- 6 The diagram represents a flat plot of land $PQRS$.
 $PQ = 40$ m, $PR = 75$ m, $QR = 90$ m, $SR = 60$ m and $\angle PRS = 70^\circ$. [Turn Over
 S is due north of R and Q is due east of R .



- (a) Find
- (i) the area of the land $PQRS$,

Answer _____ m^2 [2]

- (ii) the length of PS ,

Answer _____ m [3]

(iii) the angle PSR ,

Answer _____° [2]

(iv) the shortest distance from S to PR .

Answer _____ m [1]

(b) T is the top of a vertical tower at S .
The angle of elevation of T from R is 10° .

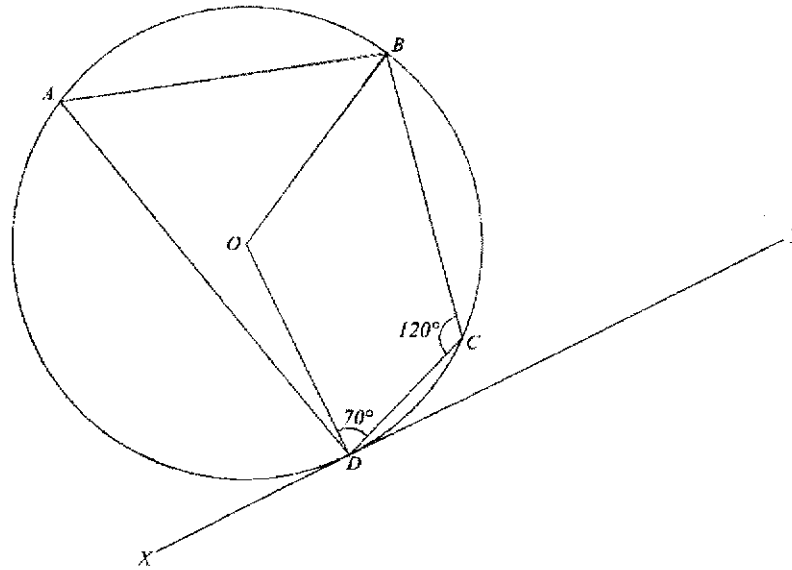
(i) Find the height of the tower.

Answer _____ m [1]

(ii) Hence, find the greatest angle of elevation of T viewed from PR .

Answer _____° [1]

- 7 (a) A circle with centre O has a tangent XY at D .
 $\angle ODC = 70^\circ$, $\angle BCD = 120^\circ$ and $\angle ODA = 15^\circ$.



Find

- (i) $\angle CDY$,

Answer _____ $^\circ$ [1]

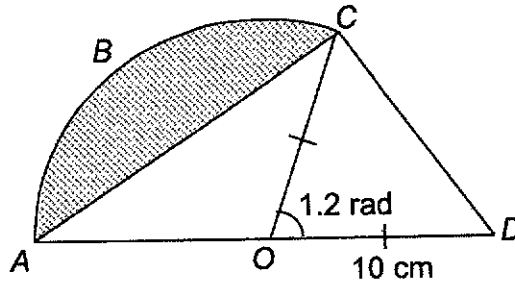
- (ii) $\angle DAB$,

Answer _____ $^\circ$ [1]

- (iii) $\angle OBA$.

Answer _____ $^\circ$ [3]

- (b) The diagram shows a sector $OABC$ of a circle, centre O and an isosceles triangle OCD .
 $OC = OD = 10$ cm and $\angle COD = 1.2$ radians.



Find

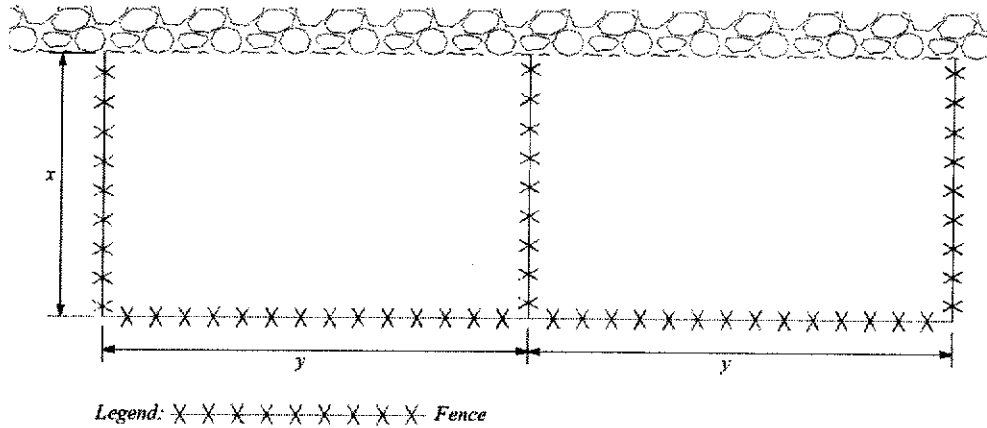
- (i) the area of the shaded segment ABC ,

Answer _____ cm^2 [3]

- (ii) the length CD .

Answer _____ cm [2]

- 8 Old MacDonald has a farm with a rock wall around it.
The figure shows a portion of his farm where he plans to build two enclosures.



The total length of the fence is 180 m.

- (a) Show that $y = 90 - \frac{3}{2}x$.

Answer

[1]

- (b) A is the total areas of the 2 enclosures.

Form a quadratic equation for A in terms of x .

Answer

[2]

- (c) If $A = 2100 \text{ m}^2$, solve for x .
Leave your answer in 2 decimal places.

Answer $x =$ _____ or _____ [3]

- (d) Using your answers in part (c), find the coordinates of the turning point of the quadratic equation of area, A .

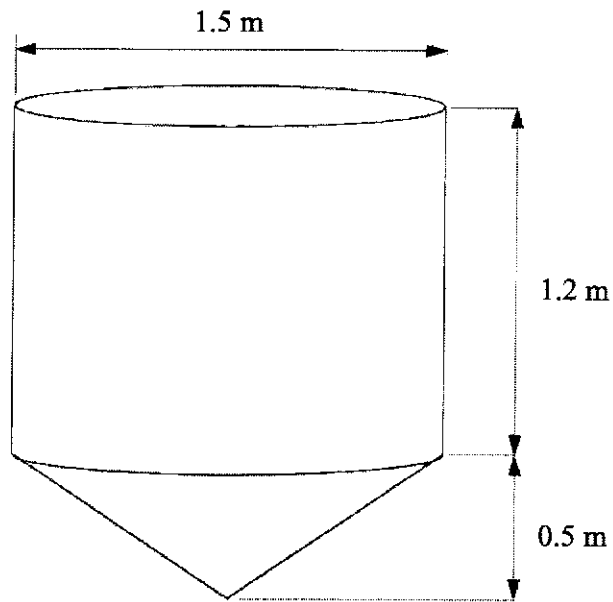
Answer (_____ , _____) [2]

- (e) Explain if the answer found in part (d) represents a maximum or minimum area.

Answer _____

_____ [2]

- 9 An industrial mixer is made up of an **open** cylinder connected to a cone. The height of the cylinder and the cone is 1.2 m and 0.5 m respectively. The diameter of the mixer is 1.5 m.



- (a) Find the capacity of the mixer in litres,

Answer _____ litres [3]

(b) Water is poured into the mixer.

Find the height of the water level, in centimetres, given that the volume is

(i) 500 litres,

Answer _____ cm [3]

(ii) 150 litres.

Answer _____ cm [2]

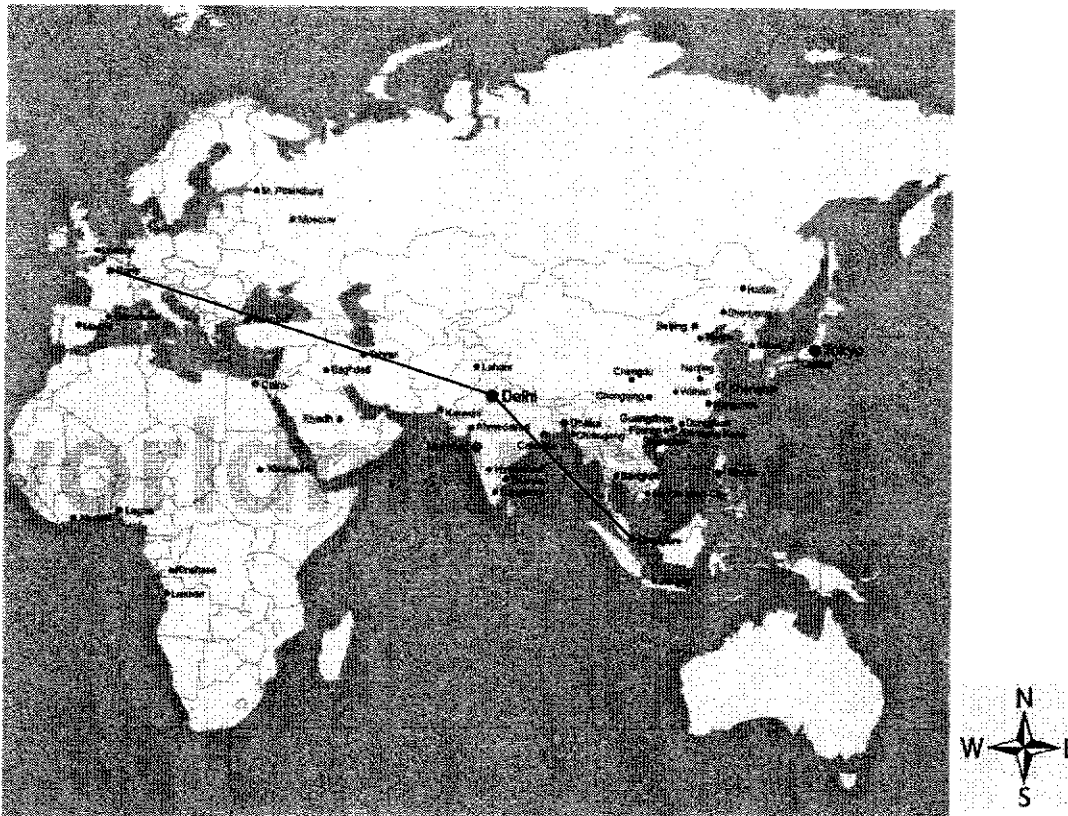
(c) The outside of the mixer is to be painted bright yellow.
1 can of paint can cover 4.5 m^2 .

How many cans are needed to paint 6 such mixers?

Answer _____ cans [3]

- 10 John is planning a trip from Singapore to Paris.
His flight will stop over in Delhi before continuing its journey to Paris.

Answer the following questions using the information from the map below.



Map is drawn to scale.

- (a) What is the bearing of Paris from Delhi?

Answer _____ ° [1]

- (b) The distance from Singapore to Delhi is 4150 km.

What is the distance from Delhi to Paris?

Answer _____ km [2]

The table below shows the Greenwich Meridian Time (GMT) for several locations in the world.

Location	GMT
Brisbane, Australia	+10:00
Delhi, India	+05:30
Greenwich, England	00:00
Los Angeles, United States	-07:00
Paris, France	+02:00
Singapore, Singapore	+08:00
Toronto, Canada	-04:00

Note: Brisbane is 10 hours ahead of Greenwich and Los Angeles is 7 hours behind Greenwich.

John departed from Singapore at 11:15 pm on a Saturday.
His flight will stop over at Delhi for 2 hours before continuing to Paris.
The average speed of an airplane is 850km/h.

(c) On what day and at what time will John arrive in Paris?

Answer

[6]

End of Paper

Answers

1	$1.734 - 1.605 = 0.129 \text{ m}$ OR $1.7349 - 1.6050 = 0.130 \text{ m}$
2	The title of the line graph is biased as it does not allow reader to make judgement. OR The vertical axis does not start from 0, which exaggerated the differences. (Can accept without the reasoning)
3	$2x^{\frac{5}{2}}$
4	$a = 0, b = -2$
5	$= \frac{1+2x}{1-x^2}$ or $\frac{1+2x}{(1+x)(1-x)}$
7	$h = -\frac{3}{2}$ or $h = 7$
8	$n = 70\ 000$
9	$1\frac{2}{5} \leq x \leq 2$
10	$a_{\text{now}} : a_{\text{original}} = 4 : 1$
11	60 square units
13a	$\sin(180^\circ - A) = \frac{5}{13}$
13b	$\cos A = -\frac{12}{13}$ OR shown adjacent side is 12 units (1 m)
14b	$\angle PZS = 33^\circ$ (accept angle values of $\pm 1^\circ$)
15a	$(p-q)(5r-2s)$
15b	$\frac{r}{s} = \frac{2}{5}$
16a	Smallest $x = 1$, Smallest $y = 1$
16b	Since the indices of the prime factors are multiples of 2, $33q$ is a perfect square.
17ai	5.5 m/s^2
17aii	11 m
17b	$v = 25.1$ or $25\frac{1}{7}$ or $\frac{176}{7}$
18a	{ 2, 3, 5, 6, 7, 9, 10, 11, 13 }
18b	{ 2, 3, 5, 7, 11, 13 }
18c	{ 6, 9, 10 }
18d	{ 4, 12 }
19	There are 180 blue masks.
20	The larger cup is a better buy since it could have been more costly.

21a	$P = \begin{pmatrix} 3 \\ 1 \\ 0 \end{pmatrix}$
21b	$RP = \begin{pmatrix} 41 \\ 17 \\ 31 \end{pmatrix}$
21c	Team Gratitude scores 41 points, Team Respect scores 17 points and Team Compassion scores 31 points. Team Gratitude is the winner.
22a	$P(0, -10)$ & $Q(5, 0)$
22b	$\sqrt{(5)^2 + (10)^2} = 11.2$ units
23a	0.67°
23b	Probability = 0.624 (to 3 sf) or 0.351 (to 3 sf)
24a	2 to 4 students
24b	interquartile range = 6 kg
24c	median = 45.5 kg
24d	The cumulative frequency curve will shift to the right by 5 kg.
25a	33
25b	$4n + 1$
25c	51
25d	Since n is not an integer, 50 is not a term of the sequence.

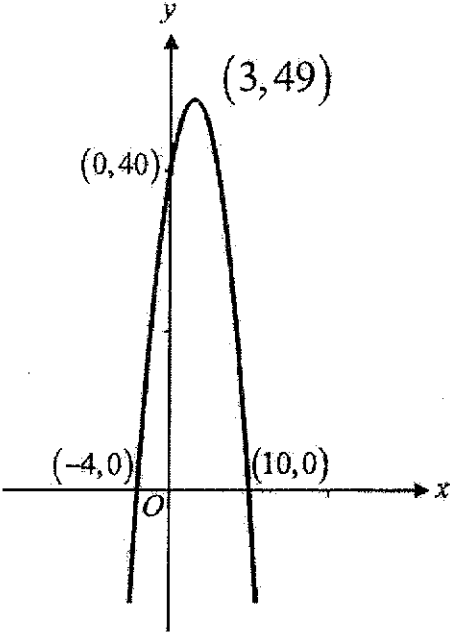
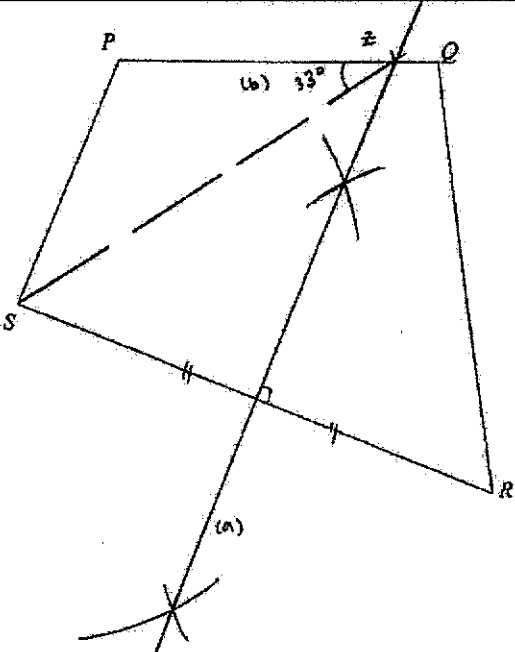
Answers

1a	$10a^2b^5$
bi	$(x-2)^2 - 10$
ii	$(2, -10)$
ci	10.5
ii	$n = m^2 - 2l$
d	$x = 1.76$ or $x = -1.42$
2ai	\$2556
ii	$66\frac{2}{3}\%$
b	Plan B offers better returns with a higher interest.
3ai	$x = 17$ $5 + 18 + 10 + 17 + 2 = 52$
ii	12
iii	$x = 5$
bii	$\frac{1}{10}$
iii	The dart will always hit one of the coloured region.
4a	Mike's claim is accurate.
ii	240°
iii	130°
5a	-8
ci	Plot $y = -5x - 8$ Since the line intersects the curve only at one point, there is only one solution for $2x^3 - x^2 - 5x = -8$.
ii	-1.9
d	-1.1
6ai	3270 m^2
ii	78.4m
iii	$\angle PSR = 64.0^\circ$
v	56.4 m
bi	10.6 m
ii	10.6°
7ai	20°
ii	60°
iii	45°
bi	50.5 cm^2
ii	11.3 cm
8a	$y = 90 - \frac{3}{2}x$
b	$A = 180x - 3x^2$
c	$x = 44.14 \text{ m}$ or $x = 15.86 \text{ m}$

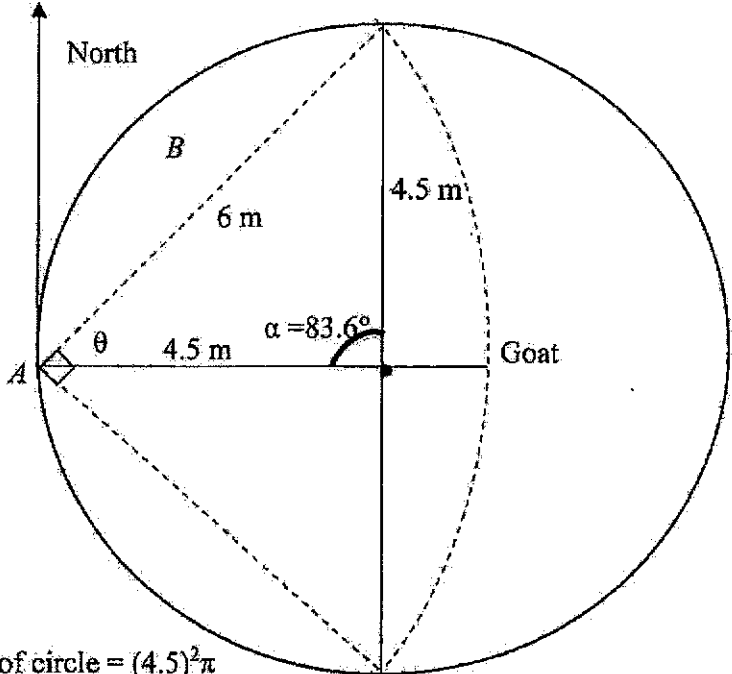
8d	<p>x-coordinate of turning point = 30</p> <p>y-coordinate of turning point = $180(30) - 3(30)^2 = 2700 \text{ m}^2$</p>
e	<p>Area is maximum, Because the coefficient of x^2 is negative.</p>
9a	2415 or 2420 litres
bi	61.6 cm
ii	39.9 cm
c	11 cans
10a	Bearing = $360 - 70 = 290^\circ$
b	8540 km
c	<p>Time difference between Singapore and Paris = $8 - 2 = 6$ hours Singapore 6 hours ahead of Paris Total distance = $4150 + 8540 = 12,690$ km Total time including stop over = $\frac{12690}{850} + 2 = 16.929$ = 16 hrs 56 mins Adjustment for time difference = $16 \text{ hrs } 56 \text{ mins} - 6 \text{ hrs} = 10 \text{ hrs } 56 \text{ mins}$</p> <p>11:15 pm \rightarrow 12:00 am Saturday (45 minutes) 12:00 am \rightarrow 10:00 am Sunday (10 hours) 10:00 am \rightarrow 10:11 am Sunday (11 minutes) Reach Paris at 10:11 am Sunday</p>

Question	Marking Scheme	Marks
1	Greatest possible difference $= 1.734 - 1.605$ OR $= 1.7349 - 1.6050$ $= 0.129 \text{ m}$ OR $= 0.130 \text{ m}$	B1
2	The title of the line graph is biased as it does not allow reader to make judgement. The vertical axis does not start from 0, which exaggerated the differences. (Can accept without the reasoning)	B1 (either one)
3	$(2x^2)^3 \div 4\sqrt{x}$ $= 8x^6 \div 4x^{\frac{1}{2}}$ $= 2x^{\frac{11}{2}}$	M1 A1
4	$9172.05 = 9 \times 10^3 + 1 \times 10^2 + 7 \times 10 + 2 \times 10^0 + 5 \times 10^{-2}$ $a = 0, b = -2$	B1, B1
5	$\frac{3}{1-x^2} - \frac{2}{x+1}$ $= \frac{3}{(1-x)(1+x)} - \frac{2}{x+1}$ $= \frac{3-2(1-x)}{1-x^2}$ $= \frac{3-2+2x}{1-x^2}$ $= \frac{1+2x}{1-x^2}$ or $\frac{1+2x}{(1+x)(1-x)}$	M1 A1
6	$\angle DQR = \angle CQP$ (vertically opposite angles) $DQ = CQ$ (given that ratio $DQ : DC = 1 : 2$) $\angle QDR = 180^\circ - 90^\circ$ (adjacent angles on straight line) $= 90^\circ$ $\angle QDR = \angle QCP = 90^\circ$ (property of a square) $\therefore \triangle DQR$ is congruent to $\triangle CQP$. (ASA) (shown)	M1 A1
7	$2h^2 - 11h - 21 = 0$ $(2h+3)(h-7) = 0$ $2h+3 = 0$ or $h-7 = 0$ $h = -\frac{3}{2}$ or $h = 7$	M1 A1

8	4 cm : 2.8 km 4 : 280 000 1 : 70 000 ∴ $n = 70\ 000$	M1 A1
9	$x \leq \frac{x+4}{3} \leq 2x-1$ $3x \leq x+4 \leq 3(2x-1)$ $3x \leq x+4 \leq 6x-3$ $3x \leq x+4 \text{ and } x+4 \leq 6x-3$ $2x \leq 4 \text{ and } -5x \leq -7$ $x \leq 2 \text{ and } x \geq 1\frac{2}{5}$ $\therefore 1\frac{2}{5} \leq x \leq 2$	M1 M1 A1
10	$a_{\text{original}} = \frac{k}{x^2}, \text{ where } k \text{ is a constant}$ $a_{\text{now}} = \frac{k}{(0.5x)^2}$ $a_{\text{now}} = \frac{k}{0.25x^2}$ $\frac{a_{\text{now}}}{a_{\text{original}}} = \frac{k}{0.25x^2} \div \frac{k}{x^2}$ $\frac{a_{\text{now}}}{a_{\text{original}}} = \frac{1}{0.25}$ $\frac{a_{\text{now}}}{a_{\text{original}}} = 4$ $\therefore a_{\text{now}} : a_{\text{original}} = 4 : 1$	M1 M1 A1
11	Base of figure = 10 units Vertical height = 6 units Area = 10×6 = 60 square units	M1 M1 A1

<p>12</p>		<p>G1 (correct shape)</p> <p>G1 (correct x and y intercepts)</p> <p>G1 (correct turning point)</p> <p>Can accept if only wrote x and y intercepts</p>
<p>13a</p>	$\sin(180^\circ - A) = \frac{5}{13}$	<p>B1</p>
<p>13b</p>	$\cos(180^\circ - A) = \frac{12}{13}$ <p>OR shown adjacent side is 12 units (1 m)</p> $\cos A = -\frac{12}{13}$	<p>M1 (correct adjacent value)</p> <p>A1</p>
<p>14a</p>		<p>B1 (perpendicular bisector drawn correctly)</p> <p>B1 (mark and label Z correctly)</p>

14b	$\angle PZS = 33^\circ$ (accept angle values of $\pm 1^\circ$)	B1
15a	$5pr - 2ps - 5qr + 2qs$ $= p(5r - 2s) - q(5r - 2s)$ $= (p - q)(5r - 2s)$	M1 A1
15b	$5pr - 2ps - 5qr + 2qs = 0$ $(p - q)(5r - 2s) = 0$ $p - q = 0$ or $5r - 2s = 0$ $p = q$ or $\frac{r}{s} = \frac{2}{5}$ (reject)	M1 A1
16a	Smallest $x = 1$ Smallest $y = 1$	B1 B1
16b	$33q$ $= 3 \times 11 \times 3 \times 7^2 \times 11$ $= 3^2 \times 7^2 \times 11^2$ Since the indices of the prime factors are multiples of 2, $33q$ is a perfect square.	M1 A1
17ai	5.5 m/s^2	B1
17aii	11 m	B1
17b	$\frac{1}{2} \times 7 \times v = \frac{1}{2} \times 2 \times 11 + 7 \times 11$ $3.5v = 88$ $v = 25.1$ or $25\frac{1}{7}$ or $\frac{176}{7}$	M1 A1
18a	{ 2, 3, 5, 6, 7, 9, 10, 11, 13 }	B1
18b	{ 2, 3, 5, 7, 11, 13 }	B1
18c	{ 6, 9, 10 }	B1
18d	{ 4, 12 }	B1
19	$3 : 4 : 5 \rightarrow 9 : 10 : 11$ $7.5 : 10 : 12.5$ 1.5 units \rightarrow 30 masks 1 unit \rightarrow 20 masks 9 units \rightarrow 180 masks There are 180 blue masks.	M1 M1 M1 A1
20	$\left(\frac{6.5}{5}\right)^3 = \frac{x}{\$1}$ $x = \$2,197$ The larger cup is a better buy since it could have been more costly.	M1 M1 M1, A1

21a	$P = \begin{pmatrix} 3 \\ 1 \\ 0 \end{pmatrix}$	B1
21b	$RP = \begin{pmatrix} 12 & 5 & 3 \\ 3 & 8 & 7 \\ 9 & 4 & 4 \end{pmatrix} \begin{pmatrix} 3 \\ 1 \\ 0 \end{pmatrix}$ $= \begin{pmatrix} 41 \\ 17 \\ 31 \end{pmatrix}$	M1 A1
21c	Team Gratitude scores 41 points, Team Respect scores 17 points and Team Compassion scores 31 points. Team Gratitude is the winner.	B1
22a	$P(0, -10)$ $Q(5, 0)$	B1 B1
22b	$\sqrt{(5)^2 + (10)^2}$ $= 11.2$ units	M1 A1
23a	067°	B1
23b	 <p>Area of circle = $(4.5)^2\pi$ $\cos \alpha = \frac{4.5^2 + 4.5^2 - 6^2}{2(4.5)(4.5)}$ $\alpha = 83.6^\circ$ $\theta = \frac{180^\circ - 83.6^\circ}{2}$ (base angles, isos Δ) $\theta = 48.2^\circ$</p>	M1 M1

	$\text{Area of sector} = \frac{48.2 \times 2}{360} \times \pi (6)^2$ $= 30.2784 \text{ m}^2$ $\text{Area of segment B} = \frac{83.6}{360} \times \pi (4.5)^2 - \frac{1}{2} \times (4.5)^2 \sin 83.6^\circ$ $= 4.7114 \text{ m}^2$ $\text{Probability} = \frac{30.2784 + 2(4.7114)}{(4.5)^2 \pi} \text{ or } \frac{30.2784 + 2(4.7114)}{(6)^2 \pi}$ $= 0.624 \text{ (to 3 sf)} \quad = 0.351 \text{ (to 3 sf)}$	A1
24a	2 or 4 students	B1
24b	interquartile range = 48.5 - 42.5 = 6 kg	M1 A1
24c	median = 45.5 kg	B1
24d	The cumulative frequency curve will shift to the right by 5 kg.	B2
25a	33	B1
25b	$4n + 1$	B2
25c	51	B1
25d	$4n + 1 = 50$ $4n = 49$ $n = 49 \div 4$ Since n is not an integer, 50 is not a term of the sequence.	M1 A1