Answer all the questions.

1 (a) The selling price of a bedroom set after a 25% discount is $4 800.

(i) Find the original price of the bedroom set. [1]

(ii) John bought the bedroom set at the selling price of $4800 on hire purchase. He paid a 10% deposit and paid the remaining amount in monthly instalments of $210 per month. If the shop charges a simple interest of 25% per annum, find the number of years John will take to repay his loan. [2]

(b) Mrs Lim deposits $20 000 into a bank that pays a compound interest of x% per year. Find the value of x if she receives $6 898 in interest after 12 years. [3]

(c) The exchange rate between Singapore and the United States is US$1 = SG$1.35. Susan bought 5 handbags from the US that cost US$320 each and sold the bags for SG$500 each. Find the percentage of the total profit made. [2]

---

2 (a) Make s the subject of the formula $2rs = \frac{\sqrt{3s^2+2r^2}}{7}$. [3]

(b) (i) Expand and simplify $\left(p - \frac{1}{p}\right)^2$. [1]

(ii) It is given that $p^2 + \frac{1}{p^2} = 11$. Hence or otherwise, find the values of $\frac{1}{3}\left(p - \frac{1}{p}\right)$. [3]

---

3 A solid metal hemisphere of radius 15 cm is melted to form some solid identical cones and solid identical spheres with radius 2.5 cm

(a) Given that each cone and each sphere have the same volume, find the height of each cone. [2]

(b) Find the number of spheres formed if the number of spheres is twice the number of cones. [2]

(c) Calculate the total surface area of each cone. [2]

(d) The surfaces of the cones are painted red. A tin of 200 ml of paint that costs $3.50 can paint an area of 450 cm^2. Calculate the total cost of paint needed to paint all the cones. [2]

---

4 Diagram I shows a semi-circular drain $ABCD$ of length 5 m. On a rainy day, the drain is filled with water to a height of 0.7 m. Diagram II shows the cross-section of the drain when it is filled with water. The cross-section has centre O and a diameter of 2.5 m.

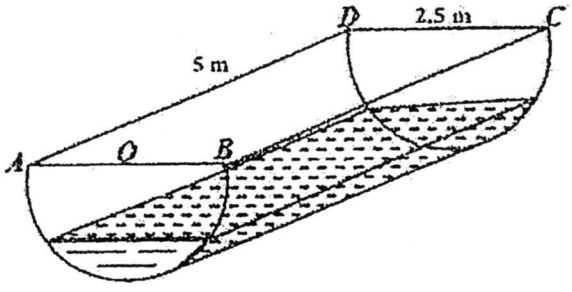


Diagram I

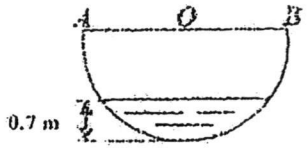


Diagram II

(a) Calculate the curved surface area of the drain that is in contact with water. [4]

(b) Find the total volume of the water in the drain. [3]

---

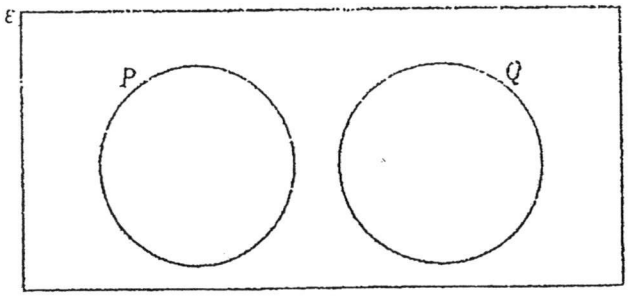
5 (a) A universal set is given as $\varepsilon = \{x : x \text{ is an even integer less than } 20\}$.
It is given that $A = \{x : x \text{ is a multiple of } 8\}$ and $B = \{x : x \text{ is a multiple of } 4\}$.

(i) Using set notation, write down the relationship between set A and set B. [1]

(ii) Hence, represent sets ε, A and B in a Venn Diagram, showing all the elements clearly. [2]

(iii) On your Venn Diagram, shade the region $A' \cap B$. [1]

(b) Refer to the Venn Diagram below and answer the questions that follows.

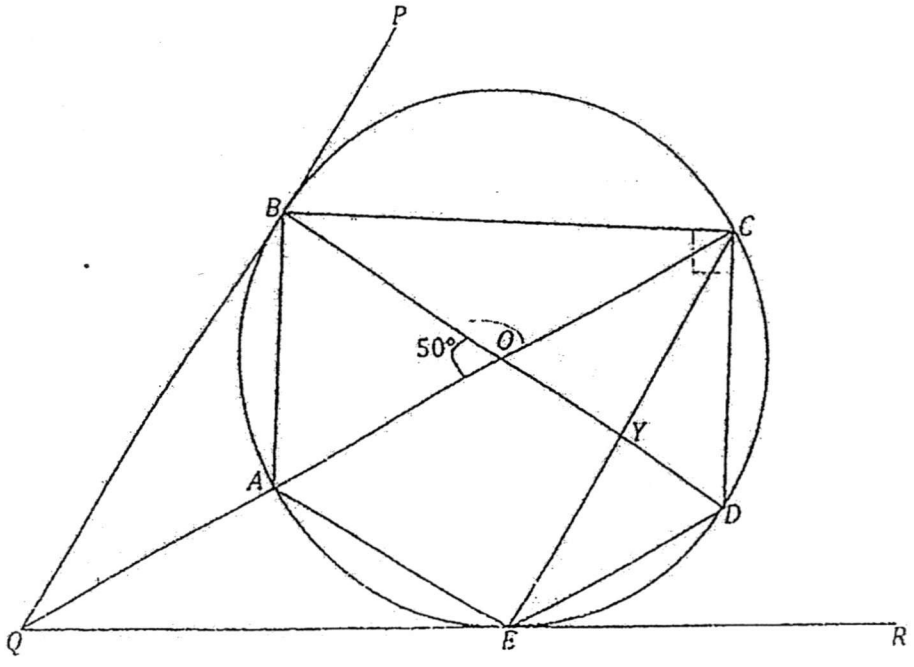


(i) Find $P \cap Q$. [1]

(ii) Write down the set notation for the shaded region. [1]

(iii) If $\varepsilon = \{t, u, v, w, x, y, z\}$, $P = \{u, w, y\}$ and $x \notin Q$, list all the possible elements in Q. [1]

6



In the diagram above, $ABCDE$ are on the circumference of a circle with centre O. QP and QR are tangents to the circle at B and E respectively. AC and CE intersect BD at O and Y respectively and $QAOC$ is a straight line.

(a) It is given that $\angle BOA = 50°$. Showing your reasons clearly, calculate

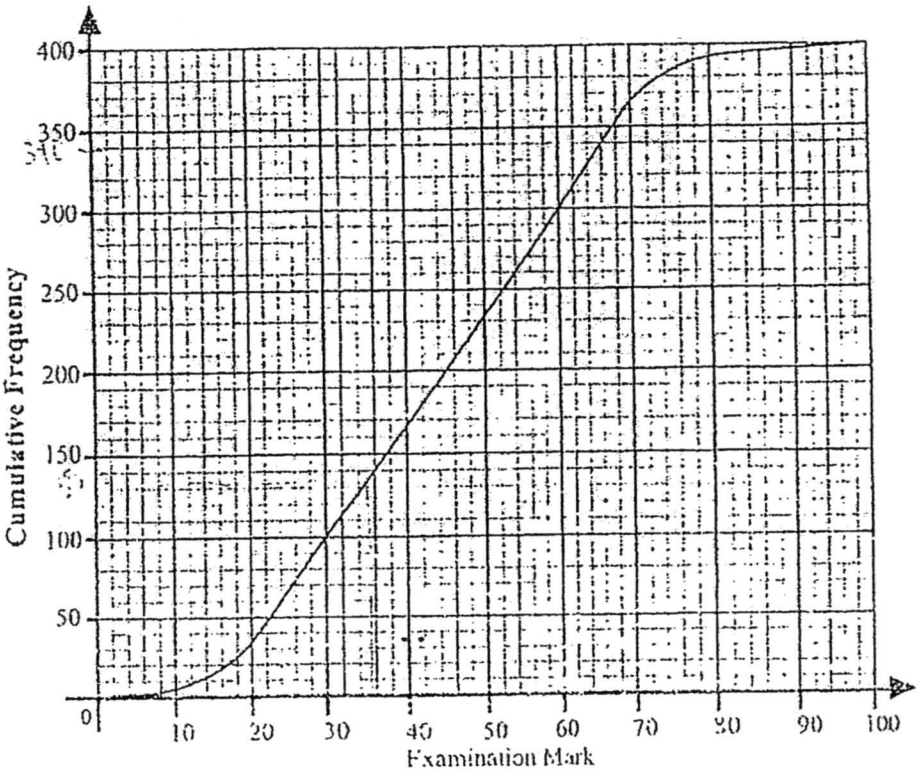
(i) $\angle BCA$, [1]

(ii) $\angle AQE$, [1]

(iii) $\angle CED$. [2]

(b) Given that $\angle BXD = 100°$, explain clearly whether point X is in the circle, on the circumference or outside the circle. [2]

7 The diagram below shows the cumulative frequency curve for the marks of 400 pupils who sat for a Mathematics Examination.



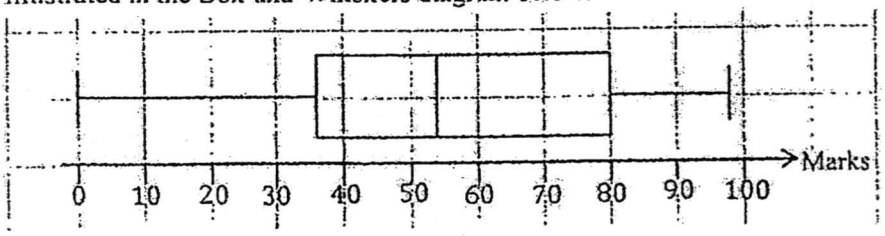
(a) Use your graph to find

(i) the median mark, [1]

(ii) the interquartile range. [1]

(b) Two students were selected at random. Find the probability that one of the students obtained less than 35 marks and the other obtained more than 66 marks. [2]

(c) The same group of students sat for a Chemistry Examination and the results are illustrated in the Box-and-Whiskers diagram below.



Use the Box-and-Whiskers diagram to find

(i) the median mark, [1]

(ii) the interquartile range. [1]

(d) Compare the marks obtained by the 400 students for the Mathematics Examination and Chemistry Examination in two different ways. [2]

---

8 Consider the following sequence

Line 1	$1^3 + 2^3 = 3^2 = \left(\frac{2 \times 3}{2}\right)^2$
Line 2	$1^3 + 2^3 + 3^3 = 6^2 = \left(\frac{3 \times 4}{2}\right)^2$
Line 3	$1^3 + 2^3 + 3^3 + 4^3 = 10^2 = \left(\frac{4 \times 5}{2}\right)^2$
Line 4	... ...

(a) (i) Write down the 4^{th} line of the sequence. [1]

(ii) Write down in terms of n, the sum of $1^3 + 2^3 + 3^3 + \ldots\ldots + n^3$. [1]

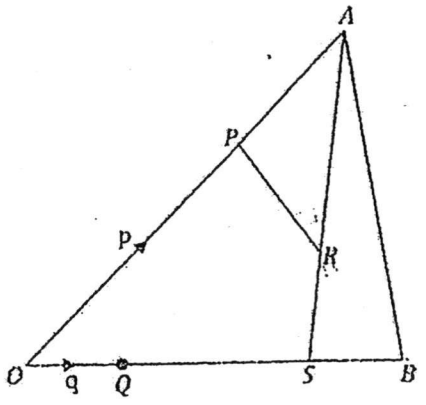
(b) Use your result in (a) to find the sum of

(i) $3^3 + 4^3 + 5^3 + 6^3 + \ldots\ldots + 50^3$ [2]

(ii) $2^3 + 4^3 + 6^3 + 8^3 + \ldots\ldots + 50^3$ [2]

---

9 In the diagram below, $\overrightarrow{OP} = \mathrm{p}$ and $\overrightarrow{OQ} = \mathrm{q}$. It is given that $\overrightarrow{OP} = \frac{2}{3}\overrightarrow{OA}$, $\overrightarrow{OQ} = \frac{1}{3}\overrightarrow{OS}$, $SB = OQ$ and $3SR = SA$.



(a) Express as simply as possible in terms of p and q,

(i) $\overrightarrow{SA}$, [1]

(ii) $\overrightarrow{PB}$, [1]

(iii) $\overrightarrow{PR}$. [2]

(b) State 2 facts about $\overrightarrow{PR}$ and $\overrightarrow{PB}$. [2]

(c) Find the numerical value of

$$\frac{\text{Area of triangle } RSB}{\text{Area of triangle } APR}.$$ [2]

10 Two language schools conduct courses for Korean, Japanese and Chinese Language. The number of students for each language course in May and June are given in the table below.

	May			June		
	Korean	Japanese	Chinese	Korean	Japanese	Chinese
School X	150	220	116	200	250	136
School Y	90	5	10	351	308	457

The number of students for each language course in both schools in May can be represented by the matrix

$$\mathbf{M} = \begin{pmatrix} 150 & 220 & 116 \\ 90 & 5 & 10 \end{pmatrix}$$

Similarly, the number of students for each language course in both schools in June can be represented by the matrix J.

(a) Write down the matrix J. [1]

(b) Evaluate $\mathbf{T} = \frac{1}{2}(\mathbf{M} + \mathbf{J})$. [1]

(c) State what the elements of T represent. [1]

The course fees were \$200, \$180 and \$100 for Korean, Japanese and Chinese language courses respectively.

(d) Write down a matrix S such that the elements of MS represent the total course fees collected by each school in the month of May
Hence, evaluate MS. [2]

---

11 A car travelled from town X to town Y, which were 320 km apart, at an average speed of x km/h. A van travelled on the same road from town Y to town X at an average speed which was 5 km/h slower than the speed of the car.

(a) Write down an expression in terms of x, for the time taken by the car to travel from town X to town Y. [1]

(b) Write down an expression in terms of x, for the time taken by the van to travel from town Y to town X. [1]

(c) Given that the difference in time taken for both vehicles to reach their respective destination is 15 minutes, form an equation in x and show that it reduces to

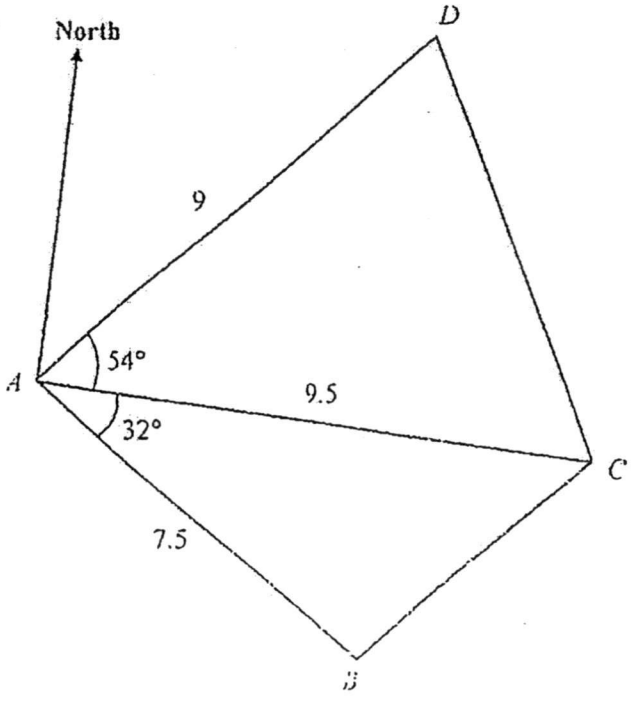
$$x^2 - 5x - 6400 = 0.$$ [3]

(d) Solve the equation $x^2 - 5x - 6400 = 0$, giving your answer correct to 2 decimal places. [2]

(e) Hence, find in hours and minutes, the time when the two vehicles meet. [3]

---

12 A, B, C and D are points on level ground such that C is due east of A. It is given that $AB = 7.5$ m, $AC = 9.5$ m, $AD = 9$ m, $\angle DAC = 54°$ and $\angle CAB = 32°$.



(a) Calculate

(i) angle ABC, given that angle ABC is an obtuse angle, [3]

(ii) the bearing of C from B. [2]

(b) A tree is at D. The angle of depression of C from the top of the tree is 25°.
Calculate the

(i) height of the tree, [3]

(ii) greatest angle of elevation of the top of the tree from a point along the line AB. [2]

13 **Answer the whole of this question on a piece of graph paper.**

The variables x and y are connected by the equation $y = x + \frac{6}{x} - 1$.

The table below shows some values of x and their corresponding values of y.

x	0.75	1	1.5	2	2.5	3	4	5	6	8
y	7.75	6	4.5	4	3.9	4	4.5	5.2	6	7.75

(a) Using a scale of 2 cm to 1 unit, draw a horizontal x-axis for $0 \leq x \leq 8$.
Using a scale of 2 cm to 1 unit, draw a vertical y-axis for $0 \leq y \leq 8$.
On your axes, plot the points given in the table and join them with a smooth curve. [3]

(b) Use your graph to find the minimum value of y. [1]

(c) (i) On the same axes, draw the graph of $x + 3y = 21$. [1]

(ii) Write down the x-coordinates of the points where the two graphs intersect. [1]

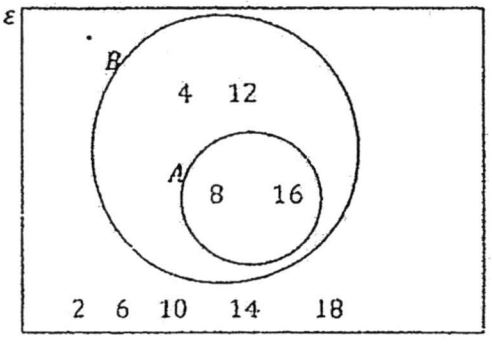
(iii) These values of x is a solution to the equation $ax^2 + bx + c = 0$, where a, b and c are integers. Find the values of a, b and c. [2]

(d) By drawing a suitable tangent to your curve, find the coordinates of the point at which the gradient of the curve is $-\frac{1}{2}$. [2]

END OF PAPER

Answer Key

1. (a)(i) \$6400 (ii) 3 (b) 2.50 (to 3 s.f.) (c) 15.7%
2. (a) $s = \pm\sqrt{\frac{2r^2}{196r^2-3}}$ (b)(i) $p^2 - 2 + \frac{1}{p^2}$ (ii) ± 1
3. (a) 10 cm (b) 72 (c) 101 cm^2 (d) \$31.50
4. 13.9 m^2 (b) 5.63 m^3
5. (a)(i) $A \subset B$ (ii)



(b) (i) $P \cap Q = \emptyset$ or null set (ii) $(P \cup Q)'$ (iii) $Q = \{t, v, z\}$

6. (a)(i) 25° (ii) 40° (iii) 25° (b) As $\angle BXD > 90°$, by converse of right angle in a semicircle, X is inside the circle.
7. (a)(i) 45 (ii) 30 (b) $\frac{27}{266}$ (c)(i) 54 (ii) 44
   (d) Overall, the students did better in Chemistry as compared to Mathematics as the median for Chemistry is greater than the median for Mathematics. The marks for Chemistry is more spread out as compared to Mathematics as the interquartile range for Chemistry is larger.
8. (a)(i) $1^3 + 2^3 + 3^3 + 4^3 + 5^3 = 15^2 = \left(\frac{5\times 6}{2}\right)^2$ (ii) $1^3 + 2^3 + 3^3 + \ldots + n^3 = \left[\frac{n(n+1)}{2}\right]^2$ (b)(i) 1 625 616 (ii) 845 000
9. (a)(i) $-3q + \frac{3}{2}p$ (ii) $-p + 4q$ (iii) $2q - \frac{1}{2}p$ (b) P, K and R are collinear (c) ½
10. (a) $J = \begin{pmatrix} 200 & 250 & 136 \\ 351 & 308 & 457 \end{pmatrix}$ (b) $\begin{pmatrix} 175 & 235 & 126 \\ 220.5 & 156.5 & 233.5 \end{pmatrix}$
    (c) T represents the average number of students taking each language lessons for the months of May and June in School X and Y respectively. (d) $\begin{pmatrix} 81\,200 \\ 19\,900 \end{pmatrix}$
11. (a) $\frac{320}{x}$ (b) $\frac{320}{x-5}$ (d) $x = 82.54$ or $x = -77.54$ (e) 2 h 0 min
12. (a)(i) 106.7° (ii) 048.7° (b)(i) 3.92 m (ii) 23.6°
13. (b) $y = 3.9$ (c)(ii) 0.9 or 5.15 (iii) $a = 2, b = -12, c = 9$ (d) (2,3)

Answer all the questions.

1 The numbers 756 and 1200 written as the products of their prime factors are:

$756 = 2^2 \times 3^3 \times 7$

$1200 = 2^4 \times 3 \times 5^2$

Find

(a) the smallest integer n if $756n$ is a multiple of 1200.

(b) the smallest integer m if $1200m$ is a perfect cube.

Answer (a) $n =$ ..... [1]

(b) $m =$ ..... [1]

2 Some boys were seated around a circular table. A bag containing 51 sweets was passed around the table, starting from Tim. Each boy took the same number of sweets. When the bag reached Tim again, there was only 3 sweets left. If Tim took one more sweet and had x sweets altogether, express the number of boys seated around the table in terms of x.

Answer ..... [1]

3 A tank was filled with water. Mary poured out $\frac{1}{2}$ of the water from the tank into another container. She then poured out $\frac{1}{3}$ of the remaining water in the tank into another container. She then poured out $\frac{1}{4}$ of the remaining water in the tank into another container and so on. How many times would she need to pour out the water from the tank so that the remaining water in the tank is exactly $\frac{1}{15}$ of the original amount?

Answer ..... [2]

---

4 A rectangular lake with an actual area of 13.5 km^2 is represented as an area of 6 cm^2 on a map.

(a) Express the scale of the map in the form $1 : n$, where n is an integer.

(b) The lake is represented on another map with a scale of 1 : 100 000. If the breadth of the lake is 2 cm on the second map, find the actual length of the lake in kilometres.

Answer (a) 1 : ..... [2]

(b) Actual length = ... km [2]

---

5 It takes 8 workers to complete a job. The job can be completed 4 days earlier if 2 more workers are added. How many workers will be needed if the job needs to be completed 10 days earlier?

Answer ..... [2]

---

6 The mass of an oxygen atom is 2.66×10^{-20} milligrams and the mass of a hydrogen atom is 1.67×10^{-12} picograms

(a) Find the ratio of the mass of an oxygen atom to the mass of a hydrogen atom is its simplest form.

(b) Find the total mass in kilograms of one oxygen atom and two hydrogen atoms, giving your answer in standard form.

Answer (a) ..... : ..... [1]

(b) ..... kg [2]

---

7 (a) Factorise completely $12a^2x - b^2y + 4a^2y - 3b^2x$.

(b) It is given that $12a^2x - b^2y + 4a^2y - 3b^2x = 0$. Hence, find the values of a if $b = 7, x = a$ and $y = 10$.

Answer (a) ..... [3]

(b) a = ... [2]

---

8 Solve the following pair of simultaneous equations.

$$2^x \times 16^y = 8$$

$$125^y \div 5^{-x} = \frac{1}{625}$$

Answer x = ... and y = ... [4]

---

9 An unbiased coin and a six-sided fair die with numbers 1 to 6 are tossed. Represent the sample space using a possibility diagram. [1]

(a) Find the probability of getting a head on the coin and a number less than 5 on the die.

(b) Sam and Tim decided to play a game. If a head is obtained from the coin, 2 points will be awarded. If a tail is obtained from the coin, 1 point will be deducted. The total points is calculated by adding the number obtained on the die with the points obtained from the tossing of the coin.
Find the probability of
(i) obtaining a total of 4 points,
(ii) obtaining more than 5 points.

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

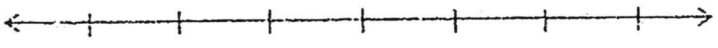
(b) (i) ..... [1]

(ii) ..... [1]

10 (a) Solve the inequality $\frac{1}{5}(5x - 29) \leq \frac{30-2x}{2} < 9$.

(b) Represent the solution on the number line below.

(c) If x is a factor of 98, find the value of x.



[1]

Answer (a) ..... [3]

(c) x = ... [1]

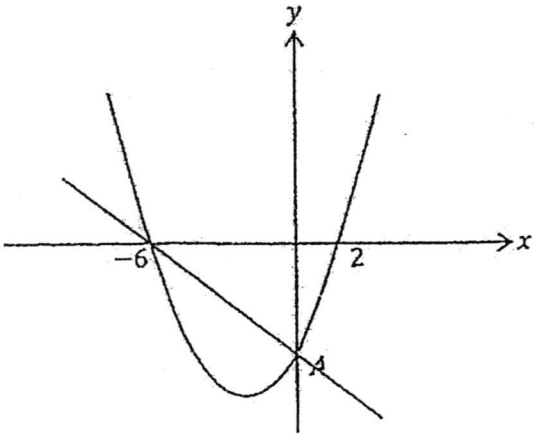
---

11 y is inversely proportional to the square of x and $y = p$ for a particular value of x. Express the value of y in terms of p when this value of x is halved.

Answer ..... [3]

---

12 The diagram below shows a curve of $y = a(x + h)^2 - 5$. The curve cuts the x-axis at -6 and 2 and the y-axis at A. B is the minimum point of the curve.



(a) Express the equation of the curve in the form of $y = a(x + h)^2 - 5$, where a and h are constants

(b) A straight line cuts the curve at $x = -6$ and point A. Find the equation of the straight line.

Answer (a) Equation of curve: $y =$ ..... [3]

(b) Equation of straight line: $y =$ ..... [2]

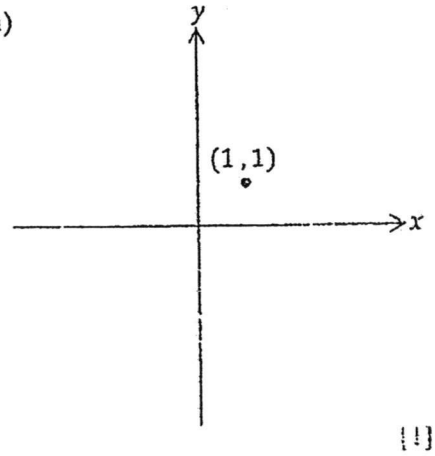
13 In the axes provided below, the point (1, 1) has been marked. Indicating clearly any intercepts, sketch the graph of

(a) $yx = 2x - 1$

(b) $2y + x = 4$

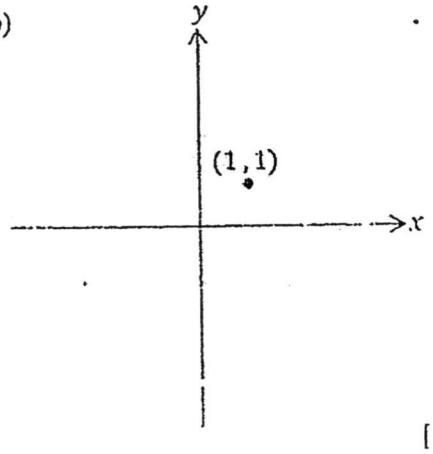
Answer

(a)



[1]

(b)



[1]

14 The equation of a curve can be expressed as $y = ax^n$. State the possible value of a and of n in each case.

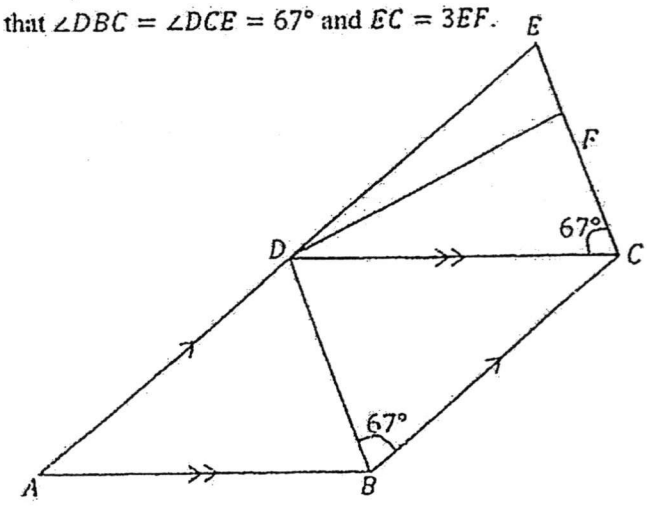
(a) y is the volume of a hemisphere with radius x.

(b) y is the acceleration of a car that has travelled a distance of 100 km in x hours.

Answer (a) $a =$ ..... $n =$ ..... [1]

(b) $a =$ ..... $n =$ ..... [1]

15 In the diagram below, $ABCD$ is a rhombus. AD is produced to point E and EFC is a straight line. It is given that $\angle DBC = \angle DCE = 67°$ and $EC = 3EF$.



(a) Name one triangle which is congruent to triangle EDC. Explain your reasons clearly.

(b) Find the numerical value of

(i) $\dfrac{\text{Area of } \Delta EDF}{\text{Area of } \Delta EDC}$,

(ii) $\dfrac{\text{Area of } \Delta DFC}{\text{Area of quadrilateral } ABCD}$.

Answer

(a) .....

.....

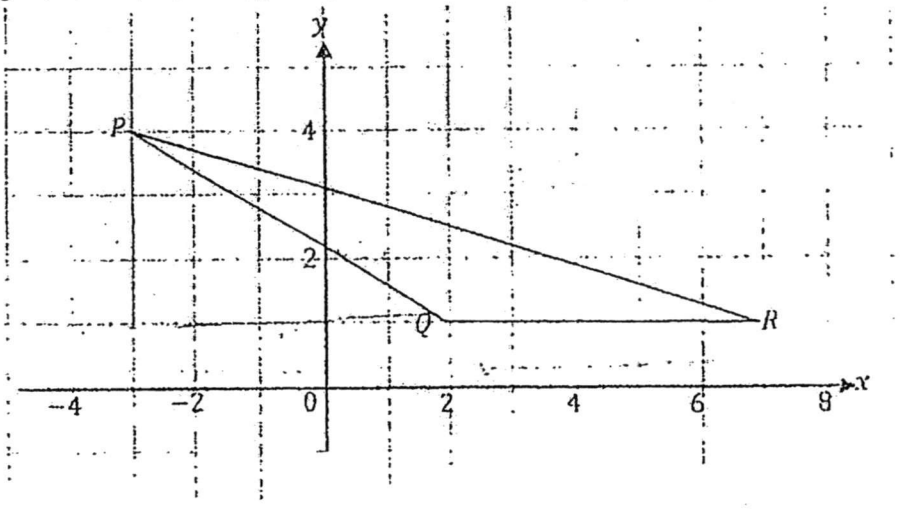
.....

..... [3]

(b) (i) ..... [1]

(ii) ..... [2]

16 The figure below shows triangle PQR with vertices $P(-3, 4), Q(2, 1)$ and $R(7, 1)$.



(a) Find the exact value of

(i) $\tan \angle PQR$,

(ii) $\sin \angle PRQ$.

(b) Hence, find the exact value of the perpendicular distance from Q to PR.

(c) $PQRS$ is a trapezium with an area that is 3 times the area of triangle PQR and PS is parallel to QR. Find the coordinates of point S.

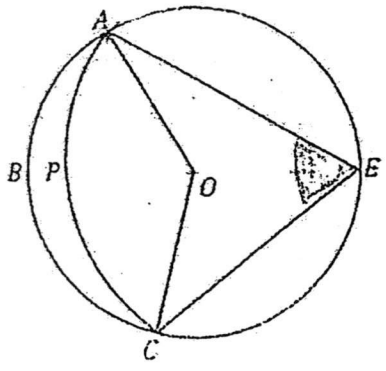
Answer (a) (i) ..... [1]

(ii) ..... [1]

(a) Perpendicular distance = ... units [2]

(b) Coordinates of S = ... [1]

17 In the figure below, $ABCE$ lies on the circumference of a circle with centre O and radius 10 cm. APC is the minor arc of a circle with centre E and radius 15 cm.



(a) Show that $\angle AEC = 1.445$ radians, correct to 3 decimal places. [2]

(b) Find $\angle AOC$ in radians.

(c) Find the area of the shaded region $AOCP$.

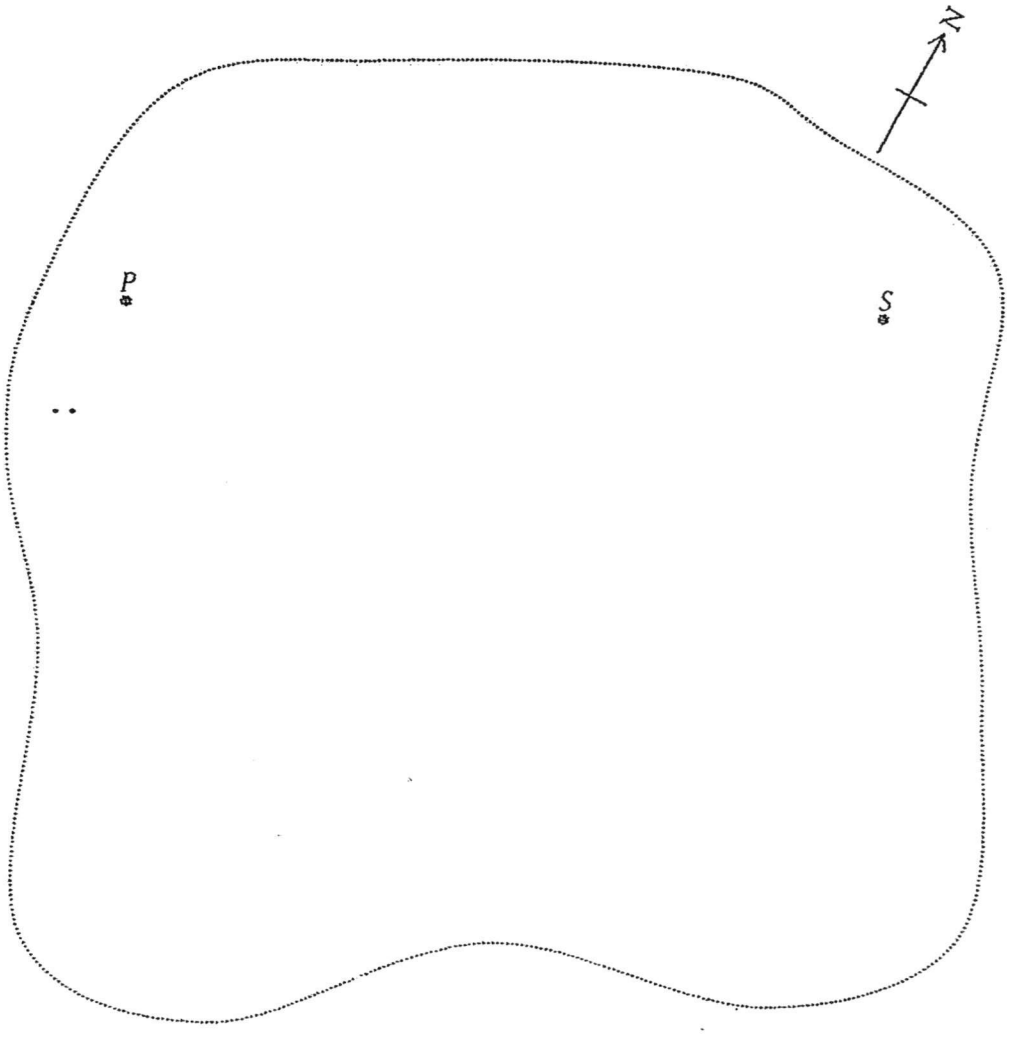
Answer (b) $\angle AOC =$ ..... [1]

(c) Area of shaded region $AOCP =$ ..... cm^2 [3]

18 The diagram below represent the map of Town Crescent drawn to the scale of 1 cm to 2 km. P and S are the positions of a primary and a secondary school respectively and the North direction is indicated in the diagram.

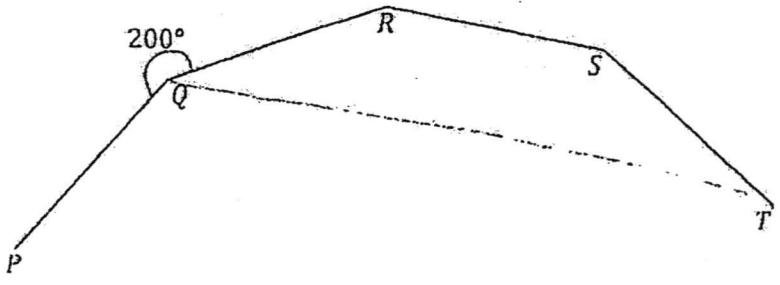
(a) The bearing of a community centre from the primary school is 085° and the distance between the community centre and the primary school is 17 km. By making appropriate measurements, find and label the location of the community centre. [2]

(b) A police station is located south of the community centre and is equidistant from the two schools. Find the distance in km, from the police station to the primary school.



Answer (b) Distance = ... km [3]

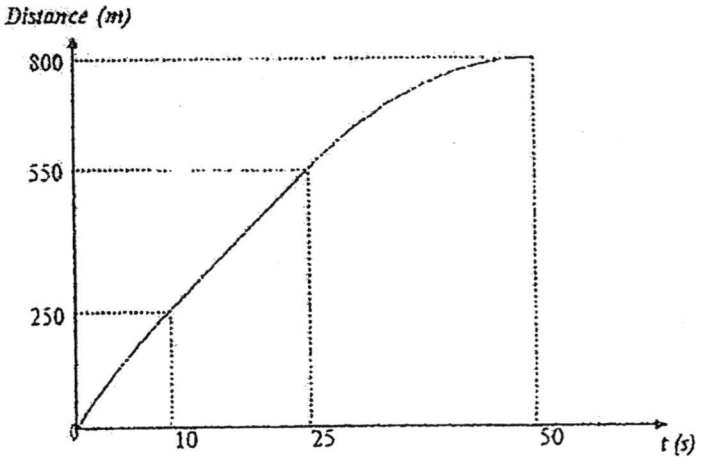
19 PQ, QR, RS and ST are adjacent sides of a regular polygon.
Given that reflex angle $PQR = 200°$, find
(a) the number of sides of the polygon,
(b) angle PQT.



Answer (a) Number of sides = ... [2]

(b) $\angle PQT$ = ... [2]

20 The diagram shows the distance-time graph for the first 50 seconds of a car's journey. The car moves at a constant speed from $t = 10$s to $t = 25$ s and comes to rest after 50 seconds



(a) Find the speed of the car when $t = 15$.

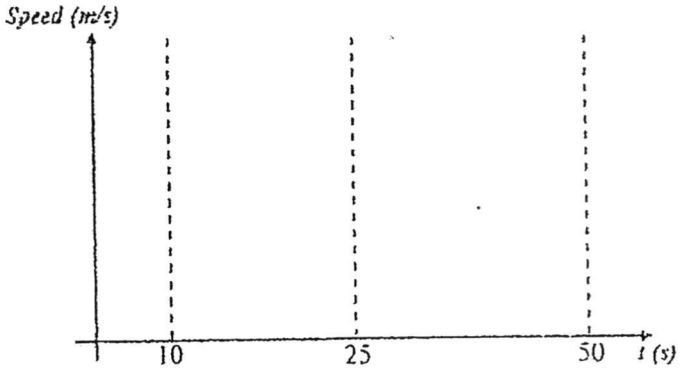
(b) Given that the car moves with a constant deceleration for the last 25 seconds, find its deceleration for the last 25 seconds.

(c) The car starts at 30m/s and decelerates uniformly for the first 10 seconds. On the axes below, sketch the speed-time graph for the car's journey.

Answer (a) ..... m/s [1]

(b) ..... m/s^2 [1]

(c)



[1]

21 Figure 1 below shows a hollow square base pyramid with base length $2l$ and height $2h$ cut into 2 parts. The lower part of the pyramid is attached to a cuboid with a square base of $2l$ and height h, as shown in Figure 2.

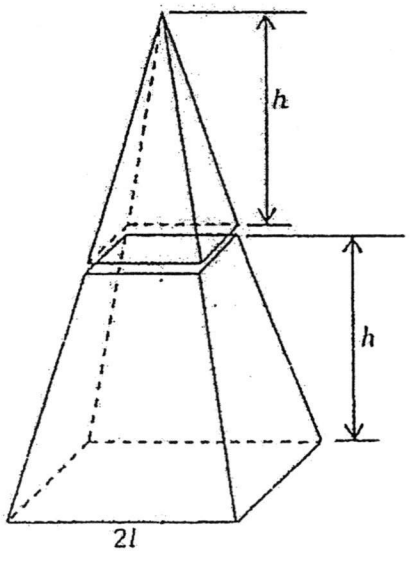


Figure 1

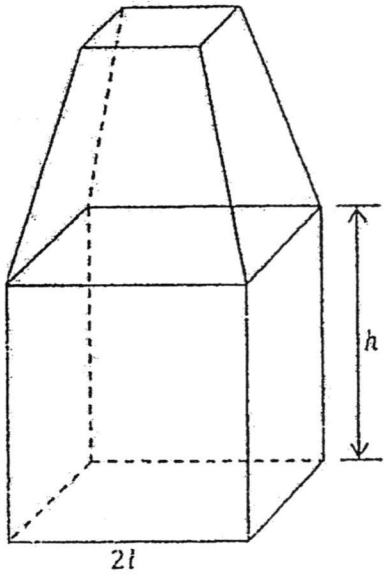


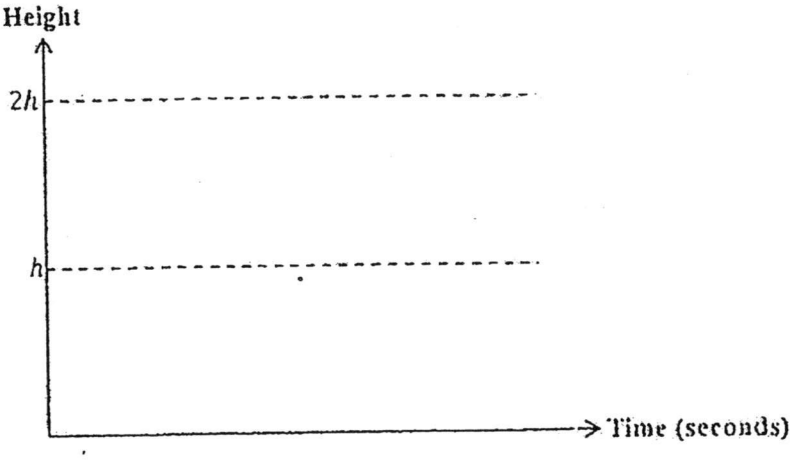
Figure 2

(a) If it takes 1 minute to fill up the cuboid, find the time taken, in seconds, to fill up the whole container in Figure 2.

(b) On the answer grid given on the next page, sketch the graph of the depth of water against time.

Answer (a) ..... seconds [2]

(b)



[1]

22 The table below shows the age distribution of customers in an electronic store.

Age (years)	$0 < x \leq 10$	$10 < x \leq 20$	$20 < x \leq 30$	$30 < x \leq 40$	$40 < x \leq 50$
Frequency	2	7	37	25	9

(a) Find the
(i) mean,
(ii) standard deviation

(b) Find the modal group of the above distribution.

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

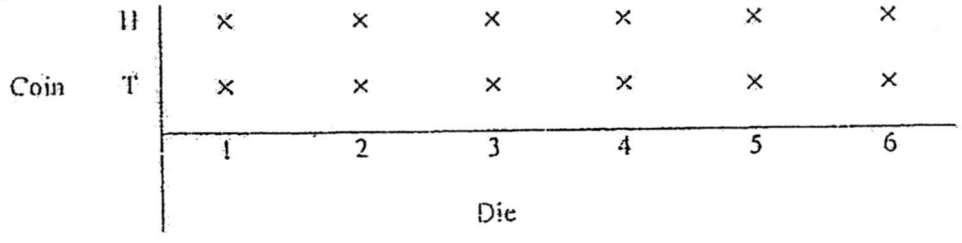
(ii) ..... [2]

(b) ..... [1]

END OF PAPER

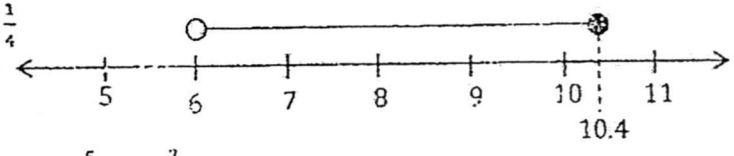
ANSWER KEY

1. (a) 100 (b) 180
2. $\frac{48}{x-1}$
3. 14
4. (a) 1 : 150 000 (b) 6.75
5. 16
6. (a) 2660 : 167 (b) 2.994×10^{-26}
7. (a) $(3x+y)(2a+b)(2a-b)$ (b) $a=-3\frac{1}{3}$ or $-3\frac{1}{2}$ or $3\frac{1}{2}$
8. $y=7$ and $x=-25$
9.



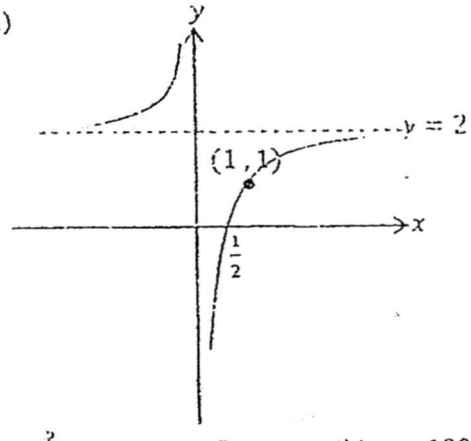
(a) $\frac{1}{3}$ (b) (i) $\frac{1}{6}$ (ii) $\frac{1}{4}$

10. (a) $6 < x \leq 10.4$ (b)

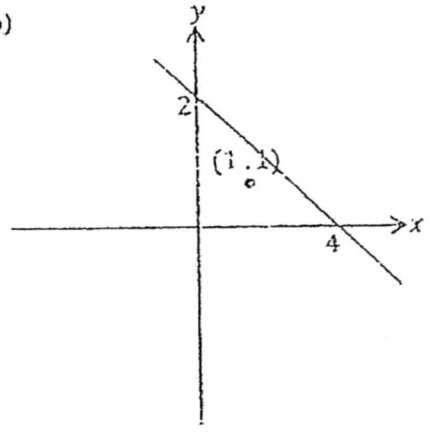


(c) $x=7$

11. $y=4p$
12. (a) $y=\frac{5}{16}(x+2)^2-5$ (b) $y=-\frac{5}{8}x-3\frac{3}{4}$
13. (a)



(b)



14. (a) $a=\frac{2}{3}\pi$ $n=3$ (b) $a=100$ $n=-2$
15. (a) $\angle CDB=\angle CBD=\angle ADB=67°$ (diagonal of rhombus bisects interior angle)
$\angle DCB=180°-67°-67°=46°$ (sum of angles in triangle BCD)
$\angle EDC=180°-67°-67°=46°$ (sum of angles on straight line ADE)
DC is a common length
$\therefore$ Triangle EDC is congruent to triangle DCB. (ASA)
(b) (i) $\frac{1}{3}$ (ii) $\frac{1}{3}$

16. (a)(i) $-\frac{3}{5}$ (ii) $\frac{3}{\sqrt{109}}$ (b) $\frac{15}{\sqrt{109}}$ (c) $(7, 4)$
17. (b) 2.89 radians (c) 63.4 cm^2
18. (b) 9.8 km ($\pm$0.2) km
19. (a) 18 (b) 140°
20. (a) 20 m/s (b) 0.8 m/s^2
21. (a) 95 seconds
22. (a) (i) 29 (ii) 8.89 (c) $20 < x \leq 30$