



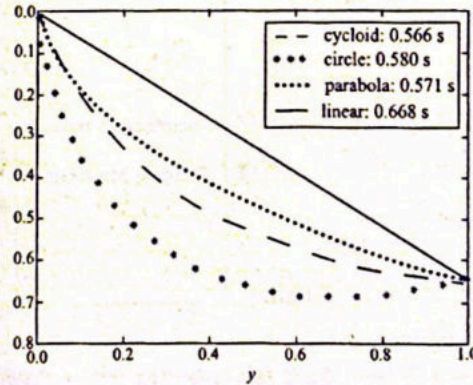
Department of Examinations-Sri Lanka

G.C.E. (O/L) Examination - 2025 (2026)

32 - Mathematics

Marking Scheme

The Brachistochrone Problem



The Brachistochrone problem seeks the curve allowing a frictionless bead to slide under gravity from one point to another in the shortest time, with the solution being an arc of a cycloid that often dips below the endpoint before rising.

Brachistochrone (බ්‍රැකිස්ටොක්‍රෝන්) ප්‍රශ්නය යනු ගුරුත්වාකර්ෂණය යටතේ වස්තුවක් එක් ලක්ෂ්‍යයක සිට තවත් ලක්ෂ්‍යයකට (එකක් අනෙකට වඩා පහළින් පිහිටි) ගමන් කිරීමේදී අඩුම කාලයක් ගත වන මාර්ගය වන්නේ සයික්ලොයිඩ් (cycloid) නම් වක්‍රයයි.

Brachistochrone (බ්‍රැකිස්ටොක්‍රෝන්) ප්‍රශ්නයේදී, ගුරුත්වය යටතේ භ්‍රමණය වන (bead) කුඩා වස්තුවක් කිසි ඉරට්ටේම පහතට යාමට හැකි වන පරිදි, එක් ලක්ෂ්‍යයක සිට තවත් ලක්ෂ්‍යයකට (එකක් අනෙකට වඩා පහළින් පිහිටි) ගමන් කිරීමේදී අඩුම කාලයක් ගත වන මාර්ගය සොයා ගැනීමයි. මෙම ප්‍රශ්නයේ solution වන්නේ cycloid වක්‍රයයි.

This document has been prepared for the use of Marking Examiners. Some changes would be made according to the views presented at the Chief Examiners' Meeting

Amendments to be included

Part A

Answer all questions on this question paper itself.

(Take the value of π as $\frac{22}{7}$)

* No need to unit

1. The initial value of an imported item is 60 000 rupees. Customs duty of 14% is charged on it. What is the value of the item after the customs duty is paid?

$$\text{Rs. } 60\,000 \times \frac{114}{100} \text{ or } \text{Rs. } 60\,000 \times \frac{14}{100} \text{ ————— } \textcircled{1}$$

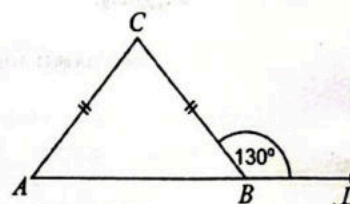
8400 ———— $\textcircled{1}$

$$\text{Rs. } 68\,400 \text{ ————— } \textcircled{1}$$

2. In the given figure, ABC is an isosceles triangle. The side AB is produced to D . Find the magnitude of $\angle ACB$ using the given information.

$$80^\circ \text{ ————— } \textcircled{2}$$

$$\angle CAB = \angle CBA \text{ or } \angle CBA = 50^\circ \text{ ————— } 1$$



3. Solve: $\frac{4}{x} - \frac{5}{2x} = \frac{1}{8}$

$$\frac{8}{2x} - \frac{5}{2x} = \frac{1}{8} \text{ ————— } \textcircled{1}$$

denominators: $2x, 4x, 8x$.

$$x = 12 \text{ ————— } \textcircled{1}$$

4. Find the first approximation of $\sqrt{30}$ (Hint: $(5.4)^2 = 29.16$).

$$5.5^2 = 30.25 \text{ ————— } \textcircled{1}$$

$$5.5 \text{ ————— } \textcircled{1}$$

5. The rate at which water flows through a pipe fixed to an empty tank is 28 litres per minute. If the capacity of the tank is 112 litres, how many minutes will it take to fill the tank completely?

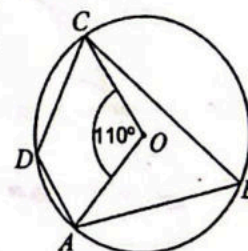
$$4 \text{ minutes ————— } \textcircled{2}$$

$$\frac{112}{28} \text{ minutes ————— } 1$$

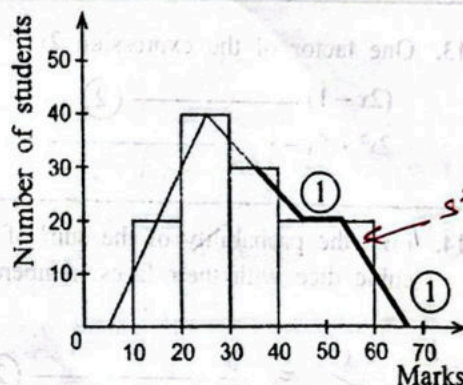
6. In the given figure, A, B, C and D are four points on the circle with centre O . Find the magnitude of $\angle ADC$ using the given information.

$$\angle ABC = 55^\circ \text{ or } \angle AOC \text{ (reflex)} = 250^\circ \text{ ————— } \textcircled{1}$$

$$\angle ADC = 125^\circ \text{ ————— } \textcircled{1}$$



7. A histogram and an incomplete frequency polygon drawn based on the marks obtained by a group of students for a test are shown here. Complete the frequency polygon.



8. Find the least common multiple of the following algebraic terms.

$3x, 6xy, 4x^2y$

Division method ok

$12x^2y$ ————— ②

$3x = 3 \times x$

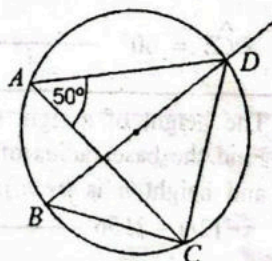
$6xy = 2 \times 3 \times x \times y$

$4x^2y = 2 \times 2 \times x \times x \times y$ } ————— 1

9. In the circle given in the figure, the diameter BD is produced to E . Find the magnitude of $\angle CDE$ using the given information.

$\angle CDE = 140^\circ$ ————— ②

$\angle DBC = 50^\circ$ or $\angle BCD = 90^\circ$ ————— 1



10. If $\lg 243 = 2.3856$, find the value of $10^{0.3856}$.

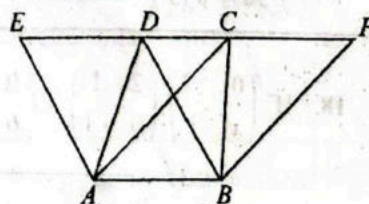
2.43 ————— ②

$243 = 10^{2.3856}$ ————— 1

11. In the given figure, $ABDE$ and $ABFC$ are two parallelograms. Moreover, the points E, D, C and F lie on a straight line. Name three triangles that have the same area as the triangle BFC .

$\triangle ABC, \triangle ABD, \triangle ADE$ ————— ②

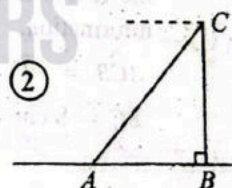
One or two correct triangles ————— 1



12. Anula, who is at point A of a level ground, sees Kamal who is at point C of a vertical building BC on the same ground, with an angle of elevation of 50° . Accordingly, select the correct statement and underline it.

(i) $\tan 50^\circ = \frac{AB}{BC}$ (ii) $\cos 50^\circ = \frac{BC}{AB}$ (iii) $\sin 50^\circ = \frac{BC}{AC}$ ②

$\angle BAC = 50^\circ$ ————— 1



13. One factor of the expression $2x^2 + 5x - 3$ is $(x + 3)$. Find the other factor.

$(2x - 1)$ ————— ②

$2x^2 + 6x - x - 3$ ————— 1

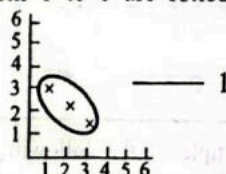
$(2x - 1)(x + 3) \rightarrow$ ①

$(2x - 1)(x + 3) \rightarrow$ ②

14. Find the probability of the sum of the two digits appearing face up being 4, when two fair cubic dice with their faces numbered from 1 to 6 are rolled.

$\frac{1}{12} = \frac{3}{36}$ ————— ②

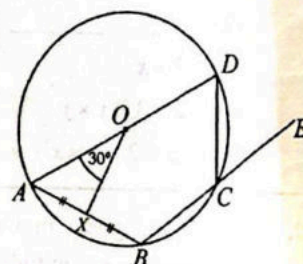
(1, 3), (2, 2), (3, 1) or



15. In the given figure, A, B, C and D are four points on the circle with centre O . Moreover, AD is a diameter and, the chord AB is bisected by OX . Find the magnitude of $\angle DCE$ using the given information.

$\angle AOX = 90^\circ$ or $\angle BOX = 90^\circ$ or $\angle AOX = 60^\circ$ ————— ①

$\angle DCE = 60^\circ$ ————— ①



16. The height of a right circular cylinder is twice its base radius, and its volume is 2156 cm. Find the base radius of this cylinder. (The volume of a right circular cylinder of base radius and height h is $\pi r^2 h$.)

$\pi r^2 (2r) = 2156$ ————— ①

$r = 7$ cm ————— ①

17. The number of ants in a container of sugar triples every 5 minutes. If there are 36 ants in the container in 10 minutes, find the number of ants in the container initially.

4 ————— ②

$36 = a(3^2)$ ————— 1

18. If $\begin{pmatrix} 0 & -2 \\ x & 1 \end{pmatrix} \begin{pmatrix} 2 & 1 \\ 0 & -1 \end{pmatrix} = \begin{pmatrix} 0 & y \\ 6 & 2 \end{pmatrix}$, find x and y separately.

$x = 3$ ————— ①

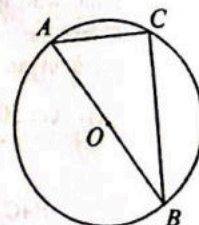
$y = 2$ ————— ①

3, 2 ————— ②

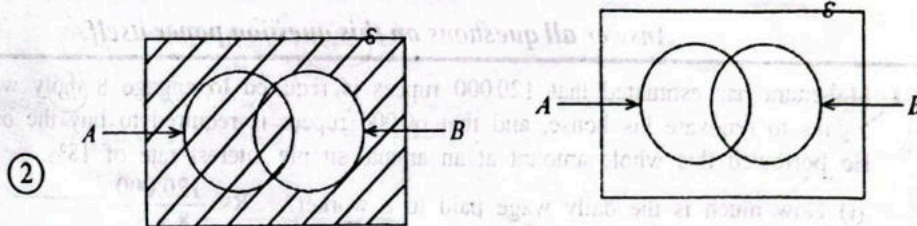
19. The centre of the circle given in the figure is O , AB is a diameter, and the radius is 5 cm. If $AC = 6$ cm, find the length of BC using the given information.

$\angle ACB = 90^\circ$ ————— ①

$BC = 8$ cm ————— ①



20. In the given Venn diagram, shade the region that represents $A \cup B'$.

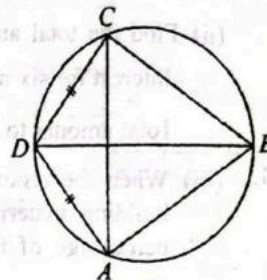


21. In the given figure, $ABCD$ is a cyclic quadrilateral. Moreover, $AD = DC$, and $\angle ABC = 70^\circ$. Find the magnitude of $\angle BDC$ using the given information.

$$\angle DAC = \angle BDC \text{ or } \angle DCA = \angle DBA \text{ or } \angle DAC = \angle DCA$$

$$\text{or } \angle ADC = 110^\circ \quad \text{①}$$

$$\angle BDC = 35^\circ \quad \text{①}$$



22. Find the positive integral solutions which are less than 5, of the inequality $3x + 10 \geq 18$.

$$x \geq \frac{8}{3} \quad \text{①}$$

$$3, 4 \quad \text{①}$$

23. Underline the correct statement from among the statements given below regarding the three rectangular faces of a right prism with an equilateral triangular cross section.

(i) Exactly two faces are equal in area.

(ii) All three faces are equal in area.

(iii) All three faces are unequal in area.

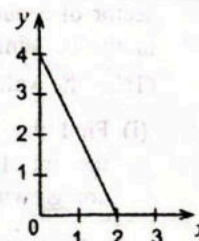
②

24. Write the equation of the straight line represented by the graph in the figure.

$$\text{gradient} = \left(\frac{4-0}{0-2} \right) \quad \text{①} \quad \frac{4}{-2} \mid m = -2 \mid c = 4$$

$$y = -2x + 4 \quad \text{②}$$

In the equation gradient / intercept correct ①



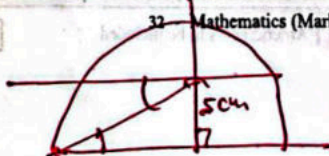
25. An incomplete sketch relevant to obtaining the chord CD which lies at a distance of 5 cm from the diameter AB of a semicircle is shown in the figure. Complete the sketch showing the construction lines, to represent how the chord CD is obtained using the knowledge (

arc and sec $\rightarrow$ ①

Perpendicular $\rightarrow$ ①

Marking a point 5 cm from AB $\rightarrow$ ①

Constructing a line parallel to AB through the above point $\rightarrow$ ①



Part B

Answer all questions on this question paper itself.

1. Mahendra has estimated that 120 000 rupees is required to engage 8 daily wage workers for 5 days to renovate his house, and that 60 000 rupees is required to buy the building material. He borrowed this whole amount at an annual simple interest rate of 18%.

(i) How much is the daily wage paid to a worker? Rs. $\frac{120\,000}{8 \times 5}$ — 1

3000 — (2) $\frac{120\,000}{40}$ — (1) = Rs. 3000 — 1 (2)

- (ii) Find the total amount that Mahendra has to pay back to settle the loan in exactly 6 months.

Interest for six months = Rs. $180\,000 \times \frac{18}{100} \times \frac{1}{2}$ = Rs. 16 200

$180\,000 \times \frac{109}{100} \rightarrow 196\,200$

Total amount to be paid = Rs. $180\,000 + 16\,200$ = Rs. 196 200 — 1 (2)

- (iii) When the renovations commenced, if the wages had increased by 12% and the cost of the building material by 15%, express the additional amount required for the renovation as a percentage of the estimated amount.

Additional amount for wages = Rs. $120\,000 \times \frac{12}{100}$ = Rs. 14 400

Additional amount for material = Rs. $60\,000 \times \frac{15}{100}$ = Rs. 9000

Percentage = $\frac{23\,400}{180\,000} \times 100\%$ — 1 = 13% — 1 (4)

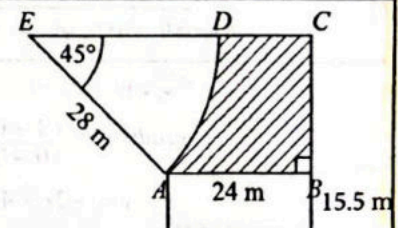
- (iv) The urban council to which Mahendra's house belongs charges 16% of the annual assessed value of the house as rates for the year. Mahendra pays 800 rupees as rates for a quarter. How much is the annual assessed value of Mahendra's house?

Annual rates = Rs. 800×4 — 1

Annual assessed value = Rs. $\frac{800 \times 4 \times 100}{16}$ = Rs. 20 000 — 1 (2)

2. As shown in the figure, in a vegetable bed in the shape of a trapezium, chillies are grown in a portion in the shape of a sector of a circle of central angle 45° , and tomatoes are grown in the remaining portion which is shaded. $AE = 28$ m.

(Take the value of π as $\frac{22}{7}$.)



- (i) Find the length of the fence that should be fixed along the arc AD to separate out the portion in which chillies are grown.

$2 \times \frac{22}{7} \times 28 \times \frac{1}{8}$ — 1 = 22 m — 1 (2)

- (ii) Find the area of the portion in which chillies are grown.

$\frac{22}{7} \times 28 \times 28 \times \frac{1}{8}$ — 1 = 308 m^2 — 1 (2)

- (iii) $AB = 24$ m. By taking $BC = 20$ m and $CE = 44$ m, find the area of the portion in which tomatoes are grown.

Area of the trapezium $ABCE = \frac{1}{2} (44 + 24) 20 \text{m}^2$ — 1 = 680 m^2 — 1

Area in which tomatoes are grown = 680 — 308 m^2

= 372 m^2 — 1 (3)

- (iv) It is required to add to this bed, a rectangular plot of land with AB as one side, lying outside the bed, of area equal to the area of the portion in which tomatoes are grown. Draw a sketch of this plot of land with its measurements, on the given figure.

Width of the plot = $\frac{372}{24}$ m = 15.5 m Diagram — 1

3. A and B are two containers of the same capacity. $\frac{2}{7}$ of container A is filled with water while container B is empty.

(i) When $\frac{3}{5}$ of the quantity of water in container A is poured into container B , what fraction of the capacity of container B is the quantity of water in it? $\frac{5}{7} \times \frac{3}{5} - 1 = \frac{3}{7} - 1$ (2)

(ii) Now, to fill the container B completely, another 600 millilitres of water is required. What is the capacity of container B ? $\frac{4}{7} \rightarrow 600 \text{ ml} - 1$ (3)

$$\text{Capacity} = 600 \times \frac{7}{4} \text{ ml} = 1050 \text{ ml} - 1$$

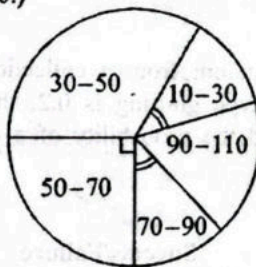
(iii) What fraction of the capacity of container A is the quantity of water remaining in it now? $\frac{5}{7} - \frac{3}{7} - 1 = \frac{2}{7} - 1$ (2)

(iv) To make the volume of water in the two containers equal, how many millilitres of water should be poured from the completely filled container B into container A ? $\frac{2}{7} \rightarrow 300 \text{ ml} - 1$ (3)

$$\begin{aligned} \text{Equal amount} &= \frac{1350}{2} = 675 \text{ ml} - 1 \\ \text{Required amount} &= 675 - 300 = 375 \text{ ml} - 1 \end{aligned}$$

$$\begin{aligned} \text{OR } \frac{2}{7} &\rightarrow 300 \text{ ml} - 1 \\ \text{Difference} &\rightarrow 1050 \text{ ml} - 300 \text{ ml} = 750 \text{ ml} - 1 \\ \text{Required amount} &= \frac{750}{2} \text{ ml} = 375 \text{ ml} - 1 \end{aligned}$$

4. An incomplete pie chart drawn using the time (in minutes) spent per day on exercises by 48 people and an incomplete frequency table containing a portion of the information used to draw this pie chart is shown below. (In the table, the interval 10–30 denotes 10 or greater and less than 30.)



Exercise Time (Minutes)	Frequency (Number of People)	Cumulative Frequency
10–30	6	6
30–50	16	22
50–70	12	34
70–90	6	40
90–110	8	48

(i) Fill in the blanks in the table in the frequency column, using the given information.

(ii) Complete the cumulative frequency column of the table and using it draw the cumulative frequency curve on the given coordinate plane.

Joining to 10 — 1 For 4 correct points — 1
Curve — 1

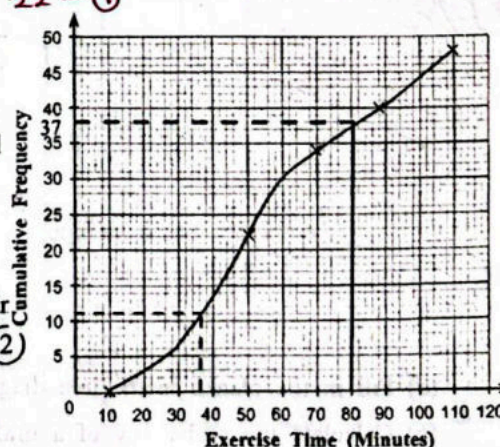
(iii) Using the cumulative frequency curve, find the number of people who spend less than 80 minutes per day on exercises.

Marking the cumulative frequency corresponding to 80 — 1 37 or 38 — 1

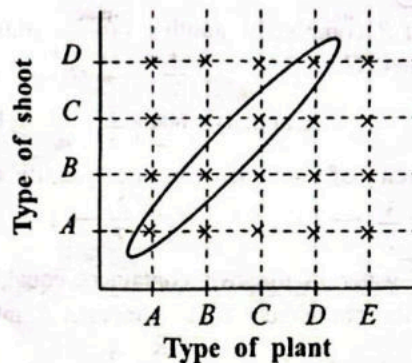
(iv) It is required to separate out the 25% who exercise the least from these 48 people. To do this, the selection should be of those who exercise for less than how many minutes per day?

Frequency corresponding to 25% = $48 \times \frac{1}{4} = 12$ — 1 Time = 38 minutes — 1

calculation not needed



- (i) A, B, C, D and E are five types of mangoes. To four plants taken from type A, four shoots of the types A, B, C and D are grafted such that each plant has exactly one shoot grafted to it. In this manner, shoots of the types A, B, C and D are grafted by taking four plants each of the types B, C, D and E too.



— 1

①

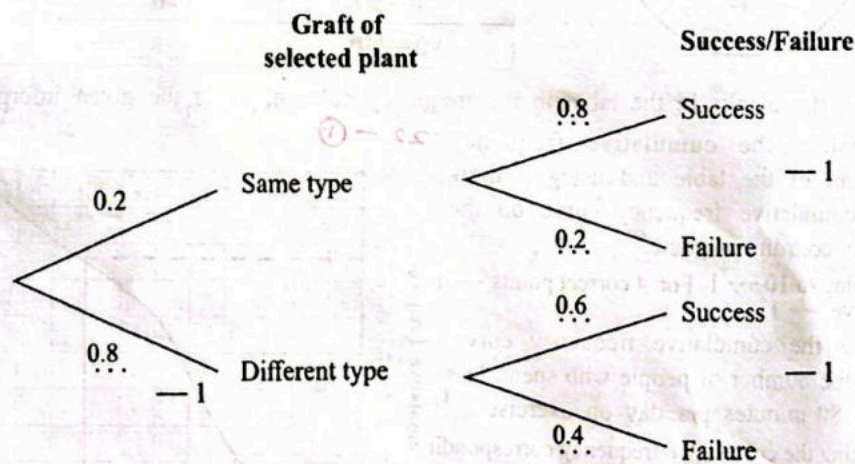
- (a) Represent the sample space of the outcomes of this activity on the given grid using the symbol 'X'.
- (b) Encircle the event of a plant picked at random from the grafted plants being a plant with a grafted shoot of the same type as the plant (same type grafting) and find the probability of that event occurring.

Encircling — 1

$$\frac{4}{20} \text{ — 2}$$

③

- (ii) It is given that the probability of a plant picked at random from a collection of grafted fruit plants in a plant nursery, being a plant of same type grafting is 0.2, the probability of a same type grafted plant being a success is 0.8 and the probability of a different type grafted plant being a success is 0.6.



— 1

— 1

③

- (a) Fill in the blanks in the tree diagram using the above information.
- (b) Calculate the probability of a grafted plant picked at random from this plant nursery being a success.

$$0.2 \times 0.8 + 0.8 \times 0.6 = 0.64$$

— 1 + 1

0.16 and 0.48 in correct position — ①

③

32 - Marking Scheme Mathematics II

1. A bank pays an annual compound interest rate of 15% for deposits. The interest is added to the deposit amount annually.
- A share of a finance company can be bought for 60 rupees.
- (i) Amal deposits 60 000 rupees in a bank account for two years. How much is the interest he receives for the first year?
- (ii) Find the total amount in Amal's bank account at the end of the two years.
- (iii) A year after Amal deposits the money in the bank, Ramani buys shares of the finance company for 60 000 rupees. How many shares does she buy?
- (iv) At the end of that year, Ramani receives the dividends for the year and sells all the shares she owns at 75.35 rupees per share. If the total amount Ramani has in hand now is equal to the total amount in Amal's bank account after 2 years, find the dividend amount the finance company has paid per share.

Question Number	Marking Scheme	Marks	Other Details
1. (i)	Interest amount for the first year $= \text{Rs. } 60\,000 \times \frac{15}{100}$ $= \text{Rs. } 9000$	1 1 (2)	
(ii)	Total amount at the end of the first year $= \text{Rs. } 60\,000 + 9000$ $= \text{Rs. } 69\,000$ Interest for the second year $= \text{Rs. } 69\,000 \times \frac{15}{100}$ $= \text{Rs. } 10\,350$ Total amount at the end of the second year $= \text{Rs. } 79\,350$	1 1 1 1 (3)	$= \text{Rs. } 69\,000 \times \frac{115}{100} - 1 + 1$ $= \text{Rs. } 79\,350 - 1 \quad (3)$ or $= \text{Rs. } 60\,000 \times \frac{115}{100} \times \frac{115}{100} - 2$ $= \text{Rs. } 79\,350 - 1 \quad (3)$
(iii)	Number of shares that were bought $= \frac{\text{Rs. } 60\,000}{\text{Rs. } 60}$ $= 1000$	1 1 (2)	

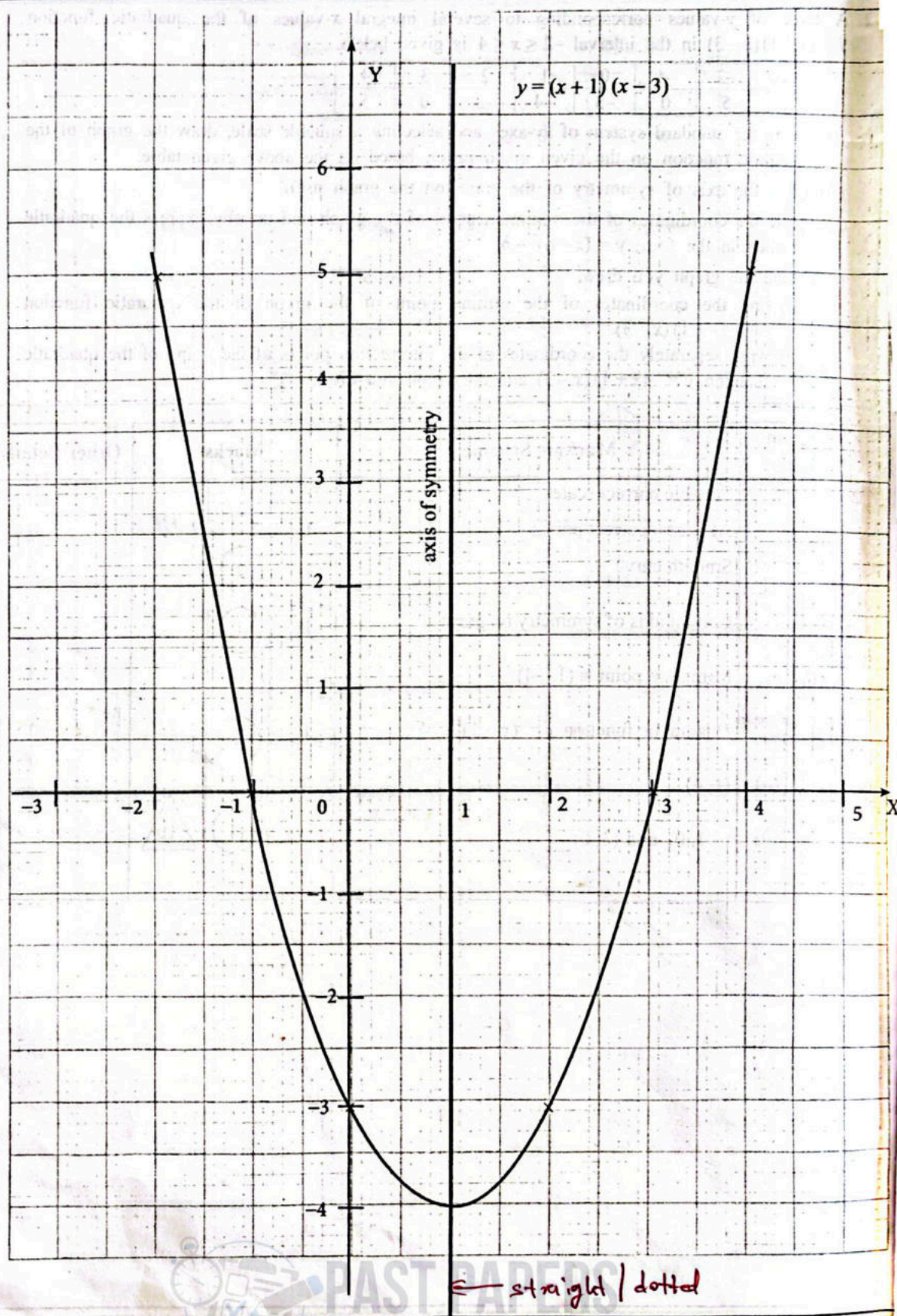
[illegible]

2. A table of y -values corresponding to several integral x -values of the quadratic function $y = (x + 1)(x - 3)$ in the interval $-2 \leq x \leq 4$ is given below.

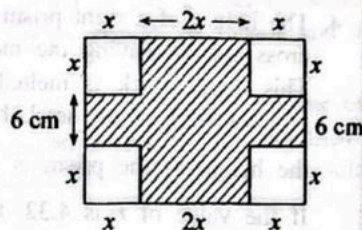
x	-2	-1	0	1	2	3	4
y	5	0	-3	-4	-3	0	5

- (i) Using the standard system of xy -axes and selecting a suitable scale, draw the graph of the quadratic function on the given graph paper, based on the above given table.
- (ii) Draw the axis of symmetry of the graph on the graph itself.
- (iii) Write the coordinates of the minimum point of the graph and thereby express the quadratic function in the form $y = (x - a)^2 - b$.
- (iv) Using the graph you drew,
 - (a) find the coordinates of the turning point of the graph of the quadratic function $y = -(x + 1)(x - 3)$.
 - (b) write separately the coordinates of the intersection points of the graph of the quadratic function $y = -(x + 1)(x - 3)$ and the graph you drew.

Question Number	Marking Scheme	Marks	Other Details
2. (i)	Suitable correct scale At least 6 correct points Smooth curve	1 1 1	(3)
(ii)	Correct axis of symmetry on graph	1	(1)
(iii)	Minimum point = (1, -4) Quadratic function $y = (x - 1)^2 - 4$	1 1	(2)
(iv) (a)	(1, 4)	2	
(b)	(-1, 0) and (3, 0)	1 + 1	(4) 



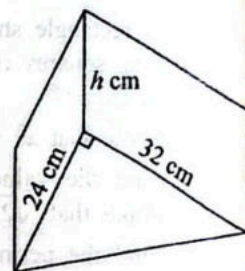
3. In the rectangle shown in the figure, the four unshaded parts are four squares of side length x cm each. The shaded area is 316 cm^2 .



- (i) Show that $x^2 + 6x - 79 = 0$.
 (ii) Find the value of x to the nearest first decimal place.
 (Take that $\sqrt{22} = 4.69$)
 (iii) Find the perimeter of the shaded region.

Question Number	Marking Scheme	Marks	Other Details
3. (i)	Area of the four squares = $4x^2$ Area of the rectangle = $4x(2x + 6)$ $\therefore 4x(2x + 6) - 4x^2 = 316$ $8x^2 + 24x - 4x^2 - 316 = 0$ $x^2 + 6x - 79 = 0$	1 1 1 1	$4x(x+6) = 316$
(ii)	$x^2 + 6x - 79 = 0$ $(x + 3)^2 - 79 - 9 = 0$ $(x + 3) = \pm 2\sqrt{22}$ Since $x > 0$ $x = -3 + 2\sqrt{22}$ $= -3 + 9.38$ $= 6.38$ $\cong 6.4$ (To the nearest first decimal place)	1 1 1 1 1	formula/ substitution $= -3 \pm 2\sqrt{22} - 1$ not separate
(iii)	Perimeter = $12(x + 1) \text{ cm}$ $= 12(6.4 + 1) \text{ cm}$ $= 88.8 \text{ cm}$	1	10

4. The height of a right prism shaped metal block with a right triangular cross section having the measurements shown in the figure, is h cm. This metal block is melted and 12 identical solid spheres are made without wastage of metal. If the radius of a sphere is r cm, show that the height of the prism is given by $h = \frac{\pi r^3}{24}$.



If the value of r is 4.32, take that $\pi = 3.14$ and find the value of h to the nearest first decimal place using the logarithms table.

Question Number	Marking Scheme	Marks	Other Details
4.	Volume of the prism = $\frac{1}{2} \times 24 \times 32 \times h \text{ cm}^3$ Volume of the 12 solid spheres = $12 \times \frac{4}{3} \pi r^3 \text{ cm}^3$ $\therefore \frac{1}{2} \times 24 \times 32 \times h = 12 \times \frac{4}{3} \pi r^3$ $h = \frac{12 \times 4 \times \pi \times r^3 \times 2}{3 \times 24 \times 32}$ $= \frac{\pi r^3}{24}$ $\lg h = \lg \pi + 3 \lg r - \lg 24$ $= \lg(3.14) + 3 \lg(4.32) - \lg 24$ $= 0.4969 + 3 \times 0.6355 - 1.3802$ $= 1.0232$ $h = \text{antilog } 1.0232$ $= 10.55$ $h = 10.6$	1 1 1 1 1 2 1 1 1 1 1	③ 1.3802 — 1 Any one logarithm from the other two $3 \cdot 14 \times 4.32 \times 4.32$ 24 $h = 10.54$ — 1 $= 10.5$ — 1 10

- | Question Number | Marking Scheme | Marks | Other Details |
|-----------------|---|-------|--|
| 5. | (i) | | |
| | $2x = y + 10 \quad \text{—————} (1)$ | 1 | |
| | $40x + 32y = 4880 \quad \text{—————} (2)$ | 1 | |
| | $(1) \times 32, 64x - 32y = 320 \quad \text{———} (3)$ | 1 | |
| | $(2) + (3), 104x = 5200$ | 1 | |
| | $x = \frac{5200}{104}$ | | Eliminating an unknown |
| | $x = 50$ | 1 | |
| | Substituting $x = 50$, in (1),
$2 \times 50 = y + 10$ | 1 | |
| | $y = 90$ | 1 | |
| | Number of white eggs = 90 | | |
| | Number of brown eggs = 50 | 7 | |
| | (ii) | | |
| | Number of white eggs bought = m | | |
| | Number of brown eggs bought = n | | |
| | $40n + 32m = 1000$ | 1 | |
| | Number of brown eggs = 9 | | Give all 3 marks if correct answer is obtained |
| | Number of white eggs = 20 | 1 | |
| | | 1 | |
| | | 3 | 10 |

6. A frequency distribution containing information on the time spent on self-study per day by a group of 70 students in Grade 11 is given below.

Time (Minutes)	40–60	60–80	80–100	100–120	120–140	140–160	160–180
Frequency (Number of Students)	8	12	15	15	10	7	3

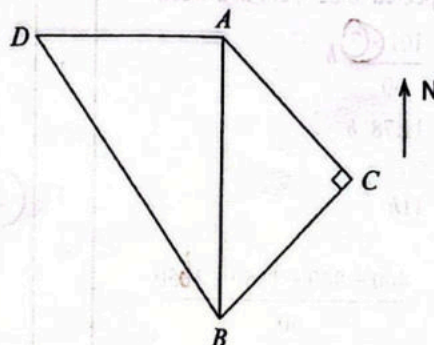
Here, the interval 40–60 denotes greater than 40 and less than or equal to 60.

- How many students are engaged in self-study for two hours or less per day?
- Find the mean time that a student in this group engages in self-study per day, to the nearest minute.
- Show that the time that can be expected to be spent by a student in this group on self-study during a week exceeds 11 hours.
- The students who spend two hours or less per day in self-study wish to increase their daily mean self-study time to 2 hours. To do this, by how many minutes should these students increase their current mean self-study time per day?

Question Number	Marking Scheme	Marks	Other Details																																				
6. (i)	$8+12+15+15 = 50$	1	50 — ①																																				
(ii)	<table border="1"> <thead> <tr> <th>Class Interval</th><th>f</th><th>x</th><th>fx</th></tr> </thead> <tbody> <tr><td>40 - 60</td><td>8</td><td>50</td><td>400</td></tr> <tr><td>60 - 80</td><td>12</td><td>70</td><td>840</td></tr> <tr><td>80 - 100</td><td>15</td><td>90</td><td>1350</td></tr> <tr><td>100 - 120</td><td>15</td><td>110</td><td>1650</td></tr> <tr><td>120 - 140</td><td>10</td><td>130</td><td>1300</td></tr> <tr><td>140 - 160</td><td>7</td><td>150</td><td>1050</td></tr> <tr><td>160 - 180</td><td>3</td><td>170</td><td>510</td></tr> <tr><td colspan="2">$\Sigma f = 70$</td><td>$\Sigma fx = 7100$</td><td></td></tr> </tbody> </table> Mean time = $\frac{7100}{70}$ = 101.4 minutes ≈ 101 (To the nearest minute)	Class Interval	f	x	fx	40 - 60	8	50	400	60 - 80	12	70	840	80 - 100	15	90	1350	100 - 120	15	110	1650	120 - 140	10	130	1300	140 - 160	7	150	1050	160 - 180	3	170	510	$\Sigma f = 70$		$\Sigma fx = 7100$		x column 1 fx column 1 Σfx 1 1 1 5	fd column — 1 Σfd — 1 n column — one interval For dividing by 70
Class Interval	f	x	fx																																				
40 - 60	8	50	400																																				
60 - 80	12	70	840																																				
80 - 100	15	90	1350																																				
100 - 120	15	110	1650																																				
120 - 140	10	130	1300																																				
140 - 160	7	150	1050																																				
160 - 180	3	170	510																																				
$\Sigma f = 70$		$\Sigma fx = 7100$																																					

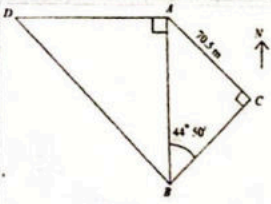
Question Number	Marking Scheme	Marks	Other Details																								
6. (iii)	Time that can be expected to be spent in a week $= \frac{101 \times 7}{60} h$ $\approx 11.78 h$ $> 11h$	1 1																									
(iv)	Current mean time = $\frac{400 + 840 + 1350 + 1950}{50}$ $= \frac{4240}{50} \text{ minutes}$ $= 84.8 \text{ minutes}$ Increase = $120 - 84.8 \text{ minutes}$ $= 35.2 \text{ minutes}$	1 1	(iv) Another method table — 1 <table border="1" data-bbox="1074 689 1305 846"> <thead> <tr> <th>f</th><th>x</th><th>y = 120 - x</th><th>fy</th></tr> </thead> <tbody> <tr> <td>8</td><td>50</td><td>70</td><td>560</td></tr> <tr> <td>12</td><td>70</td><td>50</td><td>600</td></tr> <tr> <td>15</td><td>90</td><td>30</td><td>450</td></tr> <tr> <td>15</td><td>110</td><td>10</td><td>150</td></tr> <tr> <td>$\Sigma f = 50$</td><td></td><td></td><td>$\Sigma fy = 1760$</td></tr> </tbody> </table> $\frac{\Sigma fy}{\Sigma f} = \frac{1760}{50} = 35.2 \text{ minutes} - 1$	f	x	y = 120 - x	fy	8	50	70	560	12	70	50	600	15	90	30	450	15	110	10	150	$\Sigma f = 50$			$\Sigma fy = 1760$
f	x	y = 120 - x	fy																								
8	50	70	560																								
12	70	50	600																								
15	90	30	450																								
15	110	10	150																								
$\Sigma f = 50$			$\Sigma fy = 1760$																								

7. As shown in the figure, the points A , B , C and D lie on a level ground such that the point B is to the south of A , the point C is on a bearing of $44^\circ 50'$ from B , the point D is to the west of A , $AC = 70.5$ m and $\hat{ACB}$ is a right angle.



Copy the given figure in your answer script and include the above information in it. Using trigonometric ratios,

- find the distance AB , and the time it takes to travel that distance at a speed of 8 metres per second.
- find the magnitude of $\hat{ABD}$ if $AD = 70.92$ m.

Question Number	Marking Scheme	Marks	Other Details
7.	 $\sin 44^\circ 50' = \frac{70.5}{AB}$ $0.7050 = \frac{70.5}{AB}$ $AB = \frac{70.5}{0.7050}$ $= 100\text{m}$ Time = $\frac{100}{8}$ seconds $= 12.5$ seconds	1 1 1 3 1 1 1 4 1 1 1 3 10	
(ii)	$\tan \hat{ABD} = \frac{70.92}{100}$ $= 0.7092$ $\hat{ABD} = 35^\circ 20' \text{ or } 35^\circ 21'$	1 1 1 3 10	

8. (i) 24 book racks have been placed in a row in a library. There are 33 books in the first rack and every other rack has 3 more books than the previous rack.
- (a) Write the number of books in the first three racks of this row of racks, respectively.
- (b) Find the number of books in the 13th rack of this row of racks.
- (c) Find the total number of books in the last 12 racks of this row of racks.
- (ii) In another book rack consisting of five shelves, there are 12 books in the topmost shelf and books have been placed in the remaining shelves such that every shelf has three times the number of books in the shelf immediately above it. Show that the total number of books in this rack is given by $6(3^5 - 1)$.

Question Number			Marking Scheme	Marks		Other Details
8.	(i)	(a)	33, 36, 39 ..	1	1	
		(b)	$T_n = a + (n - 1) d$	1		
			$T_{13} = 33 + (13 - 1) \times 3$	1		
			$= 33 + 12 \times 3$			
			$= 69$	1	3	
		(c)	69, 72, 75 ...			
			$S_n = \frac{n}{2} \{2a + (n - 1) d\}$	1		
			$S_{12} = \frac{12}{2} \{2 \times 69 + (12 - 1) \times 3\}$	1		
			$= 6 \{ 138 + 33 \}$			
			$= 6 \times 171$			
			$S_{12} = 1026$	1	3	
	(ii)		$S_n = \frac{a(r^n - 1)}{r - 1}$	1		
			$S_5 = \frac{12(3^5 - 1)}{3 - 1}$	1		
			$= \frac{12(3^5 - 1)}{2}$			
			$S_5 = 6(3^5 - 1)$	1	3	10

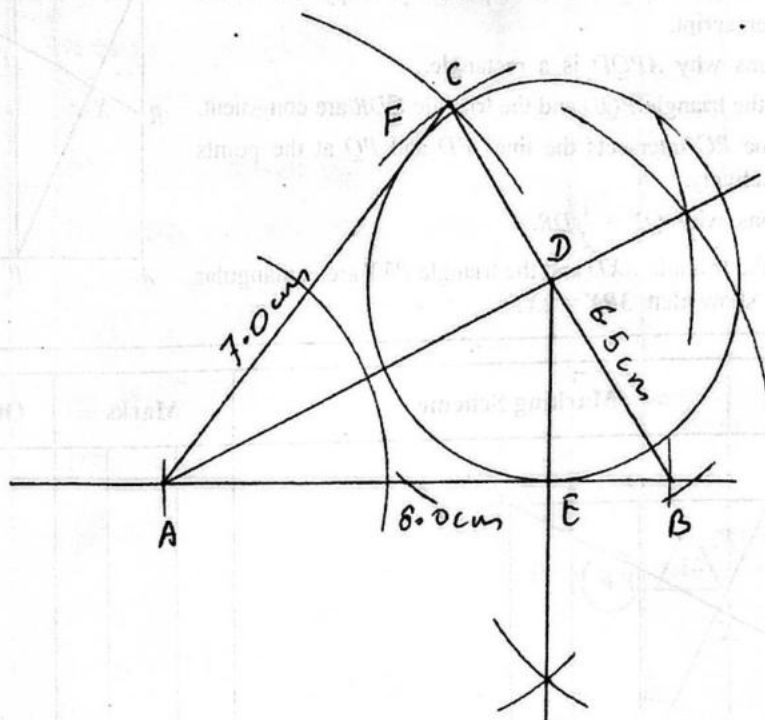
9. Do the following geometric constructions using only a straight edge with a pair of compasses. Show the construction lines clearly.
- Construct the triangle ABC such that $AB = 8.0$ cm, $AC = 7.0$ cm and BC
 - Construct the bisector of $\hat{BAC}$ and label the point at which it intersects
 - Construct a perpendicular to the side AB from the point D and construct centre D which touches the side AB at E .
 - If the point at which the circle touches the side AC is F , give reasons w cyclic quadrilateral.

Question Number	Marking Scheme	Marks	
9.	(i) Correct triangle ABC	3	(3)
	(ii) Bisector of $\hat{BAC}$	2	(2)
	(iii) Perpendicular to AB from D	2	
	Circle	1	(3)
	(iv) $\hat{AFD} = 90^\circ$ (Angle between radius and tangent) $\hat{AED} = 90^\circ$ ($DE \perp AB$) $\therefore \hat{AFD} + \hat{AED} = 180^\circ$ $\therefore AEDF$ is a cyclic quadrilateral (Interior opposite angles are supplementary) }	1 1	 (2) 

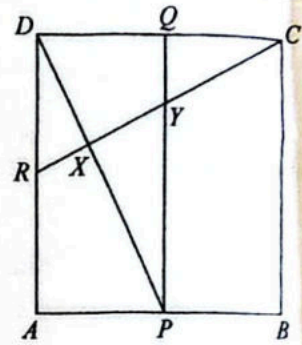
Two

Corr

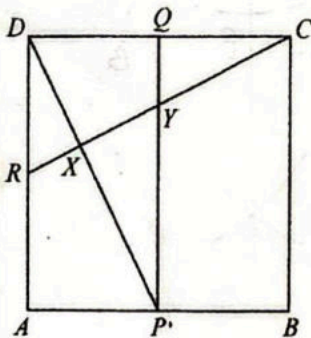
If p
is d
diffe
BC



10. In the given figure, $ABCD$ is a square. The midpoints of its sides AB , CD and DA are P , Q and R respectively. Copy this figure in your answer script.



- (i) Give reasons why $APQD$ is a rectangle.
 (ii) Show that the triangle PQD and the triangle CDR are congruent. The straight line RC intersects the lines PD and PQ at the points X and Y respectively.
 (iii) Give reasons why $QY = \frac{1}{2}DR$.
 (iv) Show that the triangle RXD and the triangle PXY are equiangular and hence show that $3RX = 2XY$.

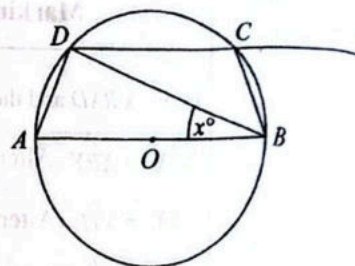
Question Number	Marking Scheme	Marks	Other Details
10.			
(i)	$APQD$ is a parallelogram. ($AP \parallel QD$, $AP = QD$) $\hat{QDA} = \hat{DAP} = 90^\circ$ ($ABCD$ is a square) $\therefore APQD$ is a rectangle.	1 1	At least one reason should be given.
(ii)	In the $\triangle PQD$ and the $\triangle CDR$, $QD = DR$ (Q, R are midpoints of equal sides) $\hat{PQD} = \hat{CDR} = 90^\circ$ $PQ = AD$ ($APQD$ is a rectangle) $AD = DC$ ($ABCD$ is a square) $\therefore PQ = DC$ $\therefore \triangle PQD \cong \triangle CDR$ (S.A.S)	1 1 1	At least one reason should be given.
(iii)	$CY = YR$ (Converse of the midpoint theorem) $\therefore QY = \frac{1}{2}DR$ (Midpoint theorem)	1	at least one reason Reason is required

11. In the circle shown in the figure, O is the centre and AB is a diameter. The chord DC drawn parallel to AB is produced to G .

Copy the figure in your answer script.

- (i) $\angle ABD = x^\circ$. Giving reasons, find the magnitude of $\angle BCG$ in terms of x° .

- (ii) The point E lies on DC produced such that $DB = BE$. Join AC and show that $AB = CE$.

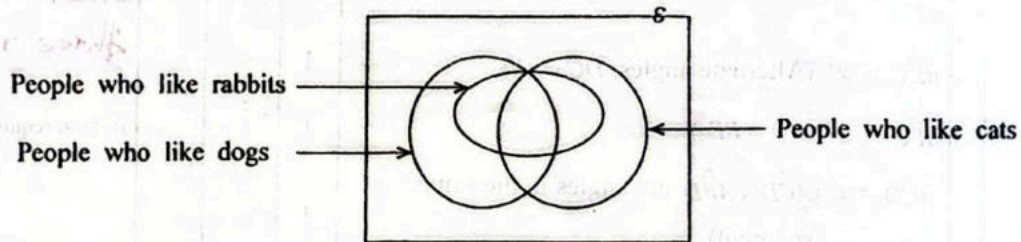


Question Number	Marking Scheme	Marks	Other Details
11.		1	Copying the given figure
(i)	$\angle ADB = 90^\circ$ (Angle in a semicircle) $\angle DAB = 90^\circ - x^\circ$ (Interior angle of a Δ) $\angle BCG = 90^\circ - x^\circ$ (Interior opposite angle of a cyclic quadrilateral)	1 1 1	Reason required
(ii)	$\angle BDC = x^\circ$ ($DC \parallel AB$, Alternate angles) $\angle BDC = \angle BEC = x^\circ$ ($BD = BE$) $\therefore \angle CBE = 90^\circ$ (Sum of the interior angles of the ΔBEC is 180°) $\angle ACB = 90^\circ$ (Angle in a semicircle) $\therefore AC \parallel BE$ (Alternate angles are equal) Moreover $AB \parallel CE$ (Data) $\therefore ABEC$ is a parallelogram. $\therefore AB = CE$ (Opposite sides of a parallelogram)	1 1 1 1 1 1 1	Reason required at least one Reason required

Question Number	Marking Scheme	Marks	Other Details
11.	or $\hat{BDC} = x^\circ$ (Alternate angles, $DC \parallel AB$) $\hat{BEC} = x^\circ$ ($BD = BE$) $\hat{ACD} = x^\circ$ ($\hat{ACD}$, $\hat{ABD}$ are angles in the same segment) $AC \parallel BE$ (Since corresponding angles are equal) Moreover, $AB \parallel CE$ (Data $AB \parallel DC$) $\therefore ABEC$ is a parallelogram. $\therefore AB = CE$ (Opposite sides of a parallelogram)	1 1 1 1 1 1 1 6	other method three reason. Reason required Reason required Reason required



12. An incomplete Venn diagram drawn to represent the information collected from 120 people regarding the types of pets they like from the types rabbits, dogs and cats is given below.



- * The number of people who like only the two types dogs and cats is 20.
- * The number of people who like all three types, rabbits, dogs and cats is 15.

Copy the given Venn diagram in your answer script and include the given information in it.

- (i) How many people like both the types dogs and cats?

- * The number of people who like rabbits is 42.
- * The number of people who like only the two types rabbits and dogs is 23.

- (ii) How many people like exactly two of these three types of pets?

- (iii) The number of people who like exactly one of these three types of pets is 52. How many people do not like even one of these three types of pets?

- (iv) The number of people who like only dogs is 30. How many people like cats?

Question Number	Marking Scheme	Marks	Other Details
12.	Those who like rabbits Those who like dogs Those who like cats 6 (120)	1 1 1 1 1+1 1 1 1 1 1+1	3 1 2 2 2 10 If only 35 is written 15 and 20 should be marked in the figure
(i)	120		
	20		
	15		
(i)	$15 + 20 = 35$		
(ii)	$20 + 23 + 4 = 47$		
(iii)	$120 - (52 + 20 + 42)$		
	$= 6$		
(iv)	$120 - (30 + 23 + 6)$		
	$= 61$		
	or $15 + 20 + 22 + 4 = 61$		