

ICSE Class 10 Maths Question Paper Solution 2016

MATHEMATICS

Question 1		
(a)	Using remainder theorem, find the value of k if on dividing $2x^3 + 3x^2 - kx + 5$ by $x - 2$, leaves a remainder 7.	[3]
(b)	Given $A = \begin{bmatrix} 2 & 0 \\ -1 & 7 \end{bmatrix}$ and $I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ and $A^2 = 9A + mI$. Find m .	[4]
(c)	The mean of following numbers is 68. Find the value of ' x '. 45, 52, 60, x , 69, 70, 26, 81 and 94. Hence estimate the median.	[3]

Comments of Examiners

- (a) Candidates made mistakes due to the following reasons:
- (i) Instead of using Remainder and Factor Theorem candidates divided the polynomial by $(x - 2)$.
 - (ii) Some candidates equated the remainder to zero instead of equating to 7.
 - (iii) Some made errors in substituting $x=2$. Hence got incorrect value of ' k '

- (b) Most candidates failed to differentiate between a constant term and a matrix. With this incorrect concept some candidates considered ' m ' to be a 2 by 2 matrix, e.g., $\begin{bmatrix} a & b \\ c & d \end{bmatrix}$.

Some candidates seemed to be unaware that division of a matrix by another matrix is not possible and hence divided $\begin{bmatrix} -14 & 0 \\ 0 & -14 \end{bmatrix}$ by

$\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ to find A . Matrix A^2 was deduced by some candidates by squaring each element of the matrix instead of finding

$$\begin{bmatrix} 2 & 0 \\ -1 & 7 \end{bmatrix} \times \begin{bmatrix} 2 & 0 \\ -1 & 7 \end{bmatrix}$$

- (c) Candidates made mistakes in finding $\sum x$ and $\sum f$. The common error was in writing $\sum x = 497x$ instead of $497+x$; $\sum f = 8$ instead of 9.

A number of candidates were unable to calculate the median of the given distribution.

Suggestions for teachers

- ✓ Stress on the basic concepts of remainder theorem. Applying the theorem is essential.
- ✓ Operations of matrix addition, scalar multiplication and multiplication of a matrix by another matrix must be made clear to students. Students must be made aware of the fact that matrix A multiplied by Identity matrix I is equal to A provided they are conformable for multiplication.
- ✓ Revision of calculations of mean, median and mode could help in eliminating such errors.

MARKING SCHEME**Question 1.**

(a)	$f(x) = 2x^3 + 3x^2 - kx + 5$ $f(2) = 2 \times 2^3 + 3 \times 2^2 - k \times 2 + 5 \quad M_1 \text{ (Substitution)}$ $16 + 12 - 2k + 5 = 7 \quad M_1 \text{ (equated to 7)}$ $33 - 2k = 7$ $\therefore 2k = 33 - 7$ $2k = 26$ $\therefore k = 13 \quad A_1$
(b)	$A^2 = 9A + mI$ $\begin{bmatrix} 2 & 0 \\ -1 & 7 \end{bmatrix} \begin{bmatrix} 2 & 0 \\ -1 & 7 \end{bmatrix} = 9 \begin{bmatrix} 2 & 0 \\ -1 & 7 \end{bmatrix} + m \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ $\begin{bmatrix} 2 \times 2 + 0 \times -1 & 2 \times 0 + 0 \times 7 \\ -1 \times 2 + 7 \times -1 & -1 \times 0 + 7 \times 7 \end{bmatrix} = \begin{bmatrix} 18 & 0 \\ -9 & 63 \end{bmatrix} + \begin{bmatrix} m & 0 \\ 0 & m \end{bmatrix}$ $\begin{bmatrix} 4 & 0 \\ -9 & 49 \end{bmatrix} = \begin{bmatrix} 18 + m & 0 \\ -9 & 63 + m \end{bmatrix} \quad M_1 \text{ (Product } A^2 \text{ or } 9A)$ $\therefore 18 + m = 4 \quad M_1$ $\text{Or } m = -18 + 4$ $m = -14 \quad A_1$ Or $63 + m = 49$ $\therefore m = 49 - 63$ $m = -14$
(c)	$\bar{x} = 68 \quad (\text{given})$ $\frac{45 + 52 + 60 + x + 69 + 70 + 26 + 81 + 94}{9} = 68 \quad M_1$ $\frac{497 + x}{9} = 68$ $x = 115 \quad A_1$ $26, 45, 52, 60, 69, 70, 81, 94, 115.$ $\text{Median} = \frac{(9+1)\text{th term}}{2} = 5\text{th term} = 69 \quad B_1$

Question 2		
(a)	The slope of a line joining P(6, k) and Q(1-3k, 3) is $\frac{1}{2}$. Find (i) k (ii) Midpoint of PQ, using the value of 'k' found in (i).	[3]
(b)	Without using trigonometrical tables, evaluate: $\operatorname{cosec}^2 57^\circ - \tan^2 33^\circ + \cos 44^\circ \operatorname{cosec} 46^\circ - \sqrt{2} \cos 45^\circ - \tan^2 60^\circ$	[4]
(c)	A certain number of metallic cones, each of radius 2 cm and height 3 cm are melted and recast into a solid sphere of radius 6cm. Find the number of cones.	[3]

Comments of Examiners

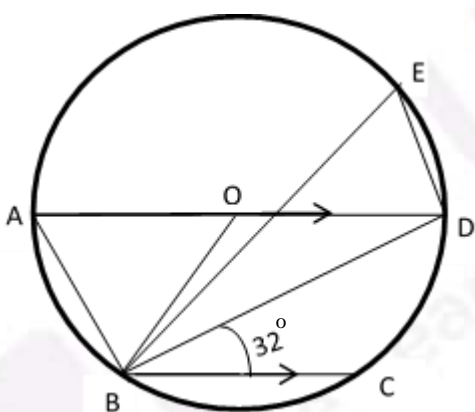
- (a) Candidates used incorrect formula of slope: $\frac{x_2 - x_1}{y_2 - y_1}$ instead of $\frac{y_2 - y_1}{x_2 - x_1}$ and hence were unable to find the correct value of k . Some candidates found $-k = 11$ but failed to identify $k = -11$.
- (b) Errors in application of complementary angles is very common among candidates. Some wrote $\operatorname{cosec}^2 57^\circ = \operatorname{cosec}^2(90^\circ - 57^\circ)$ instead of $\operatorname{cosec}^2(90^\circ - 33^\circ)$ or $\sec^2(90^\circ - 57^\circ)$ etc. Candidates applied incorrect values for $\tan 60^\circ$, $\cos 45^\circ$. Some applied complementary angles directly without showing any working, hence lost marks.
- (c) Many candidates used incorrect formula for volume of cone and sphere. Some made mistakes in calculation.

Suggestions for teachers

- ✓ Revision of different types of sums related with slope, mid-point, distance formula is necessary to overcome such errors. Visual aids could also be helpful for retention of such concepts.
- ✓ Thorough practice of complementary angles and their properties is necessary. Further errors in values of special angles e.g., $0^\circ, 30^\circ, 45^\circ, 60^\circ$ and 90° may be avoided by teaching them methods to deduce the values. Students must be made aware that all essential steps of working must be shown.
e.g. cosec 57° must not be directly written as sec 33°
- ✓ Students need additional practice with mensuration formula. To avoid calculation errors students must be encouraged to find the number of cones by forming an equation without finding the volume of cone and sphere separately, e.g., $n = \frac{\frac{4}{3}\pi R^3}{\frac{1}{3}\pi r^2 h} = \frac{4R^3}{r^2 h}$

MARKING SCHEME**Question 2.**

(a)	<p>Correct substitution in slope formula or mid-point formula $\rightarrow M_1$</p> <p>$P(6, k)$ and $Q(1 - 3k, 3)$</p> $m = \frac{1}{2} = \frac{3 - k}{1 - 3k - 6}$ $-3k - 5 = 6 - 2k$ $\therefore k = -11 \quad A_1$ $\therefore \text{Points are } (6, -11) \text{ and } (34, 3)$ <p>Midpoint of PQ = $\left(\frac{40}{2}, \frac{-8}{2}\right) = (20, -4) \quad \rightarrow A_1$</p>
(b)	$\operatorname{cosec}^2 57^\circ - \tan^2 33^\circ + \cos 44^\circ \operatorname{cosec} 46^\circ - \sqrt{2} \cos 45^\circ - \tan^2 60^\circ$ $\operatorname{cosec}^2(90^\circ - 33^\circ) - \tan^2 33^\circ + \cos(90^\circ - 46^\circ) \operatorname{cosec} 46^\circ - \sqrt{2} \cos 45^\circ - (\sqrt{3})^2$ <p>Any one complementary angle correct M_1</p> $(\sec^2 33^\circ - \tan^2 33^\circ) + \sin 46^\circ \operatorname{cosec} 46^\circ - \sqrt{2} \frac{1}{\sqrt{2}} - 3$ <p>Any one value correct M_1</p> $1 + 1 - 1 - 3 = -2 \quad A_1$
(c)	<p>Volume of the 'n' cones = vol. of sphere</p> $\therefore n \times \frac{1}{3} \times \pi \times 2^2 \times 3 \quad M_1$ $= \frac{4}{3} \times \pi \times 6^3 \quad M_1$ $\therefore n = \frac{4 \times 6^3}{2^2 \times 3} = 72 \quad A_1$ <p>$\therefore 72$ cones</p>

Question 3		
(a)	<p>Solve the following inequation, write the solution set and represent it on the number line.</p> $-3(x - 7) \geq 15 - 7x > \frac{x + 1}{3}, x \in R$	[3]
(b)	<p>In the figure given below, AD is a diameter. O is the center of the circle. AD is parallel to BC and $\angle CBD = 32^\circ$. Find:</p> <p>(i) $\angle OBD$ (ii) $\angle AOB$ (iii) $\angle BED$.</p> 	[4]
(c)	If $(3a + 2b) : (5a + 3b) = 18 : 29$. Find $a : b$.	[3]

Comments of Examiners

- (a) Some candidates committed errors while transposing like terms on to the same side. Errors were mostly sign error e.g., $-22x > -44 \therefore x > 2$ instead of writing $x < 2$. Other common errors were
- (i) Candidates did not represent solution in set form;
 - (ii) Arrow marks not drawn on both ends of the number line
 - (iii) Number line did not have extra digits marked beyond the solution set;
 - (iv) -1.5 was not located on the number line
- (b) Candidates lost marks in the question for not giving reasons supporting their answers. Some were unable to identify angle ABD to be equal to 90° .
- (c) Some candidates were not aware about the basic

concepts of ratio and proportion, e.g., $\frac{3a+2b}{5a+3b} = \frac{18}{29}$

was written as $\frac{3a + 2b}{5a + 3b} = \frac{18}{29}$ which should have been

$\frac{3a + 2b}{5a + 3b} = k$ where k is any constant $\neq 0$.

Answer $a : b$ was written as $\frac{4}{3}$ instead of 4:3.

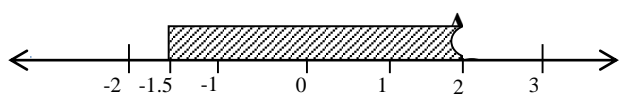
Suggestions for teachers

- ✓ To get the full credit in solving inequation all the 4 given points are essential and must be followed. Furthermore extensive drilling is necessary related to concepts of positive and negative signs.
- ✓ Thorough practice of all properties of a circle is necessary. Students must be advised to give reasons supporting their results of all geometry problems. Some students need to be guided how to name an angle correctly.
- ✓ Concepts of ratio and proportion needs to be thoroughly explained and must be made clear why it is not possible to equate directly. Students must be advised to read the question carefully and write answers in the form required.

MARKING SCHEME

Question 3.

(a) $-3x + 21 \geq 15 - 7x, \quad 15 - 7x > \frac{x+1}{3}$
 $-3x + 7x \geq 15 - 21, \quad 45 - 21x > x + 1$
 $4x \geq -6 \quad \swarrow \text{M}_1 \quad -21x - x > 1 - 45$
 $x \geq -\frac{6}{4} \quad \text{(any one)} \quad -22x > -44$
 $x \geq -1.5 \quad \quad \quad \quad \quad \quad \quad x < 2$
 $\{x: -1.5 \leq x < 2, x \in R\} \quad \quad \quad \text{A}_1$



A_1

<p>(b)</p>	<p> $\angle ADB = \angle DBC =$ $= 32^\circ$ (alternate interior angles are equal) \rightarrow $\angle OBD = \angle ODB = 32^\circ$ ($\because OA = OB = OD$) B₁ $\angle AOB = 2 \times 32^\circ$ (angle at centre = 2x angle subtended $= 64^\circ$ by the same arc at circumference) \rightarrow B₁ $\angle ABD = 90^\circ$ (angle in a semicircle is 90°) $\angle BAD = 180 - (90 + 32)$ (sum of the angles in a Δ) $= 58^\circ$ B₁ $\angle BED = \angle BAD = 58^\circ$ (angles in the same segment are equal) (ow -1 if at least 2 correct reasons are not written) </p>	
<p>(c)</p>	<p> $\frac{(3a + 2b)}{(5a + 3b)} = \frac{18}{29}$ $29(3a + 2b) = 18(5a + 3b)$ M₁ $87a + 58b = 90a + 54b$ $3a = 4b$ M₁ $\therefore a : b = 4 : 3$ A₁ </p>	

Question 4		
<p>(a)</p>	<p>A game of numbers has cards marked with 11, 12, 13, ..., 40. A card is drawn at random. Find the Probability that the number on the card drawn is:</p> <p>(i) A perfect square</p> <p>(ii) Divisible by 7</p>	<p>[3]</p>
<p>(b)</p>	<p>Use graph paper for this question.</p> <p>(Take 2 cm = 1 unit along both x and y axis.)</p> <p>Plot the points O (0, 0), A (-4, 4), B (-3, 0) and C (0, -3)</p> <p>(i) Reflect points A and B on the y axis and name them A' and B' respectively. Write down their coordinates.</p>	<p>[4]</p>

	(ii) Name the figure OACB'A'. (iii) State the line of symmetry of this figure.	
(c)	Mr. Lalit invested ₹5000 at a certain rate of interest, compounded annually for two years. At the end of first year it amounts to ₹5325. Calculate (i) The rate of interest. (ii) The amount at the end of second year, to the nearest rupee.	[3]

Comments of Examiners

(a) Common errors of candidates:

- (i) They did not list the total outcomes and the favourable outcomes
- (ii) some listed the numbers from 1 to 40 whereas it should have been 11 to 40.
- (iii) Answer to the result was not written in the simplest form, e.g., $\frac{4}{30}$ was not written as $\frac{2}{15}$.

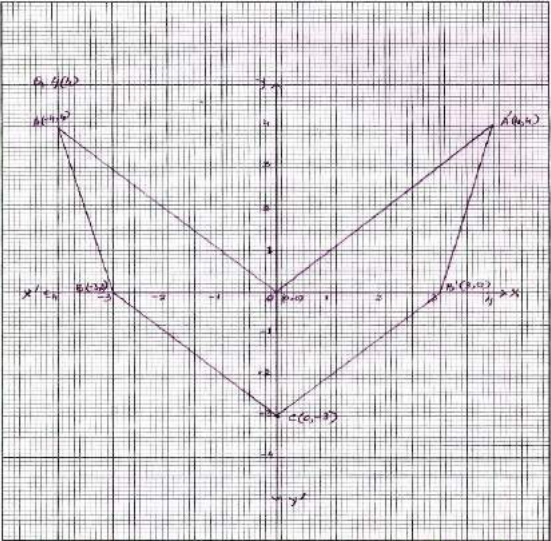
- (b) Some candidates committed errors in plotting points *B* and *C* which led to an incorrect figure. Some got confused with the images of *A* and *B*. Candidates who did not complete the figure were unable to name it. Figure being irregular some candidates were unable to name the figure correctly and some could not name the line of symmetry.
- (c) Most candidates were comfortable with the question and found the rate correctly but failed to write the answer to the nearest Rupee i.e. ₹5671.125 should have been written as ₹5671. Some took ₹ 5325 as amount for two years and hence calculated incorrectly.

Suggestions for teachers

- ✓ Insist on students to list the total and the favourable outcomes. They must be advised to write all answers based on probability in the simplest form.
- ✓ Extensive practice is necessary to plotting points, choosing coordinate axes, reflection and formation of figures of different shapes. Students must be advised to read the question carefully and choose the correct scale as given in the question.
- ✓ Regular revision is necessary for some students so as to correctly identify amount, C.I., They must be made aware of the basic knowledge that in C.I., interest is paid on the interest.

MARKING SCHEME

Question 4.

(a)	<p>(i) $n(S) = 30$ $E_1 = \{16, 25, 36\}$ $P(E_1) = \frac{3}{30} = \frac{1}{10}$ A₁ B₁ any one outcome correct</p> <p>(ii) $E_2 = \{14, 21, 28, 35\}$ $P(E_2) = \frac{4}{30} = \frac{2}{15}$ A₁</p>
(b)	<p>Plotting at least 2 points correctly B₁</p> <p>(i) $A'(4, 4), B'(3, 0)$ B₁ (one correct)</p> <p>(ii) Concave Hexagon or Hexagon (completed figure) B₁</p> <p>(iii) y axis or $x = 0$ B₁</p> 
(c)	<p>(i) $P = ₹ 5000$ and Amount at the end of first year = ₹5325 $I = 5325 - 5000 = 325$ M₁ (Applying correctly to find rate) $R = \frac{325 \times 100}{5000} = 6.5\%$ A₁</p> <p>(ii) C.I for the second year = $\frac{5325 \times 6.5}{100} = ₹346.125$ Amount at the end of two years = $5325 + 346.125 = 5671.125$ $A = ₹ 5671$ A₁ (CAO)</p>

SECTION B (40 Marks)

*Attempt any **four** questions from this Section*

Question 5																																																				
(a)	Solve the quadratic equation $x^2 - 3(x + 3) = 0$; Give your answer correct to two significant figures.	[3]																																																		
(b)	<p>A page from the savings bank account of Mrs. Ravi is given below.</p> <table border="1" style="width: 100%; border-collapse: collapse; margin: 10px 0;"> <thead> <tr> <th style="width: 15%;">Date</th> <th style="width: 30%;">Particulars</th> <th style="width: 15%;">Withdrawal (₹)</th> <th style="width: 15%;">Deposit (₹)</th> <th style="width: 25%;">Balance (₹)</th> </tr> </thead> <tbody> <tr> <td>April 3rd 2006</td> <td>B/F</td> <td></td> <td></td> <td style="text-align: right;">6000</td> </tr> <tr> <td>April 7th</td> <td>By cash</td> <td></td> <td style="text-align: right;">2300</td> <td style="text-align: right;">8300</td> </tr> <tr> <td>April 15th</td> <td>By cheque</td> <td></td> <td style="text-align: right;">3500</td> <td style="text-align: right;">11800</td> </tr> <tr> <td>May 20th</td> <td>To self</td> <td style="text-align: right;">4200</td> <td></td> <td style="text-align: right;">7600</td> </tr> <tr> <td>June 10th</td> <td>By cash</td> <td></td> <td style="text-align: right;">5800</td> <td style="text-align: right;">13400</td> </tr> <tr> <td>June 15th</td> <td>To self</td> <td style="text-align: right;">3100</td> <td></td> <td style="text-align: right;">10300</td> </tr> <tr> <td>August 13th</td> <td>By cheque</td> <td></td> <td style="text-align: right;">1000</td> <td style="text-align: right;">11300</td> </tr> <tr> <td>August 25th</td> <td>To self</td> <td style="text-align: right;">7400</td> <td></td> <td style="text-align: right;">3900</td> </tr> <tr> <td>September 6th 2006</td> <td>By cash</td> <td></td> <td style="text-align: right;">2000</td> <td style="text-align: right;">5900</td> </tr> </tbody> </table> <p>She closed the account on 30th September, 2006. Calculate the interest Mrs. Ravi earned at the end of 30th September, 2006 at 4.5% per annum interest. Hence, find the amount she receives on closing the account.</p>	Date	Particulars	Withdrawal (₹)	Deposit (₹)	Balance (₹)	April 3 rd 2006	B/F			6000	April 7 th	By cash		2300	8300	April 15 th	By cheque		3500	11800	May 20 th	To self	4200		7600	June 10 th	By cash		5800	13400	June 15 th	To self	3100		10300	August 13 th	By cheque		1000	11300	August 25 th	To self	7400		3900	September 6 th 2006	By cash		2000	5900	[4]
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(c)	In what time will Rs.1500 yield Rs.1996.50 as compound interest at 10% per annum compounded annually?	[3]																																																		

Comments of Examiners

- (a) Candidates committed errors in simplifying the equation to $x^2 - 3x - 9 = 0$. Some were unable to find the value of $\sqrt{5}$ and $\sqrt{45}$ hence failed to get the answer.

Most candidates wrote the answer as 4.85 and -1.85 instead of rounding off to two significant figures and writing the answer as 4.9, -1.9 .

- (b) Candidates made mistakes in finding minimum balance of various months. Some took September balance as ₹5900 instead of 0. The reason for this is not knowing that balance is zero on a particular month when the account is opened or closed. Candidates wrote answer as 151.5, ₹6051.5, instead of ₹151.50, ₹6051.50.

- (c) Answered correctly by most candidates, however a few committed errors in calculations.

Suggestions for teachers

- ✓ Adequate practice is necessary for simplifying quadratic equations and getting in the form $ax^2 + bx + c = 0$ and on approximation of numbers. Encourage students to use logarithm tables to find square roots of numbers.
- ✓ Basic concepts must be made clear to students to avoid such errors. They need to understand the concepts of dividing by 12 to find monthly interest. Concept of writing answers like 151.5 to two decimal places must be made very clear.
- ✓ Students must be advised to solve sums based on C.I., Amount, finding time and rate by simpler methods.

MARKING SCHEME

Question 5.

(a)

$$x^2 - 3(x + 3) = 0$$
$$x^2 - 3x - 9 = 0$$
$$x = \frac{-(-3) \pm \sqrt{(9 - 4 \times 1 \times -9)}}{2 \times 1} \quad M_1$$
$$x = \frac{3 \pm \sqrt{(9 + 36)}}{2} \Rightarrow \frac{3 \pm \sqrt{45}}{2} \Rightarrow \frac{3 \pm 3\sqrt{5}}{2}$$
$$x = \frac{3 \pm 3 \times 2.236}{2} \Rightarrow \frac{3 \pm 6.708}{2} \quad M_1$$
$$x = \frac{9.708}{2}, \quad x = \frac{-3.708}{2}, \quad x = 4.854, \quad x = -1.854$$

$$x = 4.85, \quad x = -1.85, \quad x = 4.9, \quad x = -1.9 \quad A_1$$

(b)	Month	Minimum balance	
	April	8300	
	May	7600	
	June	10300	
	July	10300	
	August	3900	
	Sept.	0	
	Total P=	40400	

M1 (any 3 minimum balance correct)

$$\text{S. I.} = \frac{40400}{12} \times \frac{1}{100} \times 4.5 \longrightarrow \text{M1}$$

$$= ₹151.50 \longrightarrow \text{A1}$$

Amount Mrs. Ravi receives

$$= ₹ (5900 + 151.50)$$

$$= ₹ 6051.50 \quad \text{A1}$$

(c)	$1996.50 = 1500 \left(1 + \frac{10}{100}\right)^n$	M ₁ correct sub in correct formula
	$\left(\frac{11}{10}\right)^3 = \left(\frac{11}{10}\right)^n$	M1 Simplification.
	$\therefore n = 3 \text{ years}$	A ₁

Question 6		
(a)	Construct a regular hexagon of side 5 cm. Hence construct all its lines of symmetry and name them.	[3]
(b)	<p>In the given figure PQRS is a cyclic quadrilateral PQ and SR produced meet at T.</p> <p>(i) Prove $\Delta TPS \sim \Delta TRQ$.</p> <p>(ii) Find SP if TP = 18cm, RQ = 4 cm and TR = 6cm.</p> <p>(iii) Find area of quadrilateral PQRS if area of $\Delta PTS = 27 \text{ cm}^2$.</p>	[4]

(c)	Given matrix $A = \begin{bmatrix} 4 \sin 30^\circ & \cos 0^\circ \\ \cos 0^\circ & 4 \sin 30^\circ \end{bmatrix}$ and $B = \begin{bmatrix} 4 \\ 5 \end{bmatrix}$ If $AX = B$ (i) Write the order of matrix X. (ii) Find the matrix 'X'.	[3]
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Comments of Examiners

(a) Candidates lost marks in the question for not constructing a hexagon using a ruler and compass. To construct the lines of symmetry candidates failed to use the steps of construction of perpendicular bisector of side and bisector of an angle.

(b) Some candidates were unable to identify two pairs of equal angles so as to prove $\Delta TPQ \sim \Delta TRS$.

Many candidates managed to write ratio $\frac{SP}{QR} = \frac{TS}{TQ}$ correctly and find $SP = 12\text{cm}$, but knowledge of ratio of area of similar triangles was not clear, hence they could not find the Area of Quad PQRS.

(c) Some candidates made mistakes in substituting values of $\sin 30^\circ, \cos 0^\circ$ which led to errors in getting $A = \begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$. Those candidates who got the incorrect value of A could not find the values of a and b.

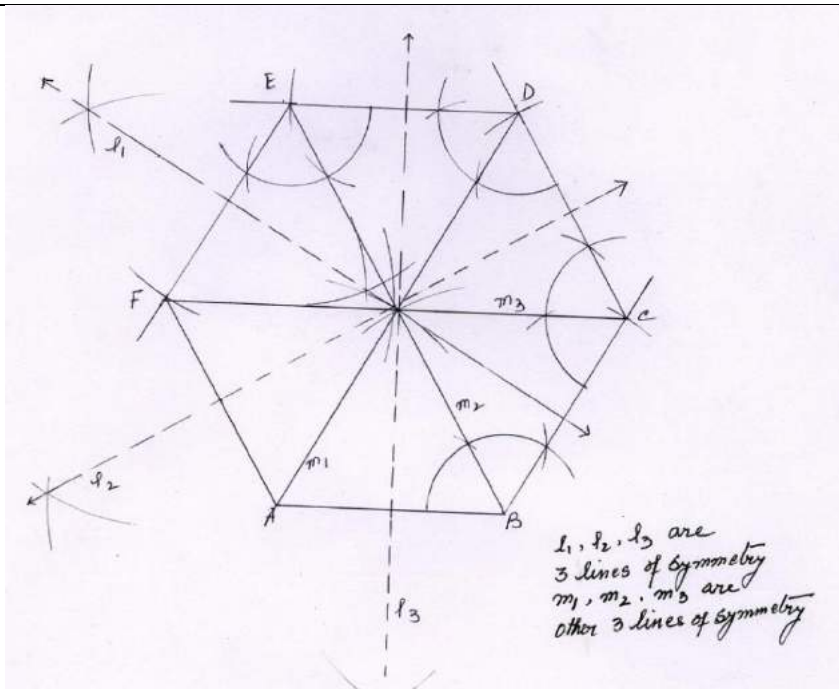
Suggestions for teachers

- ✓ To avoid errors in construction, insist students to use a ruler and compass with all traces of construction clearly shown.
- ✓ Sufficient practice of similar triangles is necessary for students. They must be taught to write the corresponding proportional sides and area of similar triangles being proportional to the square of the sides i.e. $\frac{\Delta TPS}{\Delta TRQ} = \frac{TP^2}{TR^2}$
- ✓ Students need to have a sound knowledge of standard angles. Concept of identifying order of matrix needs more revision.

MARKING SCHEME

Question 6.

(a)	Construction of one side one angle M₁ Hexagon A₁ Lines of symmetry any 2 (one side one angle) B₁
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(b) (i) In $\triangle TPS$ and $\triangle TRQ$

$\angle TQP = \angle TSP$ (ext. angle of a cyclic quad. = interior opposite angle)

$\angle TRQ = \angle TPS$ (ext. angle of a cyclic quad. = interior opposite angle)

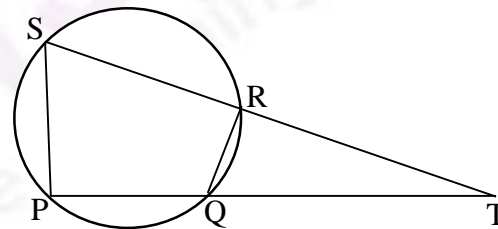
$\angle T$ common to both

$\therefore \triangle TPQ \sim \triangle TRQ$ (AAA) **B₁**

(ii) $\triangle TPS \sim \triangle TRQ$

$$\frac{SP}{QR} = \frac{TS}{TQ} = \frac{TP}{TR}$$

Or $\frac{SP}{4} = \frac{18}{6} \therefore SP = \frac{18}{6} \times 4 = 12 \text{ cm}$ **A₁**



(iii) $\triangle TPS \sim \triangle TRQ$

$$\frac{\Delta TPS}{\Delta TRQ} = \frac{TP^2}{TR^2} = \frac{18^2}{6^2} \quad \mathbf{M_1 \text{ (any form or directly used)}}$$

$$= \left(\frac{18}{6}\right)^2 = 3^2 = 9$$

$$\frac{27}{\Delta TRQ} = 9$$

$$\therefore \Delta TRQ = \frac{27}{9} = 3 \text{ cm}^2$$

$$\therefore \text{quad PQRS} = 27 - 3 = 24 \text{ cm}^2 \quad \mathbf{A_1}$$

(c)	<p>(i) $A = \begin{bmatrix} 4\sin 30^\circ & \cos 0^\circ \\ \cos 0^\circ & 4\sin 30^\circ \end{bmatrix}$</p> $A = \begin{bmatrix} 4 \times \frac{1}{2} & 1 \\ 1 & 4 \times \frac{1}{2} \end{bmatrix} = \begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$ <p>$(2 \times 2)(2 \times 1) = (2 \times 1)$ \therefore order of matrix X is (2×1) B₁</p> <p>(ii) Let $X = \begin{bmatrix} a \\ b \end{bmatrix}$</p> $\begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix} \begin{bmatrix} a \\ b \end{bmatrix} = \begin{bmatrix} 4 \\ 5 \end{bmatrix}$ $\begin{bmatrix} 2a + b \\ a + 2b \end{bmatrix} = \begin{bmatrix} 4 \\ 5 \end{bmatrix}$ <p>$2a + b = 4$ M₁ Any one method. $a + 2b = 5$ $a = 1, b = 2$</p> <p>$\therefore X = \begin{bmatrix} 1 \\ 2 \end{bmatrix}$ A₁</p>
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Question 7																								
(a)	An aeroplane at an altitude of 1500 meters finds that two ships are sailing towards it in the same direction. The angles of depression as observed from the aeroplane are 45° and 30° respectively. Find the distance between the two ships.	[4]																						
(b)	<p>The table shows the distribution of the scores obtained by 160 shooters in a shooting competition. Use a graph sheet and draw an ogive for the distribution. (Take 2cm = 10 scores on the X axis and 2cm = 20 shooters on the Y-axis).</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>Scores</th> <th>0-10</th> <th>10-20</th> <th>20-30</th> <th>30-40</th> <th>40-50</th> <th>50-60</th> <th>60-70</th> <th>70-80</th> <th>80-90</th> <th>90-100</th> </tr> </thead> <tbody> <tr> <td>No. of shooters</td> <td>9</td> <td>13</td> <td>20</td> <td>26</td> <td>30</td> <td>22</td> <td>15</td> <td>10</td> <td>8</td> <td>7</td> </tr> </tbody> </table> <p>Use your graph to estimate the following:</p> <p>(i) The median. (ii) The interquartile range. (iii) The number of shooters who obtained a score of more than 85%.</p>	Scores	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	No. of shooters	9	13	20	26	30	22	15	10	8	7	[6]
Scores	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100														
No. of shooters	9	13	20	26	30	22	15	10	8	7														

Comments of Examiners

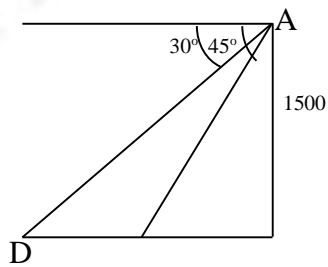
- (a) Most candidates were unable to draw the diagram as per the given data and lost marks. Some candidates made calculation errors while solving the sum. Some took $\sqrt{3} = 1.73$ instead of 1.732; hence final answer turned out to be 1095 instead of 1098.
- (b) Candidates made errors in this question at different stages such as:
- errors in finding *cf*;
 - incorrect scale chosen;
 - error in finding Q_1 and Q_3 ;
 - some plotted points with respect to lower boundaries instead of upper boundaries;
 - some failed to drop perpendiculars to locate median, quartiles etc.

Suggestions for teachers

- ✓ Advise students that all rounding off must be done at the end while calculating the final answer. More drilling is necessary for problems of heights and distances, especially where the diagram needs to be drawn.
- ✓ Students need to be taught the method of cross checking the *cf* found. They must read the question carefully so that they do not miss out the condition given, e.g., scale for graph. Students must also be explained that Ogive is a free hand smooth curve and is not drawn on the graph with a ruler.

MARKING SCHEME

Question 7.

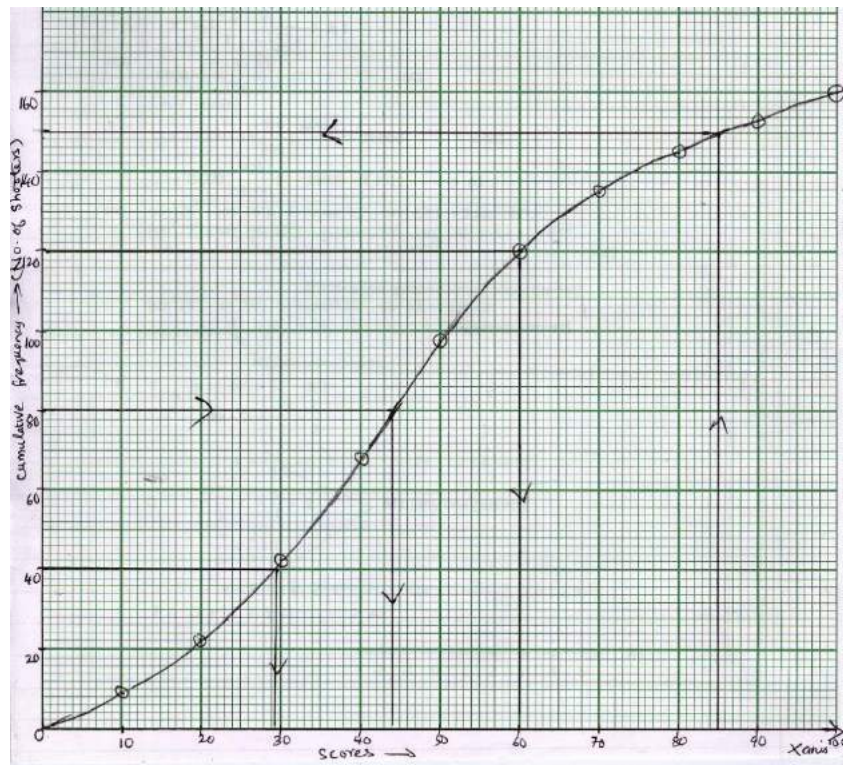
<p>(a)</p> <p>In $\triangle ABC$ $AB = BC = 1500$ \therefore From $\triangle ABD$</p> $\tan 30^\circ = \frac{1500}{1500 + x} \quad \mathbf{M_1}$ $\therefore \frac{1}{\sqrt{3}} = \frac{1500}{1500 + x}$ $1500 + x = 1500\sqrt{3}, x = 1500(\sqrt{3} - 1) = 1500 \times (1.732 - 1)$ $= 1500 \times .732 = 1098m \quad \mathbf{A_1}$	 <p style="text-align: center;">(correct value of $\tan 30$ or $\tan 45$) $\mathbf{B_1}$</p>
<p>(b)</p> <p>c.f: 9,22,42,68, 98, 120, 135, 145, 153, 160 \longrightarrow $\mathbf{B_1}$ (first 6 correct) (For smooth S curve plotted with upper boundaries) \longrightarrow $\mathbf{B_1}$</p> <p>Median = $\frac{N^{th}}{2}$ term. = 80th term = 44 $(\pm 1) \longrightarrow$ $\mathbf{A_1}$</p>	

$$Q_1 = \frac{N}{4} \text{th term} = 40\text{th term} = 29.5 \quad (\pm 1) \quad \leftarrow \text{A1 (any one correct)}$$

$$Q_3 = \frac{3N}{4} \text{th term} = 120\text{th term} = 60$$

$$\text{Interquartile range} = Q_3 - Q_1 = 60 - 29.5 = 30.5 \quad (\pm 1) \quad \longrightarrow \text{A1}$$

$$\text{No. of shooters who obtained a score of more than } 85\% = 10 \quad \longrightarrow \text{A1}$$



Question 8

- | | | |
|-----|---|-----|
| (a) | If $\frac{x}{a} = \frac{y}{b} = \frac{z}{c}$ show that $\frac{x^3}{a^3} + \frac{y^3}{b^3} + \frac{z^3}{c^3} = \frac{3xyz}{abc}$ | [3] |
| (b) | <p>Draw a line $AB = 5$ cm. Mark a point C on AB such that $AC = 3$ cm. Using a ruler and a compass only, construct:</p> <p>(i) A circle of radius 2.5 cm, passing through A and C.</p> <p>(ii) Construct two tangents to the circle from the external point B. Measure and record the length of the tangents.</p> | [4] |

(c)	<p>A line AB meets X-axis at A and Y-axis at B. P(4, -1) divides AB in the ratio 1:2.</p> <p>(i) Find the coordinates of A and B.</p> <p>(ii) Find the equation of the line through P and perpendicular to AB.</p>	[3]

Comments of Examiners

- (a) Few candidates were unable to solve the problem due to inadequate concepts of Ratio and Proportion.

Some made mistakes by taking LCM and working with both RHS and LHS simultaneously.

In general, question was solved correctly by most candidates who took $\frac{x}{a} = \frac{y}{b} = \frac{z}{c} = k$.

- (b) Some candidates made errors in locating point C. Some committed errors in locating the centre of the circle through A and C. Candidates were unable to use chord properties as well as tangent properties.

- (c) Candidates made errors in applying the correct section formula. Some candidates failed to identify points on coordinate axes A and B as $(x, 0)$ and $(0, y)$.

Some candidates found A and B correctly but were not able to use the perpendicular condition $m_1 \times m_2 = -1$ and hence were unable to find the equation of the line through P perpendicular to AB.

Suggestions for teachers

- ✓ Students must be taught that, to prove an identity one must start with either LHS or RHS and not both simultaneously. Sufficient practice is required to simplify algebraic expression.
- ✓ Expose students to different types of construction based on properties of chord, tangents, loci. Students must be instructed that all traces of construction must be clearly shown.
- ✓ Students require drilling in basic concepts like *y-coordinate* on *x-axis* and *x-coordinate* on *y-axis* is 0. Special attention must be given to find an equation of a line perpendicular to a given line and passing through a give point.

MARKING SCHEME

Question 8.

(a) Let $\frac{x}{a} = \frac{y}{b} = \frac{z}{c} = k$

$\therefore x = ak, y = bk, z = ck$ **M₁**

LHS $\frac{a^3k^3}{a^3} + \frac{b^3k^3}{b^3} + \frac{c^3k^3}{c^3} = 3k^3$ **M₁**

$= 3 \times \frac{x}{a} \times \frac{y}{b} \times \frac{z}{c} = \frac{3xyz}{abc} = RHS$ **A₁**

$RHS = \frac{3 \times ak \times bk \times ck}{abc} = 3k^3$ (or by taking RHS and proving)

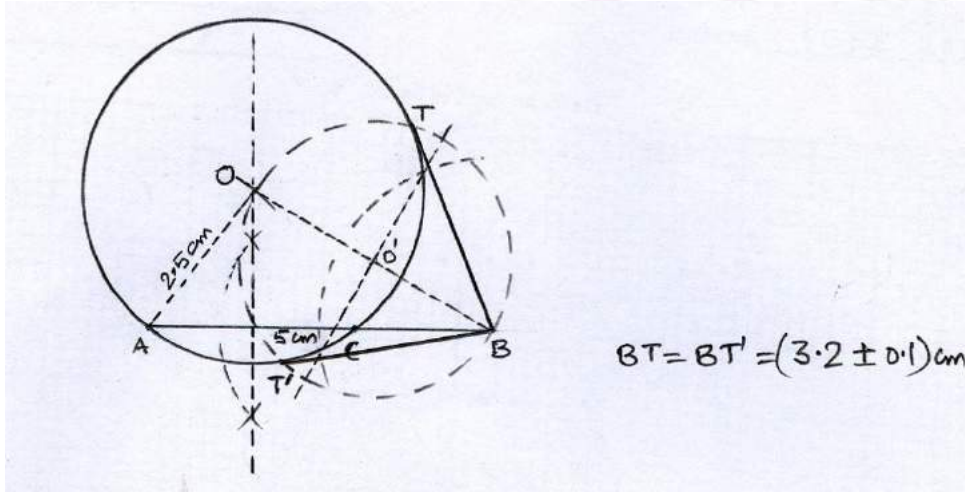
$\therefore LHS = RHS$

(b) Construction of perpendicular bisector of AC **M₁**

Construction of correct circle **A₁**

Construction of arcs/circle on OB as diameter **M₁**

BT = BT' = 3.1 cm **A₁ ± 1**

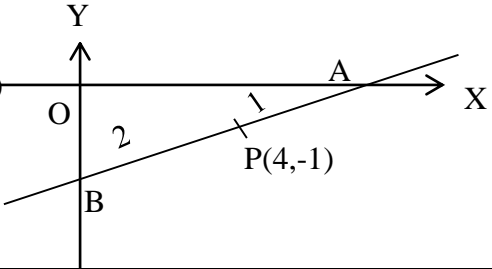


(c) Let A (x,0) , B(0, y)

$4 = \frac{2x + 1 \times 0}{2 + 1}$

$-1 = \frac{2 \times 0 + 1 \times y}{2 + 1}$

M₁ (any one correct)



	$x = 6, y = -3$ $A(6, 0), B(0, -3) \rightarrow A_1$ (any one correct) Slope of $AB = \frac{-3-0}{0-6} = \frac{1}{2}$ Slope of the line \perp to $AB = -2$ Equation of line through P and \perp to $AB =$ $y + 1 = -2(x-4)$ $2x + y = 7 \rightarrow A_1$
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Question 9		
(a)	A dealer buys an article at a discount of 30% from the wholesaler, the marked price being ₹6,000. The dealer sells it to a shopkeeper at a discount of 10% on the marked price. If the rate of VAT is 6%, find (i) The price paid by the shopkeeper including the tax. (ii) The VAT paid by the dealer.	[3]
(b)	The given figure represents a kite with a circular and a semicircular motifs stuck on it. The radius of circle is 2.5 cm and the semicircle is 2 cm. If diagonals AC and BD are of lengths 12 cm and 8 cm respectively, find the area of the: (i) shaded part. Give your answer correct to the nearest whole number. (ii) unshaded part.	[4]

(c)	<p>A model of a ship is made to a scale 1 : 300</p> <p>(i) The length of the model of the ship is 2 m. Calculate the length of the ship.</p> <p>(ii) The area of the deck ship is 180, 000 m². Calculate the area of the deck of the model.</p> <p>(iii) The volume of the model is 6.5 m³. Calculate the volume of the ship.</p>	[3]
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Comments of Examiners

- (a) Calculation errors were observed. Some candidates found the discounted price but were unable to find the VAT paid by dealer. While finding the net price for the shopkeeper some candidates subtracted ₹324 from 5400 instead of adding the two.
- (b) Most candidates managed to find the area of the circle and semi-circle but could not find the area of the kite using $\frac{1}{2}(AC \times DO) + \frac{1}{2}(AC \times BO) = \frac{1}{2}(AC \times BD)$. Some candidates used the incorrect formula for circle hence were incorrect from the initial step. Answer to area of shaded part was not rounded to the nearest whole number as stated in the question.
- (c) Some candidates were not clear about proportionality condition and corresponding scale factor k, k^2, k^3 for length, area and volume respectively. Most could find the length but some were unable to find area and volume.

Suggestions for teachers

- ✓ It is necessary to practice more sums on VAT so as to be able to identify the requirement of a given question. Due importance must be given to MP, CP, and SP.
- ✓ Students must be made to understand how knowledge of one formula may be used in another. Like applying the area of a triangle to find the area of a Kite. Advise them to use $\pi = \frac{22}{7}$ if not mentioned in the question as it helps in the working. It is essential for students to read questions carefully so as to avoid missing out on important parts.
- ✓ Drilling of problems related to scale factor could help in solving such problems related to models and maps.

MARKING SCHEME

Question 9.

(a)	(i) M R P = ₹ 6000		
		Cost of article for the dealer = $\frac{70}{100} \times 6000 = ₹ 4200$	M₁ (any one)
		Cost of article for the shopkeeper = $\frac{90}{100} \times 6000 = ₹ 5400$	
		Tax to be paid by the shopkeeper = $\frac{6}{100} \times 5400 = ₹ 324$	
		Net price for the shopkeeper = ₹ (5400 + 324) = ₹ 5724	A₁

	<p>(ii) Value added by the dealer = ₹ (5400 - 4200) = ₹ 1200 \therefore VAT paid by the dealer = 6% of ₹1200 = ₹ 72 A₁</p>
(b)	<p>(i) Area of the shaded part $= \pi \times \left(\frac{2^2}{2} + 2.5^2\right)$ M₁ (Any one correct substitution of area) $= \frac{22}{7} (2 + 6.25)$ $= \frac{22}{7} \times 8.25$ M₁ (finding sum of area) $= 25.929 = 26 \text{ cm}^2$ A₁ (CAO)</p> <p>(ii) Area of kite = $\frac{1}{2}(AC \times DO) + \frac{1}{2}(AC \times BO) = \frac{1}{2}AC \times BD$ $\frac{1}{2} \times 12 \times 8 = 48$ Area of unshaded part $= 48 - 26 = 22 \text{ cm}^2$ A₁</p>
(c)	<p>$\frac{\text{length of model}}{\text{length of ship}} = \frac{1}{300}$ ←</p> <p>$\frac{\text{area of deck model}}{\text{actual area}} = \left(\frac{1}{300}\right)^2$ ←</p> <p>$\frac{\text{volume of model}}{\text{volume of ship}} = \left(\frac{1}{300}\right)^3$ ←</p> <p>Length of ship = $300 \times 2 = 600 \text{ m}$ → B1</p> <p>Area of deck of model = $180,000 \times \left(\frac{1}{300}\right)^2 = 2 \text{ m}^2$ → B1</p> <p>Volume of ship = $(300)^3 \times 6.5 = 175, 500,000 \text{ m}^3$ → B1</p>

Question 10

(a) Mohan has a recurring deposit account in a bank for 2 years at 6 % p.a. simple interest. If he gets ₹ 1200 as interest at the time of maturity, find:

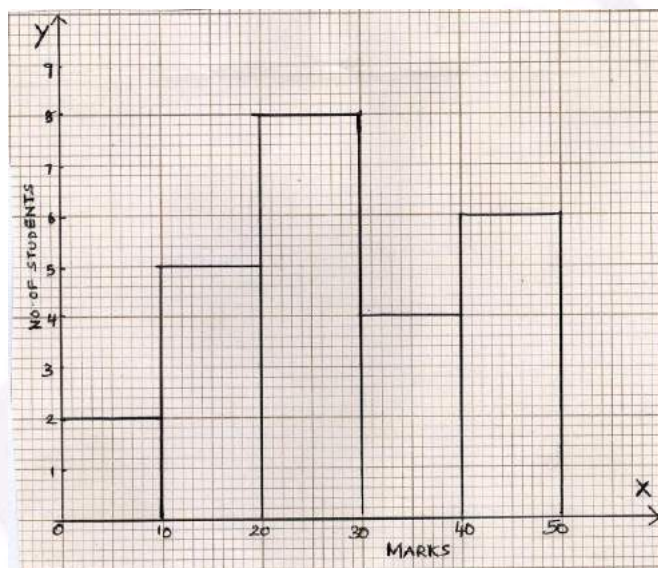
- (i) the monthly instalment
- (ii) the amount of maturity.

[3]

(b) The histogram below represents the scores obtained by 25 students in a Mathematics mental test. Use the data to:

- (i) Frame a frequency distribution table.
- (ii) To calculate mean.
- (iii) To determine the Modal class.

[4]



(c) A bus covers a distance of 240 km at a uniform speed. Due to heavy rain its speed gets reduced by 10 km/h and as such it takes two hrs longer to cover the total distance. Assuming the uniform speed to be 'x' km/h, form an equation and solve it to evaluate 'x'.

[3]

Comments of Examiners

(a) Some candidates took the monthly instalment of $P = ₹1200$ instead of taking interest as ₹1200 and hence got incorrect results. Some other common errors was in taking time as 2 years or 12 months instead of 24 months.

(b) Many candidates committed calculation errors in finding the mean with some unable to find the class mark. Some made mistakes in finding $\sum fx, \sum f$. Some candidates went on to draw the histogram to find the modal class instead of using the table formed by using the given graph.

(c) Some candidates framed the equation incorrectly $\frac{240}{x-10} - \frac{240}{x} = 2$ was taken as $\frac{240}{x} - \frac{240}{x-10} = 2$. Hence wrote incorrect answers.

Suggestions for teachers

- ✓ Students must be trained to solve more application based problems related to recurring deposit account. Insist that the first and foremost step is to identify the given data.
- ✓ Students must be made clear about class marks of a given distribution. Train them to draw graphs as well as to collect data from a given graph.
- ✓ It is necessary to make the concept very clear that $\frac{240}{x-10} > \frac{240}{x}$ Extensive drilling is necessary for students to formulate quadratic equations

MARKING SCHEME

Question 10.

(a)

$$\text{S.I.} = \frac{p \cdot n \cdot (n+1)}{2} \times \frac{1}{12} \times \frac{R}{100}$$

$$1200 = \frac{p \times 24 \times 25}{2} \times \frac{1}{12} \times \frac{6}{100} \longrightarrow \text{M1}$$

$$\text{Monthly instalment } p = ₹800 \longrightarrow \text{A1}$$

$$\text{Maturity value} = p \times n + \text{S.I.} = 800 \times 24 + 1200 = ₹20400 \longrightarrow \text{A1}$$

(b)

CI	f	x	$A=25$ $D = x - A$	Fd
0 – 10	2	5	-20	-40
10 – 20	5	15	-10	-50
20 – 30	8	25	0	0
30 – 40	4	35	10	40
40 – 50	6	45	20	120
	25			70

	$\text{Mean} = 25 + \frac{70}{25}$ $= 25 + 2.8 = 27.8$ <p>Any 3 CI vs f correct M_1</p> <p>Substituting in correct formula M_1 (any method)</p> <p>Mean = 27.8 A_1</p> <p>Modal class 20 – 30 B_1</p>
(c)	<p>Let the uniform speed be 'x' km/h</p> <p>Time taken with uniform speed = $\frac{240}{x}$ hrs B_1 (any one)</p> <p>Time taken with reduced speed = $\frac{240}{x - 10}$ hrs</p> <p>Given, $\frac{240}{x - 10} - \frac{240}{x} = 2$ hrs M_1</p> $x^2 - 10x - 1200 = 0$ $(x - 40)(x + 30) = 0$ <p>$x = 40$ km/h A_1</p>

Question 11		
(a)	Prove that $\frac{\cos A}{1 + \sin A} + \tan A = \sec A$.	[3]
(b)	<p>Use ruler and compasses only for the following question. All construction lines and arcs must be clearly shown.</p> <p>(i) Construct a ΔABC in which $BC = 6.5$ cm, $\angle ABC = 60^\circ$, $AB = 5$ cm.</p> <p>(ii) Construct the locus of points at a distance of 3.5 cm from A.</p> <p>(iii) Construct the locus of points equidistant from AC and BC.</p> <p>(iv) Mark 2 points X and Y which are at a distance of 3.5 cm from A and also equidistant from AC and BC. Measure XY.</p>	[4]
(c)	<p>Ashok invested ₹ 26,400 on 12%, ₹25 shares of a company. If he receives a dividend of ₹2,475, find the:</p> <p>(i) number of shares he bought</p> <p>(ii) Market value of each share</p>	[3]

Comments of Examiners

- (a) Some candidates tried to prove the identity by getting $\tan A$ to the RHS i.e. $\frac{\cos A}{1+\sin A} = \sec A - \tan A$.

Some made mistakes while taking $1 + \sin A$ as LCM.

A common error found was in simplification

- (b) Basic concept of locus was not known to some candidates. Some were unable to trace out:
- locus of points at a distance of 3.5cm from A which is a circle with centre at A and radius 3.5cm;
 - locus of the points equidistant from AC and BC being bisector of $\angle C$. Some candidates took incorrect measurements to draw the triangle.
- (c) Candidates made calculation errors. Some took ₹ 2475 as sum invested and hence number of shares calculated was incorrect. Some candidates took 25 as MV and tried to get the number of shares by dividing ₹ 26400 by ₹25 instead of ₹825.

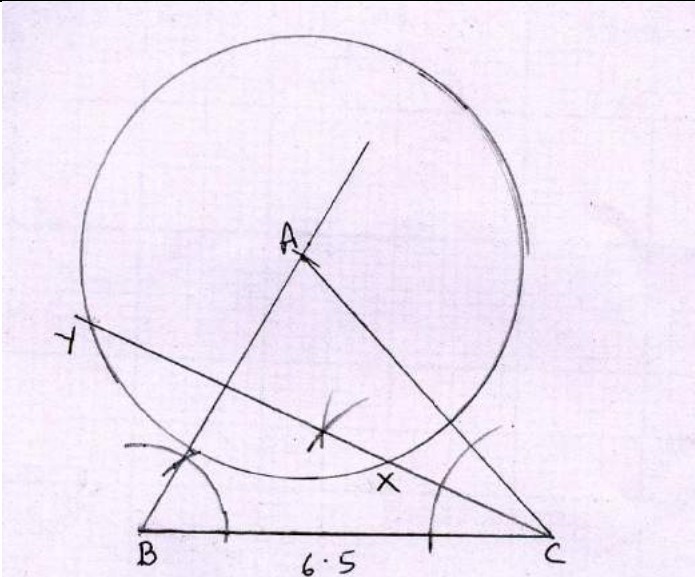
Suggestions for teachers

- ✓ Students must be advised not to change the form of a given identity. Adequate practice of identities are necessary to avoid such errors in simplification.
- ✓ Insist on students to draw a rough sketch of diagram indicating all given measurements to avoid errors while constructing. Students must be advised to read the question carefully and do the construction stepwise.
- ✓ Problems related to shares and dividends need special attention and repeated practice so as to be able to solve different types of problems correctly. Students must be instructed to first identify the given data and note them down.

MARKING SCHEME

Question 11.

(a)	$\frac{\cos A}{1 + \sin A} + \tan A = \sec A$ $LHS = \frac{\cos A}{1 + \sin A} + \frac{\sin A}{\cos A} = \frac{\cos^2 A + \sin A(1 + \sin A)}{\cos A(1 + \sin A)} \longrightarrow \mathbf{M}$ $= \frac{\cos^2 A + \sin^2 A + \sin A}{\cos A(1 + \sin A)}$ $= \frac{1 + \sin A}{\cos A(1 + \sin A)} \mathbf{M_1 \text{ (identifying } \sin^2 A + \cos^2 A = 1)}$ $= \frac{1}{\cos A} = \sec A \longrightarrow \mathbf{A1}$ <p style="text-align: center;">=RHS</p>
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(b)		
(c)	<p>Annual income from 1 share = $\frac{12}{100} \times 25 = ₹3$ M₁</p> <p>Total annual income = ₹2475</p> <p>∴ Number of shares bought = $\frac{\text{Total income}}{\text{income on one share}} = \frac{2475}{3} = 825$ A₁</p> <p>∴ Market value of each share = $\frac{\text{Total investment}}{\text{No. of shares}} = \frac{26400}{825} = ₹32$ A₁</p>	

Topics/ Concepts found difficult

- (i) VAT
- (ii) Shares and Dividend
- (iii) Geometry solving problems using properties of circle and similar triangles
- (iv) Geometry Constructions
- (v) Coordinate geometry: Section formula
- (vi) Trigonometry, complementary angles and Heights and Distances.
- (vii) Properties of Ratio and Proportion.
- (viii) Approximation: to given significant figures or to nearest whole number.

Suggestions for Students:

- Reading time must be utilised to make the right choice of question and to be thorough with the given data.
- More practice is necessary in rounding off of numbers.
- Must choose the correct scale while drawing graphs and special care must be taken while marking the axes and plotting points.
- Logarithm tables may be used to find square roots.
- All steps of working including rough works must be clearly shown on same answer page.
- While solving geometry problems reasons must be given.
- All traces of constructions must be clearly shown.