MATHEMATICS

STATISTICS AT A GLANCE

Total Number of students who took the examination	136056
Highest Marks Obtained	100
Lowest Marks Obtained	7
Mean Marks Obtained	70.12

Percentage of Candidates according to marks obtained

Details	Mark Range				
	0-20	21-40	41-60	61-80	81-100
Number of Candidates	2180	9813	37598	35662	50803
Percentage of Candidates	1.60	7.21	27.63	26.21	37.34
Cumulative Number	2180	11993	49591	85253	136056
Cumulative Percentage	1.60	8.81	36.45	62.66	100.00

Range of Marks Obtained

105
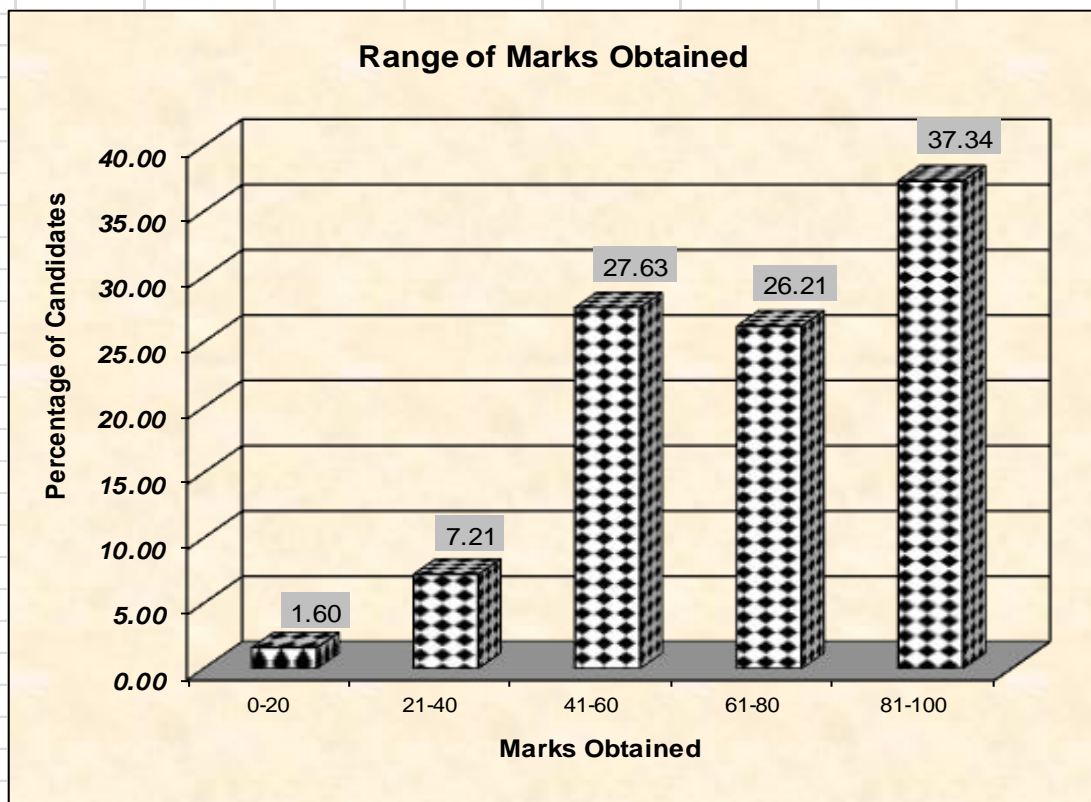
MATHEMATICS

ANALYSIS OF PERFORMANCE

Question 1

(a) Given $A = \begin{bmatrix} 2 & -6 \\ 2 & 0 \end{bmatrix}$, $B = \begin{bmatrix} -3 & 2 \\ 4 & 0 \end{bmatrix}$, $C = \begin{bmatrix} 4 & 0 \\ 0 & 2 \end{bmatrix}$

Find the matrix X such that $A + 2X = 2B + C$. [3]

(b) At what rate % p.a. will a sum of ₹ 4000 yield ₹ 1324 as compound interest in 3 years? [3]

(c) The median of the following observations 11, 12, 14, $(x-2), (x+4), (x+9)$, 32, 38, 47 arranged in ascending order is 24. Find the value of x and hence find the mean. [4]

Examiners' Comments

(a) Candidates committed errors in the addition of two matrices and made mistakes in finding $-A$ (i.e. negative of a matrix). Concept of change of sign of each element of a matrix to find negative of a matrix was unclear. Division by 2 to get X from 2X was missing, so many wrote incorrect answers.
(b) Most candidates answered the question correctly. Some candidates attempted the sum directly without showing steps hence they lost marks. Some candidates took the amount equal to ₹ 1324 instead of ₹ 5324. Some failed to express both sides in the correct cube from e.g. $1331/1000 = (11/10)^3$.
(c) Most candidates answered correctly. However a few failed to identify the difference between mean and median and also the median position. Failing to equate $x + 4 = 24$ the value of x was wrong hence the value of mean was incorrect too.

MARKING SCHEME
Question 1
$\begin{aligned} A + 2X &= 2B + C \\ 2X &= 2B + C - A \\ 2X &= 2\begin{bmatrix} -3 & 2 \\ 4 & 0 \end{bmatrix} + \begin{bmatrix} 4 & 0 \\ 0 & 2 \end{bmatrix} - \begin{bmatrix} 2 & -6 \\ 2 & 0 \end{bmatrix} \end{aligned}$

$$= \begin{bmatrix} -6 & 4 \\ 8 & 0 \end{bmatrix} + \begin{bmatrix} 4 & 0 \\ 0 & 2 \end{bmatrix} + \begin{bmatrix} -2 & -6 \\ -2 & 0 \end{bmatrix}$$

$$2X = \begin{bmatrix} -6+4-2 & 4+0+6 \\ 8+0-2 & 0+2-0 \end{bmatrix} = \begin{bmatrix} -4 & 10 \\ 6 & 2 \end{bmatrix}$$

$$\therefore X = \begin{bmatrix} -2 & 5 \\ 3 & 1 \end{bmatrix}$$

(b)
$$P = ₹\ 4000$$
$$CI = ₹\ 1324$$
$$\therefore A = ₹\ 5324$$

$$A = P\ (1 + \frac{r}{100})^n$$

$$5324 = 4000\ (1 + \frac{r}{100})^3$$

$$\frac{5324}{4000} = \left(\frac{100+r}{100}\right)^3$$

$$\frac{1331}{1000} = \left(\frac{11}{10}\right)^3 = \left(\frac{100+r}{110}\right)^3$$

$$\therefore \left(\frac{100+r}{110}\right) = \frac{11}{10}$$

$$100 + r = 110$$
$$r = 10\% \quad A1$$

(c) $11, 12, 14, (x-2), (x+4), (x+9), 32, 38, 47$ $11,12,14,18,24,29,32,38,47$

Hence $n = 9$

Median $= \frac{n+1}{2} = \frac{9+1}{2} = 5^{th}$ term   Substituting $x = 20$

$\qquad = x + 4$ sum of all the numbers $= 225$

Given median $= 24$ $\therefore$ mean $= \frac{225}{9} = 25$

ie $\quad x + 4 = 24$

$\qquad x = \underline{\ 20}$

Question 2

(a) What number must be added to each of the numbers 6, 15, 20 and 43 to make them proportional? [3]

(b) If $(x-2)$ is a factor of the expression $2x^3 + ax^2 + bx - 14$ and when the expression is divided by $(x-3)$, it leaves a remainder 52, find the values of **a** and **b**. [3]

(c) Draw a histogram from the following frequency distribution and find the mode from the graph:

Class	0-5	5-10	10-15	15-20	20-25	25-30
Frequency	2	5	18	14	8	5

[4]

Examiners' Comments

(a) The initial understanding of proportionality was clear to most candidates and hence wrote

$$\frac{6+x}{15+x} = \frac{20+x}{43+x} \quad \text{Or } (6 + x)(43 + x) = (20 + x)(15 + x)$$

The errors were mostly in multiplication or in simplification.

(b) Most candidates committed errors in the first step of application of Remainder and Factor Theorem by writing incorrect simultaneous equations in 'a' and 'b'

(c) Most candidates answered the question correctly however a few errors observed were:
   (i) Incorrect choice of axis.
   (ii) Histogram drawn with cumulative frequency instead of frequency
   (iii) Failure to draw the two intersecting lines and vertical line to identify mode.

Suggestions for teachers
− Basic concepts of remainder and factor must be taught with clarity so calculation errors are minimized.
− These basic but major errors must be highlighted to enable students avoid committing errors in all forms of examination. They must be taught on how to choose the x-axis and y-axis. Concepts of Histogram as well as determination of mode from it should be clearly explained and students should be given additional practice.

MARKING SCHEME

Question 2

Q.2 (a)	Let x be the number $$\frac{6+x}{15+x} = \frac{20+x}{43+x}$$ $(6+x)(43+x) \quad = \quad (20+x)(15+x)$ $258+49x+x^2 \quad = \quad 300+35x+x^2$ $14x \quad = \quad 42$ $x \quad = \quad \underline{3}$ The required number is $\underline{3}$
(b)	As x − 2 is a factor f(x) = x^3 + ax^2 + bx + 6 f(x) = 0 $2(2)^3 + a(2)^2 + b(2) − 14 = 0$ $16 + 4a + 2b − 14 = 0$ $4a + 2b = -2$ OR $2a + b = -1$ $2(3)^3 + a(3)^2 + b(3) − 14 = 52$ $54 + 9a + 3b = 66$ $9a + 3b = 12$ $3a + b = 4$ $2a + b = -1$ (-) (-) (+)

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	a = 5
	∴ b = 4 − 3 a
	    = 4 − 15 = -11
	    b = -11
	a = 5, b = −11

(c)	GRAPH

Question 3

(a) Without using tables evaluate 3 cos 80°. Cosec 10° + 2 sin 59° sec 31°.   [3]

(b) In the given figure, ∠BAD = 65°

   ∠ABD = 70°,   ∠BDC = 45°

   (i) Prove that AC is a diameter of the circle.

   (ii) Find ∠ACB
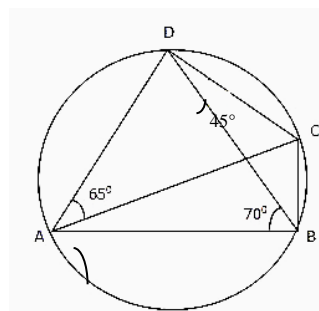
[3]

(c) AB is a diameter of a circle with centre C = (-2,5). If A = (3,-7). Find

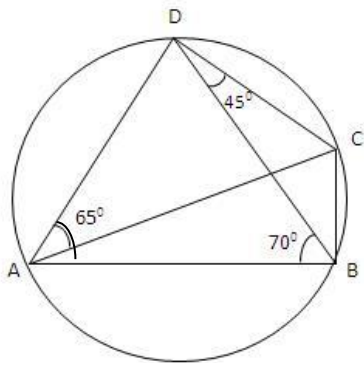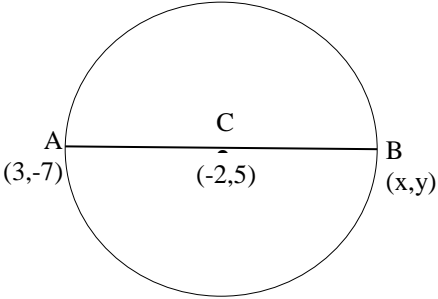   (i)   the length of radius AC

   (ii)   the coordinates of B.   [4]

Examiners' Comments

(a) Candidates committed errors in writing the complementary function correctly. Some skipped steps and wrote a direct complementary result without showing any working which led to loss of marks.
(b) Though centre was not given many candidates assumed AC as the diameter and took ∠ABC = 90°.Reasons related to the results was missing which led to loss of marks.
(c) Some candidates were incorrect in applying the distance formula ($\sqrt{\{(x_2 - x_1)^2 + (y_2 - y_1)^2\}}$) correctly. Some did not equate (3+x)/2 to -2 or (-7+y)/2 to 5 so as to find x and y. The answer too was not written in the coordinate form.

MARKING SCHEME **Question 3**	
(a)	3 cos 80°. Cosec 10° + 2 sin 59° sec 31° = 3 cos80° . cosec (90° − 80°) + 2 sin 59° sec(90° − 59°) = 3 cos 80° . sec 80° + 2 sin 59° cosec 59° = $3\cos 80° \times \dfrac{1}{\cos 80°} + 2\sin 59° \times \dfrac{1}{\sin 59°}$ = 3 + 2 = <u>5</u>
(b)	Given ∠BAD = 65° ∠ABD = 70° ∠BDC = 45° (i) ∠ADB = 180° - (65°+70°) = 45° (sum of the angles of triangle) ∠ADB + ∠BDC = 45°+45° =90° ∴ AC is a diameter (angle in a semicircle is 90°) (ii) ∠ACB = ∠ADB = 45° (angles in the Same segment).
(c)	A (3, -7) Centre C = (-2,5) $\dfrac{3+x}{2} = -2$ Or $\dfrac{-7+x}{2} = 5$ 3+x = -4　　　　-7 + y = 10 x = -7　　　　　y = 17 ∴ B = (-7, 17) Length of radius AC = $\sqrt{(3+2)^2 + (-7-5)^2}$ 　　　　= $\sqrt{25+144}$ 　　　　= $\sqrt{169}$ = 13 units

Question 4

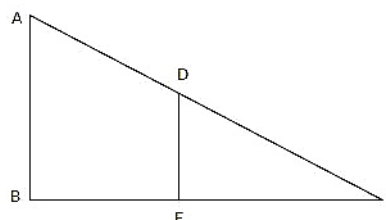(a)   Solve the following equation and calculate the answer correct to two decimal places:
　　　$x^2 - 5x - 10 = 0$.　　　　　　　　　　　　　　　　　　　　　　　　　　　　[3]

(b)   In the given figure, AB and DE are perpendicular to BC.
　　　(i)   Prove that ΔABC ~ΔDEC
　　　(ii)   If AB = 6cm: DE = 4cm and

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AC = 15 cm. Calculate CD.

    (iii)   Find the ratio of the area of ΔABC **:** area of ΔDEC. [3]

(c)   Using a graph paper, plot the points A(6, 4) and B(0, 4).

    (i)   Reflect A and B in the origin to get the images A′ and B′.

    (ii)   Write the co-ordinates of A′ and B′.

    (iii)   State the geometrical name for the figure ABA′B′.

    (iv)   Find its perimeter. [4]

Examiners' Comments

(a)   In most cases substitution in formula was correct but candidates made errors in calculations of square root. Due to rounding off to 2 decimal places at the initial stage the final answer of two decimal places was incorrect.

Candidates solved the square root by division method however use of a four figure log table to find the square root is permissible. Results obtained did not consider the 3 decimal places that would lead to the correct answer.

(b)   Proof of similarity was answered correctly by candidates but some made mistakes in writing the corresponding ratios correctly for which answer to CD was incorrect. In the third part many candidates wrote:

$\dfrac{\text{Area } \Delta \text{ ABC}}{\text{Area } \Delta \text{ DEC}} = \dfrac{36}{16}$. But answers must be written in simplified form, i.e. 9/4 or 9:4.

(c)   Various types of errors were committed such as:

    (i)   A few candidates did not use a graph paper

    (ii)   Some candidates interchanged the –ve and +ve axes of both x and y

    (iii)   Few candidates plotted the points incorrectly

    (iv)   Plotted points (-6,-4) and (0,-4) incorrectly

    (v)   Incomplete figures or named incorrectly.

    (vi)   Perimeter was found in a lengthy process by using distance formula instead of using the graph.

Suggestions for teachers

– Explain that the correct calculations to be done to the least 3 decimal places so as to obtain the correct approximated answer. Instruct candidates on how to use 4 figure log tables to find the square root that facilitates the calculation process.
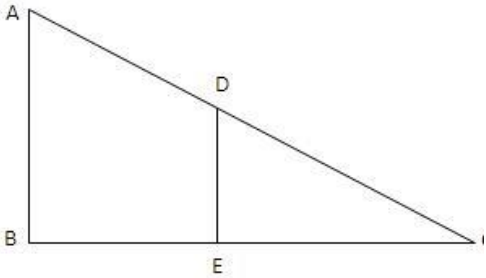
– Regular practice is necessary specially to write the corresponding ratio of sides correctly. Insist on writing all ratios in its lowest team.

– It is very necessary for graphs to be drawn for questions based on graphs. Further all coordinate forms must be written in word form. Concepts of negative and positive side of both x-axis and y-axis along with plotting points in the graph paper on the basis of the coordinates of the given points must be made very clear.

MARKING SCHEME
Question 4

(a)	Solve $x^2 - 5x - 10 = 0$
	$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$
	$$= \frac{5 \pm \sqrt{25 + 40}}{2 \times 1}$$
	$$= \frac{5 \pm \sqrt{65}}{2}$$
	$$= \frac{5 \pm 8.062}{2}$$
	$$= \frac{13.062}{2} \text{ or } \frac{-3.062}{2}$$
	$= 6.531$ or -1.531
	$= 6.53$ or -1.53
	Answer correct to 2 d.p.
(b)	In $\triangle ABC$ and $\triangle DEC$
	$\angle B = \angle E = 90°$ and
	$\angle C = \angle C$
	$\triangle ABC \sim \triangle DEC$ (A.A similarity)
	$\dfrac{AB}{DE} = \dfrac{AC}{DC}$
(ii)	$\dfrac{6}{4} = \dfrac{15}{DC} = \therefore DC = 10$ cm
(iii)	$\dfrac{\text{area } \triangle ABC}{\text{area } \triangle DEC} = \left(\dfrac{6}{4}\right)^2 = \left(\dfrac{3}{2}\right)^2 = \dfrac{9}{4} = 9 : 4$
(c)	$A'(-6, -4)$
	$B'(0, -4)$
	AB A′B′ is a parallelogram B_1
	Perimeter $= 2(6+10) = 32$ units

Question 5

(a) Solve the following inequation, write the solution set and represent it on the number line:

$$-\frac{x}{3} \le \frac{x}{2} - 1\frac{1}{3} < \frac{1}{6}, x \in R$$

[3]

(b) Mr. Britto deposits a certain sum of money each month in a Recurring Deposit Account of a bank. If the rate of interest is of 8% per annum and Mr. Britto gets ₹ 8088 from the bank after 3 years, find the value of his monthly instalment. [3]

(c) Salman buys 50 shares of face value ₹ 100 available at ₹ 132.

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(i)   What is his investment?

(ii) If the dividend is 7.5%, what will be his annual income?

(iii) If he wants to increase his annual income by ₹ 150, how many extra shares should he

   buy?   [4]

Examiners' Comments

(a)   Errors were in transposition of x terms on one side
   and constants on the other.
   Many candidates failed to write the solution in the set
   form hence they lost marks. There were errors in
   representation of the solution on the number line.
   1⅗ was not marked on the number line.

(b)   Some candidates took n as 3 instead of 12 x 3 = 36.
   Many lost marks for using ₹ 8088 as interest instead
   of the matured value.   In some cases candidates
   forgot to divide by 12 so as to convert rate per annum
   to per month.

(c)   Most candidates answered the question correctly.
   Some made errors in finding the dividend for taking
   N.V. as ₹ 32 instead of ₹ 100. Some committed
   errors in shifting the decimal point of 7.5% and
   ended up writing   ₹ 37.50 instead of ₹ 375.

MARKING SCHEME
Question 5

(a)   If $-\dfrac{x}{3} \le \dfrac{x}{2} - 1\dfrac{1}{3}$

   $-\dfrac{x}{3} \le \dfrac{x}{2} \dfrac{-4}{3}$

   $\dfrac{4}{3} \le \dfrac{x}{2} + \dfrac{x}{3}$

   $\dfrac{4}{3} \le \dfrac{3x + 2x}{6}$ correctly transposing all x terms to one side and numbers

   $8 \le 5x$ to the other side.
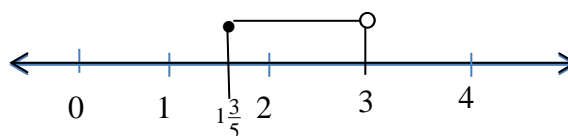
   $\dfrac{8}{5} \le x$

   $1\dfrac{3}{5} \le x$

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|		
	$\Rightarrow \quad \dfrac{x}{2} < \dfrac{1}{6} + \dfrac{4}{3}$ $\Rightarrow \quad \dfrac{x}{2} < \dfrac{9}{6}$ $\Rightarrow \quad x < \dfrac{9}{6} \times 2$ $\Rightarrow \quad x < 3$ Sol. Set { x: $1\dfrac{3}{5} \le x < 3, x \in R$ }	

(b)	Let the monthly deposit be ₹ x **OR** n = 36 months $P = \dfrac{n(n+1)x}{2} = \dfrac{36 \times 37 \times x}{2}$ $Int = \dfrac{36 \times 37 \times x}{2} \times \dfrac{1}{12} \times \dfrac{8}{100}$ $\quad = \dfrac{111x}{25}$ Amt = nx + Int $8088 = 36x + \dfrac{111x}{25}$ $\dfrac{900x + 111x}{25} = 8088$ $\dfrac{1011x}{25} = 8088$ $x = \dfrac{8088 \times 25}{1011}$ x = ₹ 200	Let the monthly deposit be ₹100 $P = = \dfrac{36 \times 37 \times 100}{2}$ $Int = \dfrac{36 \times 37 \times 100 \times 8}{2 \times 12 \times 100}$ $\quad = 444$ Amount = 3600 + 444 $\quad\quad = 4044$ Amt x 4044 100 8088 $\dfrac{8088 \times 100}{4044} = 200$ ∴ The monthly deposit = ₹200

(c)	

	i) Total investment = ₹50 x 132
	                                = ₹ <u>6600</u>
	
	 ii) The dividend of a share = $\dfrac{7.5}{100} \times 100 \times 50$
	
	         50 shares = $\dfrac{7.5 \times 100}{100} \times 50$
	
	                        = ₹ <u>375</u>
	 iii) ₹ 7.50 can be earned from 1 share
	
	      No. of extra shares he should buy $= \dfrac{150}{7.5}$ = <u>20 shares</u>
	
	      Or Extra dividend = $\dfrac{d}{100} \times$ extra shares × FV
	
	            $150 = \dfrac{7.5}{100} \times x \times 100$
	            x = <u>20 shares</u>

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Question 6

(a)   Show that $\sqrt{\dfrac{1-\cos A}{1+\cos A}} = \dfrac{\sin A}{1+\cos A}$.   [3]

(b)   In the given circle with centre O, $\angle ABC = 100°$, $\angle ACD = 40°$ and CT is a tangent to the circle at C. Find $\angle ADC$ and $\angle DCT$.
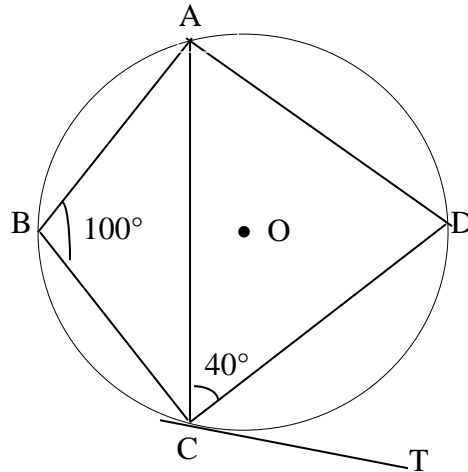
[3]

(c)   Given below are the entries in a Savings Bank A/c pass book:

Date	Particulars	Withdrawals	Deposit	Balance
Feb 8	B/F	-	-	₹ 8500
Feb 18	To self	₹ 4000	-	-
April 12	By cash	-	₹ 2230	-
June 15	To self	₹ 5000	-	-
July 8	By cash	-	₹ 6000	

Calculate the interest for six months from February to July at 6 % p.a.   [4]

Examiners' Comments

(a) Common errors observed were :
   (i) Working with both sides together instead of starting with either LHS or the RHS
   (ii) Squaring of both sides or omitting the square root sign.
   (iii) Some candidates cross multiplied and then went about proving it.
(b) A few candidates made calculation errors in finding ∠DCT. In many cases reasons were not stated to support their answers.
(c) It is important to show all essential working. Many candidates were unable to show the completion process of the pass book leading to incomplete answers. Candidates made mistakes in finding the minimum qualifying balance. Some took time as 6 months instead of 1 and did not divide the same by 12 so as to have the rate per month instead of per year.

MARKING SCHEME
Question 6

(a)

L.H.S $\sqrt{\dfrac{1-\cos A}{1+\cos A}}$ = $\sqrt{\dfrac{1-\cos A}{1+\cos A} \times \dfrac{1+\cos A}{1+\cos A}}$

$= \sqrt{\dfrac{1-\cos^2 A}{(1+\cos A)^2}}$

$= \sqrt{\dfrac{\sin^2 A}{(1+\cos A)^2}}$

$= \dfrac{\sin A}{1+\cos A}$

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(b)	$\angle ADC = 180° - \angle ABC = 80°$	Opp $\angle$s of cyclic quad are supplementary
	$\angle CAD = 180° - (80° + 40°) = 60°$	sum of the $\angle$s of a $\triangle$ is 180°
	$\angle DCT = \angle CAD = 60°$	alternate segment theorem

(c)

Date	Particulars	Withdrawals	Deposit	Balance
Feb 8	B/F	-	-	8500
Feb 18	To self	4000	-	4500
April 12	By cash	-	2230	6730
June 15	To self	5000	-	1730
July 8	By cash	-	6000	7730

Principal for the month February   =   4500

Principal for the month March   =   4500

Principal for the month April   =   4500

Principal for the month May   =   6730

Principal for the month June   =   1730

Principal for the month July   =   <u>7730</u>

Total principal for 1 month   =   ₹ 29690

$$\text{Interest} = \frac{29690 \times 6}{12 \times 100}$$

$$= ₹ 148.45$$

Question 7

(a) In $\triangle$ ABC, A(3, 5), B(7,8) and C(1,-10). Find the equation of the median through A.   [3]

(b) A shopkeeper sells an article at the listed price of ₹ 1500 and the rate of VAT is 12% at each stage of sale. If the shopkeeper pays a VAT of ₹ 36 to the Government, what was the price, inclusive of Tax, at which the shopkeeper purchased the article from the wholesaler? [3]

(c) In the figure given, from the top of a building AB = 60 m high, the angles of depression of the top and bottom of a vertical lamp post CD are observed to be 30° and 60° respectively. Find:

(i) the horizontal distance between AB and CD.

(ii) the height of the lamp post.

[4]
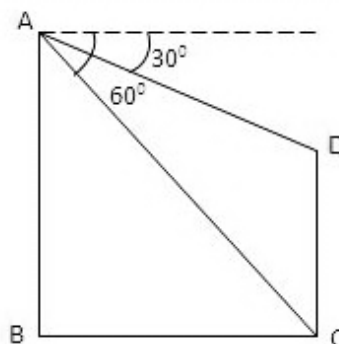
Examiners' Comments
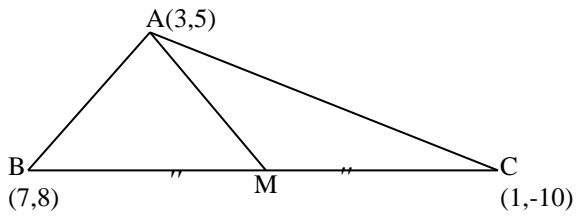
(a) Few candidates made incorrect observations on the slope of the median. It was +6 instead of -6. Some used incorrect points in finding the equation of the median.
(b) Some candidates could not identify M.P. as ₹ 1500. In some cases candidates were unable to calculate the profit of the shopkeeper.
(c) Most candidates answered the question correctly, However a few instead of using Tan 60 = √3, tan 30 = 1/√3 used trigonometric tables which led to long and tedious working.

MARKING SCHEME

Question 7

(a)	Mid point M = $\left(\dfrac{7+1}{2}, \dfrac{8-10}{2}\right)$

Mid point M = $\left(\dfrac{7+1}{2}, \dfrac{8-10}{2}\right)$

$= (4, -1)$

Slope AM $= \dfrac{5+1}{3-4} = -6$

Equation of AM

$y - 5 = -6 (x - 3)$

$y - 5 = -6x + 18$

$6x + y = 23$

A(3,5)

B (7,8)   M   C (1,-10)

(b)

Out put tax $=$ 12% of ₹1500

$=$ ₹ $1500 \times \dfrac{12}{100}$

$=$ ₹ <u>180</u>

Let the price of the article charged by the wholesales be P before tax.

∵ Input tax $=$ 12%P   **OR**

$= \dfrac{12P}{100} = \dfrac{3}{25}P$

VAT = out put Tax − input Tax

$36 = 180 - \dfrac{3}{25}P$

$\dfrac{3}{25}P = 180 - 36$

$= \underline{144}$

$P = \dfrac{144 \times 25}{3}$

$= ₹\underline{1200}$

Price inclusive of tax $=$ P + input tax

$= P + \dfrac{3}{25}P$

$= 1200 + 144$

$= ₹ \underline{1344}$

> VAT paid by shopkeeper = 12% of his profit
>
> $36 = \dfrac{12}{100}$ of profit
>
> Profit $= \dfrac{36 \times 100}{12} =$ Rs. 300
>
> ∴ CP = SP − Profit
>
> $= 1500 - 300 = ₹1200$

> Price inclusive of VAT
>
> $= 1200 + \dfrac{12}{100} \times 1200$
>
> $= 1200 + 144$
>
> $= ₹ 1344.$

(c)

In the rt-angled triangle ABC

$\tan 60° = \dfrac{AB}{BC} = \sqrt{3}$

$$= \frac{60m}{BC}$$

$$BC = ED = \frac{60}{\sqrt{3}}$$

$$= \frac{60 \times \sqrt{3}}{\sqrt{3} \times \sqrt{3}} = 20 \times \sqrt{3}$$

$$= 20 \times 1.732 m$$

$$= \underline{34.64 \text{ m}}$$
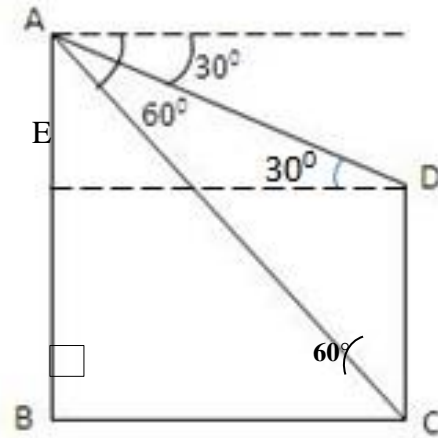
the horizontal distance between AB and CD = 34.64 m

In the right – angled triangle AED

$$\tan 30° = \frac{AE}{ED} = \frac{1}{\sqrt{3}}$$

$$= \frac{AE}{20\sqrt{3}m}$$

$$AE = 20\sqrt{3} \times \frac{1}{\sqrt{3}}$$

$$= \underline{20 \text{ m}}$$

∴ the height of the Lamp post is 60 – 20 = <u>40 m</u>

Question 8

(a) Find x and y if $\begin{bmatrix} x & 3x \\ y & 4y \end{bmatrix} \begin{bmatrix} 2 \\ 1 \end{bmatrix} = \begin{bmatrix} 5 \\ 12 \end{bmatrix}$. [3]

(b) A solid sphere of radius 15 cm is melted and recast into solid right circular cones of radius 2.5 cm and height 8 cm. Calculate the number of cones recast. [3]

(c) Without solving the following quadratic equation, find the value of 'p' for which the given equation has real and equal roots:

$$x^2 + (p – 3) x + p = 0.$$ [4]

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Examiners' Comments

(a) A number of candidates failed to show the necessary working of matrix multiplication but went on to write directly prove $\begin{bmatrix} 5x \\ 6y \end{bmatrix} = \begin{bmatrix} 5 \\ 12 \end{bmatrix}$. This led to loss of marks.

(b) Some candidates used incorrect formula for cone or sphere. Some made calculation errors mostly in cases where individual volumes have been calculated instead of forming an equation.

(c) Many candidates substituted correctly for discriminant ($b^2 - 4ac$) but did not equate to zero which is the basic concept of equal roots. Some made mistakes in expanding $(p-3)^2$ or in factorization.

Suggestions for teachers
– Stress on all working related to matrix addition with multiplication being clearly shown.
– Adequate practice of problems related to equating of volumes of different solids is necessary. Simpler methods of dealing with mensuration problems need to be taught that are time saving and effective too.
– Regular practice is necessary on nature of roots of quadratic equation and stress must be laid on steps in solving problems.

MARKING SCHEME

Question 8

(a)
$$\begin{bmatrix} x & 3x \\ y & 4y \end{bmatrix} \begin{bmatrix} 2 \\ 1 \end{bmatrix} = \begin{bmatrix} 5 \\ 12 \end{bmatrix}$$

$$\begin{bmatrix} 2 \times x + 3x \times 1 \\ 2 \times y + 4y \times 1 \end{bmatrix} = \begin{bmatrix} 5 \\ 12 \end{bmatrix}$$

$$\begin{bmatrix} 2x + 3x \\ 2y + 4y \end{bmatrix} = \begin{bmatrix} 5 \\ 12 \end{bmatrix}$$

$$\begin{bmatrix} 5x \\ 6y \end{bmatrix} = \begin{bmatrix} 5 \\ 12 \end{bmatrix}$$

$5x = 5$ $\qquad$ $6y = 12$

$\underline{\underline{x = 1}}$ A_1 $\quad$ $\underline{\underline{y = 2}}$

(b)
Volume of the metal obtained by melting sphere $= \dfrac{4}{3}\pi r^3$

$$= \dfrac{4}{3} \times \pi \times 15 \times 15 \times 15 \, cm^3$$
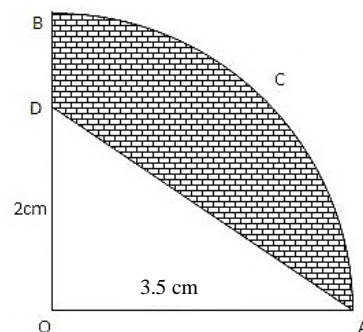
Volume of the right circular cone

of radius 2.5cm and height 8 cm $= \dfrac{1}{3} \times \pi r^2 h$

$$= \dfrac{1}{3} \times \pi \times (2.5)^2 \times 8$$

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	Number of cones recast	$= \dfrac{\frac{4}{3} \times \pi \times 15 \times 15 \times 15}{\frac{1}{3} \times \pi \times 2.5 \times 2.5 \times 8}$
		$= \underline{\quad 270 \quad}$
(c)	$x^2 + (p\text{-}3)\,x + p = 0$	
	If roots are equal $b^2 - 4\,ac = 0$, $a = 1$, $b = (p\,\text{-}3)$ and $c = p$	
	$(p - 3)^2 - 4(p) = 0$ Or $(p - 3)^2 = 4\,p$	
	$p^2 - 6p + 9 = 4\,p$	
	$p^2 - 10p + 9 = 0$	
	$(p - 9)\,(p - 1) = 0$	
	$p = 9$ or 1	

Question 9

(a)   In the figure alongside, OAB is a quadrant of a circle.
The radius OA = 3.5 cm
and OD = 2 cm. Calculate the area of the shaded
portion. (Take $\pi = \dfrac{22}{7}$)

[3]

(b)   A box contains some black balls and 30 white balls. If the probability of drawing a
black ball is two-fifths of a white ball, find the number of black balls in the box.   [3]

(c)   Find the mean of the following distribution by step deviation method:

Class interval	20-30	30-40	40-50	50-60	60-70	70-80
Frequency	10	6	8	12	5	9

[4]

Examiners' Comments
(a) Two major errors committed were:
   (i) Using π as 3.14 instead of 22/7 as stated in the question.
   (ii) In the process of calculation, initial rounding of results led to incorrect answers.
(b) Most candidates solved the problem correctly.
(c) Some candidates used the direct method instead of step deviation method as asked in the question and hence scored poorly. A number of calculation errors were detected.

MARKING SCHEME

Question 9

(a)	Area of the quarter circle $= \dfrac{\pi r^2}{4}$ $= \dfrac{1}{4} \times \dfrac{22}{7} \times \dfrac{7}{2} \times \dfrac{7}{2} \, cm^2$ $= \underline{9.625 cm^2}$ Area of the $\Delta AOD = \dfrac{1}{2} \times OA \times OD$ $= \dfrac{1}{2} \times 2 \times 3.5$ $= 3.5 \, cm^2$ Area of the shaded portion $= 9.625 - 3.5$ $= \underline{6.125 \ cm^2}$
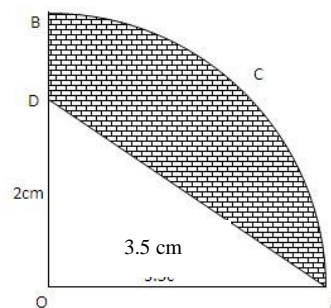
(b)	Let the box contain x black balls $\because$ Total number of balls in the box $= x + 30$ Probability of drawing a black ball $= \dfrac{x}{x+30}$ Probability of drawing a white ball $= \dfrac{30}{x+30}$ $\dfrac{x}{x+30} = \dfrac{2}{5} \times \dfrac{30}{x+30}$ $x = \underline{12}$

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(c)	Class Interval	x =Mid	$d = \dfrac{x-A}{c}$	f	fd
	20 – 30	25	−2	10	−20
	30 – 40	35	−1	6	−6
	40 – 50	45 → A	0	8	0
	50 – 60	55	1	12	12
	60 – 70	65	2	5	10
	70 – 80	75	3	9	27
					49 – 26

$\sum fd = 23$, $\sum f = 50$, C = 10

$$\text{Mean} \quad = \quad A + \dfrac{\sum fd}{\sum f} \times C$$

$$= \quad 45 + \dfrac{23}{50} \times 10 \quad = 45 + 4.6 \quad = \quad \underline{49.6}$$

Question 10

(a) Using a ruler and compasses only:

  (i) Construct a triangle ABC with the following data:

   AB = 3.5 cm, BC = 6 cm and $\angle ABC = 120°$

  (ii) In the same diagram, draw a circle with BC as diameter. Find a point P on the

   circumference of the circle which is equidistant from AB and BC.

  (iii) Measure $\angle BCP$.   [4]

(b) The marks obtained by 120 candidates in a test are given below:

Marks	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
No of candidates	5	9	16	22	26	18	11	6	4	3

Draw an ogive for the given distribution on a graph sheet.
Use suitable scale for ogive to estimate the following:

(i) The median.

(ii) The number of candidates who obtained more than 75% marks in the test.

(iii) The number of candidates who did not pass the test if minimum marks required to pass

  is 40.   [6]

Examiners' Comments

(a) In problems of construction many candidates did not use a ruler and compass to draw ∠ABC = 120°. Some took an incorrect length for AB and BC. To draw the semicircle some candidates used a ruler to locate mid-point of BC instead of bisecting BC. Some were not clear about the locus of points equidistant from AB and AC.

(b) Some candidates made mistakes in computing the c.f. which lead to an incorrect graph. A few plotted the graph with respect to lower boundaries instead of upper boundaries. Some candidates used the given frequency instead of cumulative frequency to draw an Ogive.

Suggestions for teachers
- Focus on basic locus concepts of points equidistant from 2 arms of the angle or equidistant from 2 points. Special attention must be given to the use of ruler and compass for all types of construction.
– Students must be told to recheck the c.f. carefully and to see that the last c.f is same as summation Σf. Ogive is to be drawn with respect to upper boundaries and corresponding cumulative frequency. Ensure students are clear regarding median position n/2 and (n/2 + (n+1)/2)/2.

MARKING SCHEME

Question 10

(a)
(i) Construction of ∆ABC, BC = 6 cm, ∠B = 120°, AB = 3.5 cm.
(ii) Bisecting BC and drawing a circle on diameter BC.
(iii) Drawing an angle bisector of ∠ABC and marking P on the circumference.
(iv) Join PC and measuring ∠BCP = 30°
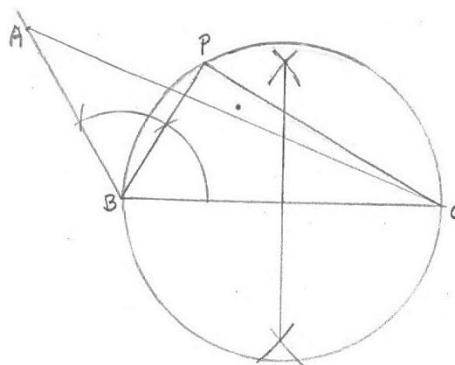
(b)

| Class	f	Cu.f
0 – 10	5	5
10 – 20	9	14
20 – 30	16	30
30 – 40	22	52
40 – 50	26	78
50 – 60	18	96
60 – 70	11	107
70 –80	6	113
80 – 90	4	117
90 – 100	3	120

(i) Median = 44
(ii) Number of candidates who obtained more than 75% = 120 -110 = 10

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(iii) Number of candidates who did not pass the test = <u>52</u>

Question 11

(a) In the figure given below, the line segment AB meets X-axis at A and Y-axis at B. The point P(-3,4) on AB divides it in the ratio 2:3. Find the coordinates of A and B.
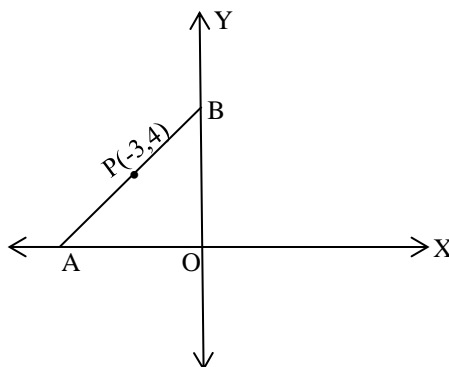
[3]

(b) Using the properties of proportion, solve for x, given $\dfrac{x^4 + 1}{2x^2} = \dfrac{17}{8}$. [3]

(c) A shopkeeper purchases a certain number of books for ₹ 960. If the cost per book was ₹ 8 less, the number of books that could be purchased for ₹ 960 would be 4 more. Write an equation, taking the original cost of each book to be ₹ x, and solve it to find the original cost of the books. [4]

Examiners' Comments
(a) Concepts of A(a,0) and B(0,b) points on x-axis and y-axis were incorrect. Some candidates made mistakes in the application of the section formula. A number of candidates fared poorly for not writing the final answer in coordinate form as mentioned in the question.
(b) This question was answered correctly by most candidates however a few did not use componendo and dividendo but cross multiplied directly. Some did not write $x = \pm 2$ and lost marks for accuracy.
(c) Most candidates misread the question and took a number of books to be x instead of cost of each book as x as given in the question. Some were unable to factorize $x^2 - 8x - 1920 = 0$.

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MARKING SCHEME

Question 11

(a)	A $\frac{\quad\quad 2 \quad\quad \overset{P}{,} \quad\quad 3 \quad\quad}{}$ A (x,0) $\quad\quad$ (-3,4) $\quad\quad$ (0,y) The coord of P = $\left(\dfrac{2 \times 0 + 3x}{5}, \dfrac{2y + 3 \times 0}{5} \right)$ = (-3,4) $\dfrac{0 + 3x}{5} = -3 \qquad , \qquad \dfrac{2y + 0}{5} = 4$ x = -5 $\qquad\qquad$, $\qquad$ y = 10 $\therefore$ A(-5, 0) (A$_1$) $\quad$ and $\quad$ B(0,10)
(b)	$\dfrac{x^4 + 1}{2x^2} = \dfrac{17}{8}$. Using componendo and dividend $\dfrac{x^4 + 1 + 2x^2}{x^4 + 1 - 2x^2} = \dfrac{17 + 8}{17 - 8}$ $\dfrac{(x^2 + 1)^2}{(x^2 - 1)^2} = \dfrac{25}{9}$ $\dfrac{x^2 + 1}{x^2 - 1} = \dfrac{5}{3}$ $3x^2 + 3 = 5x^2 - 5$ $2x^2 = 8$ $x^2 = 4$ $x = \pm 2$
(c)	Original cost of each book $\qquad\qquad\qquad = \quad x$ No. of books bought for $\quad ₹\ 960\ = \quad \dfrac{960}{x}$ The cost of each book was $₹\ 8$ less, $\quad$ then the cost of a book $\qquad = \quad x - 8$ Difference in the number of books bought $\quad = \quad \dfrac{960}{x - 8} - \dfrac{960}{x} = 4$ $\qquad\qquad\qquad \dfrac{240}{x - 8} - \dfrac{240}{x} = 1$ $\qquad\qquad\qquad 240x - 240(x - 8) = x(x - 8)$ $\qquad\qquad\qquad x^2 - 8x - 1920 = 0$ $\qquad\qquad\qquad x^2 - 48x + 40x - 1920\ = 0$ $\qquad\qquad\qquad (x - 48)\ (x + 40) = 0$ $\qquad\qquad\qquad x = 48\ $ or $\ x = -40\ $ not valid

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	∴ the original cost of the book = ₹ 48

Topics/Concepts Found Difficult
– Value Added Tax (VAT)
– Trigonometry
– Similarity
– Probability
– Choosing of scale for graph as scale was not provided
– Geometry Locus Construction
– Rounding off final result
– Step deviation method of calculation of mean
– Coordinate geometry , Section formula and points and x and y axis
– Quadratic equation problem

Suggestions For Candidates
– Reading time must be utilized to make the right choice of questions and to be thorough with the given data
– Adequate practice must be done on rounding off digits
– Use graph paper for question based on graphs
– Use of log table to find square root of numbers
– Ensure all necessary steps of workings are clearly shown while solving problems.
– Working for matrix multiplication is essential
– Adopt methods where calculations are minimal to obtain final answers.