

MATHEMATICS
(with answer)
(Two hours and a half)

Answers to this Paper must be written on the paper provided separately.

You will **not** be allowed to write during the first **15** minutes.

This time is to be spent in reading the question paper.

The time given at the head of this paper is the time allowed for writing the answers.

Attempt **all** questions from **Section A** and **any four** questions from **Section B**.

All working, including rough work, must be clearly shown and must be done on the same sheet as the rest of the answer.

Omission of essential working will result in loss of marks.

The intended marks for questions or parts of questions are given in brackets [].

Mathematical tables are provided.

SECTION A (40 Marks)

Attempt all questions from this Section

Question 1

(a) Find the range of values of x which satisfies

$$-2\frac{2}{3} \leq x + \frac{1}{3} < 3\frac{1}{3} ; x \in \mathbb{R}$$

Graph these values of x on the number line.

[3]

(b) Puja purchases an article for ₹ 3600 and sells it to Nilakshi for ₹ 4800. Nilakshi, in turn, sells the article to Shubham for ₹ 5500. If the VAT rate is 10% find the VAT levied on Puja and Nilakshi.

[3]

(c) Nistha Jain saves ₹ 300 per month and puts it in a bank recurring deposit scheme which pays an interest at the rate of 12% p.a. In order to have a total amount of ₹ 23,490 nearly, how many instalments must she deposit? [4]

Question 2

(a) If $A = \begin{pmatrix} -3 & \sec 60^\circ \\ \operatorname{cosec} 30^\circ & -4 \end{pmatrix}$, $B = \begin{pmatrix} 2 \sin 30^\circ & a \\ 2 & \cos 90^\circ \end{pmatrix}$

and $(A + B)(A - B) = A^2 - B^2$, find the value of "a". [3]

(b) A sum of money amounts to ₹ 8640 at simple interest and ₹ 8652.80 at compound interest after 2 years at r% p.a. Find the original sum and value of "r". [4]

(c) (i) Write down the coordinates of point P which divides the line segment joining A (-4, 1) and B (17, 10) in the ratio 1 : 2.
(ii) Calculate the distance OP, where O is the origin.
(iii) In what ratio does the y-axis divide the line AB? [3]

Question 3

(a) A rectangle of size 8 cm x 6 cm is circumscribed by a circle. What is the probability that the dart will be in the rectangle? [3]

(b) If A, B, C are the angles of a triangle, prove that :
 $\sin \left\{ \frac{B+C}{2} \right\} = \cos \frac{A}{2}$ [3]

(c) An iron disc of diameter 35 cm weights 4.5 Kg. A ring shaped piece of width 3.5 cm is cut off from the disc. If the weight of the ring be $\frac{1}{5}$ of the weight of the disc, find the internal and external diameters of the ring. What is the ratio of the weight of three pieces into which the iron disc is divided? [4]

Question 4

(a) $(x - 2)$ is a factor of the expression $x^3 + ax^2 + bx + 6$. When this expression is divided by $(x - 3)$, it leaves the remainder 3. Find the values of "a" and "b".
With this value of a and b, factorise the expression completely. [4]

(b) The centre of a circle of radius 13 units is the point (3, 6), P(7, 9) is a point inside the circle. APB is a chord of the circle such that AP = PB. Calculate the length of AB. [3]

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- (c) Mohit scored the following marks in various class tests during a term, each test being marked out of 20.

15, 17, 16, 10, 7, 12, 16, 14, 16, 12, 19.

- (i) What are his modal marks?
(ii) What are his median marks?
(iii) What are his total marks?
(iv) What are his mean marks?

[3]

SECTION B (40 Marks)

Attempt ANY FOUR questions from this Section

Question 5

- (a) Solve $x^2 - 5x = 10$ and give your answer correct to 2 decimal places. [3]

- (b) Prove the following identity: $\frac{\tan \theta + \sec \theta - 1}{\tan \theta - \sec \theta + 1} = \frac{1 + \sin \theta}{\cos \theta}$. [3]

- (c) Mr. Ayush Banerjee has a savings bank account with the state bank of India, Bhawanipur, Kolkata. A page from his passbook in a particular year is given below.

Date	Particulars (in ₹)	Withdrawals (in ₹)	Deposits (in ₹)	Balance (in ₹)
Jan 1	Balance B/F	.....	.....	2,000
Jan 9	By Cash	.....	4,000	.....
Jan 29	To Cheque	2,000	.....	.....
Feb 18	By Cheque	.....	7,500	.....
March 18	To Cheque	8,500	.....	.....
March 24	By Cash	.....	4,000	.....
March 31	By Interest	.....	.....	.....
May 20	By Cheque	.....	2,500	.....
Sept 10	To Cash	1,500	.....	.....
Sept 20	To Cash	500	.....	.....
Sept 31	By Interest	.....	.....	.....
Oct 28	By Cash	.....	3500	.....
Oct 31	Total balance	.....	.....	.....

The bank calculates interest at 6% p.a. and compounds it at the end of March and September every year. Complete the passbook showing his total balance up to 31st Oct of the same year. [4]

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Question 6

- (a) By selling an article for ₹ 24, a trader loses as much percent as the cost price of the article. Calculate the cost price. [3]
- (b) If $p : q = r : s$ then show that $(mp + nq) : q = (mr + ns) : s$ [3]
- (c) Points (3, 0) and (-1, 0) are invariant points under reflection in the line L_1 ; points (0, -3) and (0, 1) are invariant points on reflection in line L_2 . [3]
- (i) Write down the equations for the lines L_1 and L_2 .
- (ii) Write down the images of points P (3, 4) and Q (-5, -2) on reflection in line L_1 . Name the images as P' and Q' respectively.
- (iii) Write down the image of P and Q on reflection in line L_2 . Name the images as P'' and Q'' respectively.
- (iv) State or describe a single transformation that maps P' onto P''. [4]

Question 7

- (a) Ruler and compasses may be used in this question. All construction lines and arcs must be clearly shown and be of sufficient length and clarity to permit assessment.
- (i) Construct a triangle ABC, in which $BC = 5$ cm, $AB + AC = 11$ cm and angle $ABC = 75^\circ$.
- (ii) Construct the locus of all points inside the triangle ABC, which are equidistant from B and C.
- (iii) Construct the locus of the vertices of the triangle with BC as base and which are equal in area to triangle ABC.
- (iv) Mark the point Q, in your construction, which would make triangle QBC equal in area to the triangle ABC and isosceles.
- (v) Measure and record the length of CQ. [4]
- (b) A (0, 0), B (4, 6), C (8, 3) are the vertices of triangle ABC. Find the equation of :
- (i) The median AM,
- (ii) The altitude BN,
- (iii) The coordinates of fourth vertex D of the parallelogram ABCD. [3]
- (c) What quantity must be added to each term of the ratio $(m + n) : (m - n)$ to make it equal to $(m + n)^2 : (m - n)^2$. [3]

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Question 8

- (a) A (5, x) , B (-4 , 3) and C (y , -2) are the vertices of the triangle ABC whose centroid is the origin. Calculate the values of x and y. [3]
- (b) The contents of 100 match boxes were checked to determine the number of matches they contained.

No of matches	35	36	37	38	39	40	41
No. of boxes	6	10	18	25	21	12	8

- (i) Using step deviation method calculates to one decimal place, the mean of matches per box.
- (ii) Determine, how many extra matches would have to be added to the total contents of the 100 boxes to bring the mean up to exactly 39 matches. [4]
- (c) The angles of elevation of the top of the tower from two points at distances 15 m and 8 m from the base and in the same straight line with it are complementary. Find the height of the tower and give your answer correct to $\frac{1}{100}$ of a metre. [4]

Question 9

(a) If $\begin{pmatrix} 8 & -2 \\ 1 & 4 \end{pmatrix} \times A = \begin{pmatrix} 12 \\ 10 \end{pmatrix}$

Write down :

- (i) the order of matrix A.
- (ii) the matrix A [3]

- (b) A line PQ is drawn parallel to the base BC of triangle ABC that meets sides AB and AC at points P and Q respectively. If $3AP = PB$; find the value of :

(i) $\frac{\text{Area of triangle ABC}}{\text{Area of triangle APQ}}$ (ii) $\frac{\text{Area of triangle APQ}}{\text{Area of trapezium PBCQ}}$ [3]

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- (c) Mr Harsh Jha invests ₹ 80,000 in 10%, ₹100 shares available at ₹ 25 premium. If income tax is to be deducted at the rate of 20%, find the annual income.

Later on, when the share rises to ₹140, he sells half the shares and invests the proceeds in 15%, ₹10 shares available at ₹2 discount. Find his new annual income, if the income tax is to be deducted at the same rate.

[4]

Question 10

- (a) A right triangle, whose sides are 15 cm and 20 cm, is made to revolve about its hypotenuse. Find the volume and the surface area of the double cone so formed. (take $\pi = 3.14$)

[4]

- (b) The daily wages of 160 workers in a building project are given below:

Wages in ₹	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	60 - 70	70 - 80
No. of workers	12	20	30	38	24	16	12	8

Using a graph paper, draw an ogive for the above distribution.

Use your ogive to estimate:

- the median wage of the workers.
- the upper quartile wage of the workers.
- The lower quartile wage of the workers.
- The percentage of workers who earn more than ₹ 45 a day.

[6]

Question 11

- (a) Draw a circle of radius 3 cm. Mark a point P at a distance of 5 cm from the center of the circle drawn. Draw two tangents PA and PB to the given circle and measure the length of each tangent.

[4]

- (b) Two trains X and Y start from a railway station at the same time. The X train travels due west and the Y train due north. The X train travels 5 km/hr faster than the Y train. If after two hours, they are 50 km apart, find the average speed of each train.

[3]

- (c) From a point P, two tangents PA and PB are drawn to a circle C(O,r). If $OP = 2r$, Show that APB is an equilateral triangle. Also find angle AOB and angle AQB, where Q is any point on the circumference of circle in major segment.

[3]

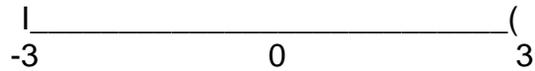
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Answers:

1(a) Solution set = $\{ x : x \in \mathbb{R}, -3 \leq x < 3 \}$,



1(b) Puja = ₹120, Nilakshi = ₹70

1(c) 60

2(a) $a = 2$

2(b) ₹8000, $r = 4\%$

2(c) (i) (3, 4), (ii) 5 units (iii) 4:17

3(a) 168/275

3(c) 14cm, 21cm; 16:5:4

4(a) $a = -3, b = -1, (x - 2)(x^2 - x - 3)$

4(b) 24 units

4(c) (i) 16, (ii) 15 (iii) 154, (iv) 14.

5(a) 6.53, -1.53

5(c) ₹11306.65

6(a) ₹60, or ₹40

6(c) (i) $y = 0, x = 0$

(ii) $P' = (3, -4), Q' = (-5, 2)$

(iii) $P'' = (-3, 4), Q'' = (5, -2)$

(iv) Reflection in origin

7(a) $CQ =$

7(b) (i) $AM : 3x - 4y = 0$

(ii) $BN : 8x + 3y = 50$

(iii) (4, -3)

7(c) $(n^2 - m^2) / 2m$

8 (a) $x = y = -1$

8 (b) (i) 38.1

(ii) 87

8(c) 10.95

9 (a) order 2×1 ,

$$A = \begin{pmatrix} 2 \\ 2 \end{pmatrix}$$

9(b) 16:1, 1:15

9(c) ₹5120, ₹9280

10(a) Volume : 3768 cm^3 , Surface area = 1318.8 cm^2

10(b) (i) 35, (ii) 48, (iii) 24, (iv) 28.75%

11(a) 6 cm

11(b) 15 km/hr

11(c) angle $AOB = 120^\circ$, angle $AQB = 60^\circ$.