

BUDHA DAL PUBLIC SCHOOL PATIALA
FIRST TERM EXAMINATION (20 September 2025)
Class - XII
Paper- Applied Mathematics (241)

Time: 3hrs.

M.M. 80

General Instructions:

1. Section A has 18 MCQ's and 02 Assertion-Reason based questions of 1 mark each.
3. Section B has 5 Very Short Answer type questions of 2 marks each.
4. Section C has 6 Short Answer type questions of 3 marks each.
5. Section D has 4 Long Answer type questions of 5 marks each.
6. Section E has 3 case based studies of 4 marks each.

Section - A

1. $(18 \times 10) \pmod{7}$ is
 - a) 5
 - b) 4
 - c) 3
 - d) 2
2. If $100 \equiv x \pmod{7}$, then the least positive value of x is
 - a) 2
 - b) 3
 - c) 6
 - d) 4
3. If a man rows 32 km downstream and 14 km upstream in a 6 hours each, then speed of stream is
 - a) 2 km/hr
 - b) 1.5 km/hr
 - c) 2.5 km/hr
 - d) 2.25 km/hr
4. In what ratio must water be mixed with milk to gain $16\frac{2}{3}\%$ on selling the mixture at cost price?
 - a) $1:6$
 - b) $6:1$
 - c) $3:2$
 - d) $2:3$
5. In what ratio must a grocer mix two varieties of pulses costing Rs. 85 per kg and Rs. 100 per kg respectively so as to get a mixture worth Rs. 92/kg?
 - a) $7:8$
 - b) $8:7$
 - c) $5:7$
 - d) $7:5$
6. Pipes A and B can fill a tank in 5 hours and 6 hours respectively. Pipe C can empty it in 12 hours. If all the three pipes are opened together, then time taken to fill the tank is
 - a) 2 hours
 - b) $2\frac{3}{4} \text{ hrs}$
 - c) 3 hrs
 - d) $3\frac{9}{17} \text{ hrs}$
7. In a 50 m race, A can give a start of 5m to B and a start of 14m to C. In the same race, how much start can B give to C?
 - a) 9 m
 - b) 10 m
 - c) 11 m
 - d) 12 m
8. The solution set of $6 \leq -3(2x - 4) < 12, x \in \mathbb{R}$ is
 - a) $(0, 1]$
 - b) $[1, 0)$
 - c) $(0, 1)$
 - d) $[0, 1]$
9. If $x \leq 8$, then
 - a) $-x \leq -8$
 - b) $-x \geq -8$
 - c) $-x < -8$
 - d) $-x > -8$

10. If A and B are symmetric matrices of same order, then $AB - BA$ is a

- a) Symmetric matrix
- b) skew-symmetric matrix
- c) zero matrix
- d) identity matrix

11. The number of all possible matrices of order 3×3 with each entry 0 or 1 is

- a) 18
- b) 27
- c) 81
- d) 512

12. If A is a square matrix of order 3×3 such that $|A| = 4$, then $|3A| =$

- a) 27
- b) 81
- c) 108
- d) 256

13. If for matrix A, $A^3 = I$, then $A^{-1} =$

- a) A
- b) A^2
- c) A^3
- d) None of these

14. Derivative of a^{2x+3} w.r.t. x is

- a) $2a^{2x+3}$
- b) $2a^{2x+3} \log a$
- c) $a^{2x+3} \log a$
- d) a^{2x+3}

15. If $x^y = e^{x-y}$, then $\frac{dy}{dx} =$

- a) $\frac{-\log x}{(1+\log x)^2}$
- b) $\frac{\log x}{(1+\log x)^2}$
- c) $\frac{-\log x}{1+\log x}$
- d) $\frac{\log x}{1+\log x}$

16. If radius of a circle is increasing at the rate of 2cm/sec, then the area of the circle when its radius is 20cm is increasing at the rate of

- a) $80\pi \text{ m}^2/\text{sec}$
- b) $80 \text{ m}^2/\text{sec}$
- c) $80\pi \text{ cm}^2/\text{sec}$
- d) $80 \text{ cm}^2/\text{sec}$

17. The rise in prices before Diwali is an example of

- a) Seasonal trend
- b) cyclic trend
- c) long term trend
- d) irregular trend

18. A box contains 100 bulbs of which 10 are defective. The probability that out of a sample of 5 bulbs drawn one by one with replacement none is defective is.

- a) $\left(\frac{1}{2}\right)^5$
- b) $\frac{9}{10}$
- c) $\left(\frac{9}{10}\right)^5$
- d) $\left(\frac{1}{10}\right)^5$

Assertion - Reason Based Questions

The following questions consists of two statements - Assertion (A) and Reason (R). Answer the question selecting appropriate option given below:

- a) Both A and R are true and R is correct explanation for R.
- b) Both A and R are true but R is not correct explanation for R.
- c) A is true but R is false.
- d) A is false but R is true.

19. Assertion (A) : For given six values 17, 22, 21, 35, 40, 51, the three years moving averages are 20, 26, 32, 42

Reason (R) : If $x_1, x_2, x_3, \dots, x_n$ is given annual time series, then 3 yearly moving averages are $\frac{x_1+x_2+x_3}{3}, \frac{x_2+x_3+x_4}{3}, \dots$

20. Assertion (A) : Kunal and Vihaan are two equally capable badminton players. Probability that Vihaan will beat Kunal in 3 games out of 4 is 25%.
 Reason (R) : The probability of r successes in n -trials, denoted by $P(X = r)$ is given by
 $P(X = r) = n_{C_r} p^r q^{n-r}, i = 0, 1, 2, \dots, n$

Section - B

21. Pipe A can fill the tank 2 times faster than pipe B. If both pipes A and B running together can fill the tank in 24 minutes. Find how much time will pipe B alone take to fill the tank?

22. Given $\begin{bmatrix} x & y \\ z & w \end{bmatrix} = \begin{bmatrix} x & 6 \\ -1 & 2w \end{bmatrix} + \begin{bmatrix} 4 & x+y \\ z+w & 3 \end{bmatrix}$, find values of x, y, z and w

23. If $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$, find $|A \text{ adj } A|$

24. Find the second ^{order} derivative of $x^3 \log x$

25. Find the probability distribution of X , the number of heads in three tosses of a coin.

Section - C

26. A particular river near a small town floods and overflows twice in every 10 years on an average. Assuming that the Poisson distribution is appropriate, what is mean expectation? Also calculate the probability of 3 or less overflow floods in a 10 years interval.
 (use $e^{-2} = 0.135$)

27. Find the intervals in which the function $f(x) = 20 - 6x^2 - x^3$ is strictly increasing or decreasing.

28. Find $\frac{dy}{dx}$ if $x = \frac{1+\log t}{t^2}, y = \frac{3+2 \log t}{t}$

29. Solve following system of linear equations by Cramer's Rule :

$$\begin{aligned} 6x + y - 3z - 5 &= 0 \\ x + 3y - 2z - 5 &= 0 \\ 2x + y + 4z - 8 &= 0 \end{aligned}$$

30. Solve (a) $4 - 5x > -11, 4x + 11 \leq -13$ b) $|x + 3| \leq 5$

31. A runs 3 times as fast as B. If A gives B a start of 50m. Find how far must be the finish point on the race course so that A and B reach the goal at the same time?

Section - D

32. A metal box with a square base and vertical sides is to contain 1024 cm^3 . The material for the top and bottom costs ~~25/~~ cm^2 and the material for the sides costs Rs. $2.50/\text{cm}^2$. Find the least cost of the box. $\text{Rs } 5/\text{cm}^2$

33. Fit a straight line trend by the method of least squares and tabulate the trend values from the data

Year	2004	2005	2006	2007	2008	2009	2010
Profit	114	130	126	144	138	156	164

34. A random variable X has the following probability distribution

X	0	1	2	3	4	5	6	7
$P(X)$	0	k	$2k$	$2k$	$3k$	k^2	$2k^2$	$7k^2+k$

Determine

a) k b) $P(X < 3)$ c) $P(X > 6)$ d) $P(0 < X < 3)$ e) $P(X > 3)$

35. Find A^{-1} , where $A = \begin{bmatrix} 4 & 2 & 3 \\ 1 & 1 & 1 \\ 3 & 1 & -2 \end{bmatrix}$. Hence, solve the system of equations :

$$4x + 2y + 3z = 2, x + y + z = 1, 3x + y - 2z = 5$$

Section - E (Case Studies)

36. A school wants to award its students for the values of honesty, regularity and hard work with a total cash award of Rs. 6000. Three times the award money for hard work added to that given for honesty amounts to Rs. 11,000. The award money given for honesty and hard work together is double the one given for regularity.

Based on above information, answer the following questions

a) If Rs. x is awarded to honesty, Rs. y to regularity and Rs. z awarded to hard work, then what is the matrix equation representing the above situation?
b) What is the value of $|adj A|$?
c) What are the values of x, y, z in this case?

OR

What is the value of $(adj A)$?

37. Ruby is rowing a boat. She takes 6 hours to row 48 km upstream whereas she takes 3 hours to go the same distance downstream.



Based on above information, answer the following questions

- a) What is her speed of rowing in still water?
- b) What is the speed of the stream?
- c) What is her average speed?

OR

The stream is flowing at the speed of 4 km/h. If Ruby rows a certain distance upstream in 3.5 hours and returns to the same place in 1.5 hours, then find the speed of Ruby's boat in still water.

38. An urn contains 25 balls of which 10 balls bear a mark X and remaining 15 bear a mark Y. A ball is drawn at random from the urn, its mark is noted down and it is replaced. In this way 6 balls are drawn.

Based on above information, answer the following questions

- a) Find the probability that all balls will bear X mark.
- b) Find the probability that the number of balls with X mark and Y mark will be equal.
- c) Find the probability that atmost 2 balls will bear mark Y.

OR

Find the probability that atleast 2 balls bear mark Y.