CBSE CLASS XII

APPLIED MATHEMATICS

QUESTION PAPER 2024-25

EXAM HELD ON 08-03-2025

Question paper code
465

REGION

Series : W1XZY

SET ~ 4

रोल नं.

Roll No.

प्रश्न-पत्र कोड Q.P. Code **465**

परीक्षार्थी प्रश्न-पत्र कोड को उत्तर-पुस्तिका के मुख-पृष्ठ पर अवश्य लिखें ।

Candidates must write the Q.P. Code on the title page of the answer-book.

व्यावहारिक गणित

APPLIED MATHEMATICS

निर्धारित समय : 3 घण्टे *अधिकतम अंक : 80*

Time allowed : 3 hours *Maximum Marks : 80*

नोट

(I) कृपया जाँच कर लें कि इस प्रश्न-पत्र में मुद्रित पृष्ठ 23 हैं ।

(II) कृपया जाँच कर लें कि इस प्रश्न-पत्र में 38 प्रश्न हैं ।

(III) प्रश्न-पत्र में दाहिने हाथ की ओर दिए गए प्रश्न-पत्र कोड को परीक्षार्थी उत्तर-पुस्तिका के मुख-पृष्ठ पर लिखें ।

(IV) कृपया प्रश्न का उत्तर लिखना शुरू करने से पहले, उत्तर-पुस्तिका में यथा स्थान पर प्रश्न का क्रमांक अवश्य लिखें ।

(V) इस प्रश्न-पत्र को पढ़ने के लिए 15 मिनट का समय दिया गया है । प्रश्न-पत्र का वितरण पूर्वाह्न में 10.15 बजे किया जाएगा । 10.15 बजे से 10.30 बजे तक परीक्षार्थी केवल प्रश्न-पत्र को पढ़ेंगे और इस अवधि के दौरान वे उत्तर-पुस्तिका पर कोई उत्तर नहीं लिखेंगे ।

NOTE

(I) Please check that this question paper contains **23** printed pages.

(II) Please check that this question paper contains **38** questions.

(III) Q.P. Code given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.

(IV) **Please write down the serial number of the question in the answer-book at the given place before attempting it.**

(V) 15 minute time has been allotted to read this question paper. The question paper will be distributed at 10.15 a.m. From 10.15 a.m. to 10.30 a.m., the candidates will read the question paper only and will not write any answer on the answer-book during this period. ~

General Instructions :

Read the following instructions very carefully and strictly follow them :

(i) *This question paper contains 38 questions. **All** questions are **compulsory**.*

(ii) *This question paper is divided into **five** Sections – Section **A**, **B**, **C**, **D** and **E**.*

(iii) *In Section – **A**, Questions Number **1** to **18** are Multiple Choice Questions (MCQs) and questions Number **19** & **20** are Assertion-Reason based questions of **1** mark each.*

(iv) *In Section – **B**, Questions Number **21** to **25** are Very Short Answer (VSA) type questions, carrying **2** marks each.*

(v) *In Section – **C**, Questions Number **26** to **31** are Short Answer (SA) type questions, carrying **3** marks each.*

(vi) *In Section – **D**, Questions Number **32** to **35** are Long Answer (LA) type questions, carrying **5** marks each.*

(vii) *In Section – **E**, Questions Number **36** to **38** are case study based questions, carrying **4** marks each.*

(viii) *There is no overall choice. However, an internal choice has been provided in **2** questions in Section – **B**, **2** questions in Section – **C**, **2** questions in Section – **D** and **3** questions in Section – **E**.*

(ix) *Use of calculators is **NOT** allowed.*

SECTION – A

This section comprises of Multiple Choice Questions (MCQs) of 1 mark each. Select the correct option (Question 1 to Question 18) :

1. $-41 \bmod 9$ is

(A) 5 (B) 4

(C) 3 (D) 0

2. If $a > b$ and $c < 0$, then which of the following is true ?

(A) $a + c < b + c$ (B) $a - c < b - c$

(C) $a c > b c$ (D) $a - c > b + c$

3. If A and B are symmetric matrices of the same order, then $(AB' - BA')$ is a

(A) symmetric matrix (B) null matrix

(C) diagonal matrix (D) skew symmetric matrix

4. The inverse of matrix $A = \begin{bmatrix} 4 & -1 \\ 2 & 1 \end{bmatrix}$ is

(A) $\frac{1}{6}\begin{bmatrix} -4 & 2 \\ -1 & -1 \end{bmatrix}$ (B) $\begin{bmatrix} 1/3 & 1/6 \\ 2/3 & -1/6 \end{bmatrix}$

(C) $\begin{bmatrix} 1/6 & 1/6 \\ -1/3 & 2/3 \end{bmatrix}$ (D) $\begin{bmatrix} -2/3 & 1/6 \\ -1/3 & -1/6 \end{bmatrix}$

5. If $\begin{vmatrix} 2x & 5 \\ 4 & x \end{vmatrix} = \begin{vmatrix} 3 & 5 \\ 4 & 6 \end{vmatrix}$, then the value of x is

(A) $3/2$ (B) 6

(C) 3 (D) ± 3

6. The slope of the normal to the curve $y = \frac{x-3}{x-4}$ at $x = 6$ is

(A) 4 (B) $-\frac{1}{4}$

(C) -4 (D) $\frac{1}{4}$

7. The rate of change of population P(t) with respect to time (t), where α, β are the constant birth and death rates, respectively, is

(A) $\frac{dP}{dt} = (\alpha + \beta)P$ (B) $\frac{dP}{dt} = (\alpha - \beta)P$

(C) $\frac{dP}{dt} = \frac{\alpha + \beta}{P}$ (D) $\frac{dP}{dt} = \frac{\alpha - \beta}{P}$

8. A pair of dice is thrown two times. If X represents the number of doublets obtained, then the expectation of X is

(A) $\frac{1}{6}$ (B) 1

(C) $\frac{1}{3}$ (D) $\frac{11}{36}$

9. The mean of t-distribution is

(A) 0 (B) 1

(C) 2 (D) not defined

10. The variations which occur due to change in climate, festivals or weather conditions are known as

(A) secular variations (B) cyclic variations

(C) seasonal variations (D) irregular variations

11. In a LPP, the maximum value of $z = 3x + 4y$ subject to the constraints $x + y \leq 40$, $x + 2y \leq 60$, $x, y \geq 0$ is

(A) 120 (B) 140

(C) 150 (D) 130

12. The present value of a sequence of payments of ₹ 100 made at the end of every year and continuing forever, if the money is worth 5% compounded annually, is

(A) ₹ 2,000 (B) ₹ 20,000

(C) ₹ 5,000 (D) ₹ 12,000

13. The demand function of a monopolist is given by $p = 30 + 5x - 3x^2$, where x is the number of units demanded and p is the price per unit. The marginal revenue when 2 units are sold, is

(A) ₹ 28 (B) ₹ 23

(C) ₹ 1 (D) ₹ 14

14. If the cost function and revenue function of x items are respectively given as $C(x) = 100 + 0.015\,x^2$, $R(x) = 3x$, then the value of x for maximum profit is

(A) 50 (B) 100

(C) 150 (D) 200

15. If a random variable X has the probability distribution

$$P(X = x) = \begin{cases} k, & \text{if } x = 0 \\ 2k, & \text{if } x = 1 \text{ or } 2 \\ 0, & \text{otherwise,} \end{cases}$$

then the value of k is

(A) $\frac{1}{3}$ (B) $\frac{1}{5}$

(C) $\frac{1}{6}$ (D) $\frac{1}{4}$

16. The test statistic t for testing the significance of differences between the means of two independent samples is given by

(A) $t = \frac{\bar{x} - \bar{y}}{\sqrt{s}}$ (B) $t = \frac{\bar{x} - \bar{y}}{s\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$

(C) $t = \frac{\bar{x} - \bar{y}}{\frac{s}{\sqrt{n-1}}}$ (D) $t = \frac{\bar{x} + \bar{y}}{s\sqrt{\frac{1}{n_1} - \frac{1}{n_2}}}$

17. The effective rate of interest equivalent to a nominal rate of 4% compounded semi-annually, is

(A) 4.12% (B) 4.04%

(C) 4.08% (D) 4.14%

18. The CAGR of an investment, whose starting value is ₹ 5,000 and it grows to ₹ 25,000 in 4 years, is : [Given $(5)^{0.25} = 1.4953$]

(A) 49.53% (B) 14.95%

(C) 495.3% (D) 1.49%

Questions number **19** and **20** are Assertion – Reason based questions of **1** mark each. Two statements are given – one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below :

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is correct explanation of Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not correct explanation for Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

19. **Assertion (A)** : The area of the region bounded by the line $y - 1 = x$, the x-axis and the ordinates $x = -1$ and $x = 1$ is 2 square units.

Reason (R) : The area of the region bounded by the curve $y = f(x)$, the x-axis and the ordinates $x = a$ and $x = b$ is given by $\int_a^b f(x)\,dx$.

20. **Assertion (A)** : The differential equation representing the family of curves $y = mx$, m being an arbitrary constant, is $x\frac{dy}{dx} - y = 0$.

Reason (R) : For a family of curves, the differential equation is obtained by differentiating the equation of family of curves with respect to x and then eliminating the arbitrary constant, if any.

SECTION – B

Questions Number 21 to 25 are Very Short Answer (VSA) type questions of 2 marks each.

21. (a) The cost of Type I sugar is ₹ 25 per kg and Type II sugar is ₹ 35 per kg. If both Type I sugar and Type II sugar are mixed in the ratio 3:2, find the price per kg of the mixture.

OR

(b) Pipe A can fill a tank in 1 hour and Pipe B can fill it in 1½ hours. If both the pipes are opened in the empty tank, how much time will they take to fill the tank ?

22. A boat goes 3.5 km upstream and then returns. Total time taken is 1 hour and 12 minutes. If the speed of the current is 1 km/h, then find the speed of the boat in still water.

23. A runs $\frac{3}{2}$ times as fast as B. If A gives B a start of 40 m, how far must the winning post from the starting point be, so that A and B reach at the same time ?

24. Given $A = \begin{bmatrix} 2 & 0 & 1 \\ 3 & 4 & 5 \\ 0 & 2 & 3 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 1 & -5 \\ -5 & 1 & -5 \\ 1 & -2 & 4 \end{bmatrix}$, find BA.

25. (a) If a fair coin is tossed 6 times, find the probability of getting atleast 4 heads.

OR

(b) Given that mean of a normal variate X is 9 and standard deviation is 3, then find :

(i) the z-score of the data point 15

(ii) the data point if its z-score is 4.

SECTION – C

Questions Number 26 to 31 are Short Answer (SA) type questions of 3 marks each.

26. Find the units digit in 7^{295}.

27. Two numbers are selected at random (without replacement) from first six positive integers. Let X denotes the smaller of the two numbers obtained. Calculate the mathematical expectation of X.

28. (a) If the mean and variance of a binomial distribution are $\frac{4}{3}$ and $\frac{8}{9}$ respectively, then find $P(x = 1)$.

OR

(b) The mortality rate for a certain disease is 0.007. Using Poisson distribution, calculate the probability for 2 deaths in a group of 400 people. [Use $e^{-2.8} = 0.0608$]

29. (a) There are two types of fertilizers F_1 and F_2. F_1 consists of 10% nitrogen and 6% phosphoric acid. F_2 consists of 5% nitrogen and 10% phosphoric acid. After testing the soil conditions, a farmer finds that he needs atleast 14 kg of nitrogen and 14 kg of phosphoric acid for his crop. If F_1 costs ₹ 6 per kg and F_2 costs ₹ 5 per kg, how much of each type of fertilizer should be used so that the cost is minimum. Formulate a linear programming problem.

OR

(b) Solve the following linear programming problem graphically :

Maximise $z = 50x + 30y$

subject to $2x + y \leq 18$

$3x + 2y \leq 34$

$x, y \geq 0$.

30. A machinist is making engine parts with axle diameter of 0.7 cm. A random sample of 10 parts shows mean diameter 0.742 cm with a standard deviation of 0.04 cm. On the basis of this sample, find if you would say that the work is inferior. (Given t_9 (0.05) = 2.262)

31. Calculate EMI under Flat-Rate System for a loan of ₹ 5,00,000 with 7.5% annual interest rate for 5 years.

SECTION – D

Questions number **32** to **35** are Long Answer (LA) type questions of **5** marks each.

32. (a) If $A = \begin{bmatrix} 2 & -3 & 5 \\ 3 & 2 & -4 \\ 1 & 1 & -2 \end{bmatrix}$, find A^{-1} and hence solve the following system of linear equations :

$2x - 3y + 5z = 11,\ 3x + 2y - 4z = -5,\ x + y - 2z = -3$

OR

(b) Using properties of determinants, prove that

$$\Delta = \begin{vmatrix} (b+c)^2 & a^2 & a^2 \\ b^2 & (c+a)^2 & b^2 \\ c^2 & c^2 & (a+b)^2 \end{vmatrix} = 2abc\,(a+b+c)^3$$

33. If the supply function is $p = 4 - 5x + x^2$, then find the producer's surplus when price is 18.

34. (a) Compute the seasonal indices by 4-year moving averages from the given data of production of paper (in thousand tons) :

Year :	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Index number :	2450	1470	2150	1800	1210	1950	2300	2500	2480	2680

OR

(b) Fit a straight-line trend by method of least squares for the following data :

Year :	2011	2012	2013	2014	2015	2016
Production (in tons) :	210	225	275	220	240	235

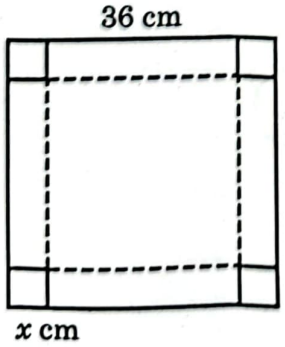
35. A machine costs ₹ 1,00,000 and its effective life is estimated to be 12 years. A sinking fund is created for replacing the machine by a new model at the end of its life time when its scrap realizes a sum of ₹ 5,000 only. Find what amount should be set aside at the end of each year, out of the profits for the sinking fund if it accumulates at 5% effective.

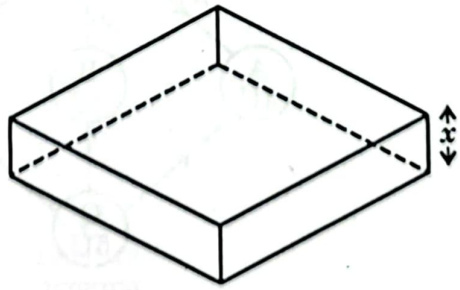
[Use $(1.05)^{12} = 1.7958$]

SECTION – E

Questions number **36** to **38** are case-study based questions of **4** marks each.

36. A man has an expensive square-shaped piece of golden board of side 36 cm. He wants to turn it into a box without top by cutting a square from each corner and folding the flaps. Let x cm be the side of square, which is cut from each corner.





Based on the above information, answer the following questions :

(i) Find the expression for the volume (V) of open box in terms of x.

(ii) Find $\frac{dV}{dx}$.

(iii) Find the value of x for which the volume (V) is maximum.

OR

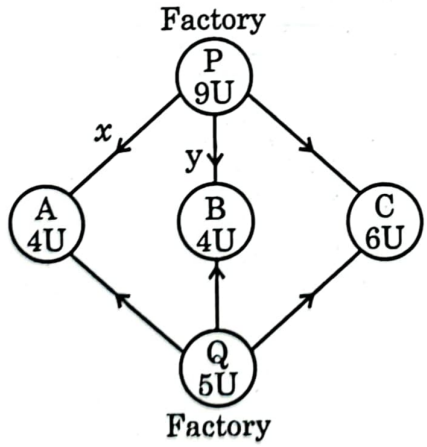
(iii) Find the maximum volume of the open box.

37. There are two factories located one at P and the other at Q. From these locations, a certain commodity is to be delivered to each of the three depots situated at A, B and C. The weekly requirements of the depots are respectively 4, 4 and 6 units of the commodity while the production capacity of the factories at P and Q are 9 and 5 units respectively. The cost of transportation per unit is given as :

From / To	Cost (in ₹)		
	A	B	C
P	160	100	150
Q	100	120	100

Based on the above information, answer the following questions :

Let x units and y units of the commodity be transported from factory P to the depots at A and B respectively, then



(i) Find (in terms of x and y) how many units of commodity be transported from factory P to depot C.

(ii) Find how many units of commodity be transported from factory Q to A, B and C respectively.

(iii) Using (i) and (ii), find the total transportation cost z.

OR

(iii) Using (i) and (ii), find the constraint inequalities for minimum cost z.

38. Ramesh borrowed a home loan amount of ₹ 7,00,000 from a bank at an interest of 12% per annum for 30 years, to be paid in monthly installments.

Based on the above information, answer the following questions :

(i) Write the formula for calculating EMI by reducing balance method.

(ii) Write the values of P, i and n respectively.

(iii) Find the EMI. [Use $(1.01)^{-360} = 0.02781668$]

OR

(iii) If the loan is to be returned in 20 years, find EMI.

[Use $(1.01)^{-240} = 0.09180584$]