SAHODAYA SCHOOL COMPLEX PUDUCHERRY

COMMON SAHODAYA PRE BOARD EXAMINATIONS- 2023

CLASS XII Applied Mathematics(241) Set-C

Time Allowed: 3 hrs **Maximum Marks: 80**

General Instructions:

1. This question paper contains five sections A, B, C, D and E. Each section is compulsory.
2. Section - A carries 20 marks weightage, Section - B carries 10 marks weightage, Section - C carries 18 marks weightage, Section – D carries 20 marks weightage and Section – E carries 3 case-based questions with total weightage of 12 marks.
3. Section A comprises of 18 MCQs and 2 Assertion- Reason based question of 1 mark each.
4. Section B comprises of 5 VSA type questions of 2 marks each.
5. Section C comprises of 6 SA type questions of 3 marks each.
6. Section D comprises of 4 LA type of questions of 5 marks each.
7. Section E has 3 case studies. Each case study comprises of 3 case-based questions, where 2 VSA type questions are of 1 mark each and 1 SA type question is of 2 marks. Internal choice is provided in 2 marks question in each case-study.
8. Internal choice is provided in 2 questions in Section – B, 2 questions in Section – C, 2 questions in Section – D. You have to attempt only one of the alternatives in all such questions.

SECTION –A

Q1. If A and B are invertible matrices, then which of the following statement is not correct. (1)

(a) adj A = | A | A^{-1} (b) det (A^{-1}) = $(\det A)^{-1}$

(c) $(A + B)^{-1} = A^{-1}+B^{-1}$ (d) $(AB)^{-1} = B^{-1} A^{-1}$

Q2. If let A be a square matrix of order 2x2,then | KA | is equal to

(a) K| A | (b) K^2| A | (c) K^3| A | (d) 2K| A | (1)

Q3. What effective rate is equivalent to a nominal rate of 8% converted quarterly?

(a) 8.24% (b) 8.25% (c) 8.27% (d) 8.30% (1)

Q4. Find the value of 5^6(mod4)

(a) 1 (b) 2 (c) 3 (d) 4 (1)

Q5. The slope of the tangent at a point (2,6) to the curve $y=x^3-x$

(a) -11 (b) 11 (c) 1/11 (d) -1/11 (1)

Q6. In a game of 160 points, A can give 10 points to B and 30 points to C. How many points B can give to C in a game of 60 points? (1)

(a) 4 points (b) 6 points (c) 7 points (d) 8 points

Q7. $\int (e^x + 2x - 3)\, dx$ is equal to:
(a) $x^2 - 3x + xe^x + C$ (b) $x^2 - 3x + e^x + C$ (c) $x^2 - 3x - e^x + C$ (d) $x^2 + 3x + xe^x + C$ (1)

Q8. The function $f(x) = x^3 + 3x$ is increasing on
(a) $(-\infty, 0)$ (b) $(0, \infty)$ (c) R (d) (0, 1) (1)

Q9. A man purchases a lottery ticket, in which he may win the first prize of ₹ 1,00,000 with probability 0.0001 or the second prize of ₹ 40,000 with probability 0.0004. Expected value of winning / losing is : (1)
(a) 26 (b) 25 (c) 23 (d) 24

Q10. In a Poisson distribution the sum of mean and variance is 32. Its S.D. is
(a) 4 (b) 8 (c) 128 (d) 256 (1)

Q11. If the mean and variance of a binomial distribution are 4 and 2 respectively, then the Probability of 2 successes is: (1)
(a) 28256 (b) 219256 (c) 128256 (d) 37256

Q12. If we want to examine that on an average college student take less than five years to complete their education. The null and alternative hypotheses are: (1)
(a) $H_0 : \mu \geq 5$ $H_1 : \mu < 5$, (b) $H_0 : \mu \geq 5$, $H_1 : \mu = 5$
(c) $H_0 : \mu \geq 4$, $H_1 : \mu < 5$ (d) none of these

Q13. If 'X' is normally distributed with mean 30 and variance 25, then the standard normal variable Z corresponding to X = 32 is: (1)
(a) 0.08 (b) 0.48 (c) 0.44 (d) 0.4

Q14. For the purpose of t-test of significance, a random sample of size (n) 34 is drawn from a normal population, then the degree of freedom (v) is: (1)
(a) 134 (b) 33 (c) 34 (d) 35

Q15. What is the face value of a sinking fund that yields a dividend of ₹1800 at 10% semi-annually? (1)
(a) ₹ 3600 (b) ₹ 18000 (c) ₹ 24000 (d) ₹ 36000

Q16. The number of all possible matrix of order 3x3 with each entry 0 or 1 is..
(a) 27 (b) 18 (c) 81 (d) 512 (1)

Q17. In a school, a random sample of 145 students is taken to check whether a student's average calory intake is 1500 or not. The collected data of average calories intake of sample students is presented in a frequency distribution, which is called : (1)
(a) Statistics (b) Sampling distribution (c) Parameter (d) Population sampling

Q18. A grain whole-seller visits the granary market. While going around to make a good purchase, he takes a handful of rice from random sacks of rice, in order to inspect the quality of farmers produce. The handful of rice taken from a sack of rice for quality inspection is a: (1)
(a) statistic (b) population (c) parameter (d) sample

Assertion- Reason Based Question:

For questions 19 and 20, two statements are given – one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:

(a) Both (A) and (R) are true and (R) is the correct explanation of (A).

(b) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(c) (A) is true but (R) is false.

(d) (A) is false but (R) is true.

Q19. **Assertion (A):** Kuhu and Beena are two equally capable badminton players. Probability that Beena will beat Kuhu in 3 games out of 4 is 25%. (1)

Reason (R): C The probability of successes in trials, denoted by P(X = r) is given by $P(X = r) = {}^{n}C_r\, p^r\, q^{n-r}$, r = 0, 1,…, n where denotes success and denotes failure in each trial.

Q20. **Assertion (A) :** The third derivative of y = log x is $-\frac{2}{x^3}$

Reason (R) : The differentiation process could be continued to find the third, fourth and successive derivatives of f(x), which are called higher order derivative of f(x). (1)

SECTION – B

Q21. A man can row 6 km/h in still water. It takes him twice as long to row up as to row down the river. Find the speed of the stream. (2)

Q22. It is known that 3% of plastic buckets manufactured in a factory are defective. Using the Poisson distribution on a sample of 100 buckets, find the probability of zero defective buckets,[Use $e^{-3} = 0.049$] (2)

OR

In a math aptitude test, student scores are found to be normally distributed having mean as 45 and standard deviation 5. What percentage of students have scores more than the mean score?

Q23. A shoemaker company produces a specific model of shoes having 15 month average lifetime. One of the employees in their R. D. division claims to have developed a product that lasts longer. This latest product was worn by 30 people and lasted on average for 17 months. The variability of the original shoe is estimated based on the standard deviation of the new group which is 5.5 months. Is the designer's claim of a better shoe supported by the findings of the trial? Make your decision using two-tailed testing using 5% level of significance. (Given $t_{29}(0.05) = 2.05$) (2)

OR

Mr. Anup creates an endowment fund of ₹ 60,000 to provide a prize at the starting of every year. This fund earns interest of 8% per annum, compounded annually. What is the prize amount?

Q24. **S**urjeet purchased a new house, costing ₹ 40,00,000 and made a certain amount of down payment so that he can pay the balance by taking a home loan from XYZ Bank. If his equated monthly instalment is ₹ 30,000, at 9% interest compounded monthly (reducing balance method) and payable for 25 years, then what is the initial down payment made by him? [Use $(1.0075)^{-300} = 0.1062$] (2)

Q25. If A and B are symmetric matrices, then prove that AB – BA is a skew symmetric matrix (2)

OR

Using Cramer's rule, show that the following system of equations has no solution:
$2x – y + z = 4$
$x + 3y + 2z = 12$
$3x + 2y + 3z = 10$

SECTION – C

Q26. The speed of a boat in still water is 12 km/h. It takes twice as long as go upstream to a point as to return downstream to the starting point. What is the speed of the stream? (3)

Q27. Using inverse coefficient matrix, solve the $x + 2y = 5$; $y + 2z = 8$; $2x + z = 5$ (3)

OR

The cost of 4 kg onion, 3 kg wheat and 2 kg rice is ₹ 60, The cost of 2 kg onion, 4 kg wheat and 6 kg rice is ₹ 90. The cost of 6 kg onion, 2 kg wheat and 3 kg rice is ₹ 70 .Find the cost of each item per kg. Using Cramer's rule

Q28. The small firm manufactures gold ring and chains. The combined number of rings and chains manufactured per day is almost 24.It takes one hour to make a ring and half hour for a change .The maximum number of hours available per day is 16.If the profit of the ring is Rs.300 and chain is Rs.190 how many of each should be manufacture daily so as do maximise the profit. (3)

OR

Solve the following LPP graphically using corner point method:
Minimise $Z = x - 5y + 20$
subject to the constraints
$x – y \geq 0$; $-x + 2y \geq 2$; $x \geq 3$, $y \leq 4$ $x \geq 0$, $y \geq 0$

Q29. Under the pure market competition scenario, the demand function p_d and the supply function p_s for a certain commodity are given as $p_d = \frac{8}{x+1} - 2$ and $p_s = x + \frac{3}{2}$ respectively, where p is the price and x is the quantity of the commodity. Using integrals, find the producer's surplus. (3)

Q30. An urn contains 5 white, 7 red and 8 black balls. If four balls are drawn one by one with replacement, what is the probability that (i) all are white? (ii) only 3 are white? (3)

Q31. 10 years ago, Mr Mehra set up a sinking fund to save for his daughter's higher studies. At the end of 10 years, he has received an amount of ₹ 10,21,760. What amount did he put in the sinking fund at the end of every 6 months for the tenure, which paid him 5% p.a. compounded semi-annually? [Use $(1.025)^{20} = 1.6386$] (3)

SECTION- D

Q32. A person amortizes a loan of Rs.1500000 for renovation of his house by 8 years mortgage at the rate of 12 % p.a compounded monthly. (5)
Find (Given $(1.01)^{96} = 2.5993$, $(1.01)^{57} = 1.7633$)
(i)the equated monthly instalment (ii) the principal outstanding at the beginning of 40^{th} month (iii)the interest paid in 40^{th} payment.

Q33. Mrs. Shamita runs a bread factory and the record of her sales of bakery items for the period of 2015 – 2019 is as follows (5)

Year	2015	2016	2017	2018	2019
Sales(in $)	35	42	46	41	48

(i) By taking year 2017 as origin, use method of least-squares to find the best-fit trend line equation for Mrs. Shamita's business. Show the steps of your working.
(ii) Demonstrate the technique to fit the best-suited straight-line trend by the method of 3-years moving averages. Also draw the trend line.

Q34. An event management company charges ₹ 4,800 per guest, for a bulk booking for 100 guests. In addition, it offers a discount of ₹ 200 for each group of 10 guests over and above 100 guest booking. What is the number of guests that will maximise the amount of money the company receives on a booking? What is the maximum profit on such booking? (5)

OR

To manufacture 'x' number of dolls, a company's total cost function C(x) is given by $C(x) = 100 + 0.025x^2$ and the total revenue function R(x) is described as R(x) = 5x. Given that C(x) and R(x) are in thousand rupees, what number of dolls shall be manufactured to maximise the profit of the company? What is the maximum profit?

Q35. Rahul is at the whole sale market to purchase folding tables and chairs, to later sell them at his furniture shop. He has only ₹ 5,760 to spend and his van has space to carry at the most 20 items. A table costs him ₹ 360 and a chair costs ₹ 240. Back at his shop, he plans to sell a table at a profit of ₹ 22 and a chair at a profit of 18. Given that he can sell all the items that he purchases, how many tables and chairs shall he purchase In order to maximise his profit? (5)

OR

There are two factories located one at place P and the other at place 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 5, 5 and 4 units of the commodity while the production capacity of the factories at P and Q are respectively 8 and 6 units. The cost of transportation per unit is given below:

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

How many Units should be transported from each factory to each depot in order that the transportation cost in minimum. What will be the minimum transportation cost?

SECTION- E

Q36. In a Kilometre race, if A gives B, a start of 40 m, than A wins by 19 seconds but if in a Kilometre race A gives B, a start of 30 seconds then B wins by 40 m. Let the time taken by A to run 1 km be x sec and time taken by B to run 1 km be y sec. Based on above information answers the following questions:

a) In first case, find the time taken by B to complete the race? (1)

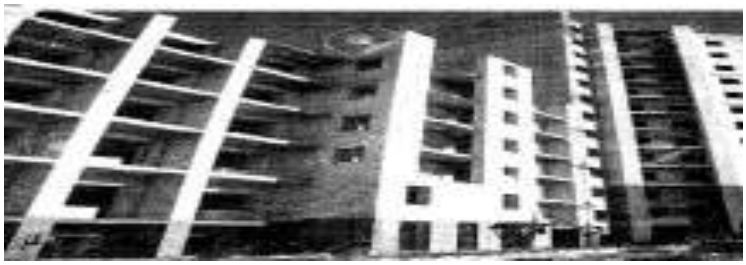
b) If A gives a start of 30 seconds to B, then how much time does A run for. (1)

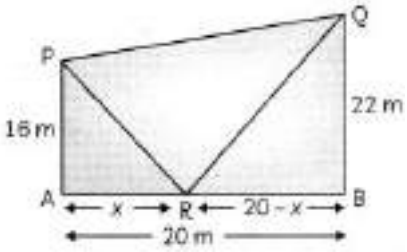
c) What is the time taken by A to run a kilometre? (2)

OR

A can run 22.5m while B runs 25m. By what distance B beat A in a kilometre race?

Q37. Two multi storey building (represented by AP and BQ) are on opposite side of a 20 m wide road at point A and B respectively. There is a point R. as shown in figure. Based on the above information answer the following questions.





a) What is area of trapezium? (1)

b) What is the length of PQ? (1)

c) Let there be a quantity s, such that $s = RP^2 + RQ^2$, then find the minimum value of s. (2)

OR

Find the interval in which $f(x) = 256 + x^2$ is a decreasing function

Q38.

A machine costs a company ₹ 2, 30, 000 and its the scrap value of the machine at the end of its life is expected to realise ₹ 10,000 only. Effective life is estimated to be 15 years. In order to provide money at that time for a new machine costing the same amount, a sinking fund is set up. Equal amount of ₹10,000 is contributed to the fund at the end of every year and the funds earns an interest at 6% per annum compounded annually. Based on above information answers the following questions:

a) What amount of money is needed to buy the new machine at the end of 15 years? (1)

b) What amount of money is contributed to the sinking fund at the end of every year? (1)

c) What amount of interest will be earned by the sinking fund over a period of 15 years? (2)

OR

If a discount of 5% on the purchase of the new machine and VAT of 18% is added to the price, what is the net cost of the new machine?