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**PB1/APMQP/1223/A 27-NOV-2023**

**PREBOARD EXAMINATION I- (2023-2024)**

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| **SUBJECT: Applied Mathematics**  **GRADE: XII** | **Maximum Marks: 80****Time Allowed: 3 Hours** |
| **General Instructions:**   1. Section A has 18 MCQ’s and 02 Assertion-Reason based questions of 1 mark each. 2. Section B has 5 Very Short Answer (VSA)-type questions of 2 marks each. 3. Section C has 6 Short Answer (SA)-type questions of 3 marks each. 4. Section D has 4 Long Answer (LA)-type questions of 5 marks each. 5. Section E has 3 source based/case based/passage based/integrated units of   assessment (4 marks each) with sub parts | |

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| **SECTION A**  **(Multiple Choice Questions) Each question carries 1 mark** | |
| **1.** | The revenue function is given by . Find the marginal revenue at x=3.  (a)33 (b) 70 (c) 77 (d) 17 |
| **2.** | If A is a matrix of order 3x3, and A.Adj.A= 3 I . Find the value of  (a) 12 (b) 9 (c) 27 (d) 24 |
| **3.** | Find the point at which the tangent line to the curve y = x 2 – 2x +7 is parallel to X-axis.   1. (0,6) (b) (1,6) (c) (2,7) (d) 6,0) |
| **4.** | Let X be a random variable with mean 𝜇 = 20 and standard deviation 𝜎 = 4. A sample of size 64 is randomly selected from this population, Find the standard deviation of chosen sample.   1. 5 b) 0.2 c) 2 d) 0. |
| **5.** | A=\_\_\_\_\_  (a) 2 (b) 12 (c) 6 (d) 8 |
| **6.** | The t-distribution depends on a parameter known as  (a) Critical value (b) p-value (c) degrees of freedom (d) Hypothesis |
| **7.** | Consider the following hypothesis test:    A sample of 25 provided a sample mean as 14 and a sample standard deviation as 4.32, and then the value of the test statistic is  (a) 2.11 (b) 2.21 (c) 2.31 (d) 2.41 |
| **8.** |  |
| **9.** | The probability distribution of a discrete random variable X is given below :   |  |  |  |  |  | | --- | --- | --- | --- | --- | | X | 2 | 3 | 4 | 5 | | P(X) | 5/k | 7/k | 9/k | 11/k |   The value of k is  (a) 8 (b) 16 (c) 32 (d) 48 |
| **10.** | If y=log) Find  (a) (b) (c) (d) |
| **11.** | A newspaper printing machine costs Rs.400000 and an estimated scrap value of Rs.30000 at the end of its useful life of 10 years. What is its annual depreciation as per linear method?  (a) Rs.40000 (b) Rs.37000 (c) Rs.44000 (d) Rs.37700 |
| **12.** | If A=and, then equals  (a) 2 (b) -1/2 (c) 1/2 (d) 1 |
| **13.** | What sum of money invested now could establish a scholarship of Rs.2500, which is to be awarded at the end of every year forever, if money is worth 4% compounded annually?  (a) Rs.62500 (b) Rs.125000 (c) Rs.31250 (d) Rs.62000 |
| **14.** | Ramesh invested ₹300000 in a fund for two years. At the end of two years the investment was worth ₹327000 then Ramesh’s rate of return is  a) 6% b) 7% c) 8% d)9% |
| **15.** | A measurable characteristic of a sample is called.  (a) Population (b) Statistic (c) Sampling (d) Estimation |
| **16.** | a) b) *c) d) +C* |
| **17.** | Irregular variations in a time series are caused by  (a)Lockouts and strikes (c) Epidemics (b)Floods (d) All of these |
| **18.** | The matrix is a singular matrix, if is equal to  (a) -3 (b) 3 (c) 0 (d) any value of b |
|  | **ASSERTION-REASON BASED QUESTIONS**  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 (i), (ii), (iii) and (iv) as given below:   1. Both A and R are true, and R is the correct explanation of the assertion. 2. Both A and R are true, but R is not the correct explanation of the assertion. 3. A is true, but R is false. 4. A is false, but R is true |
| **19.** | 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%  Reason (R) : The probability of 𝑟 successes in 𝑛 trials, denoted by P(X = 𝑟) is given by  where 𝑝 denotes success and 𝑞 denotes failure in each trial. |
| **20.** | Assertion (A): The function f(x) = x3 – 3x2 + 6x – 100 is strictly increasing on R  Reason (R): If f ’(x) 0 , then f(x) is strictly increasing function. |
| **SECTION B**  **This section comprises of very short answer type-questions (VSA) of 2 marks each** | |
| **21.** | Find the effective rate which is equivalent to the nominal rate of 10% p.a. compounded monthly. [ Given that (1.00833)12=1.1047] |
| **22.** |  |
| **23.** | Find the intervals in which the function is   1. increasing (2) decreasing   **OR**  Find the equation of the tangent line to the curve y = x 2 – 2x +7 which is parallel to the line  2x – y + 9 = 0 |
| **24.** | The average heart rate for Indians is 72 beats per minute. To lower their heart rate, a group of 25 people participated in an aerobics exercise program. The group was tested after six months to see if the group had significantly slowed their heart rate. The average heart rate for the group was 69 beats/minute with a standard deviation of 6.5. Was the aerobics program effective in lowering heart rate? (Given α = 0.05, =1.711) |
| **25.** | If the matrix A = is skew symmetric, find the values of a , b and c. |
|  | **SECTION C**  **(This section comprises of short answer type questions (SA) of 3 marks each)** |
| **26.** |  |
| **27.** | Astha and Roma went to the Big Bazaar. Astha purchased 2 pairs of jeans, 5 tops and 2 pairs of footwear. Roma purchased 3 pairs of jeans, 4 tops and 1 pair of footwear. If a pair of jeans costs ₹500, top costs ₹140 and a pair of footwear costs ₹120, calculate the total amount spent by Astha and Roma in the Big Bazaar using matrix algebra. |
| **28.** | A Cooperative Society of farmers has 50 hectares of land to grow two crops X and Y. The profit from crops X and Y per hectare are estimated at Rs.10,500 and Rs 9,000 respectively. To control weeds, a liquid herbicide must be used for crops X and Y at rates of 20 litres and 10 litres per hectare. Further, no more than 800 litres of herbicide should be used to protect fish and wildlife using a pond which collects drainage from this land. Formulate it as a linear programming problem to maximize the total profit of the Society? |
| **29.** |  |
| **30.** | Mr. Sharma borrowed₹ 500000 from a bank to purchase a house and decided to repay the loan by equal monthly payments in 10 years. If bank charges interest at 7.5% p.a. compounded monthly, Calculate the EMI [Given (1.00625)120=2.1121] |
| **31.** | A machine being used by a company is estimated to have a life of 15 years At that time a new machine would cost ₹750000 and the scrap of the old machine would yield ₹9600 only. A sinking fund is created for replacing the machine at the end of its life. What sum should be retained by the company at the end of every year to accumulate at 6% per annum? [(1.06) 15 = 2.396] |
|  | **SECTION D**  **(This section comprises of long answer-type questions (LA) of 5 marks each)** |
| **32.** | The demand and supply functions for a commodity are  Find the producer’s surplus and consumer’s surplus at equilibrium price. |
| **33.** | In a certain factory turning razor blades, there is a small chance of 1 out of 500 for any blade to be defective. The blades are in packets of 10. Calculate the approximate number of packets containing no defective, one defective and two defective blades respectively in a consignment of 10000 packets. [use 𝑒 -0.02 = 0.9802]  **OR**  The weights of students of class 12 follow normal distribution with mean 50kg and standard deviation 2kg. Find the probability that a student selected at random will have weight.   1. Less than 45 kg 2. More than 54kg 3. Between 48 and 56kg [ F (2.5) =0.9938, F(2)=0.9772,F(3)= 0.9986, F(1)=0.8413] |
| **34.** | A diet is to contain at least 80 units of Vitamin A and 100 units of minerals. Two foods, F1 and F2 are available costing Rs.5 per unit and Rs.6 per unit respectively. One unit of food F1 contains 4 units of vitamin A and 3 units of minerals whereas one unit of food F₂ contains 3 units of vitamin A and 6 units of minerals. Formulate this as a linear programming problem to minimize the cost of diet that consists of mixture of these two foods. |
| **35.** | The sum of three numbers is 6. If we multiply third number by 3 and add it to the second number, we get 11. By adding first and third numbers, we get a number which is double the second number. Use this information and find a system of linear equations. Find the three numbers using the method of matrices. |
|  | **SECTION E**  **(This section comprises of 3 case study/passage -based questions of 4 marks each with two sub-parts. First two case study questions have three sub-parts (i),(ii),(iii) of marks 1,1,2 respectively. The third case study question has two sub-parts of 2 marks each.)** |
| **36.** | **Case study 1**  A sugar cane mill is a factory that processes sugar cane to produce raw or white sugar. The term is also used to refer to the equipment that crushes the sticks of sugar cane to extract the juice. Khatauli’s Triveni Sugar Mill is the largest in Asia in terms of scale of production and storage capacity. The mill has been operational since 1983. A sugar mill is committed to accepting sugar canes from local producers and has experienced the following supply pattern (in thousands of tons/year and rounded).    Based on the above information, answer the following questions. Show steps to support your answers. (a) Develop a linear trend line for the time series using least square method (2)  **OR**  Demonstrate the technique to fit the best suited straight-line trend by t method of 3- year moving averages. Also draw the trend line. (2)  (b) Use this strength to estimate the supply in year 2014. (1)  (c) In which year will the supply be 56.13(1) |
| **37.** | Mr. Dhar is an architect in Dubai.He designed a building and provided an entry door in the shape of a rectangle surmounted by a semi circular opening .The perimeter of the door is 10 m . If 2x meters and y meters be the breadth and the height of the reactangular part of the door, answer the following questions.   1. Find the area in terms of x and y 2. Find the dimensions of the window which allows maximum airflow 3. Find the area of the door which permits the maximum airflow inside the building |
| **38.** | Case study 3  In a manufacturing unit inspection, from a lot of 20 baskets which include 6 defectives, a sample of 2 baskets is drawn at random with replacement. Based on the above information, answer the following questions. Show steps to support your answers.  (a)Prepare the binomial distribution of the number of defective baskets. Find E(X) and Variance(X) for the random variable X.  (b) Find the probability that at least one is defective.  (c) Find the probability that at most one is defective. |

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