

Question number 19 & 20 are Assertion and Reason based question. Two statements are given , one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the codes (a), (b), (c), & (d) as given below:

- (a) Both Assertion (A) and Reason (R) are true, and Reason (R) is the correct explanation of the Assertion (A).
 (b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the 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 slope of the normal to the curve $y = 2x^2 - 5x$ at $x = -1$ is -1 .

Reason (R) : The slope of the normal to the curve $y = f(x)$ at point (a,b) is given by

$$(x - a) + \left(\frac{dy}{dx}\right)_{(a,b)} \cdot (y - b) = 0$$

20.Assertion (A): If A is a square matrix of order 3 such that $|\text{adj}A| = 144$, then the value of $|A|$ is ± 12 .

Reason (R) : If A is an invertible matrix of order n, then $|\text{adj} A| = |A|^{n-1}$.

Section – B

21.In a 1000 meter race, A,B and C get Gold, Silver and Bronze medals respectively . if A beats B by 100 m and B beats C by 100 m , then by how many meters does A beat C?

22.Find a matrix X such that $3A - 2B + X = O$, where $A = \begin{bmatrix} 4 & 2 \\ 1 & 3 \end{bmatrix}$ and $B = \begin{bmatrix} -2 & 1 \\ 3 & 2 \end{bmatrix}$.

23. Using Cramer's rule, solve : $2x + 3y = 10$ and $x + 6y = 4$.

24.Find the second derivative of: $x^3 \log x$.

25. Integrate: $\int \left(\sqrt{x} - \frac{1}{\sqrt{x}}\right)^2 dx$

Section – C

26. A person can row a boat at 5 km/h in still water. It takes him thrice as long to row upstream as to row downstream , Find the rate at which the stream is flowing.

27.If $A = \begin{bmatrix} 3 \\ 5 \\ 2 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 0 & 4 \end{bmatrix}$, verify that $(AB)^T = B^T A^T$.

28. Find the adjoint of matrix $A = \begin{bmatrix} -1 & -2 & -2 \\ 2 & 1 & -2 \\ 2 & -2 & 1 \end{bmatrix}$ and hence show that $A(\text{adj}A) = |A| I_3$.

29. Determine for what value of x , the function $f(x) = x^4 - \frac{x^3}{3}$ is strictly increasing or strictly decreasing.

30. Integrate : $\int \frac{2x}{(2x+1)^2} dx$ **OR** $\int e^x \frac{x-3}{(x-1)^3} dx$

31.The demand and supply functions for a commodity are $p_d = 56 - x^2$ and $p_s = 8 + \frac{x^2}{3}$. Find consumer' surplus at equilibrium price.

Section- D

32.i)Solve the inequality: $\frac{3}{5}x - \frac{2x-1}{3} > 1, x \in W$.

ii) Two vessels A and B contain milk and water in the ratio 7:5 and 17:7 respectively. In what ratio mixtures from two vessels should be mixed to get a new mixture containing milk and water in the ratio 5:3?

33. Ten students were selected from a school on the basis of values for giving awards and were divided into three groups. Double the number of students of the first group added to the number of students in the second group gives 13, while the combined strength of the first and the second group is four times the third group. Assume that x , y and z denote the number of students in 1st, 2nd and 3rd group respectively, determine the number of students in each group.

34. A firm has the following total cost and demand functions:

$$C(x) = \frac{x^3}{3} - 7x^2 + 111x + 50 \text{ and } x = 100 - p.$$

- Find the total revenue function in terms of x .
- Find the total profit function P in terms of x ,
- Find the profit maximizing level of output of x .
- What is the maximum profit?

35. The following table shows the annual rainfall (in mm) recorded for Cherrapunji, Meghalaya:

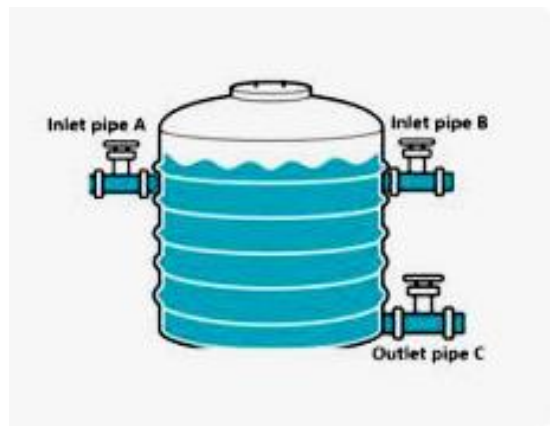
Year	2001	2002	2003	2004	2005	2006	2007	2008	2009
Rainfall	1.2	1.9	2	1.4	2.1	1.3	1.8	1.1	1.3

Determine the trend of rainfall by 3-year moving average. Draw graph to show the trend.

Section – E

36. Case Study 1:

An overhead water tank has three pipes A, B and C attached to it. The inlet pipes A and B can fill the empty tank independently in 15 hours and 12 hours respectively. The outlet pipe C alone can empty a full tank in 20 hours.



Based on the above information, answer the following questions:

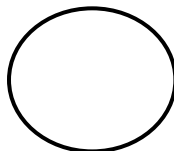
- For a routine cleaning of the tank, the tank needs to be emptied. If pipes A and B are closed at the time when the tank is filled to two-fifths of its total capacity, how long will pipe C take to empty the tank completely?
- How long will it take for the empty tank to fill completely, if all the three pipes are opened simultaneously?
- On a given day, pipes A, B and C are opened (in order) at 5 am, 8 am and 9 am respectively, to fill the empty tank. In how many hours will the tank be filled completely?

OR

Given that the tank is half-full, only pipe C is opened at 6 am to empty the tank. After closing the pipe C and an hour's cleaning time, tank is filled completely by pipe A and B together. What is the total time taken in the whole process?

37. Case Study 2:

A carpenter has a wire of length 28cm. He wants to cut into two pieces , one of the two pieces is to be made into square and other into circle.



Based on the above information, answer the following questions:

i) If x metres wire is used in making a square, then what is the expression of combined area A ?

OR

What is the length of radius for minimum combined area?

ii) What is the length of the circular part?

iii) What is the length of the square part?

38. Case Study 3:

The following data shows the percentage of rural, urban and sub-urban Indians who have high speed internet connection at home.

Year	Rural	Urban	Sub -Urban
2016	3	9	9
2017	6	18	17
2018	9	21	23
2019	16	29	29
2020	24	38	40

Based on the above information , answer the following questions-;

i) Derive the straight line trend by the method of least square for the rural students

OR

Derive the straight line trend by the method of least square for the Urban Indians

ii) What is the forecast for the year 2021 for Urban/Rural group using trend equation.

iii) What is the forecast for the year 2023 for Urban/Rural group using trend equation.