SECTION 'A'

Q1. Evaluate:

$$\begin{vmatrix} 6 & 4 & 2 \\ 4 & 0 & 7 \\ 1 & 3 & 1 \end{vmatrix}$$

Using determinant formula:

$$= 6\begin{vmatrix} 0 & 7 \\ 3 & 1 \end{vmatrix} - 4\begin{vmatrix} 4 & 7 \\ 1 & 1 \end{vmatrix} + 2\begin{vmatrix} 4 & 0 \\ 1 & 3 \end{vmatrix}$$

$$= 6(0 \cdot 1 - 7 \cdot 3) - 4(4 \cdot 1 - 7 \cdot 1) + 2(4 \cdot 3 - 0 \cdot 1)$$

$$= 6(0 - 21) - 4(4 - 7) + 2(12)$$

$$= -126 + 1 \downarrow 24 = -90$$

Q2. Find the area using Simpson's Rule:

Ordinates: 4, 7, 8, 10, 7, 6, 3

Common distance $h = 1$

Simpson's Rule:

$$\text{Area} = \frac{h}{3}\left[y_0 + y_6 + 4(y_1 + y_3 + y_5) + 2(y_2 + y_4)\right]$$

Substituting values:

$$= \frac{1}{3}\left[4 + 3 + 4(7 + 10 + 6) + 2(8 + 7)\right]$$

$$= \frac{1}{3}[7 + 4(23) + 2(15)]$$

$$= \frac{1}{3}[7 + 92 + 30] = \frac{1}{3}(129) = 43 \,\text{square meters}$$

Q3. Find the 9th term of H.P.:

First term $T_1 = \frac{1}{3}$, Second term $T_2 = \frac{1}{5}$.

Since H.P. is the reciprocal of an A.P., convert to A.P.:

$$T_1' = 3, \quad T_2' = 5$$

Common difference $d = 5 - 3 = 2$.

9th term in A.P.:

$$T_9' = 3 + (9 - 1) \cdot 2 = 3 + 16 = 19$$

So, 9th term in H.P.:

$$T_9 = \frac{1}{19}$$

Q4. Explain any four types of matrices:

1. **Square Matrix**: A matrix with an equal number of rows and columns.
2. **Diagonal Matrix**: All off-diagonal elements are zero.
3. **Identity Matrix**: A diagonal matrix where all diagonal elements are 1.
4. **Zero Matrix**: All elements are zero.

Q5. Evaluate the following integrals:

a) $\int 4x^3 dx = x^4 + C$

b) $\int_0^{\pi/2} \sin x \, dx = [-\cos x]_0^{\pi/2} = -(0 - (-1)) = 1$

Q6. State Euler's Theorem on homogeneous functions:

If $f(x, y)$ is a homogeneous function of degree n, then:

$$x\frac{\partial f}{\partial x} + y\frac{\partial f}{\partial y} = nf(x, y)$$

Q7. Differentiate $\sin x$ with respect to x:

$$\frac{d}{dx}(\sin x) = \cos x$$

Q8. State the rules of integration:

1. $\int [f(x) + g(x)]dx = \int f(x)dx + \int g(x)dx$
2. $\int c \cdot f(x)dx = c \cdot \int f(x)dx$ (where c is a constant)
3. $\int x^n dx = \frac{x^{n+1}}{n+1} + C$ (for $n \neq -1$)
4. $\int e^x dx = e^x + C$

Q9. Prove matrix A is singular:

$$A = \begin{bmatrix} 3 & 2 \\ 6 & 4 \end{bmatrix}$$

Determinant:

$$|A| = 3 \cdot 4 - 2 \cdot 6 = 12 - 12 = 0$$

Since the determinant is zero, matrix A is singular.

Q10. State the rules of differentiation:

1. $\frac{d}{dx}(c) = 0$ (where c is a constant)
2. $\frac{d}{dx}(x^n) = nx^{n-1}$
3. $\frac{d}{dx}[f(x) + g(x)] = f'(x) + g'(x)$
4. $\frac{d}{dx}[\sin x] = \cos x$

SECTION 'B'

Q11. Fill in the blanks:

1. A matrix with an equal number of rows and columns is called a **square** matrix.
2. The derivative of a constant term is **zero**.
3. Simpson's Rule is used to find the approximate **area** of a figure bounded by a curve.
4. $\int \sin x \, dx = -\cos x + C.$

Q12. State True or False:

1. Integration and derivatives are similar processes. — **False**
2. If any two rows or columns of a determinant are identical, the determinant is zero. — **True**
3. The derivative of $\log x$ with respect to x is $\frac{1}{x}$. — **True**
4. The definite integral of a function is unique. — **True**