1. If $y = c_1e^{2x} + c_2e^{x} + c_3e^{-x}$ satisfies the differential equation $\frac{d^3y}{dx^3} + a\frac{d^2y}{dx^2} + b\frac{dy}{dx} + cy = 0$, then $\frac{a^3+b^3+c^3}{abc}$ is equal to

   (A) $\frac{1}{2}$

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

   (C) $\frac{1}{2}$

   (D) 0

2. The solution of the differential equation $(x\cos x - \sin x)dx = \frac{x}{y}\sin x dy$ is

   (A) $\sin x = \ln|xy| + c$

   (B) $\ln|\frac{\sin x}{x}| = y + c$

   (C) $|\frac{\sin x}{xy}| = c$

   (D) none of the above.

   where c is any arbitrary constant.

3. If $y = f(x)$ passing through $(1, 2)$ satisfies the differential equation $y(1 + xy)dx - xdy = 0$, then

   (A) $f(x) = \frac{2x}{2-x^2}$

   (B) $f(x) = \frac{x+1}{x^2+1}$

   (C) $f(x) = \frac{x-1}{4-x^2}$

   (D) $f(x) = \frac{4x}{1-2x^2}$

4. The real value of n for which the substitution $y = z^n$ will transform the differential equation $2x^4y\frac{dy}{dx} + y^4 = 4x^6$ into a homogeneous equation is

   (A) $\frac{1}{2}$

   (B) 1

(C) $\frac{3}{2}$

(D) 2

5. The integrating factor of the differential equation $\frac{dy}{dx}(x \ln x) + y = 2 \ln x$ is given by

   (A) x

   (B) e^x

   (C) $\ln x$

   (D) $\ln(\ln x)$.

6. The total number of linearly independent solutions of a homogeneous n^{th} order first degree differential equation with constant coefficients is

   (A) n^2

   (B) n

   (C) $n - 1$

   (D) $n + 1$

7. The general solution of the differential equation $(2x \cos y + y^2 \cos x)dx + (2y \sin x - x^2 \sin y)dy$ is

   (A) $x^2 \cos y + y^2 \sin x = C$

   (B) $x \cos y - y \sin x = C$

   (C) $x^2 \cos^2 y + y^2 \sin^2 x = C$

   (D) none of the above.

8. The number of distinct values of a 2×2 determinant whose entries are from the set $\{-1, 0, 1\}$ is

   (A) 3

(B) 4

(C) 5

(D) 6

9. If $0 \le [x] < 2$, $-1 \le [y] < 1$ and $1 \le [z] < 3$ where [.] denotes the greatest integer function, then the maximum value of the $det(A)$ where
$A = \begin{pmatrix} \text{[x]+1} & \text{[y]} & \text{[z]} \\ \text{[x]} & \text{[y]+1} & \text{[z]} \\ \text{[x]} & \text{[y]} & \text{[z]+1} \end{pmatrix}$ is

(A) 2

(B) 4

(C) 6

(D) 8

10. If all the elements of a third order determinant are equal to 1 or -1, then the determinant itself is

(A) an odd number

(B) an even number

(C) an imaginary number

(D) a real number

11. For the system of equation $x + 2y + 3z = 1$, $2x + y + 3z = 2$, $5x + 5y + 9z = 4$

(A) There is only one solution

(B) There exist infinitely many solutions

(C) There dose not exist any solution

(D) None of the above

12. If $\vec{a}+\vec{b}+\vec{c}=0$, $|\vec{a}|=3$, $|\vec{b}|=5$, and $|\vec{c}|=7$ then the angle between $\vec{a}$ and $\vec{b}$ is

(A) $\pi/6$

(B) $\pi/3$

(C) $2\pi/3$

(D) $5\pi/3$

13. Vectors $|\vec{a}|$ and $|\vec{b}|$ are inclined at an angle $\theta = 120^0$, if $|\vec{a}| = 1$, $|\vec{b}| = 2$, then $\{(\vec{a}+3\vec{b})\times(3\vec{a}-\vec{b})\}^2$ is equal to

(A) 310

(B) 290

(C) 301

(D) 300

14. The characteristic of an orthogonal matrix A is

(A) $A^{-1}A = I$

(B) $A.A^{-1} = I$

(C) $A'.A^{-1} = I$

(D) $A.A' = I$

15. The Laplace transform of the function $f(t) = 3\sin 4t - 2\cos 5t$ is

(A) $\frac{12}{s^2+16} - \frac{2s}{s^2+25}$

(B) $\frac{12}{s^2-16} - \frac{2s}{s^2+25}$

(C) $\frac{12}{s^2+16} - \frac{2s}{s^2-25}$

(D) $\frac{12}{s^2+16} + \frac{2s}{s^2+25}$

16. The inverse Laplace transform of $\frac{2s+1}{s^2-4}$ is

(A) $2\cos h3t + \frac{1}{2}\sin h3t$

(B) $2\cos h2t - \frac{1}{2}\sin h2t$

(C) $2\cos h2t + \frac{1}{2}\sin h2t$

(D) $2\cos ht + \frac{1}{2}\sin ht$

17. The function $f(x) = \cos 3x$ has period

(A) $2\pi/3$

(B) 2π

(C) $3\pi/2$

(D) π

18. Let $f(x) = f(-x)$, $\forall\, x \in (-\pi, \pi)$ and f is periodic with period 2π, then the Fourier series of $f(x)$

(A) contains only cosine terms

(B) contains only sine terms

(C) contains both sine and cosine terms

(D) Fourier series of the above function does not exist.

19. If A is a skew symmetric matrix, then the trace of A is

(A) -5

(B) -1

(C) 0

(D) 1

20. The equations $\lambda x - y = 2$, $2x - 3y = -\lambda$, $3x - 2y = -1$ are consistent for

(A) $\lambda = -4$

(B) $\lambda = -1$

(C) $\lambda = -1, 4$

(D) $\lambda = 1, -4$

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