

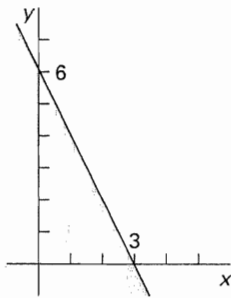
1. The Laplace transform of a step function of height h is

- (A) s/h
 (B) $1/s$
 (C) $1/h$
 (D) h/s

2. What is the slope of the line tangent to the parabola $y = 12x^2 + 3$ at a point where $x = 5$?

- (A) 24
 (B) 120
 (C) 303
 (D) 515

3. Which of the following equations correctly describes the shaded area of the x - y plane?



- (A) $2x - y \leq 6$
 (B) $2x + y \leq 6$
 (C) $2x - y \geq 6$
 (D) $x + 2y \geq 6$

4. What is the (x, y) solution for the following system of two simultaneous equations?

$$\begin{aligned} 3x - 6y &= 7 \\ 2x - 11y &= -5 \end{aligned}$$

- (A) $\left(\frac{107}{21}, \frac{29}{21}\right)$
 (B) $\left(-\frac{17}{45}, \frac{1}{45}\right)$
 (C) $\left(-\frac{107}{21}, \frac{29}{21}\right)$
 (D) $\left(\frac{107}{45}, -\frac{106}{45}\right)$

5. What is the volume of the parallelepiped for which vectors \mathbf{V}_1 , \mathbf{V}_2 , and \mathbf{V}_3 are the coterminous edges?

$$\begin{aligned} \mathbf{V}_1 &= 3\mathbf{i} + 2\mathbf{j} + \mathbf{k} \\ \mathbf{V}_2 &= -\mathbf{i} + \mathbf{j} - 2\mathbf{k} \\ \mathbf{V}_3 &= \mathbf{j} + 2\mathbf{k} \end{aligned}$$

- (A) 3
 (B) 7
 (C) 15
 (D) 20.5

6. What is the simplified equivalent expression of

$$(\cot^2 \theta)(\sin^2 \theta) + \frac{1}{\csc^2 \theta}$$

- (A) $2 \sin^2 \theta$
 (B) $2 \cos \theta$
 (C) $2 \cos^2 \theta$
 (D) 1

7. What is the derivative with respect to x of $\sqrt{2x + 9x^2}$?

- (A) $\frac{1 + 9x}{\sqrt{2x + 9x^2}}$
 (B) $9x + 1$
 (C) $\sqrt{2 + 18x}$
 (D) $(9x + 1)\sqrt{2x + 9x^2}$

8. What is the limit?

$$\lim_{x \rightarrow \infty} \left[\frac{10x^2 - 5x + 1}{(5x - 3)(2x)} \right]$$

- (A) $-1/3$
 (B) 0
 (C) $5/6$
 (D) 1

9. What is the integral $\int x(x + 1)dx$?

- (A) $\frac{x^3}{3} + x + C$
 (B) $\frac{x^3}{3} + \frac{x^2}{2}$
 (C) $\frac{x^3}{3} + \frac{x^2}{2} + C$
 (D) $x^3 + x^2 + C$

10. How many significant digits are there in the number 023059.11005?

- (A) 5
- (B) 9
- (C) 10
- (D) 11

11. Seven measurements are taken: 4.31, 4.39, 4.38, 4.33, 4.36, 4.32, and 4.37. What is the sample standard deviation?

- (A) 0.0155
- (B) 0.0167
- (C) 0.0291
- (D) 0.0313

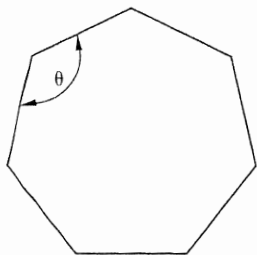
12. The horizontal angle from the ground to the top of a palm tree some unknown distance away is 46.18° . At a point 40 m directly behind the first point, the horizontal angle to the top of the tree is 29.23° . What is the distance from the palm tree to the first point?

- (A) 42 m
- (B) 46 m
- (C) 51 m
- (D) 61 m

13. What is the acute angle between vectors $\mathbf{V}_1 = (3, 2, 1)$ and $\mathbf{V}_2 = (2, 3, 2)$ based at the origin?

- (A) 25°
- (B) 33°
- (C) 35°
- (D) 59°

14. What is the interior angle, θ , of a regular polygon with seven sides?

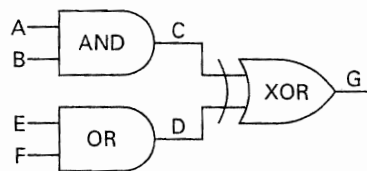


- (A) 51°
- (B) 64°
- (C) 116°
- (D) 129°

15. Which of the following statements is true concerning the Taylor series expansion for $\cos x$?

- (A) The series contains only odd powers of x .
- (B) The series contains only even powers of x .
- (C) The series contains only negative odd powers of x .
- (D) The series contains only every other odd power of x .

16. For $A = 1$, $B = 0$, $E = 1$, and $F = 0$, choose the following correct outputs.



- (A) $C = 1$, $D = 1$, and $G = 0$
- (B) $C = 1$, $D = 0$, and $G = 1$
- (C) $C = 0$, $D = 1$, and $G = 1$
- (D) $C = 0$, $D = 1$, and $G = 0$

17. A and B are subsets of Q .

$$A = \{4, 7, 9\}$$

$$B = \{4, 5, 9, 10\}$$

$$Q = \{4, 5, 6, 7, 8, 9, 10\}$$

What is $\overline{A} \cup B$?

- (A) $\{4, 5, 6, 7, 8, 9, 10\}$
- (B) $\{4, 5, 7, 9, 10\}$
- (C) $\{4, 5, 6, 8, 9, 10\}$
- (D) $\{5, 10\}$

18. What is the total area inside the cardioid, r ?

$$r = a(1 + \cos \theta)$$

- (A) $\frac{3\pi a^2}{2}$
- (B) $\frac{2\pi a^2}{3}$
- (C) $\frac{3\pi a^2}{4}$
- (D) $\frac{4\pi a^2}{3}$

19. What are the values of B_1 and B_2 ?

$$\begin{bmatrix} 9 & 7 \\ 1 & 3 \end{bmatrix} \begin{bmatrix} B_1 \\ B_2 \end{bmatrix} = \begin{bmatrix} 2 \\ 1 \end{bmatrix}$$

- (A) $B_1 = -\frac{1}{20}$; $B_2 = \frac{7}{20}$
 (B) $B_1 = \frac{7}{20}$; $B_2 = -\frac{1}{20}$
 (C) $B_1 = -\frac{1}{20}$; $B_2 = -\frac{7}{20}$
 (D) $B_1 = 10$; $B_2 = 20$

Problems 20–22 refer to the following equation.

$$xy' + 3x - 1 = 0$$

20. What type of differential equation is this?

- (A) homogeneous
 (B) second-order linear
 (C) non-linear
 (D) first-order separable

21. The solution for this equation is

- (A) $y = \ln(1 - 3x) + C$
 (B) $y = \frac{1}{x} - 3 + C$
 (C) $y = \ln x - 3x + C$
 (D) $y = \ln x - \frac{3x^2}{2} + C$

22. In the differential equation $xy' + 3x - 1 = 0$, if $y = 1$ when $x = 1$, what is the constant of integration, C ?

- (A) 1
 (B) 2
 (C) 3
 (D) 4

23. Consider three vectors, \vec{A} , \vec{B} , and \vec{C} , with the following two properties.

$$\vec{A} \cdot (\vec{B} \times \vec{C}) = 0$$

$$\vec{B} \perp \vec{C}$$

Which of the following must be true?

- (A) $\vec{A} \parallel \vec{B}$
 (B) \vec{A} , \vec{B} , and \vec{C} are coplanar
 (C) $\vec{A} \parallel \vec{C}$
 (D) $\vec{A} \perp$ to \vec{B} or \vec{C}

24. Consider the matrices \mathbf{A} and \mathbf{B} , which are given by

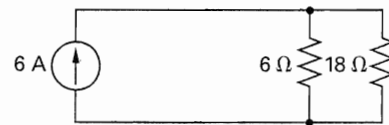
$$\mathbf{A} = \begin{bmatrix} 7 & 6 & 3 \\ 2 & 1 & 4 \end{bmatrix}$$

$$\mathbf{B} = \begin{bmatrix} 1 & 6 \\ 2 & 1 \end{bmatrix}$$

Which operation cannot be performed?

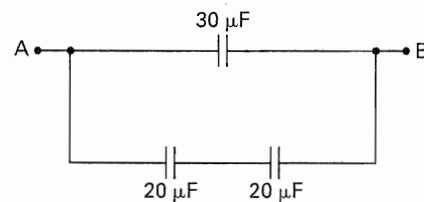
- (A) \mathbf{AB}
 (B) \mathbf{BA}
 (C) \mathbf{B}^{-1}
 (D) \mathbf{A}^T

25. What is the current in the 6Ω resistor?



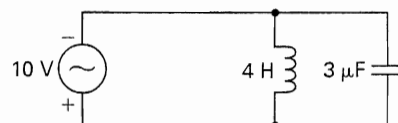
- (A) 1.5 A
 (B) 2 A
 (C) 4 A
 (D) 4.5 A

26. What is the equivalent capacitance between terminals A and B for the following circuit?



- (A) $7.5 \mu\text{F}$
 (B) $32 \mu\text{F}$
 (C) $40 \mu\text{F}$
 (D) $70 \mu\text{F}$

27. What is the resonant frequency of the circuit?



- (A) 1.9 Hz
 (B) 4.6 Hz
 (C) 46 Hz
 (D) 75 Hz

