Chapter 1
Engineering Mathematics

1. Let $\vec{a}$ and $\vec{b}$ be two non-zero vectors such that $\left|\vec{a}+\vec{b}\right| = \left|\vec{a}-\vec{b}\right|$. Then

(A) $\vec{a}$ and $\vec{b}$ are parallel to each other.
(B) $\vec{a}$ and $\vec{b}$ are perpendicular to each.
(C) $\vec{a}$ is NOT a scalar multiple of $\vec{b}$.
(D) $\vec{a}\times\vec{b}=\vec{0}$

2. Let $\mathbb{N}$ be the set of all-natural numbers. Consider the relation R on $\mathbb{N}$ given by
$R = \{(m, n): m–n$ is divisible by $2\}$. Then,
(A) R is symmetric and transitive.
(B) R is symmetric but NOT transitive.
(C) R is reflexive but NOT symmetric.
(D) R is reflexive and transitive.

3. If $\begin{cases} f(x) = ax^2 + b \text{ for } 0 \le x \le 1 \\ \quad = cx + \sin\left(\frac{\pi}{2}x\right) \text{ for } 1 \le x \le 2 \end{cases}$ is continuous and differentiable at all points in the interval [0,2] and $f(2)=\frac{\pi}{4}$, then

(A) $a=\frac{\pi}{16}$ and $b=\frac{\pi}{16}+1$
(B) $b=\frac{\pi}{16}+1$ and $c=\frac{\pi}{8}$
(C) $a=\frac{\pi}{8}$ and $c=\frac{\pi}{8}$
(D) $a=\frac{\pi}{8}$ and $b=-\frac{3\pi}{16}$

4. In ΔPQR, $\angle Q = 60°$, and S is the mid-point of QR. If $QS = PS$ and $PR = 5$, then
(A) $PQ = 5/\sqrt{3}$
(B) $PS = 5/\sqrt{2}$
(C) Area of the triangle $PSR = \left(25-5\sqrt{3}\right)/2\sqrt{3}$ $(25–5/\sqrt{3})/ 2/\sqrt{3}$
(D) S is the circumcenter of ΔPQR

5. Which of the following point(s) lies(lie) on the plane $2x + 3y + z = 6$?
(A) (0, 0, 6)
(B) (0, 2, 0)
(C) (1, 1, 1)
(D) (3, 0, 0)

6. Consider the equation $x^3 - 1 = 0$. If one of the solutions to this equation is 1, the other solution(s) is/are

(A) $-\frac{1}{2}+\frac{\sqrt{3}}{2}i$ **(B)** i

(C) $-I$ **(D)** $-\frac{1}{2}-\frac{\sqrt{3}}{2}i$

7. Let $U = \{1, 2,\ldots, 15\}$. Let $P \subseteq U$ consist of all prime numbers, $Q \subseteq U$ consist of all even numbers and $R \subseteq U$ consist of all multiples of 3. Let $T = P - Q$. Then, which of the following is/are CORRECT?

(A) $|T| = 5 \text{ and } |T \cup R| = 9$ **(B)** $|T| = 6 \text{ and } |T \cup R| = 9$

(C) $|T| = 5 \text{ and } |T \cap R| = 1$ **(D)** $|T| = 6 \text{ and } |T \cap R| = 1$

8. Let $f(x) = (x - 1)(x - 2)(x - 3)(x - 4)$ and let $\alpha = f\left(\frac{3}{2}\right), \beta = f\left(\frac{5}{2}\right)$ and $\gamma = f\left(\frac{7}{2}\right)$. Which of the following is/are CORRECT?

(A) α and β have the same sign
(B) α and γ have the same sign
(C) β and γ have the same sign
(D) $\alpha\beta$ and $\beta\gamma$ have the same sign

9. Which of the following curve/straight line equations will pass through the origin when plotted on a graph?

(A) $\frac{-x}{2}+\frac{y}{2}=0$
(B) $1 + y + x = 1$
(C) $xy = 1$
(D) $2y - 2x + 2 = 0$

10. Let $a = \lim_{n\to\infty}\left(\frac{1}{n^2}+\frac{2}{n^2}+\ldots+\frac{(n-1)}{n^2}\right)$ and $b = \lim_{n\to\infty}\left(\frac{1}{n+1}+\frac{1}{n+2}+\ldots+\frac{1}{n+n}\right)$. Which of the following is/are true?

(A) $a > b$
(B) $a < b$
(C) $ab = \ln\sqrt{2}$
(D) $\frac{a}{b} = \ln\sqrt{2}$

Answer Key

1. (B), (C)
2. (A), (D)
3. (A), (B)
4. (A), (D)
5. (A), (B), (C), (D)
6. (A), (C), (D)
7. (A), (C)
8. (B), (D)
9. (A), (B)
10. (B), (C)