Sample Questions
Part-I: Mathematical Aptitude

1. The number of real roots of the function \( f(x) = x^4 + 11x - 4 \) is
   (a) 1
   (b) 2
   (c) 3
   (d) 4
   (e) None of the above

2. The value of \( \lim_{n \to \infty} \frac{1^3 + 2^3 + \ldots + n^3}{n^4} \)
   (a) \( \frac{1}{7} \)
   (b) \( \frac{1}{2} \)
   (c) 0
   (d) 1
   (e) None of the above

3. If \( a_n = 11 \ldots .1 \) with \( 3^n \) digits, then which of the following is true
   (a) \( a_n \) is a prime number.
   (b) \( a_n \) is divisible by \( 2a_{n-1} \)
   (c) \( a_n \) is divisible by \( 3a_{n-1} \)
   (d) \( a_n \) is divisible by \( 3^n \)
   (e) None of the above

4. If \( f_1(x) = e^x \) and \( f_n(x) = e^{f_{n-1}(x)} \) for \( n > 1 \), then \( \frac{d}{dx} f_n(x) \) is
   (a) \( f_{n-1}(x)f_n(x) \)
   (b) \( f_1(x)f_2(x) \ldots f_{n-1}(x) \)
   (c) \( f_1(x)f_2(x) \ldots f_n(x) \)
   (d) \( f_2(x)f_3(x) \ldots f_n(x) \)
   (e) None of the above

5. Let \( p \) denote the statement \( e^x > \pi^x \) and \( q \) denote the statement \( a^b > b^a \) when \( b > a > e \), then which of the following holds
   (a) both \( p \) and \( q \) are true
   (b) both \( p \) and \( q \) are false
   (c) \( p \) is true and \( q \) is false
   (d) \( q \) is true and \( p \) is false
   (e) None of the above

6. Let \( A = \{1, 2, 3, \ldots, 30\} \). The number of subsets of \( A \) with exactly one multiple of 3 is
   (a) \( 2^{10} \)
   (b) \( 2^{10} \times 20 \)
   (c) \( 2^{20} \times 10 \)
   (d) \( 2^{20} \)
7. A function is said to be injective (one-to-one) if
   (a) the image set/range is a superset of the codomain
   (b) the image set/range is a subset of the codomain
   (c) the image set/range is empty
   (d) the image set/range is equal to the codomain
   (e) None of the above

8. Let $A$ and $B$ be two sets. Which of the following is not necessarily true?
   (a) $A \cup B \subseteq \overline{A} \cup \overline{B}$
   (b) $A \cap \overline{B} \subseteq \overline{A} \cup \overline{B}$
   (c) $\overline{A} \cap \overline{B} \subseteq A \cup B$
   (d) $\overline{A} \cap \overline{B} \subseteq A \cup \overline{B}$
   (e) None of the above

9. How many four digit numbers greater than 3000 can be formed using the digits 2, 2, 3, 3, 3, 4, 4, 4, 4?
   (a) 25
   (b) 26
   (c) 51
   (d) 102
   (e) None of the above

10. A shipment agency wishes to audit its accounts statement. This can be done only when all the shipment orders are cleared. Currently, there are some backlog/pending shipment orders. Assume that the number of shipment orders received is the same on all days. Further, assume that all ships have equal capacity. Under these assumptions, it takes 4 days for 7 ships to clear the shipment orders while it takes 10 days for 3 ships to clear the shipment orders. If the shipment orders are to be cleared in 5 days then what is the minimum number of ships required?
    (a) 3
    (b) 5
    (c) 7
    (d) 9
    (e) None of the above

11. A green and a blue dice are cast. The number three occurs on the green die. What is the probability that the sum (of both dice) is an even number?
    (a) $\frac{1}{2}$
    (b) $\frac{1}{12}$
    (c) $\frac{1}{6}$
    (d) $\frac{1}{4}$
    (e) None of the above

12. Three numbers have a mean of 3 and a standard deviation of $\sqrt{2}$. If one of them is 1 the other two numbers are
    (a) $\{4, 4\}$
    (b) $\{3, 5\}$
13. If \( \vec{k} \) is a unit vector and scalar product \((\vec{x} - \vec{k}) \cdot (\vec{x} + \vec{k}) = 8\) then the magnitude \(|\vec{x}| = \\
(a) \ 9 \\
(b) \ 6 \\
(c) \ 4 \\
(d) \ 3 \\
(e) \ \text{None of the above}

14. If \( A = \begin{pmatrix} \cos \theta & -\sin \theta \\ \sin \theta & \cos \theta \end{pmatrix} \) and \( A + A^T = I \) then \( \theta = \\
(a) \ \frac{\pi}{6} \\
(b) \ \frac{\pi}{3} \\
(c) \ \pi \\
(d) \ \frac{3\pi}{2} \\
(e) \ \text{None of the above}

15. If \( A = \begin{pmatrix} x + y & y + z & z + x \\ z & x & y \\ 1 & 1 & 1 \end{pmatrix} \) then \( \det(A) = \\
(a) \ 1 \\
(b) \ x+y+z \\
(c) \ 0 \\
(d) \ xyz \\
(e) \ \text{None of the above} \)