**Monotonic Functions and Lagrange’s Theorem**

**Choose the most appropriate option (a, b, c or d).**

Q 1. If f(x) = x3 + 4x2 + λx + 1 is a monotonically decreasing function of x in the largest possible interval (-2, -2/3) then

(a) λ = 4 (b) λ = 2 (c) λ = -1 (d) λ has no real value

Q 2. The function f(x) = sin4x + cos4x increases if

(a)  (b)  (c)  (d) 

Q 3. If and , where 0 < x ≤ 1, then in the interval

(a) both f(x) and g(x) are increasing functions (b) both f(x) and g(x) are decreasing functions

(c) f(x) is an increasing function (d) g(x) is an increasing function

Q 4. The function f(x) = tan-1x – x is monotonically decreasing in the set

(a) R (b) (0, +∞) (c) R – {0} (d) none of these

Q 5. Let f(x) = tan-1{φ(x)}, where φ(x) is m.i. for 0 < x < π/2. Then f(x) is

(a) increasing in (0, π/2) (b) decreasing in (0, π/2)

(c) increasing in (0, π/4) and decreasing in (π/4, π/2) (d) none of these

Q 6. If is a decreasing function of x in R then the set of possible values of p (independent of x) is

(a) [-1, 1] (b) [1, ∞) (c) (-∞, -1] (d) none of these

Q 7. If f(x) = (ab – b2 – 2)x + is a decreasing function of x for all x ∈ R and b ∈ R, b being independent of x, then

(a) a ∈ (0, ) (b) a ∈ (-,) (c) a ∈ (-, 0) (d) none of these

Q 8. Let f(x) = cos πx + 10x + 3x2 + x3, -2 ≤ x ≤ 3. The absolute minimum value of f(x) is

(a) 0 (b) -15 (c) 3 - 2π (d) none of these

Q 9. If x ∈ [-1, 1] then the minimum value of f(x) = x2 + x + 1 is

(a) -3/4 (b) -15 (c) 3 - 2π (d) none of these

Q 10. Let f(x) = x3 – 4x, 0 ≤ x ≤ 2. Then the global minimum value of the function is

(a) 0 (b) -8/3 (c) -4 (d) none of these

Q 11. Let f(x) = 6 – 12x + 9x2 – 2x3, 1 ≤ x ≤ 4. Then the absolute maximum value of f(x) in the interval is

(a) 2 (b) 1 (c) 4 (d) none of these

Q 12. If , then

(a) the maximum value of f(x) is  (b) the minimum value of f(x) is 10

(c) the maximum value of f(x) is 26 (d) none of these

Q 13. Let the interval I = [-1, 4] and f : I → R be a function such that f(x) = x3 – 3x. Then the range of the function is

(a) [2, 52] (b) [-2, 2] (c) [-2, 52] (d) none of these

Q 14. The range of the function f(x) = |2x + 1| - 2|x – 1|, x ∈ R, is

(a) [-3, 3] (b) [0, 6] (c) R (d) none of these

Q 15. Let the function f(x) be defined as follows :

f(x) = x3 + x2 – 10x, -1 ≤ x < 0

cos x, 0 ≤ x < 

1 + sin x, ≤ x ≤ π.

Then f(x) is

(a) a local minimum at x = π/2 (b) a local maximum at x = π/2

(c) an absolute minimum at x = -1 (d) an absolute maximum at x = π

Q 16. Let f(x) be a function defined as below :

f(x) = sin(x2 – 3x), x ≤ 0

6x + 5x2, x > 0

Then at x = 0, f(x)

(a) has a local maximum (b) has a local minimum

(c) is discontinuous (d) none of these

Q 17. If θ is a positive acute angle then

(a) tan θ < θ < sin θ (b) θ < sin θ < tan θ (c) sin θ < tan θ < θ (d) none of these

Q 18. Let f : R → R be a function such that f(x) = ax + 3 sin x + 4 cos x. Then f(x) is invertible if

(a) a ∈ (-5, 5) (b) a ∈ (-∞, -5) (c) a ∈ (5, +∞) (d) none of these

Q 19. The function f(x) = x3 + λx2 + 5x + sin 2x will be an invertible function if λ belongs to

(a) (-∞, -3) (b) (-3, 3) (c) (3, +∞) (d) none of these

Q 20. The value of c in Lagrange’s theorem for the function |x| in the interval [-1, 1] is

(a) 0 (b) 1/2 (c) -1/2 (d) nonexistent in the interval

Q 21. The equation sin x + x cos x = 0 has at least one root in the interval

(a) (-π/2, 0) (b) (0, π) (c) (-π/2, π/2) (d) none of these

Q 22. If 4a + 2b + c = 0 then the equation 3ax2 + 2bx + c = 0 has at least one real root lying between

(a) 0 and 1 (b) 1 and 2 (c) 0 and 2 (d) none of these

Q 23. If the equation anxn + an-1xn-1 + ….. + a1x = 0, a1 ≠ 0, n ≥ 2, has a positive root α then the equation nanxn-1 + (n – 1)an-1 xx-2 + …. + a1 = 0 has a positive root which is

(a) greater than α (b) smaller than α (c) greater than or equal to α (d) equal to α

**Choose the correct options. One or more options may be correct.**

Q 24. Let h(x) = f(x) – {f(x)}2 + {f(x)}3 for all real values of x. Then

(a) h is increasing whenever f(x) is increasing (b) h is increasing whenever f'(x) < 0

(c) h is decreasing whenever f is decreasing (d) nothing can be said in general

Q 25. If f(x) = sin x, -π/2 ≤ x ≤ π/2, then

(a) f(x) is increasing in the interval [-π/2, π/2] (b) f{f(x)| is increasing in the interval [-π/2, π/2]

(c) f{f(x)} is decreasing in [-π/2, 0] and increasing in [0, π/2]

(d) f{f(x)} is invertible in [-π/2, π/2]

Q 26. Let f(x) = 2sin3x – 3sin2x + 12 sin x + 5, 0 ≤ x ≤ π/2. Then f(x) is

(a) decreasing in [0, π/2] (b) increasing in [0, π/2]

(c) increasing in [0, π/4] and decreasing in [π/4, π/2] (d) none of these

Q 27. Let f(x) = -2x3 + 21x2 – 60x + 41. Then

(a) f(x) is m.d. in (-∞, 1) (b) f(x) is m.i. in (1, +∞)

(c) f(x) > 0 for x < 1 (d) f(x) < 0 for x > 1

Q 28. Let , 1 ≤ x ≤ 3.9. [.] denote the greatest integer function. Then

(a) f(x) is m.d. in [1, 3.9] (b) f(x) is m.i. in [1, 3.9]

(c) The greatest value of f(x) is  (d) The least value of f(x) is 2

Q 29. Let f(x) = |x2 – 3x – 4|, -1 ≤ x ≤ 4. Then

(a) f(x) is m.i. in [-1, 3/2) (b) f(x) is m.d. in (3/3, 4]

(c) the maximum value of f(x) is  (d) the minimum value of is 0

Q 30. Let f(x) = φ(2 – x) + φ(x) and φ"(x) < 0 for x ∈ [0, 2]. Then

(a) f(x) is m.i. in [0, 1] (b) f(x) is m.d. in [0, 1]

(c) f(x) is m.i. in [1, 2] (d) f(x) is m.i. in [1, 2]

Q 31. Let f'(x) > 0 and g'(x) < 0 for all x ∈ R. Then

(a) f{g(x)} > f{g(x + 1)} (b) f{g(x)} > f{g(x – 1)} (c) g{f(x)} > g{f(x + 1)} (d) g{f(x)} > g{f(x – 1)}

Q 32. Let f(x) = 2x2 – log |x|, x ≠ 0. Then f(x) is

(a) m.i. in  (b) m.d. in 

(c) m.i. in  (d) m.d. in 

Q 33. Let f(x) = x3 – 6x2 + 15x + 3. Ten

(a) f(x) > 0 for all x ∈ R (b) f(x) > f(x + 1) does not hold for any real x

(c) f(x) is invertible (d) f(x) is a one-one function

Q 34. Let f(x) = a5x5 + a4x4 + a3x3 + a2x2 + a1x, where ai’s are real and f(x) = 0 has a positive root α0. Then

(a) f'(x) = 0 has a root α1such that 0 < α1 < α0 (b) f'(x) = 0 ahs at least one real root

(c) f"(x) = 0 has at least two real roots (d) none of these

1a 2b 3c 4c 5a 6a 7b 8b 9a 10b

11b 12a 13c 14a 15b 16b 17d 18a 19b 20d

21b 22c 23b 24ac 25abd 26b 27ac 28cd 29abcd 30ad

31ac 32ad 33bcd 34abc