Self-Assessment Quiz: Optimization (Maxima & Minima)

Ungraded – for conceptual understanding only

Q1. A point $x = c$ is called a **critical point** of $f(x)$ if:

(a) $f(c) = 0$

(b) $f'(c) = 0$ or $f'(c)$ does not exist

(c) $f''(c) = 0$

(d) $f(c)$ is undefined

Q2. The **first derivative test** helps to determine:

(a) The concavity of a function

(b) The points of inflection

(c) Whether a critical point is a maximum or a minimum

(d) The slope of the tangent

Q3. The **second derivative test** states that if $f'(c) = 0$ and $f''(c) > 0$, then $x = c$ is:

(a) A local maximum

(b) A local minimum

(c) A point of inflection

(d) None of the above

Q4. A **global maximum** is:

(a) The largest value of $f(x)$ in a small neighborhood

(b) The largest value of $f(x)$ on its entire domain

(c) The point where $f'(x) = 0$

(d) The highest derivative value

Q5. For $f(x) = x^3 - 3x^2 + 4$, the local maximum occurs at:

(a) $x = 2$

(b) $x = 0$

(c) $x = 3$

(d) $x = 1$

Q6. In optimization problems, the first step is usually to:

(a) Differentiate the constraint equation

(b) Express the quantity to be optimized in a single variable

(c) Set the derivative equal to zero

(d) Compute the second derivative

Q7. If $f'(x) = 0$ and $f''(x) = 0$ at a point $x = c$, then:

(a) $x = c$ is always a maximum

(b) $x = c$ is always a minimum

(c) The test is inconclusive

(d) $x = c$ is an inflection point

Q8. A rectangle is inscribed under the curve $y = 12 - x^2$ in the first quadrant. The value of x that maximizes the area is:

(a) $x = 3$

(b) $x = 2$

(c) $x = \sqrt{6}$

(d) $x = 4$

Q9. For $f(x) = x^3 - 6x^2 + 9x + 15$, the local minimum occurs at:

(a) $x = 0$

(b) $x = 1$

(c) $x = 3$

(d) $x = 4$

Q10. The profit function $P(x) = -2x^2 + 40x - 150$ is maximized when:

(a) $x = 5$

(b) $x = 10$

(c) $x = 15$

(d) $x = 20$

Q11. A box with square base and open top has volume $32{,}000\,\text{cm}^3$. The height for minimum surface area is:

(a) $h = 10\,\text{cm}$

(b) $h = 20\,\text{cm}$

(c) $h = 30\,\text{cm}$

(d) $h = 40\,\text{cm}$

Q12. The endpoints of a closed interval must be tested for extrema because:

(a) The derivative is always undefined there

(b) Absolute extrema may occur at endpoints

(c) The second derivative changes sign there

(d) They simplify calculations

Q13. In real-world optimization problems, the function to be optimized usually represents:

(a) A random variable

(b) A constraint

(c) A quantity such as cost, area, or profit

(d) A constant term

Q14. If $f''(x) > 0$ for all x in an interval, the function is:

(a) Concave upward

(b) Concave downward

(c) Linear

(d) Undefined

Q15. For $f(x) = e^x(3 - x)$, the function has a:

(a) Maximum at $x = 1$

(b) Minimum at $x = 2$

(c) Maximum at $x = 2$

(d) Minimum at $x = 0$

Answer Key

Q1: (b)

Q2: (c)

Q3: (b)

Q4: (b)

Q5: (b)

Q6: (b)

Q7: (c)

Q8: (b)

Q9: (c)

Q10: (b)

Q11: (b)

Q12: (b)

Q13: (c)

Q14: (a)

Q15: (b)