Self-Assessment Quiz: Related Rates

Ungraded – for conceptual understanding only

Q1. In a related rates problem, two or more quantities are related by:

(a) Algebraic equations only

(b) A relationship that changes over time

(c) Constant proportionality

(d) Static geometry

Q2. The key technique used in solving related rates problems is:

(a) Integration

(b) Implicit differentiation with respect to time

(c) Substitution before differentiation

(d) Numerical approximation

Q3. When differentiating both sides of an equation involving x and y, we use:

(a) $\frac{dy}{dx}$

(b) $\frac{dx}{dy}$

(c) $\frac{dy}{dt}$ and $\frac{dx}{dt}$

(d) $\frac{d^2y}{dx^2}$

Q4. In a right triangle, if one leg is increasing and the other is constant, how does the hypotenuse change?

(a) It increases

(b) It decreases

(c) It remains constant

(d) It depends on the angle

Q5. A spherical balloon is being inflated. The volume is given by $V = \frac{4}{3}\pi r^3$. The rate of change of volume with respect to radius is:

(a) $4\pi r^2$

(b) $\frac{4}{3}\pi r^2$

(c) $3\pi r^2$

(d) $12\pi r^3$

Q6. When solving a related rates problem, what should be done before substituting numerical values?

(a) Differentiate all variables first

(b) Plug in values immediately

(c) Simplify and isolate the derivative

(d) Draw a diagram and identify known quantities

Q7. If a ladder 10 ft long is sliding down a wall, and the bottom is moving away from the wall at 2 ft/s, which relation connects x, y, and the ladder length?

(a) $x + y = 10$

(b) $x^2 + y^2 = 10^2$

(c) $xy = 10$

(d) $x^2 - y^2 = 10$

Q8. The derivative of the volume of a sphere $V = \frac{4}{3}\pi r^3$ with respect to time is:

(a) $\frac{dV}{dt} = 4\pi r^2 \frac{dr}{dt}$

(b) $\frac{dV}{dt} = 3\pi r^2 \frac{dr}{dt}$

(c) $\frac{dV}{dt} = 12\pi r \frac{dr}{dt}$

(d) $\frac{dV}{dt} = 2\pi r \frac{dr}{dt}$

Q9. The derivative of an equation with respect to time t requires:

(a) The product rule only

(b) The chain rule, since variables depend on time

(c) The quotient rule only

(d) No rule — direct differentiation

Q10. If the radius of a circle increases at a constant rate, the area:

(a) Increases at a constant rate

(b) Increases at an increasing rate

(c) Decreases at a constant rate

(d) Remains unchanged

Q11. In a cone, if the height and radius are related by $h = 3r$, then $\frac{dh}{dt}$ equals:

(a) $3\frac{dr}{dt}$

(b) $\frac{dr}{dt}$

(c) $\frac{1}{3}\frac{dr}{dt}$

(d) $r\frac{dh}{dt}$

Q12. When a quantity decreases over time, its rate of change is:

(a) Zero

(b) Positive

(c) Negative

(d) Undefined

Q13. In solving related rate problems, what is typically given?

(a) Values of variables only

(b) Values of derivatives (rates of change)

(c) Final results only

(d) None of the above

Q14. A conical tank is draining so that the water level decreases. If the height decreases at $2\,\text{cm/s}$, then $\frac{dh}{dt}$ is:

(a) $+2$

(b) -2

(c) 0

(d) Undefined

Q15. The general method of solving related rates problems includes:

(a) Writing a formula relating variables, differentiating implicitly with respect to time, substituting values, and solving for the unknown rate

(b) Integrating both sides and then differentiating

(c) Guessing rates using numerical estimates

(d) Assuming all rates are constant

Answer Key

Q1: (b)

Q2: (b)

Q3: (c)

Q4: (a)

Q5: (a)

Q6: (d)

Q7: (b)

Q8: (a)

Q9: (b)

Q10: (b)

Q11: (a)

Q12: (c)

Q13: (b)

Q14: (b)

Q15: (a)