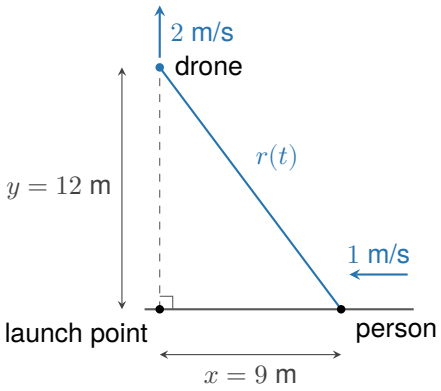
Quiz 05 – Version B Solutions

1. (10 points) A drone rises vertically above its launch point at 2 m/s while a person on the ground walks toward the launch point at 1 m/s. How fast is the distance between the person and the drone changing when the person is 9 m from the launch point and the drone is 12 m above it?



Solution. Let $x(t)$ be the person's distance from the launch point, $y(t)$ the drone's height, and $r(t)$ the distance between them. The Pythagorean theorem gives $r^2 = x^2 + y^2$. Differentiating with respect to time and solving for the separation rate gives

$$2r\frac{dr}{dt} = 2x\frac{dx}{dt} + 2y\frac{dy}{dt}, \qquad \frac{dr}{dt} = \frac{x(dx/dt) + y(dy/dt)}{r}.$$

The person walks toward the launch point, so $dx/dt = -1$ m/s, and the drone rises, so $dy/dt = 2$ m/s. At the given instant, $r = \sqrt{9^2 + 12^2} = 15$ m. Substituting these values gives

$$\frac{dr}{dt} = \frac{9(-1) + 12(2)}{15} = \boxed{1 \text{ m/s}}.$$

The distance between the person and the drone is increasing at 1 m/s at that instant.

Rubric (10 points)

- **2 points.** Relate the three distances by $r^2 = x^2 + y^2$ or an equivalent equation.
- **2 points.** Use $dx/dt = -1$ and $dy/dt = 2$, one point for each signed rate.
- **2 points.** Differentiate the distance relation with respect to time.
- **1 point.** Find $r = 15$ m at the given instant.
- **2 points.** Substitute into the rate equation and evaluate dr/dt, one point for each step.
- **1 point.** Interpret the positive rate as increasing and give units of m/s.

Grading notes. Accept equivalent correct methods and exact expressions. Correct requested answers earn full credit even if intermediate work is omitted. For partial credit, award points for the steps supported by the work. Carry arithmetic errors forward when later steps use those values consistently.