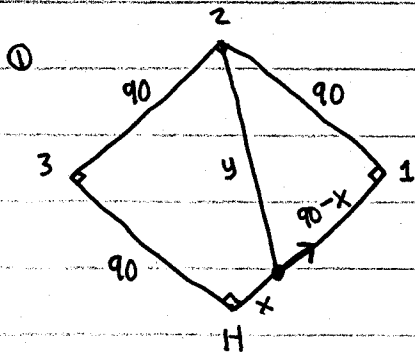


Show all work on this sheet, including mental steps, in a clearly organized way that speaks for itself. Use proper mathematical notation. **Box** short final answers.



A baseball diamond is a square with side 90 ft.

A batter hits the ball and runs towards first base with a speed of 24 ft/s. (title IX intervention)

At what rate is her distance from second base decreasing when she is halfway to first base?

Answer with a complete English sentence restating the question as a statement. [You have a headstart with the setup.]

② Suppose oil spills from a ruptured tanker and spreads in a circular pattern. If the radius of the oil spill increases at a constant rate of 1 m/s, how fast is the area of the spill increasing when the radius is 30 m?

① Given: $\frac{dx}{dt} = 24$ (ft/sec), Find: $-\frac{dy}{dt} \Big|_{x=45}$ (rate of decrease)

relation: pythagorean:

$$y^2 = 90^2 + (x-90)^2$$

rate equation:

$$2y \frac{dy}{dt} = 0 + 2(x-90) \frac{d}{dt}(x-90)$$

$\frac{dx}{dt} = 0$

$$2y \frac{dy}{dt} = 2(x-90) \frac{dx}{dt}$$

$$\frac{dy}{dt} = \frac{x-90}{y} \frac{dx}{dt} \quad \text{simplified \& solved for desired rate}$$

$$\frac{dy}{dt} \Big|_{x=45} = \frac{45-90}{y \Big|_{x=45}} (24) \quad \left\{ \begin{array}{l} x=45: \\ y^2 = 90^2 + 45^2 = 4 \cdot 45^2 + 45^2 = 5 \cdot 45^2 \\ y = 45\sqrt{5} \end{array} \right.$$

$$= \frac{-45(24)}{45\sqrt{5}} = \frac{-24}{\sqrt{5}} \quad \text{rate of increase.} \rightarrow \text{rate of decrease} \quad \boxed{\frac{24}{\sqrt{5}}}$$

Her distance from second base is decreasing at $\frac{24}{\sqrt{5}}$ ft/sec when she is halfway to first base.

② $\left[A = \pi r^2 \right]$, $\frac{dr}{dt} = 1$ (m/s), find $\frac{dA}{dt} \Big|_{r=30}$.

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

$$\frac{dA}{dt} \Big|_{r=30} = 2\pi(30)(1) = \boxed{60\pi \text{ (m}^2\text{/s)}}$$

If technology available:
 $\frac{24}{\sqrt{5}} \approx 10.7$
 $60\pi \approx 188$