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.

1. 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.]

\[ \text{rate of decrease} \]

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?

\[ \text{Given: } \frac{dx}{dt} = 24 \text{ (ft/sec), Find: } -\left. \frac{dy}{dt} \right|_{x=45} \]

relation: pythagorean: \[ y^2 = 90^2 + (x-40)^2 \]

rate equation: \[ 2y \frac{dy}{dt} = 0 + 2(x-40) \frac{dx}{dt} (x-40) \]

\[ 2y \frac{dy}{dt} = 2(x-40) \frac{dx}{dt} \]

simplified & solved for desired rate

\[ \frac{dy}{dt} \bigg|_{x=45} = \frac{45-40}{y} \bigg|_{x=45} \]

\[ x=45: \]

\[ y^2 = 90^2 + 45^2 = 45^2 + 45^2 = 5,45^2 \]

\[ y = 45\sqrt{5} \]

\[ \frac{dy}{dt} \bigg|_{x=45} = -\frac{45}{45\sqrt{5}} = -\frac{24}{15} \text{ rate of increase. } \to \text{ rate of decrease } \frac{24}{15} \]

Her distance from second base is decreasing at \( \frac{24}{15} \text{ ft/sec} \) when she is halfway to first base.

3. \[ A = \pi r^2 \]

\[ \frac{dA}{dt} = 1 \text{ (m/s)}, \text{ find } \left. \frac{dA}{dt} \right|_{r=30} \]

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

\[ \left. \frac{dA}{dt} \right|_{r=30} = 2\pi (30)(1) = 60\pi \text{ (m}^2/\text{s}) \]

If technology available:

\[ \frac{24}{15} \approx 10.7 \]

\[ 60\pi \approx 188 \]