1. Suppose $f'(2) = 4, g'(2) = -3, f(2) = -1, g(2) = 1, f'(1) = 2,$ and $g'(-1) = 5$. Find the derivative at $x = 2$ of:

(a) $h(x) = f(g(x))$

$$h'(x) = f'(g(x)) \, g'(x)$$
$$h'(2) = f'(g(2)) g'(2)$$
$$= f'(1)(-3) = 2(-3) = \boxed{-6}$$

(b) $k(x) = g(f(x))$

$$k'(x) = g'(f(x)) f'(x)$$
$$= g'(f(2)) f'(2)$$
$$= g'(-1) \, 4 = 5(4) = \boxed{20}$$

2. A baseball diamond is a square 90 feet on a side. A runner starts from home plate running towards first base at 20 feet per second. How fast is the runner's distance from second base changing when the runner is halfway to first base? Is the distance increasing or decreasing? Why?
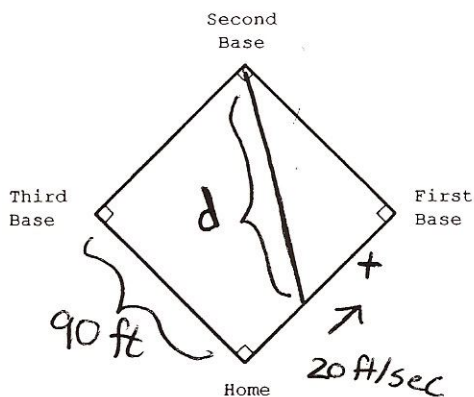
$$\frac{dx}{dt} = -20 \text{ ft/sec}$$

find $\frac{dd}{dt}$ @ $x = 45$

$$d^2 = x^2 + 90 \qquad d^2 = 45^2 + 90^2$$
$$2d\frac{dd}{dt} = 2x\frac{dx}{dt} \qquad d = 45\sqrt{5}$$
$$2(45\sqrt{5})\frac{dd}{dt} = 2(45)(-20)$$
$$\frac{dd}{dt} = \frac{-20}{\sqrt{5}} \text{ ft/sec}$$

decreasing, negative