RELATED RATES:

1. DETERMINE WHAT YOU ARE SOLVING FOR / WHAT YOU ARE TRYING TO FIND.
2. WRITE DOWN THE "GIVEN" QUANTITIES IN THE PROBLEM (DRAW A PICTURE)
3. WRITE AN EQUATION RELATING THE GIVEN QUANTITIES
4. TAKE DERIVATIVE IMPLICITLY (OF BOTH SIDES) WITH RESPECT TO TIME
5. PLUG IN GIVEN QUANTITIES AND SOLVE

LOGARITHMIC DIFFERENTIATION:

(1) $\frac{d}{dx}\ln(x) = \frac{1}{x}$

(2) $\frac{d}{dx}\log_a x = \frac{1}{\ln(a)x}$

(3) $\frac{d}{dx}\left[\ln(f(x))\right] = \frac{1}{f(x)} f'(x)$

(4) $\frac{d}{dx}\left[\log_a(f(x))\right] = \frac{f'(x)}{f(x)\ln(a)}$

LINEARIZATION:

$L(x) = f'(a)(x-a) + f(a)$

↑ $L(x)$ IS THE LINEAR APPROXIMATION TO $f(x)$ AT $x=a$

WE USE THE ABOVE EQUATION TO APPROXIMATE $f(x)$, SO $f(x) \approx L(x)$

*THE ERROR IS GIVEN BY $|f(x) - L(x)|$

DIFFERENTIALS:

A DIFFERENTIAL IS A SMALL CHANGE IN A VARIABLE.

(1) dx IS THE DIFFERENTIAL FOR x, dy IS THE DIFFERENTIAL FOR y

(2) $\Delta x = dx \Rightarrow$ "ACTUAL" CHANGE IN X

(3) FOR $y = f(x)$, $dy = f'(x)\,dx$ AND $\Delta y \approx dy$

(4) THE ACTUAL CHANGE IN Y IS $\Delta y = f(x + \Delta x) - f(x)$

(5) RELATIVE ERROR IS $\dfrac{\Delta y}{y_0} \approx \dfrac{dy}{y_0}$

(6) THE EQUATION FOR LINEAR APPROXIMATION IS NOW GIVEN BY:

$L(x) = f(a) + dy \Rightarrow$ "NEW = OLD + CHANGE"