Related Rates

w-up: AP Multiple Choice #26(non-calculator)

Differentiate $y = x^2 - 3x$ with respect to x

Remember, we can differentiate with respect to any variable. When differentiating "with respect to time" while using real world formulas results in real world Rates of Change.

So… $\frac{dA}{dt}$ could represent rate of change of area and $\frac{dV}{dt}$ could represent rate of change of volume, etc…

Differentiate $y = x^2 - 3x$ with respect to t.

Now find $\frac{dx}{dt}$ if $\frac{dy}{dt} = 5$ when $x = 1$.

Related Rate Application Problems

1) Write a formula(*equation*) related to problem.

2) Differentiate only after variables match given information. If not, rewrite one variable in terms of another and substitute in first.

3) After differentiation, replace variable with given or found values and solve for missing quantity.

Note: Be sure to use a negative value for rates of changes where the quantity is decreasing over time!

EX 1) A pebble is dropped into a calm pond causing ripples. The radius of the outer ripple is increasing at 1 ft/sec. When the radius is 4 feet, at what rate is the area changing?

EX 2) The radius of a sphere is increasing at a rate of 2 inches per minute. Find the rate of change of the volume when the radius is 24 inches.

EX 3) An airplane is flying at an elevation of 6 miles above the ground, on a flight path that will take it directly over a radar station. Let "s" be the distance in miles between the radar station and the plane. If "s" is decreasing at a rate of 400 mph when "s" is 10 miles. What is the ground velocity of the plane?

EX4)

A water tank has the shape of an inverted circular cone with base radius 2m and height 4m. If water is being pumped into the tank at a rate of 2 cubic m/min, find the rate at which the water level is rising when the water is 3m deep.

EX5)

A man walks along a straight path at a speed of 4ft/sec. A searchlight is located on the ground 20 feet from the path and is kept focused on the man. At what rate is the search light rotating when the man is 15ft. from the point on the path closest to the searchlight?