Strategy for Solving Related Rates Problems:

0. _____ . Underline important quantities and relationships given.

1. Draw a diagram, introduce notation, and label.
Label quantities that change in time with _____
Label quantities that are fixed (in time) with _____

2. Identify all relevant quantities.
Make a table of _____ described in words.

3. Write down what is to be determined (unknown) and what is given (known):

Find _____ **when** _____

4. Write down an equation that _____ .

5. Differentiate ***both*** sides of the equation _____ . Remember to use the chain rule!

6. Substitute in all the known values and rates of change and then solve for the desired rate of change.

Solve the following related rates problems by completing the steps 0-6 given above.

Ex A boat is pulled into a dock by a pulley that is 12 ft above the deck of a boat. If the winch pulls the rope in at a rate of 4 ft/sec, determine the speed of the boat when it is 5 ft from the dock.

Ex The angle of elevation of the sun is decreasing at a rate of $\frac{1}{4}$ rad/hour. How fast is the shadow cast by a 400 ft building increasing when the angle of elevation is $\frac{\pi}{6}$?

Ex A tanker oil spill creates a circular oil slick. The radius of the circle is growing at a rate of 6 in/sec. When the radius is 15 ft, how fast is the circular area changing.

Ex A 6 ft tall man walks with a speed of 8 ft/sec away from a street light on a post 18 ft high.

1. How fast is the tip of his shadow moving when he is 30 ft from the pole?

2. How would the problem change if you were asked to find how fast the length of the shadow is changing?

1. If a snowball melts so that its surface area decreases at a rate of 1 cm^2/min, find the rate at which the diameter decreases when the diameter is 10 cm.

2. A person parachutes out of a plane. After the parachute opens, the parachutist begins falling at a constant rate of 14 miles per hour. The plane continues flying at a speed of 100 miles per hour. How fast is the distance between the parachutist and the plane increasing after the parachutist has fallen 0.2 miles and the plane has flown 1 mile past the drop site.

3. Sand is pouring from a pipe at the rate of 120π ft^3/s. The falling sand forms a conical pile on the ground. The altitude of the cone is always one-third the radius of its base. How fast is the altitude increasing when the pile is 20 ft high? [Work on board]

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