AP Calculus
4.6 Worksheet

All work must be shown in this course for full credit. Unsupported answers may receive NO credit.

OK … I couldn't find a decent looney tunes picture for the next problem, so I thought I'd just throw in this cartoon (which by the way has nothing to do with related rates!) since I found it looking for any other good pictures. Besides, poor Wile E. Coyote has been working so much this year, it's about time he finally got a good meal. ☺

1. The radius *r* and area *A* of a circle are related by the equation: $A = \pi r^2$
Write an equation that relates $\frac{dA}{dt}$ and $\frac{dr}{dt}$.

2. A spherical container is deflated such that its volume is decreasing at a constant rate of $3141\text{cm}^3/\text{min}$.
[The Surface area of a sphere is $S = 4\pi r^2$ The volume of a sphere is $V = \frac{4}{3}\pi r^3$]

a) At what rate is the radius changing when the radius is 5 cm? Indicate units of measure.

b) At that same moment, how fast is the Surface Area changing? Indicate units of measure.

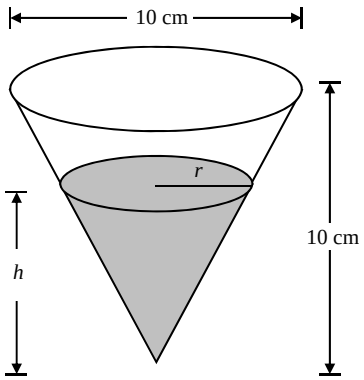
3. A 14 ft ladder is leaning against a wall. The top of the ladder is slipping down the wall at a rate of 2 ft/s.

a) How fast will the end of the ladder be moving away from the wall when the top is 6 ft above the ground? Indicate units of measure.

b) At the same moment, how fast is the angle between the ground and the ladder changing?

4. A pebble is dropped into a still pool and sends out a circular ripple whose radius increases at a constant rate of 4 ft/s. How fast is the area of the region enclosed by the ripple increasing at the end of 8 s? Indicate units of measure.

5. A container has the shape of an open right circular cone, as shown in the figure to the right. The height of the container is 10 cm and the diameter of the opening is 10 cm. Water in the container is evaporating so that its depth h is changing at the constant rate of $\frac{-3}{10}$ cm/hr.

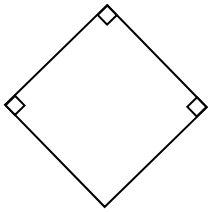


(The volume of a cone of height h and radius r is given by $V = \frac{1}{3}\pi r^2 h$.)

a) Find the volume V of water in the container when h = 5 cm. Indicate units of measure.

b) Find the rate of change of the volume of water in the container, with respect to time, when h = 5 cm. Indicate units of measure.

6. A baseball diamond has the shape of a square with sides 90 feet long. Tweety is just flying around the bases, running from 2nd base (top of the diamond) to third base (left side of diamond) at a speed of 28 feet per second. When Tweety is 30 feet from third base, at what rate is Tweety's distance from home plate (bottom of diamond) changing? Indicate units of measure.



7. The radius r, height h, and volume V of a right circular cylinder are related by the equation $V = \pi r^2 h$.

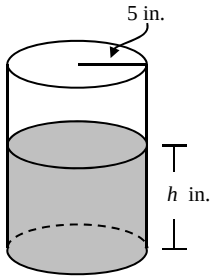
a) How is $\frac{dV}{dt}$ related to $\frac{dh}{dt}$ <u>if r is constant</u>?

b) How is $\frac{dV}{dt}$ related to $\frac{dr}{dt}$ <u>if h is constant</u>?

c) How is $\frac{dV}{dt}$ related to $\frac{dr}{dt}$ and $\frac{dh}{dt}$ if neither r nor h is constant?

8. A coffeepot has the shape of a cylinder with radius 5 inches, as shown in the figure to the right. Let h be the depth of the coffee in the pot, measured in inches, where h is a function of time t, measured in seconds. The volume V of coffee in the pot is changing at the rate of $-5\pi\sqrt{h}$ cubic inches per second. (The volume V of a cylinder with radius r and height h is $V = \pi r^2 h$.)

Show that $\frac{dh}{dt} = -\frac{\sqrt{h}}{5}$.



9. Sand pours out of a chute into a conical pile whose height is always one half its diameter. If the height increases at a constant rate of 4 ft/min, at what rate is sand pouring from the chute when the pile is 15 ft high? Indicate units of measure.

10. A camera man is standing 1000 feet from the launch of a rocket. As the rocket launches, the camera man must change the angle of elevation of his camera to keep the rocket in the camera's view. How fast is the angle of elevation changing when the rocket is 1 mile (5280 feet) in the air if the rocket is moving at 2300 feet per second?