AP Calculus
4.6 Worksheet

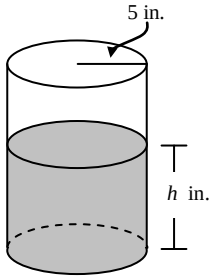
All work must be shown in this course for full credit. Unsupported answers may receive NO credit.

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 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 $V = \pi r^2 h$.)

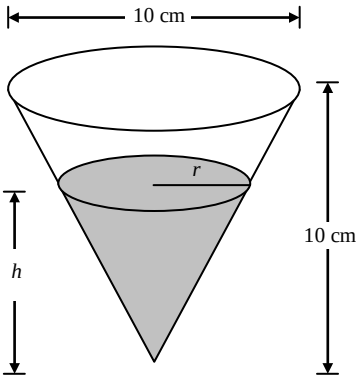


Show that $\frac{dh}{dt} = -\frac{\sqrt{h}}{5}$.

3. A 14 ft ladder is leaning against a wall. If the top of the ladder slips down the wall at a rate of 2 ft/s, how fast will the end be moving away from the wall when the top is 6 ft above the ground?

4. An aircraft is climbing at a 45° angle to the horizontal. How fast is the aircraft gaining altitude if its horizontal speed is 400 mi/hr?

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.



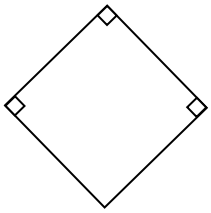
(The volume of a cone of height h and radius r is given by $V = \frac{1}{3}\pi r^2 h$.)

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.

c) Show that the rate of change of the volume of water in the container due to evaporation is directly proportional to the exposed surface area of the water. What is the constant of proportionality?

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?



7. A spherical container is deflated such that its radius decreases at a constant rate of 10 cm/min. At what rate must air be removed when the radius is 5 cm? [The volume of a sphere is $V = \frac{4}{3}\pi r^3$]

8. 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?

9. Liquid is pouring through a cone shaped filter at a rate of 3 in^3/min. Assume that the height of the cone is 12 inches and the radius of the base of the cone is 3 inches. How rapidly is the depth of the liquid in the filter decreasing when the level is 6 inches deep?

10. 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?

11. 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 $\frac{dh}{dt}$ if r is constant?

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

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

12. Complete #42 on page 254 of your textbook.