Class prep quiz on section 3.9, Stewart's Calculus (8th ed.)

1. Consider the following related rates problem:

   > A cylindrical metal can of volume $V = \pi r^2 h$ is being heated and expands. At the moment when it has radius $r = 55$mm and height $h = 178$mm, its radius is increasing at a rate of 2mm/min and its height is increasing at a rate of 1mm/min. At that moment, how fast is the volume increasing?

   In this problem, what is the independent variable, i.e., the variable with respect to which you take derivatives?

   (a) V (b) h (c) r (d) t

2. If we have n moles of an ideal gas in a sealed container, then the ideal gas law is

$$PV = nRT \tag{1}$$

   where P is the pressure on the gas, V is the volume of the gas, n is the (constant) amount of gas, R is a constant from physics, and T is the temperature of the gas. What equation do we get by taking the derivative of both sides of (1) and putting the result in **simplest possible form**?

   (a) $P'V + PV' = nRT'$ (b) $PV = nR$
   (c) $PV = nRT'$ (d) $P'V + PV' = nR'T + nRT'$

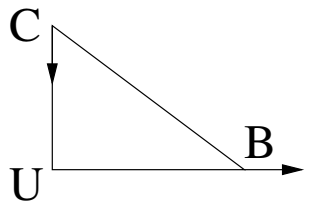
3. If an object of constant mass m moves under the influence of gravity (only), h is the height of the object at a given time, and v is the (magnitude of the) velocity of the object at a given time then

$$mgh + \frac{1}{2}mv^2 = C,$$

   where g and C are constants.

   Suppose we want to know the rate of change of the height of the object at a given point in time. What is the **minimum** amount of information we need to know, in addition to the values of the constants m and g?

   (a) The acceleration of the object at that point in time.
   (b) The velocity of the object at that point in time.
   (c) The velocity and acceleration of the object at that point in time.
   (d) None of the above are enough to determine the rate of change of h.



4. Cal the Caltrain is 30 miles due north of Unpleasantville Station and headed south at 65 miles per hour, and Bart the BART train is 40 miles due east of Unpleasantville Station and headed east at 75 miles per hour, as shown above. At what rate are Cal and Bart getting closer together or farther away from each other?
   (a) Closer together, at 2.8 miles per hour
   (b) Closer together, at 0.2 miles per hour
   (c) Farther apart, at 2.8 miles per hour
   (d) Farther apart, at 0.2 miles per hour