Math 251 PRACTICE EXERCISES, FALL 2012 **October 12th**

For the following, use the derivative rules

$$(e^{at})' = ae^{at} \qquad (\sin at)' = a\cos at \qquad (\cos at)' = -a\sin at \qquad (\ln x)' = \frac{1}{x}$$

Product Rule: $(uv)' = uv' + vu'$ **Quotient Rule:** $\left(\frac{u}{v}\right)' = \frac{vu' - uv'}{v^2}$

1. Consider the function $y = \dfrac{x^4}{6}$.
   (a) Rewrite the function as $y = ax^n$ for some values of a and n. Find the derivative and write your answer back in the sort of form that the original function was given in.
   (b) Find the derivative using the quotient rule. You answer should be the same as what you got for (a). If not, find your error(s).

2. Repeat Exercise 1 for the function $y = \dfrac{6}{x^4}$.

3. Calculate each derivative. Check your answers at Wolfram Alpha, *http://www.wolframalpha.com/* Look to see whether you entered the original function correctly, and remember that you may need to look down at the alternate forms.

   (a) $y = 5x^3 \sin 2x$ (b) $f(t) = 3t^2 e^{-4t}$ (c) $y = \dfrac{\cos 3x}{x^2}$

   (d) $y = x^3 \ln x$ (e) $y = \dfrac{x}{x+2}$ (f) $i = e^{-\frac{t}{2}} \cos 5t$

4. Let $y = (2x-3)(x^2 - 5x + 2)$.
   (a) Use the product rule to find the derivative.
   (b) Multiply out your answer to (a) and combine like terms.
   (c) Multiply the parts of the original function, *THEN* take the derivative. Your answer should be the same as what you got for (b).

5. The equation $h = e^{-3t}[5\sin(2t) - 7\cos(2t)]$ gives the height (in inches) of a vibrating mass on a spring at any time t seconds.
   (a) Find the first derivative of height with respect to time, which you do by either applying the product rule the way the equation is written or by first distributing the e^{-3t} and then applying the product rule. Give your answer in the $\frac{d\ something}{d\ something}$ form, and give units with your answer.
   (b) Your answer to (a) is a velocity. Assuming that up is positive, is the mass moving up or down at time $t = 2$? (Remember, calculator in radians!)
   (c) Be sure that the result from (a) is simplified (combine like terms). Then take the second derivative.

6. The current i (in amperes) in an electrical circuit at time t seconds is $i = 8.3 - 8.3e^{-0.05t}$. Find the rate at which the current is changing at time $t = 6$ seconds.