Implicit Differentiation
For problems 1 & 2 find $y'$.

1. $x^2e^{y^2} = 12 + 8x - 9y^2$

2. $\ln\left(x^3 - y^2\right) = x^3y^2$

3. Find the equation of the tangent line to $e^{x^3y^3} = y^4 - 15$ at (0, -2).

Related Rates
In order to receive any credit for problems 4 – 7 you MUST use Calculus techniques to find the answer. Any decimal work should include at least 4 decimal places.

4. A snowball in the shape of a sphere is melting and losing volume at a rate of 3 cm$^3$/sec. How fast is the radius of the snowball decreasing when the surface area of the snowball is 35 cm$^2$?

5. A water tank is in the shape of a cone whose base radius of 12 ft and height is 35 ft and water is entering the tank at a rate of 2 ft$^3$/hr. At what rate is the height of the water changing when the height of the water is 20 ft.

6. Two people start out 1000 meters apart with person A directly to the west of person B. At the same time both people start moving with person A traveling to the east at 40 m/hr while person B travels north at 25 m/hr. Determine if the distance between the people is increasing, decreasing or not changing after,
   (a) 10 hours          (b) 20 hours          (c) 30 hours

7. In the equation $P^2 - 4P = 7(z - 1)e^{6-7z}$ both $P$ and $z$ are functions of time. It is known that at some particular time we have $z = 1$, $P > 0$ and $z$ is decreasing at a rate of 2 (don’t worry about units here). Is $P$ increasing or decreasing at this time?

Higher Order Derivatives
For problems 8 – 10 compute the second derivative.

8. $f(x) = 8x^4 + \frac{2}{3x^2} + 81 \sqrt{x}$

9. $y = \cos(z^3) - \cot(5z)$

10. $A(t) = \ln(1 + \cos(t))$

11. Compute $g^{(3)}(x)$ for $g(x) = \sin\left(\frac{x}{e}\right) + \ln\left(4x^{20}\right) - e^{-3x}$