1. **(8 points)** Compute the following derivatives:

   (a) **(4 points)** Given $y = x^2 e^{\sec x}$, find $\frac{dy}{dx}$.

   (b) **(4 points)** For $f(t) = \cos\left(\frac{e^t - 2}{\arcsin t}\right)$, find $f'(t)$.

   (c) **(4 points)** Compute $\frac{d}{d\theta}\sin(\theta + \ln\theta)$.

2. **(4 points)** Given the equality $x \sin y = 1 - y^2$, find a formula for $\frac{dy}{dx}$ by implicit differentiation.

3. **(4 points)** An air compressor which delivers 10 cubic feet per minute is being used to inflate a spherical balloon of volume V and radius r which is currently 8 feet in radius; we wish to know how quickly the radius is increasing. Calculate $\frac{dr}{dt}$ below, using the given information:

   $V = \frac{4}{3}\pi r^3$.

   $\frac{dV}{dt} = 10$.

   $r = 8$ currently.

   What is $\frac{dr}{dt}$ currently?

4. **(2 point bonus)** If n is a positive integer, find a general formula for $\frac{d^n}{dx^n}\left(x^{n-1}\ln x\right)$ on the back of this page.