(1) Find the derivatives of the following functions with respect to $x$.

(a) $e^x(x + x\sqrt{x})$  
(b) $2xe^x - \frac{1}{\sqrt{x}}$  
(c) $x^{7/6} - \ln(x^2 + 1)$  
(d) $3^{-x^2}$  
(e) $(x^3 - 1)\sin(x)$  
(f) $2^{40}$  
(g) $\frac{e^{1/x}}{x^2}$  
(h) $\arctan\left(\frac{x^2 + 3}{x - 1}\right)$  
(i) $\frac{x^2 + 4x + 3}{\sqrt{x}}$  
(j) $\arcsin(2x)\sqrt{1 - x^2}$  
(k) $\frac{e^{1/x}}{x^2}$  
(l) $(\tan(2) + \tan(x))^e$  
(m) $x\cos(e^x \sqrt{x})$  
(n) $\ln(10)$  
(o) $\frac{1}{1 + \frac{1}{x}}$  
(p) $\frac{\ln(x) - x^3}{x^2 + 1}$  
(q) $\ln\left(\frac{1}{\sin(5x)}\right)$  
(r) $\sqrt{x + \sqrt{x}}$

Here are a few other problems to remember how we work with derivatives:

(2) Find $y''' = \frac{d^3y}{dx^3}$ for $y = (x - 3)\sqrt{x + 2}$.

(3) Which of the following functions is concave up on the entire interval $(0, \infty)$? Circle all that are concave up, and be sure to justify your answer.

(a) $f(x) = -\ln(x)$  
(b) $g(x) = x(x - 2)^2$  
(c) $h(x) = x^2 + \cos(x)$  
(d) $k(x) = e^{-x}$

(4) On what interval(s) is the function $h(x) = 4(x - 2)^2(x + 1)$ increasing?