Differential Equations Review Assignment

Instructions: Answer all questions to the best of your ability *without using a calculator*. Provide *all* solutions where appropriate.

1. Differentiate the following:
   (a) $-\sin(3x)$
   (b) xe^{x^2-1}
   (c) $\arctan(x)$
   (d) $\ln\sqrt{x}$
2. Factor completely $2x^3 - 3x^2 - 8x + 12$
3. Complete the square: $-2x^2 + 8x + 1$
4. Evaluate:
   (a) $\lim_{x\to\infty} e^{-x}$
   (b) $\lim_{x\to\infty} x \ln x$
   (c) $\int x^3 - 3x^2 + 2\,dx$
   (d) $\int x\sqrt{x^2+1}\,dx$
   (e) $\int x\cos x\,dx$
   (f) $\int \frac{2x+1}{x^2+x-6}\,dx$
   (g) $\int \frac{1}{9-x^2}\,dx$
5. Suppose that $f(t)$ represents the volume (in gallons) of water in a swimming pool as a function of time (in hours). Suppose that $f(3) = 800$ and $\frac{df}{dt}(3) = -20$. Explain exactly what these equations means in a plain English sentence with no equations (though you can and should use the numbers and express your answers using the proper units).
6. Suppose $f(t)$ represents the number of dollars raised per second during the course of a charity fundraising drive. Suppose $\int_{60}^{120} f(t)\,dt = 400$. Assuming that $t = 0$ is the start time for the charity drive, explain exactly what this equation means in a plain English sentence with no equations (though you can and should use the numbers and express your answers using the proper units).