Name: ____________________ ________ / 30

There are 30 points possible on this quiz. No aids (book, calculator, etc.) are permitted. Show all work for full credit.

1. **[15 points]** Compute the derivatives of the following functions.

   a. $f(x) = 2 + \sqrt{x} - e^x$

   $f'(x) = 0 + \frac{1}{2}x^{-1/2} - e^x = \frac{1}{2}x^{-1/2} - e^x$

   b. $f(r) = \frac{3}{r^3}$ $= 3r^{-3}$

   $f'(r) = -9r^{-4} = -\frac{9}{r^4}$

   c. $f(x) = \frac{\sqrt[3]{x}+5}{x}$. Hint: Don't bother with the quotient rule.

   $f(x) = x^{\frac{1}{3}-1} + 5x^{-1}$ $f'(x) = \frac{-2}{3}x^{-5/3} - 5x^{-2}$

   $= x^{-\frac{2}{3}} + 5x^{-1}$

   d. $f(x) = x^{-\frac{1}{2}}e^x$

   $f'(x) = \frac{-1}{2}x^{-3/2}e^x + x^{-1/2}e^x$

   e. $f(x) = \frac{x^2+1}{x^2-1}$

   $f'(x) = \frac{2x(x^2-1) - 2x(x^2+1)}{(x^2-1)^2}$

   $= \frac{-4x}{(x^2-1)^2}$

2. [5 points] A population of moose is declining. The population at time t is

$$P(t) = \frac{1000}{1+t}$$

where P is the number of moose and where t is measured in years.

Compute the rate of change of the moose population, with units, at time $t = 4$ years.

$$P'(t) = \frac{0\cdot(1+t) - 1000\cdot 1}{(1+t)^2} = \frac{-1000}{(1+t)^2}$$

$$P'(4) = \frac{-1000}{25} = -40 \text{ moose/year}$$

3. [6 points] A particle is moving along a line, and its position x as a function of time t is

$$x(t) = (1-t^2)e^t.$$

a. Compute the velocity of the particle.

$$x'(t) = -2te^t + (1-t^2)e^t$$

$$= (1-2t-t^2)e^t$$

b. Compute the acceleration of the particle.

$$x''(t) = (-2-2t)e^t + (1-2t-t^2)e^t$$

$$= -(1+4t+t^2)e^t$$

4. [4 points] Find the formula for the tangent line to the curve $y = x - x^3$ at $x = 2$.

@ $x=2$ $y = 2-2^3 = -6$

$y' = 1-3x^2$

@ $x=2$ $y' = 1-3\cdot 4$

$= -11$

point-slope form

$y+6 = -11(x-2)$

$y = -6 - 11(x-2)$