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. $f(r) = \dfrac{3}{r^5}$

    $$f(r) = 3r^{-5}$$
    $$f'(r) = -15r^{-6} = \frac{-15}{r^6}$$

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

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

    c. $f(x) = \dfrac{\sqrt{x}+5}{x^2}$. Hint: Don't bother with the quotient rule.

    $$f(x) = x^{1/2 - 2} + 5x^{-2} \qquad f'(x) = -\frac{3}{2}x^{-5/2} - 10x^{-3}$$
    $$= x^{-3/2} + 5x^{-2}$$

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

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

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

$$P(t) = \frac{800}{2+t}$$

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

Compute the rate of change of the lynx population, with units, at time $t = 3$ years.

$$P'(t) = \frac{0 \cdot (2+t) - 800(\cdot 1)}{(2+t)^2} = \frac{-800}{(2+t)^2}$$

$$P'(3) = \frac{-800}{25} = -32 \ lynx/year$$

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

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

a. Compute the velocity of the particle.

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

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

b. Compute the acceleration of the particle.

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

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

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

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

$y' = 1 - 2x$

@ $x = 3$, $y' = -5$

point-slope form

$y + 6 = -5(x-3)$

$$\boxed{y = 6 - 5(x-3)}$$