

Name: \_\_\_\_\_

1. (30 pts) Find  $\frac{d}{dx} \frac{\sqrt{x}}{\sqrt{\sqrt{x}}}$ .

2. (40 pts) Find the specified derivatives.

$$\frac{d}{dt} \ln t$$

$$\frac{d}{dx} (5z^4 + 3z^2 + z)$$

$$\frac{d}{dx} \frac{1}{\sqrt[3]{x^2}}$$

$$\frac{d}{dx} (e^x + x^e)$$

3. (35 pts) Suppose the phase of the moon (in percent of full)  $t$  days after January 6, 2000 is given by  $M(t) = 50 + 50 \cos\left(\frac{2\pi}{29.530589}t\right)$ . Find  $M(365)$  and  $M'(365)$ . Give units and interpret your answer.

4. (35 pts) Suppose the height of an eagle (in feet)  $t$  seconds after spotting a dove is given by  $E(t) = 25te^{-t/10} + 250e^{-t/10} + 125$ . Find the vertical velocity and acceleration (including units) of the eagle after 15 seconds, and determine whether the eagle is rising or falling, and whether it is speeding up or slowing down.

5. (30 pts) Find the global maximum and minimum of  $\frac{1}{\sqrt{x^2+1}}$ .

6. (30 pts) Graph the function  $x^3 - 30x^2$  by hand. Show all your work, including the calculation of zeros, local maxima/minima, and inflection points.

7. (Bonus 30 pts) Use Calculus to prove that  $e^{x^2-4} - x^2 + 8$  is never equal to zero.

8. (Bonus 20 pts) Prove the sum rule using the definition of the derivative.