

Show all work. Use back of sheets if necessary. Hand in to your TA.

Name _____

Score

1. _____ (10)

2. _____ (25)

3. _____ (10)

4. _____ (10)

5. _____ (10)

6. _____ (10)

7. _____ (10)

8. _____ (15)

Total _____ (100) Grade _____

1. Suppose H and K are positive infinite hyperreals. Determine whether

$$\frac{H + K}{\sqrt{H^2 + K^2}}$$

is infinitesimal, finite but not infinitesimal, or infinite.

2. a. Suppose $y = 2x^2 - 3x + 7$. What is $\frac{dy}{dx}$?

b. Suppose $p = \sin(y) \log(y)$. What is $\frac{dp}{dy}$?

c. Suppose $r = \frac{e^{2\theta}}{\tan(\theta)}$. What is $\frac{dr}{d\theta}$?

d. Suppose $y = \sin(e^{x^2+x-1})$. What is $\frac{dy}{dx}$?

e. What is $\frac{d}{dx}((x^3 + 1)^{4c})$ where c is a constant?

3. Suppose that the derivative of $f(x)$ is $x \log(x)$. What is the derivative of $f(\sin^2(x))$ with respect to x ?

4. Derive a rule for finding $\frac{d}{dx}(u^v)$ in terms of $u, v, \frac{du}{dx}$ and $\frac{dv}{dx}$ where u and v are functions of x . You may use any rules for differentiation you know.

5. Suppose $x = \sin(t)$ and $y = \sin(2t)$. Find the equation of the tangent line to this curve when $t = 0$. What is the slope when $t = \frac{\pi}{2}$?

6. Suppose y is a function of x satisfying $x^2 + xy^2 + 3y = 12$ for every x . What is $\frac{dy}{dx}$?

7. Suppose $y = \frac{1}{x}$ and Δx is a nonzero infinitesimal. Find $\frac{\Delta y}{\Delta x}$. Simplify and use this to find $\frac{dy}{dx}$. Find an infinitesimal ϵ so that $dy = \Delta y \pm \epsilon \Delta x$.

8. On the back of this page state and prove the product rule for differentiation.