

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

Please show all work and justify your answers.

1. (20 pts.) Find the following limits (or state that the limit fails to exist). Justify your answers.

$$(a) \lim_{x \rightarrow 2^+} \frac{|2-x|}{x-2} \quad (b) \lim_{x \rightarrow \infty} \frac{2-x}{x-2} \quad (c) \lim_{x \rightarrow 0} \sin(2x)/x \quad (d) \lim_{x \rightarrow 0} x^2 \sin(1/x)$$

2. (20 pts.) Assuming a yearly inflation rate of 1.5% the average price of a music CD is given by  $P(t) = 16 \cdot 1.015^t$  where  $t$  is in years. How much does a CD cost now? How much will it cost 10 years from now? How fast will the price of a CD be rising in 10 years?

3. (20 pts.) Let  $f(x) = 1/x^2$ .

- (a) Use the definition of derivative to find  $f'$  and show that it satisfies the power rule.  
 (b) Find an equation for the tangent line to  $f$  at  $x = -2$ . Sketch.

4. (20 pts.) Find  $dy/dx$ , if

$$(a) x^e + e^y = 1 \quad (b) x \ln(y) = \cos(y)$$

5. (20 pts.) A champagne glass is a cone of height 5 cm and radius 2 cm (at the top). On New Year's eve your significant other fills the glass at the rate of  $3 \text{ cm}^3/\text{s}$ . How fast will the level of champagne be rising at the moment when the glass is filled two thirds of the way up?

**Hint:** Sketch the glass and the champagne in it. At any given time, the level of champagne and the radius of its surface are related. Solve for one in terms of the other.

**Note:** The volume of a cone with radius  $r$  and height  $h$  is  $\frac{1}{3}\pi r^2 h$ .

1	2	3	4	5	total (100)

Prelim. course grade: %