

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

Please show all work and justify your answers.

1. (10 pts.) Find the following limits (or state that the limit fails to exist).

(a)  $\lim_{x \rightarrow 2^+} \frac{|4 - x^2|}{x - 2}$       (b)  $\lim_{x \rightarrow \infty} \frac{4 - x^2}{(x - 2)^2}$       (c)  $\lim_{x \rightarrow 0} \cos(2x)/x$       (d)  $\lim_{x \rightarrow \infty} \cos(2x)/x$

2. (10 pts.) Assuming a yearly inflation rate of 1.2% the average price of a sixpack of Duff is given by  $P(t) = 3 \cdot 1.012^t$  where  $t$  is in years. How much does a sixpack cost now? What will it cost 30 years from now? How fast will the price of Duff be rising in 10 years?

3. (10 pts.) Let  $f(x) = \sin(2x)$

- (a) Use the definition of derivative to find  $f'(0)$   
 (b) Find an equation for the tangent line to  $f$  at  $x = \frac{3\pi}{8}$ . Sketch.

4. (10 pts.) Find  $dy/dx$ , if      (a)  $\pi^x + y^\pi = e$       (b)  $yx = \sin[\ln(y)]$

5. (10 pts.) An imperial fighter jet, flying level 10 km above the ground, approaches a rebel defense position. The jet's speed is 500 km/h. Rubble the rebel follows the fighter's progress through a telescope. When the telescope makes an angle of  $30^\circ$  to the ground, how fast must Rubble rotate it to keep the imperial jet in his sights?

6. (10 pts.) Annie the anarchist throws a cream pie at a group of bureaucrats. The pie's position is given in meters as a function of time in seconds by  $x(t) = 60t, y(t) = 40t - 10t^2$ .

- (a) When will the cream pie splat? How far from Annie is the target standing?  
 (b) With what speed will the cream pie make contact with face?

7. (10 pts.) Bob wants to build a plexiglas kennel in the shape of a box with a hollow square footprint for his genetically modified giant pet amoeba Blob. Blob is flexible and his volume is a whopping  $0.5 \text{ m}^3$ . What should Bob pick for the dimensions of the kennel to save money on plexiglas for the walls and roof?

8. (10 pts.) The rate of leakage of oil from a crippled tanker is measured twice a day and the results are recorded in the following table:

time (days)	0	0.5	1	1.5	2	2.5
rate (barrels/h)	2.1	2.8	4.5	6.1	8.5	9.8

- (a) Find upper and lower estimates on the amount of oil leaked during the first 2.5 days.  
 (b) What sampling frequency would give estimates that differ by at most 5 barrels?

9. (10 pts.) Evaluate      (a)  $\int t^3 [\sqrt{t} - 1]^2 dt$       (b)  $\int_{-2}^0 |1 - t^2| dt$

10. (10 pts.) The rate of students at Filthy U getting infested by lice is roughly proportional to the cube root of time (in days). At the beginning of finals week 195 students carry lice. The next day the number is 210. Approximately how many students have lice at the beginning of the following week?

1	2	3	4	5	6	7	8	9	10	total (100)
										%