

- 1) [10pts] Find the max and min values of  $f(x) = 5 - 12x - 9x^2$  on  $[-1,1]$ .
- 2) [10pts] Find the max and min values of  $f(x) = |2x - 3|$  on  $[0,2]$ .
- 3) [10pts] Compute the derivative of  $y = x^{2x}$  using logarithmic diff'n.
- 4) [10pts] Compute  $y'$  given that  $\cos(xy) = y$ , using implicit differentiation.
- 5) [5pts each] Compute  $y'$  using any valid method.
  - a)  $y = \frac{3x}{2x+1}$
  - b)  $y = x^2 \cos(x)$
  - c)  $y = \sin(x^3)$
  - d)  $y = x^7 \tan(x)$
  - e)  $y = \ln(\ln(x))$

6) (10 pt) Use a linear approximation to estimate  $\cos(43^\circ)$ .

7) (15 pts) A man 6 ft tall walks with a speed of 6 ft/s away from a street light that is atop a 12-foot pole. How fast is the tip of his shadow moving along the ground when he is 100 ft from the pole?

8) (10pts) CHOOSE ONE; (remember to explain properly)

A) Use the definition of derivative (a limit) to show that the derivative of  $\sin(x)$  is  $\cos(x)$ .

B) State and prove the Product Rule.

BONUS (a hard 5 pts): Give an example of a differentiable function  $f(x)$  such that  $f'(x)$  is *not* differentiable. (Hint: in my favorite example, there is an absolute value)

## Answers

After removing some very low scores, the average was about 67. So, use the original scale. The lowest scores, by far, occurred on the related rates problem. So, we will practice more word problems in class, and try this again on Exam 3.

1) Max at  $(-2/3, 9)$ . Min at  $(1, -16)$ . Since this is a frowning parabola, you can use your common sense to partially check your answer.

2) This has a non-differentiability point, and a minimum of 0, at  $x = 3/2$ . Max at  $(0, 3)$ .

3)  $y' = (2 + 2 \ln x)x^{2x}$

4) Use the Chain Rule and Product Rule to get  $y' = -\sin(xy)[y + xy']$ . Then do the algebra:  $y' = -y \sin(xy)/(1 + x \sin(xy))$

5) I usually give little partial credit in short problems like these.

a) Quotient Rule:  $3/(2x + 1)^2$

b) Product Rule:  $2x \cos(x) - x^2 \sin(x)$

c) Chain Rule:  $3x^2 \cos(x^3)$

d) Product Rule:  $x^7 \sec^2 x + 7x^6 \tan x$

e) Chain Rule:  $1/(x \ln x)$

6) Use  $f(x_0) + f'(x_0)\Delta x = \cos(45^\circ) - \sin(45^\circ)[-2^\circ]$ , but use  $-2^\circ = -\pi/90$  radians. So,  $\sqrt{2}/2 + \pi\sqrt{2}/180$ .

7) 12 ft/s. We did one like this in class. Begin by drawing a picture, and labelling the variables, such as the distance to the lamppost and the length of the shadow.

8) See text/lectures.

Bonus)  $y = x|x|$ , a graph may help you see why this works. It does not have a  $y''(0)$ .