

## Homework Key for Section 1

1. Differentiate the following:

(a)

$$f'(x) = \frac{3}{(3x-1) \ln 2}$$

(b)

$$f'(x) = \frac{1}{5x\sqrt[5]{(\ln x)^4}}$$

(c)

$$f'(x) = \frac{\sin x}{x} + \cos x \ln(5x)$$

(d)

$$f'(x) = \frac{6}{2x+1} - \frac{12}{3x-1}$$

(e)

$$f'(x) = \frac{2x^2 - 1}{x(x^2 - 1)}$$

2. Find  $y'$  and  $y''$ :

(a)

$$y' = x + 2x \ln(2x) \quad y'' = 3 + 2 \ln(2x)$$

(b)

$$y' = \frac{1 - 2 \ln x}{x^3} \quad y'' = \frac{6 \ln x - 5}{x^4}$$

3. Use LD to find the derivative of the following:

(a)

$$y' = (2x+3)^5(x^5-2)^3 \left( \frac{10}{2x+3} + \frac{15x^4}{x^5-2} \right)$$

(b)

$$y' = x^{\sin x} \left( \frac{\sin x}{x} + \cos x \ln x \right)$$

## Homework Key for Section 2

1. A bacteria culture initially contains 100 cells and grows at a rate proportional to its size. After one hour the population is 420.
  - (a) Find an expression for the number of bacteria after  $t$  hours.  
 $100(4.2)^t$
  - (b) Find the number of bacteria after 3 hours.  
 $\approx 7409$
  - (c) Find the rate of growth after 3 hours.  
 $\approx 10,632 \text{ bacteria/hr}$
  - (d) When will the population reach 10,000?  
 $\approx 3.2 \text{ hrs}$
2. The half-life of Cesium-137 is 30 years. Suppose we have a 100 mg sample
  - (a) Find an expression for the mass after  $t$  years.  
 $100(2)^{-t/30} \text{ mg}$
  - (b) How much remains after 100 years?  
 $\approx 9.92 \text{ mg}$
  - (c) When will the mass be 1 mg?  
 $\approx 199.3 \text{ yrs}$
3. A turkey is taken from the oven when its temperature has reached  $185^\circ\text{F}$  and placed in a room where the temperature is  $75^\circ\text{F}$ 
  - (a) If the temp is  $150^\circ\text{F}$  after 30 minutes, what is the temp after 45 minutes?  
 $\approx 137^\circ \text{ F}$
  - (b) When will it have cooled to  $100^\circ\text{F}$ ?  
 $\approx 116 \text{ minutes}$
4. A cold drink is removed from the fridge and its temp is  $5^\circ\text{C}$ . After 25 minutes in a  $20^\circ\text{C}$  room its temp has increased to  $10^\circ\text{C}$ .
  - (a) What is its temp after 50 minutes?  
 $\approx 13.3^\circ \text{ C}$
  - (b) When will its temp be  $15^\circ\text{C}$ ?  
 $\approx 67.74 \text{ min}$

### Homework Key for Section 3

1. If  $y = x^3 + 2x$  and  $dx/dt = 5$ , find  $dy/dt$  when  $x = 2$   
70
2. If  $z^2 = x^2 + y^2$ ,  $dx/dt = 2$  and  $dy/dt = 3$ , find  $dz/dt$  when  $x = 5$  and  $y = 12$   
 $\pm \frac{46}{13}$
3. A street light is mounted at the top of a 15ft pole. A man 6 feet tall walks away from the pole at a rate of 5 ft/sec in a straight line. How fast is the tip of his shadow moving when he is 40 ft from the pole?

$$\frac{15}{6} = \frac{x+y}{y} \implies \frac{25}{3} \text{ ft/sec}$$

4. At noon, ship A is 150km west of ship B. Ship A is sailing east at 35 km/hr and ship B is sailing north at 25 km/hr. How fast is the distance between the ships changing at 4 PM?  
 $\approx 28.36 \text{ km/hr}$
5. Two cars start moving from the same point. One travels south at 60 mi/hr and the other west at 25 mi/hr. At what rate is the distance between the cars increasing two hours later?  
 $65 \text{ mi/hr}$

## Homework Key for Section 4

1. Find the linearization,  $L(x)$ , of the function at  $a$ .

(a)  $L(x) = -10x - 6$

(b)  $L(x) = -x + \pi/2$

2. Find the differential for  $y = x^2 \sin 2x$

$$dy = 2x(x \cos 2x + \sin 2x)dx$$

3. Find the differential  $dy$  and evaluate it for the given values of  $x$  and  $dx$

(a)  $dy = (1/10)e^{x/10}dx$  ,  $dy = 0.01$

(b)  $dy = \frac{-dx}{(x+1)^2}$  ,  $dy = 0.0025$

4. Use a linear approximation to estimate  $(2.001)^5$   
32.08

## Homework Key for Section 5

1. Prove the following:  $\sinh(-x) = -\sinh x$

2. Differentiate the following:

(a)

$$f'(x) = \operatorname{sech}^2(1 + e^{2x})(2e^{2x})$$

(b)

$$f'(x) = x \cosh x$$

(c)

$$f'(x) = \frac{\sinh(\ln x)}{x}$$

(d)

$$f'(x) = \tanh x$$