

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.
 ≈ 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°F and placed in a room where the temperature is 75°F
 - (a) If the temp is 150°F after 30 minutes, what is the temp after 45 minutes?
 $\approx 137^\circ \text{ F}$
 - (b) When will it have cooled to 100°F ?
 $\approx 116 \text{ minutes}$
4. A cold drink is removed from the fridge and its temp is 5°C . After 25 minutes in a 20°C room its temp has increased to 10°C .
 - (a) What is its temp after 50 minutes?
 $\approx 13.3^\circ \text{ C}$
 - (b) When will its temp be 15°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?
 $\approx 21.4 \text{ km/hr}$
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 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)

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