

**Week in Review # 10**  
**Sections 10.1, 10.2(some)**

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**Things to know:**

- Be able to setup a differential equation.
  - Understand what it means to be a solution to a differential equation.
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1. A cup of coffee contains about 250 mg of caffeine. Caffeine is metabolized and leaves the body at a continuous rate of 21% every hour. Write a differential equation that measures the amount of caffeine,  $A$ , in the body as a function of the number of hours,  $x$ , since the coffee was consumed.
2. Dead leaves accumulate on the ground in a forest at a rate of 4 grams per square centimeter per year. At the same time, these leaves decompose at a continuous rate of 70% per year. Write a differential equation for the total quantity of dead leaves( per square centimeter) at time  $x$ .
3. A patient is given a drug intravenously at a rate of 43.2 mg/hour. The rate at which the drug leaves the body is proportional to the quantity present. When there are 100mg of the drug in a patient, then the rate that the drug is leaving is 8.2 mg/hour. Write a differential equation that measures the amount of the drug in the body as a function of the number of hours since it was started.
4. A population of fish was modeled by the following differential equation where  $P$  has units of millions of fish, and  $P'$  has units of millions of fish per year.

$$P' = .45P - 18$$

Assuming the the population started at 85 million fish and that time is measured from this starting value.

- (a) Use the information provided to approximate the population of the fish at the indicated values of  $t$ .

$t$	$P$
0	85
1	
2	
3	

- (b) Use the information provided to approximate the population of the fish at the indicated values of  $t$ .

$t$	$P$
0	85
0.5	
1	
1.5	
2	
2.5	
3	

- (c) Show that  $P = 40 + Ce^{0.45t}$  is a solution to the differential equation.

- (d) Find the value of  $C$  in part (c)

- (e) Which method, part (a) or part (b), gave a better approximation to the population of fish three years after the start?

5. Is  $y = x^3 + 2x + 7$  is a solution to the differential equation  $3y - xy' = 4x + 18$ ?

6. Is  $y = 2e^{5x} + 3x$  a solution to the differential equation  $y'' - 4y' + 12 = 5y - 15x$  ?

7. Find the value of  $k$  so that  $y = x^4 + kx$  is a solution to the differential equation  $4y - xy' = 30x$

8. Find the values of  $c$  and  $k$  such that  $y = ce^{kx}$  is a solution to the differential equation  $5y' = 3y$ .