

**Calculus II**  
**Practice Problems 2**

1. Solve the initial value problem:

$$4y' + 3y = e^x, \quad y(0) = 7.$$

2 Solve the initial value problem:

$$xy' - 3y = x^2, \quad y(1) = 4.$$

3. If I invest \$ 8,000 at 12.5 percent per year (compounded continuously) in how many years will my investment be worth \$ 30,000 ?

4. At what rate (continuously compounded) should I invest \$10,000 so as to have \$14,000 in five years?

5. The half-life of Radium<sub>226</sub> is 4,801 years. How long will it take for a mass of Radium<sub>226</sub> to decay to 98 % of its original size?

6. According to Newton's Law of Cooling, if a hot object is immersed into a cool environment, the rate of decrease of the temperature of the object is proportional to the difference in the temperature of the object and its environment. If, then,  $h(t)$  is the temperature of the object at time  $t$ , and  $T_0$  is the temperature of the environment, Newton's law says

$$\frac{dh}{dt} = -k(h(t) - T_0),$$

where  $k$  is the coefficient of cooling. Suppose that a body at 95° Celsius is immersed in a water bath held at 5° Celsius, and the coefficient of cooling is  $k = .08$ . What will be the temperature of the body in 10 minutes?

7. Suppose that I wish to make iced tea of tea at the boiling point, to be consumed in three minutes. To get the tea as cold as possible, should I put in an ice cube immediately, or just before the three minutes are up?

8. A lake containing 300,000 acre-feet of water has 20% salinity. Clear water flows in from rivers, and out at a dam, both at the rate of 4,000 acre-feet per day. In how many days will the salinity be reduced to 10%?

9. A pond is in the form of a cylinder of radius 100 ft. and depth 8 ft. Water flows into the pond at the rate of 100 cu. ft./hr and seeps into the ground through the porous bottom at a rate proportional to the volume, where the constant of proportionality is .0005. What is the maximum height of water in the pond that can be achieved? If the water level in the pond is 2 feet at time  $t = 0$ , what is the height after 1000 days?

10. Water flows into an elastic ball at a rate of 4 cu. in/minute. The ball has a puncture out of which water flows at a rate proportional to the volume of water in the ball, where the constant of proportionality is .02. Assuming the ball is empty at the beginning, how much water is in the ball after 20 minutes?