Supplement #7

More Practical Practice with Rates

1. A bacteria culture initially contains 100 cells and grows at a rate proportional to its size (that is, it grows exponentially). After an hour the population has increased to 420.

   (a) Find the rate of growth after 3 hours.

   (b) When will the population reach 10,000

2. A roast turkey is taken from an oven when its temperature has reached 185°F and is placed on a table in a room where the temperature is 75°F. The equation for this cooling is: $T(t) = 75 + 110e^{-0.012766t}$, where T is temperature and t is time in minutes.

   (a) What is the temperature after 45 minutes?

   (b) When will the turkey have cooled to 100°F?

   (c) At what rate is the turkey cooling when its temperature is 125°F?

3. If $3000 is invested at 5% interest, at what rate is the investment growing when the present value is $6500?

4. A stone is thrown vertically upward from the surface of the moon. Its position, at any time, t, is given by $h(t) = 10t - 0.83t^2$. How fast is the stone going as it hits the surface of the moon?

5. If a helicopter fuel tank holds 5000 gallons of fuel, which drains from the bottom of the tank in 40 minutes, then Torricelli's Law gives the volume V of fuel remaining in the tank after t minutes as: $V(t) = 5000\left(1 - \frac{t}{40}\right)^2$.

   When is the fuel **<u>draining</u>** at a rate of 31.25 gallons per minute?

Answers:

1. $A'(t) = 143.5e^{1.435t}$ (a) 10,632 bacteria/hour (b) 3.2 hours

2. (a) 137°F (b) 116 minutes (c) $T'(t) = -1.4^{e-0.012766t}$ t = 61.76 min -0.64°F

3. $A'(t) = 150e^{.05t}$ t = 15.46 years $324.94/year

4. h'(t) = 10 - 1.66t t = 12 seconds to hit ground h'(t) = -10feet/second

5. $V'(t) = -250\left(1 - \frac{t}{40}\right)$ t = 35 minutes