**Part 2 – Exponential Decay**

The exponential function can be used as a model to solve problems involving exponential decay.

where:

*a* =

*r* =

n=

**Ex1.** A new car costs $24 000. It loses 18% of its value each year after it is purchased.

**a)** Find an expression to represent the value of the car after *x* years.

**b)** Determine the value of the car after 30 months.

**Ex2.** A used-car dealer sells a five-year-old car for $4 200. What was the original value of the car if the depreciation is 15% a year?

**HALF LIFE**

The “half-life” of a radioactive material (an isotope) is the time it takes for a sample to decay to half of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ amount. In general, radioactive materials \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ according to the following equation:

where *AL* is the amount of isotope \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*AO* is the original amount of isotope

*t* is the elapsed \_\_\_\_\_\_\_\_\_\_\_\_\_

*h* is the half-life of the isotope

**Ex1.** The half-life of ruthenium-106 is 1 year. If an original sample of ruthenium-106 had an original mass of 128 mg, and there are 2 mg left, what is the elapsed time?

**Ex2.** A radioactive isotope, iodine-131, is used to determine whether a person has a thyroid deficiency. The iodine-131 is injected into the blood stream. A healthy thyroid gland absorbs all of the iodine. The half-life of iodine-131 is 8.2 days. After how long would 25% of the iodine-131 remain in the thyroid gland of a healthy person?

**PRACTICE**

1. To determine whether a pancreas is functioning normally, a tracer dye is injected. A normally functioning pancreas secretes 4% of the dye each minute. A doctor injects 0.50 g of the dye.
   1. If the pancreas is functioning normally, how much dye should remain after 20 minutes?
   2. The doctor determines that the actual level after 20 minutes is 0.35g. Is the pancreas functioning normally?
2. An element is decaying at the rate of 12%/h. Initially we have 100g.
   1. How much remains after 10 h? (round to the nearest gram)
   2. How much remains after 30 h? (round to the nearest gram)
   3. When will there be 40 g left?
3. A research assistant made 160 mg of radioactive sodium (Na24) and found that there were only 20 mg left 45 h later.
   1. What is the half-life of Na24 ?
   2. If the laboratory requires 100 mg of Na24 12 h from now, how much Na24 should the research assistant make now?
   3. How much of the original 20 mg would be left in 12 h?
4. On the day her daughter is born, an excited mother wants to give her new daughter a season’s ticket to watch the Toronto Marlies. A season’s ticket costs $900 when the daughter is born, but the mother decides to wait until her daughter is 6 years old before buying the ticket. If inflation is assumed to be 3% per year, how much money will the mother need in 6 years to buy the season’s ticket?
5. Two different strains of cold virus were isolated and put in cultures to grow. Virus A doubles every 4.8 h while Virus B triples every 8 h. If each culture has 1000 viruses to start, which has more after 24 h?
6. A certain radioactive material has a half-life of 35 years. If 100 g is present now, how many grams will be present in 350 years?
7. In 30 hours, a sample of plutonium decays to of its original amount. What is the half-life of the substance?