Word Problems Homework

Name: _____

Date: _____ Block: _____

Answer the following questions using a complete sentence. You may use a calculator to find approximate values, but make sure you have the EXACT values as well.

1. Plutonium – 239 (commonly used in nuclear power plants) has a half – life of 24,100 years! One plant can use up to 300 kilograms of plutonium – 239 each year. How long will it take 300 kilograms of plutonium to decay to a size of 50 kilograms?

$A = Pe^{rt}$

$\frac{1}{2} = 1e^{r(24,100)}$

$\frac{\ln \frac{1}{2}}{24,100} = r$

$A = Pe^{xt}$

$50 = 300e^{xt}$

$\ln\left(\frac{50}{300}\right) = xt$

$\frac{\ln(1/6)}{x} = t$

$t \approx 62,297.596$ years

2. A mummy discovered in a pyramid in the Valley of the Tomb of Kings had lost 46% of its carbon. How old is the mummy?

$\frac{1}{2}$ life $= 5730$ (54% left)

$A = Pe^{rt}$

$\frac{1}{2} = 1e^{r(5730)}$

$\frac{\ln \frac{1}{2}}{5730} = r$

$A = Pe^{xt}$

$0.54 = 1e^{xt}$

$\frac{\ln 0.54}{x} = t$

$t \approx 5093.791$ years

3. Suppose $10,000 is invested at 10% interest compounded annually. The investment yields $19,487. For how many years was the amount invested?

$A = P\left(1 + \frac{r}{n}\right)^{nt}$

$19,487 = 10,000\left(1 + \frac{0.1}{1}\right)^{1t}$

$1.9487 = (1.1)^t$

$\ln 1.9487 = \ln(1.1)^t$

$\ln 1.9487 = t(\ln 1.1)$

$\frac{\ln 1.9487}{\ln 1.1} = t$

$7.000 \approx t$

4. When a person takes a dosage of M milligrams ibuprofen, the amount A (in mg)of medication remaining in the person's bloodstream after t hours can be modeled by the equation $A = M(0.71)^t$. How much ibuprofen is in a person's bloodstream if he takes a 250 milligram dosage after 3 hours? After 6 hours?

$A = M(0.71)^t$

$A = 250(0.71)^3$

$A = 89.478$ mg

$A = 250(0.71)^6$

$A = 32.025$ mg

5. The iodine that is released from a power plant is Iodine 131. It has a half-life of 10 days. If the plant leaks 100 pounds of Iodine 131, when will only 5 pounds remain in the environment?

$A = Pe^{rt}$

$\frac{1}{2} = 1e^{r(10)}$

$\frac{\ln \frac{1}{2}}{10} = r$

$A = Pe^{xt}$

$5 = 100e^{xt}$

$\frac{1}{20} = e^{xt}$

$\frac{\ln \frac{1}{20}}{x} = t$

$t \approx 43.219$ days

6. If the plant leaks 100 ounces cesium 137 which has a half-life of 30 years, how much will be left after 200 years?

$A = Pe^{rt}$

$\frac{1}{2} = 1e^{r(30)}$

$\frac{\ln \frac{1}{2}}{30} = r$

$A = Pe^{xt}$

$A = 100e^{x(200)}$

$A \approx 0.984$ oz

7. (a) Archeologists use carbon dating to tell how long something has been deceased. When an organism dies, it takes in no more carbon. Carbon – 14 has a half – life of 5730 years. How old is an animal bone that has lost 30% of its carbon – 14?

$A = Pe^{rt}$

$\frac{1}{2} = 1e^{r(5730)}$

$\frac{\ln \frac{1}{2}}{5730} = r$

$A = Pe^{xt}$

$0.7 = 1e^{xt}$

$\frac{\ln 0.7}{x} = t$

$t \approx 2948.504$

(b) A piece of wood discovered at a Mesopotamian civilization site was found to have lost 62% of its carbon. What is the approximate age of the wood?

$A = Pe^{rt}$

$\frac{1}{2} = 1e^{r(5730)}$

$\frac{\ln \frac{1}{2}}{5730} = r$

$A = Pe^{xt}$

$.38 = 1e^{xt}$

$\frac{\ln .38}{x} = t$

$t \approx 7998.671$ years