

Exponential Growth and Decay

- 1) 2.90 g
- 2) 12.50 years
- 3) 4.81 hours or 4:49 P.M.
- 4) 3.26 g
- 5) 5726.68 years
- 6) 998.12 g
- 7) a) 15.54 years
b) 1967

Algebra II Exponential Growth and Decay V-5

Name: _____

Solve.

- 1) The radioactive gas radon has a half-life of 3.8 days. How much of a 15 g sample remains after 9 days?

1st step → Find b

$$y = ae^{bx}$$

$$\frac{7.5}{15} = \frac{15e^{b \cdot 3.8}}{15}$$

$$\ln .5 = \ln e^{3.8b}$$

$$\frac{\ln .5}{3.8} = \frac{3.8b}{3.8}$$

$$b = -.182407153\dots$$

$$y = 15e^{-.1824\dots x}$$

$$y = 15e^{-.1824\dots 9}$$

$$y = 2.9 \text{ grams}$$

- 2) If 10 g of tritium decays to 8.50 g in 2.93 years, what is the half-life of tritium?

1st step, Find b

$$y = ae^{bx}$$

$$\frac{8.5}{10} = \frac{10e^{2.93b}}{10}$$

$$\ln .85 = \ln e^{2.93b}$$

$$\ln .85 = 2.93b$$

$$\frac{\ln .85}{2.93} = b$$

$$-.055467211\dots$$

$$\frac{5}{10} = \frac{10e^{-.055\dots x}}{10}$$

$$\ln .5 = \ln e^{-.055\dots x}$$

$$\ln .5 = -.055\dots x$$

$$\ln(.5) / \text{ANS} =$$

$$12.496 \text{ years}$$

- 3) The population of a colony of bacteria grew from 3×10^5 to 4×10^5 from noon until 2 PM. At what time will the population be 6×10^5 ?

$$y = ae^{bx}$$

$$\frac{4 \times 10^5}{3 \times 10^5} = \frac{3 \times 10^5 e^{b \cdot 2}}{3 \times 10^5}$$

$$\ln 1.\bar{3} = \ln e^{2b}$$

$$\frac{\ln 1.\bar{3}}{2} = \frac{2b}{2}$$

$$.143841036 = b$$

$$\frac{6 \times 10^5}{3 \times 10^5} = \frac{3 \times 10^5 e^{.1438\dots x}}{3 \times 10^5}$$

$$\ln 2 = \ln e^{.1438\dots x}$$

$$\frac{\ln 2}{.1438\dots} = \frac{.1438\dots x}{.1438\dots}$$

$$x = 4.818$$

$$(818)60 \approx 49 \text{ min}$$

$$4:49:05 \text{ PM}$$

- 4) The half-life of radium-226 is 1620 years. How much of a 5 g sample remains after 1000 years?

$$y = ae^{bx}$$

$$\frac{2.5}{5} = \frac{5e^{1620b}}{5}$$

$$\ln .5 = \ln e^{1620b}$$

$$\ln .5 = 1620b$$

$$b = -.000427867\dots$$

$$y = 5e^{-.000427\dots \cdot 1000}$$

$$y = 3.26 \text{ g}$$

- 5) If 20 g of Carbon-14 (^{14}C) decomposes to 17.72 g in 1000 years, what is the half-life of ^{14}C ?

6) Plutonium (^{230}Pu) has a half-life of 24,360 years, what initial quantity of ^{230}Pu will be reduced to 58 g after 100,000 years?

just picked whatever.

$$y = ae^{bx}$$

$$\frac{2.5}{5} = \frac{5}{5} e^{b \cdot 24360}$$

$$\ln \frac{2.5}{5} = \ln e^{24360b}$$

$$\frac{\ln(2.5)}{\ln(5)} = \frac{24360b}{24360}$$

$$b = -.000028454 \dots$$

$$y = ae^{bx}$$

$$58 = ae^{-.000028454(100000)}$$

$$58 = a(.05810977)$$

$$a = 998.12 \text{ g}$$

7) The population of a city has an exponential growth pattern. In the year 1900 ($t = 0$) the population was 2500 people. In the year 1920, it was 6100.

a) What is the doubling time of the city's population?

$$y = ae^{bx}$$

$$\frac{6100}{2500} = \frac{2500}{2500} e^{b \cdot 20}$$

$$\ln \frac{6100}{2500} = \ln e^{20b}$$

$$\frac{\ln 2.44}{20} = \frac{20b}{20}$$

$$b = .044599902$$

$$2 = ae^{.044599902x}$$

$$\ln 2 = .044599902x$$

$$x = 15.54$$

b) In what year will the city reach 50,000 people?

$$50000 = 2500 e^{.044599902x}$$

$$x = 1967$$