

1. How long does it take for an investment to double in value if it is invested at 8% per annum compounded monthly? Compounded continuously?

$A = P(1 + \frac{r}{n})^{nt}$ $n = 12$ $A = Pe^{rt}$ $2P \rightarrow A$ $\rightarrow 0.08 = r$
 $2P = P(1 + \frac{0.08}{12})^{12t}$ $2 = (1 + \frac{0.08}{12})^{12t}$ $\log 2 = \frac{12t \log 1.007}{\log 1.007}$ $2P = \frac{Pe^{.08t}}{P}$
 $2 = 1.007^{12t}$ $2 = e^{.08t}$ $\frac{99.4}{12} = \frac{12t}{12}$ $\ln 2 = \ln e^{.08t}$ $\frac{\ln 2}{.08} = \frac{.08t}{.08}$
 $t \approx 8.3 \text{ yrs.}$ $t \approx 8.7 \text{ years}$

2. If Sam has \$100 to invest at 8% per annum compounded monthly, how long will it be before he has \$150? If the compounding is continuous, how long will it be?

$A = P(1 + \frac{r}{n})^{nt}$ $P = 100$ $A = 150$ $r = 0.08$ $n = 12$ $t = ?$
 $150 = 100(1 + \frac{0.08}{12})^{12t}$ $1.5 = 1.007^{12t}$ $\log 1.5 = \frac{12t \log 1.007}{12 \log 1.007}$ $t \approx 4.8 \text{ yrs.}$
 $A = Pe^{rt}$ $150 = 100e^{.08t}$ $1.5 = e^{.08t}$ $\ln 1.5 = \ln e^{.08t}$ $\frac{\ln 1.5}{.08} = \frac{.08t}{.08}$ $t \approx 5.1 \text{ yrs.}$

3. How many years will it take for an initial investment of \$10,000 to grow to \$25,000? Assume a rate of interest of 6% compounded continuously

$A = Pe^{rt}$ $P = 10000$ $A = 25000$ $r = .06$
 $\frac{25000}{10000} = \frac{10000e^{.06t}}{10000}$ $2.5 = e^{.06t}$
 $\ln 2.5 = \frac{.06t}{.06}$ $t \approx 15.3 \text{ yrs.}$

- HW 4. Sears charges 19.25% per month on the unpaid balance for customers with charge accounts (compounded monthly). A customer charges \$200 and does not pay her bill for 6 months. What is the bill at that time?

5. Rupert will be buying a new car for \$15000 in three years. How much money should he ask his parents for now so that, if he invests it at 5% compounded continuously, he will have enough to buy a new car?

6. On January 1, Kim places \$1000 in a certificate of deposit that pays 6.8% compounded continuously and matures in 3 months. Then Kim places the \$1000 and the interest in a passbook account that pays 5.25% compounded monthly. How much does Kim have in the passbook account on May 1?

7. The population of a colony of mosquitoes obeys the law of $P = a e^{rt}$ uninhibited growth. If there are 1000 mosquitoes initially, and there are 1800 after one day, what is the size of the colony after 3 days? How long is it till there are 10000 mosquitoes?

$$\frac{1800}{1000} = \frac{1000 e^{r(1)}}{1000}$$

$$1.8 = e^r$$

$$\ln 1.8 = \ln e^r$$

$$r \approx .59$$

$$P = 1000 e^{.59 \cdot 3}$$

$$P \approx 5971$$

mosquitoes

$$\frac{10000}{1000} = \frac{1000 e^{.59t}}{1000}$$

$$10 = e^{.59t}$$

$$\frac{\ln 10}{.59} = \frac{.59t}{.59}$$

$$t \approx 3.9 \text{ days}$$

8. The population of a southern city follows the exponential law. If the population doubled in size over an 18-month period and the current population is 10000, what will be the population 2 years from now?

9. The half-life of Radium is 1690 years. If ten grams are present now, how much will be present in 50 years?

10. A piece of charcoal is found to contain 30% of the carbon-14 it originally had. When did the tree from which the charcoal came die? Use 5600 years as the half-life of carbon-14.

11. After the release of radioactive material into the atmosphere in Ukraine in 1986, the hay in Austria was contaminated by iodine-131 (half life 8 years). If it is okay to feed the hay to cows when 10% of the iodine-131 remains, how long do the farmers need to wait to use this hay?

12. The size of P of a certain insect population at time t (in days) obeys the equation $P = 500e^{0.02t}$. After how many days will the population reach 1000? When will it reach 2000?

13. The half-life of radium is 1690 years. If 10 grams are present now, how much will be present in 50 years?