

Name: _____

Exponential Growth and Decay

614 - Word Problems

For constant growth or decay use: $y = ab^x$ or $A_n = A_0(1 \pm r)^t$

For continuous growth or decay use: $A = Pe^{(rt)}$

For compounding use: $A = P(1 + (r/n))^{(nt)}$

1. Assume you invest \$5,000 in an account paying 8% interest compounded monthly. How much money will be in the account after 5 years?

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

$$A = 5000 \left(1 + \frac{0.08}{12}\right)^{12 \cdot 5} \quad A = \$7,449.23$$

2. Find the amount of money you will have after 10 years if \$15,000 is invested in accounts paying 6% interest compounded:

a. Annually

$$A = 15000 (1 + 0.06)^{10} = \$26,862.72$$

b. Quarterly

$$A = 15000 \left(1 + \frac{0.06}{4}\right)^{40} = \$27,210.28$$

c. Monthly

$$A = 15000 \left(1 + \frac{0.06}{12}\right)^{120} = \$27,290.95$$

d. Daily

$$A = 15000 \left(1 + \frac{0.06}{365}\right)^{3650} = \$27,330.43$$

e. Continuously

3. Would it be better to invest \$10,000 for 8 years at 8% interest compounded quarterly or 6.5% interest compounded continuously? Justify your answer.

4. Derek invested \$1,500 into an account that pays 9% interest compounded monthly. How long must the money be left in the account for it to grow to \$2,147.11?

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

$$\frac{2147.11}{1500} = (1.0075)^{12t}$$

$$2,147.11 = 1500 \left(1 + \frac{0.09}{12}\right)^{12t}$$

$$t = 4 \text{ years}$$

5. Rebecca invested \$15,000 into an account that pays 10% interest compounded continuously. How long must the money be left in the account for it to grow to \$110,835.84?

6. E.Coli. bacteria have a growth rate of 116% per hour. Assume that there are initially 500 E.Coli. bacteria infecting the body. How long will it take for the bacteria population to grow to 17 million?

$$A = P(1+r)^t$$

$$A = 500(1+1.16)^t$$

$$17 \times 10^7 = 500(2.16)^t$$

$$34000 = 2.16^t$$

$$t \approx 13.55 \text{ hours}$$

7. If the world population is about 6 billion people now and if the population grows *continuously* at an annual rate of 1.7%, what will the population be in 10 years?

8. In 1996 the population of Russia was 148 million and the population of Nigeria was 104 million. If the populations of Russia and Nigeria grow *continuously* at annual rates of -0.62% and 3.0%, respectively, when will Nigeria have a greater population than Russia?

9. A promissory note will pay \$30,000 at maturity 10 years from now. How much should you be willing to pay for the note now if the note gains value at a rate of 9% compounded *continuously*?

10. At what annual rate compounded *continuously* will \$1,000 have to be invested to amount to \$2,500 in 10 years?

12. How many years, to the nearest year, will it take a sum of money to double if it is invested at 15% compounded *annually*? $A = 2P$

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

$$2P = P(1 + 0.15)^t$$

$$2 = (1.15)^t$$

$$t \approx 5 \text{ years}$$