

Exponential Growth & Decay Problems:

Exponential Growth -

- When a value increases by the ^{same} percentage every period of time.

Formula:

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

a = initial value (start with)

Same units of time $\left\{ \begin{array}{l} r = \text{rate of growth in decimal form} \\ \quad (\%) \\ t = \text{time} \end{array} \right.$

A = final result

1910 population = 120000

pop. grows at 1.5% per year

How many people will there be in 2010?

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

$$a = 120,000$$

$$r = .015$$

$$t = 100$$

$$A = 120000(1+.015)^{100}$$

$$\rightarrow A = 531845 \text{ people}$$

$$A = 531845$$

How long did it take for the population to double?

$$a = 120000$$

$$r = .015$$

$$t = ?$$

$$A = 240000$$

$$t = 46.31 \text{ years}$$

$$\frac{240000}{120000} = \frac{120000(1+.015)^t}{120000}$$

$$2 = 1.015^t$$

$$\log 2 = t \cdot \log 1.015 \quad 46.31 = t$$

$$\frac{\cdot 301}{\cdot 0065} = \frac{t(\cdot 0065)}{\cdot 0065}$$

Continuous Interest:

$$A = Pe^{rt}$$

A = Final Amount

P = Initial Amount

r = interest rate/year

t = time

Invest \$1000 in a continuously compounded interest rate of 12% per year. How much will you have in 5 years.

$$P = 1000$$

$$r = .12$$

$$t = 5$$

$$A = 1000e^{.12(5)}$$

$$A = \$1882.12$$

$$1000e^{(.12 \times 5)}$$

Exponential Decay

- when something decreases by the % every period of time

$$A = a(1-r)^t$$

a = initial amount

r = rate of decrease

t = time

A = Final Amount

Bought a car for \$15,000
depreciates at a rate of 7% per year
how much is it worth after 6 years?

$$a = 15000 \quad A = 15000(1-.07)^6$$

$$r = .07$$

$$t = 6$$

$$A = \$9704.85$$

Carbon-14 Half Life Problems

$$A = a e^{-.00012t}$$

a = initial amount of C-14

A = Amount found (%)

t = time in years

Found a woolley Mammoth w/ 3% of it's original C-14 left. How old is the W.M.?

$$\frac{.03a}{a} = \frac{a \cdot e^{-.00012t}}{a}$$

$$.03 = e^{-.00012t}$$

$$\ln .03 = \ln e^{-.00012t}$$

$$\frac{-3.5066}{-.00012} = \frac{-.00012t}{-.00012}$$

$$t = 29221.32 \text{ yrs.}$$

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563: 10-14, 17-18 ALL