* Notes

"b" words indicating base	"a" words	"y" words
Double, Triple, half, quarter	initial, started with	final amount after

EXPONENTIAL GROWTH/DECAY: We learned in previous lessons that exponential functions can take on two forms, either growth, when b is ___greater___ than 1 or decay, where b is ___between___ 0 and 1.

$$Y = a(1-r)^x$$

$$y = ab^x$$

$$Y = a(1+r)^x$$

y = final amount   a = initial amount   b = growth/decay   x = time/trials

Example A: You are reading a novel where an entire 40 player baseball team become zombies. It is predicted that the number of zombies will triple each day. How many zombies will there be after a week (7 days)?

$$y = ab^x$$
$$y = 40(3)^7 = 87480 \text{ zombies}$$

Seems easy right, but you need to be careful with the variable b, because that example was a nice clean whole number.

Example B: You bought a used car for $18,000. The value of the car will be less each year because of depreciation. The car depreciates (loses value) at the rate of 12% per year. Write an exponential decay model to represent the situation then use that model to estimate the value of the car in 8 years.

DECAY: $A = P(1-r)^t$
$$y = a(1-r)^x$$

$$y = 18,000(1 - .12)^8$$
$$y = \$6473.42$$

Example C: A train is going downhill at 140 mph. Suddenly the brake system fails and the train begins picking up speed, going 11% faster every minute. How fast will the train be going in 5 minutes?

GROWTH: $A = P(1+r)^t$
$$y = a(1+r)^x$$

$$y = 140(1 + .11)^5$$

$$y = 235.91 \text{ mph}$$

For each problem, write the known information, the unknown, and an equation to model each scenario. Then answer each question.

1. A population of insects doubles every month. If there are 100 insects to start with, how many will there be after 7 months?

$$y = 100(2)^7 = 12{,}800 \text{ insects}$$

2. A stock loses half its value every week. If the stock was worth $125 starting out, what is it worth after 4 weeks at this rate of decline?

$$y = 125\left(\tfrac{1}{2}\right)^4 = \$7.81$$

3. A type of bacteria in a Petri dish doubles every hour. If there were 1,073,741,824 bacteria after 24 hours, how many were there to start with?

$$1{,}073{,}741{,}824 = a(2)^{24}$$
$$a = 64$$

4. Annual sales for a fast food restaurant are $650,000 and are increasing at a rate of 4% per year. What will sales be in 5 years?

$$y = 650{,}000(1+.04)^5 = \$790{,}824.37$$

5. The population of a school is 800 students and is increasing at a rate of 2% per year. What will the population be in 4 years?

$$y = 800(1+.02)^4 = 865.95$$
$$866 \text{ students}$$

6. The value of a company's equipment is $25,000 and decreases at a rate of 15% each year. What will the equipment be worth after 8 years?

$$y = 25{,}000(1-.15)^8$$
$$\$6812.26$$