Simplify:

1.)

$$3x^0y^3 \cdot 3x^2y^2$$

$3 \cdot 3 \cdot x^0 \cdot x^2 \cdot y^3 \cdot y^2$

Zero exponent Rule

$=1$

$9 \cdot 1 \cdot x^2 \cdot y^{3+2}$

$9x^2y^5$

2.)

$$\frac{2xy^2}{2x^{-2}y^{-3}}$$

Quotient Rull

$\dfrac{2x^{1--2}y^{2--3}}{2}$

Simplify

$\boxed{1x^3y^5}$

Housekeeping:

- Homework will be scored on accuracy of the assignment.
  - You will be allowed to rework missed problems to earn full credit.
- Homework will be due the next class period, after it is assigned.
  - If you turn it in after the due date, you can only earn up to half credit.
- Incentives
  - Turn in homework on due date-earn a raffle ticket
  - Complete homework during homework time in class-Bubble Wrap

4-2 Exponential Equations

4-2a: I can use exponential formulas to model and solve situations of growth and decay.

EXPONENTIAL FUNCTION

$$f(x) = a(b)^x$$

Exponent

Initial Value
(y-intercept)

Base
(Multiplier)

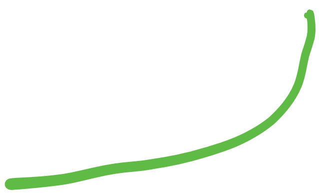
a - initial Value, y-intercept or
also what you start with

b - base multiplier, rate

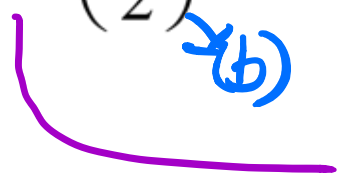
x - exponent

Graph the following functions on a calculator and sketch.

a. $f(x) = 2^x$ (b)



b. $f(x) = \left(\frac{1}{2}\right)^x$ (b)



What did you notice about the graphs and their equations?

They are a reflection over the y-axis.

$f(x) = 2^x$ is increasing $\quad f(x) = \left(\frac{1}{2}\right)^x$ is decreasing

When b>1, the function represents **exponential** growth

When 0<b<1, the function represents **exponential** decay.

Exponential Growth and Decay

$$f(t) = \underline{a}(\underline{1 \pm r})^{t}$$

$(1+r) =$ growth

$(1-r) =$ decay

f(t) = value of the function after time (t)

a = initial value

r = interest rate (written in decimal form)

t = time (in years unless otherwise stated)

John researches a baseball card and find that it is currently worth $3.25. However, it is supposed to increase in value 11% per year. $f(t) = a(1 \pm r)^t$

a) Write an exponential equation to represent this situation

$$f(t) = 3.25(1+.11)^t = 3.25(1.11)^t$$

b) How much will the card be worth in 10 years?

$$f(t) = 3.25(1+.11)^{10} = \$9.23$$

c) Use your graphing calculator to determine in how many years will the card be worth $26.

$$26 = 3.25(1.11)^t$$

In your graphing calculator - graph each side of the equation...

Press $\boxed{y=}$ - under y_1 = enter 26
under y_2 = enter $3.25(1.11)^t$

Hit graph. If both graphs do not show. Press $\boxed{\text{window}}$ and adjust the X-max and Y-max. For this problem X-max should be around 20. For Y-max it should be 26.

Next - press $\boxed{2^{nd}}$ $\boxed{\text{trace}}$ $\boxed{5}$ (for intersection) & then press $\boxed{\text{enter}}$ 3 times press $\boxed{\text{enter}}$ 3 times.

The number of years in which it will take for the card to be worth \$26 is the x-value on the calculator. $x = 19.92$ so it will take approximately 20 years.

On federal income tax returns, self employed people can depreciate the value of business equipment. Suppose a computer valued at \$2765 depreciates at a rate of 30% per year. $f(t) = a(1 \pm r)^t$

a) Write an exponential equation to model this situation

$f(t) = 2765(1-.3)^t = 2765(.7)^t$

b) How much will this computer be worth in 5 years?

$f(t) = 2765(1-.3)^5 = \$464.71$

c) Use your graphing calculator to determine in how many years will the computer be worth \$350.

$350 = 2765(.7)^t$

$y_1 = 350 \quad y_2 = 2765(.7)^t$

press graph, if the graphs don't show up adjust the window (xmax and ymax values). Press $\boxed{2^{nd}}$ $\boxed{\text{trace}}$ $\boxed{5}$ $\boxed{\text{enter}}$ $\boxed{\text{enter}}$ $\boxed{\text{enter}}$.

the computer will be worth \$350 in approximately 5.79 years or rounded to 6 years.

1950 to 1975 is 25 years

$$f(t) = a(1 \pm r)^t$$

The population of Orem in 1950 was 4,000 and was increasing at a rate of 2.6% per year.

Because

a) Predict the population of Orem in 1975 and 2000.

$$f(25) = 4000(1 + .026)^{25}$$

$$f(25) \approx 7599$$

$f(50) = 14,435$

b) Using your graphing calculator, predict when Orem's population will hit 200,000 people.

$$200,000 = 4000(1.026)^t$$

Orem's population will hit 200,000 in approximately 152 years.

$$f(t)=a(1\pm r)^t$$

You try! ☺

As a birthday present you received a pair of track shoes signed by Mr. Myrup that is valued at $500 (ya know cause he's so awesome). Over time the value increases at a rate 5.5% per year.

a) Write an exponential equation to represent the situation.

$$f(t)=500(1+.055)^t$$

b) How much will the shoes be worth after 7 years?

$$f(7)=500(1+.055)^7 \approx \$727.34$$

c) How long until they are worth $1000?

Use graphing calculator

Press Y=

$y_1=$ enter 1000

$y_2=$ enter $500(1.055)^x$

Press $\boxed{\text{graph}}$ - if you can't see the graphs - Press $\boxed{\text{Window}}$ and change the XMax to 50, and YMax to 1500.

Press $\boxed{\text{Graph}}$ - To find the intersection

Press $\boxed{2^{nd}}$ - $\boxed{\text{Trace}}$ - $\boxed{5}$ - To find X -

Press $\boxed{\text{Enter}}$ 3 times. X = 12.94

or ≈ 13 years.

Compound Interest Formula

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

A(t) is the value after time (t)

P is the principal

r is the annual interest rate

n is the number of compounding periods per year

t is the time in years

Write an equation then find the final amount for each investment.

a. $1000 at 8% compounded semiannually for 15 years

$$A(t)=1000\left(1+\frac{.08}{2}\right)^{2(15)} \qquad A(t)=P\left(1+\frac{r}{n}\right)^{nt}$$

$$=\$3243.40$$

You Try!

b. $1750 at 3.65% compounded daily for 10 years

$$A(t)=1750\left(1+\frac{.0365}{365}\right)^{365(10)}=\$2520.85$$

Using a calculator, determine how many years it will take for the amount to reach $4000.

$$4000=1750\left(1+\frac{.0365}{365}\right)^{365t}$$

$$y_1=4000 \qquad y_2=1750\left(1+\left(\frac{.0365}{365}\right)\right)^{365t}$$

graph - adjust window if needed, then find the intersection.

$t \approx 22.64$ or 23 years.

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

Write an equation then find the final amount for each investment.

a) An investment of $1000 comounded monthly at a rate of 4.5%.

$$A(t) = 1000\left(1+\frac{.045}{12}\right)^{12(t)}$$

b) How much money is there after 5 years?

$$A(5) = 1000\left(1+\frac{.045}{12}\right)^{12(5)} = \$1251.80$$

c) How long until the investment has tripled its value?

$$3000 = 1000\left(1+\frac{.045}{12}\right)^{12t}$$

$t \approx 24.46$ or 25 years.

4.2 B -

Investigate the growth of $1 investment that earns 100% annual interest (r=1) over 1 year as the number of compounding periods, n, increases. Do this with a group/partner.

Compounding schedule	n	$1\left(1+\frac{1}{n}\right)^n$	Value of A
annually	1	$1\left(1+\frac{1}{1}\right)^1$	2
semiannually	2	$1\left(1+\frac{1}{2}\right)^2$	2.25
quarterly	4	$1\left(1+\frac{1}{4}\right)^4$	2.44
monthly	12	$1\left(1+\frac{1}{12}\right)^{12}$	2.61
daily	365	$1\left(1+\frac{1}{365}\right)^{365}$	2.7146
hourly	8760	$1\left(1+\frac{1}{8760}\right)^{8760}$	2.71813
every minute	525600	$1\left(1+\frac{1}{525600}\right)^{525600}$	2.71828

What does the value of A approach?

2.71....

The value e is called the natural base

The exponential function with base e, $f(x)=e^x$, is called the natural exponential function.

$$e \approx 2.71828182827$$

what you need to know is $e \approx 2.7$

Evaluate $f(x) = e^x$ for

a. $x = 2$ $e^2 = 7.389056$

b. $x = ½$ $e^{1/2} = 1.64872$

c. $x = -1$ $e^{-1} = .367879$

Many banks compound the interest on accounts daily or monthly. However, some banks compound interest continuously, or at every instant, by using the *continuous compounding formula.*

Continuous Compounding Formula

If P dollars are invested at an interest rate r, that is compounded continuously, then the amount, A, of the investment at time t is given by

$$A(t) = Pe^{rt}$$

A person invests $1550 in an account that earns 4% annual interest compounded continuously.

a. Write an equation to represent this situation

b. Using a calculator, find when the value of the investment reaches $2000.

a.) $A(t) = 1500(e)^{.04t}$

b.) $2000 = 1500e^{.04t}$

$t \approx 7.19$ or 7 years

An investment of $1000 earns an annual interest rate of 7.6%.

Compare the final amounts after 8 years for interest *compounded quarterly* and for interest *compounded continuously.*

$f(t) = 1000\left(1 + \frac{.076}{4}\right)^{4 \cdot 8} = 1826.31$

$f(t) = 1000e^{(.076)8} = 1836.75$

Homework 4.2 1-2