33) $\ln \sqrt[4]{x-1} = 1$

$\frac{1}{4} \ln(x-1) = 1$

$e^{\ln(x-1)} = e^{4}$

$x-1 = e^{4}$

$x = e^{4} + 1$

27.) $8^{x} \cdot 16^{x-1} = 4\left(32^{2x+3}\right)$

$$2^{3x} \cdot 2^{4(x-1)} = 2^{2} \cdot 2^{5(2x+3)}$$

$$3x + 4(x-1) = 2 + 5(2x+3)$$

37.) $x\left(2\ln\frac{1}{x} - 1\right) = 0$

$\cancel{x = 0}$ $\quad 2\ln\frac{1}{x} - 1 = 0$

$e^{\ln\frac{1}{x}} = e^{\frac{1}{2}}$

$\frac{1}{x} = e^{1/2}$

$x = \frac{1}{e^{1/2}} = \frac{1}{\sqrt{e}}$

35.) $e^{x}+7e^{-x}=8$

$$e^{x}\left(e^{x}+\frac{7}{e^{x}}=8\right)$$

$$\boxed{e^{\ln x}=x}$$

$$e^{2x}+7=8e^{x}$$

$$e^{2x}-8e^{x}+7=0$$

$$(e^{x}-7)(e^{x}-1)=0$$

$e^{x}=7 \quad e^{x}=1 \qquad 0, \ln 7$

31.)

$$x^3 = x$$

$$x^3 - x = 0$$

$$x(x^2 - 1) = 0$$

$$x = 1$$

21.) $3^1 \cdot 3^{3/2} = 3^{4x}$

$1 + \frac{3}{2} = 4x$

$\sqrt{27} = 27^{1/2}$

$= (3^3)^{1/2}$

25.) $4^{1/x} = 4^2$

$x = \frac{1}{2}$

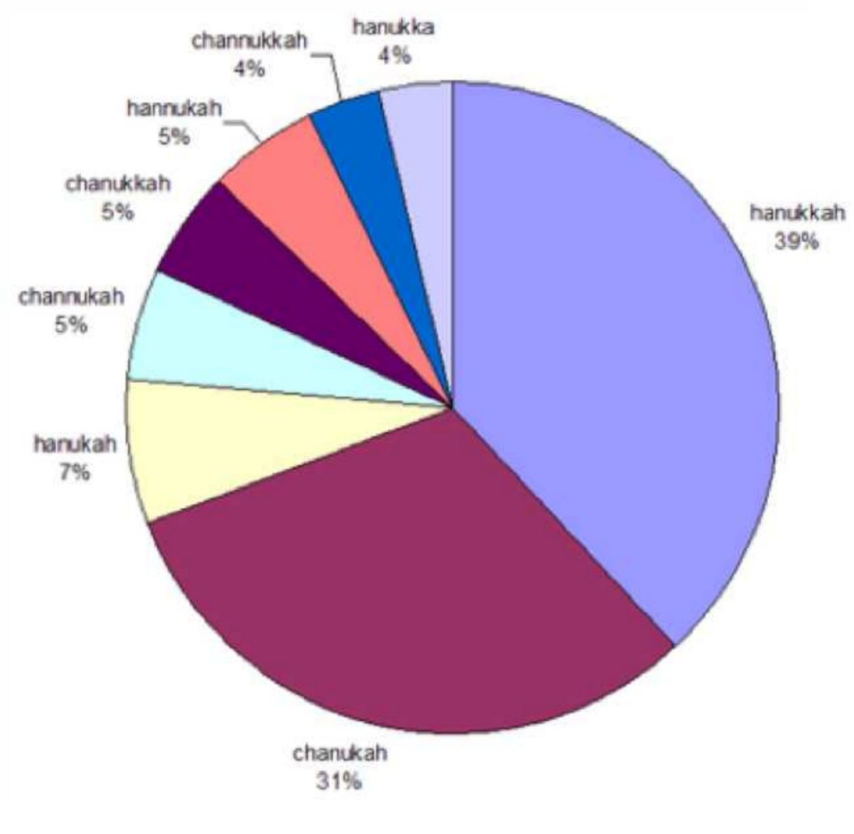
$\frac{1}{x} = 2$

$$\frac{-3\log 4 - 2\log 5}{\log 3 - \log 10}$$

$$\frac{-(\log 64 + \log 25)}{\left(\log \frac{3}{10}\right)} = \frac{-\log 1600}{\log(.3)}$$

$$= 6.128$$

4.7 Exponential Word Problems - Day 2



HW:

Exponential Models WKST

3cd, 5, 6, 9ab, 11 - 16 all

#20 (optional review)

Growth/Decay Models

$$y = ab^x$$
$$a \neq 0, \quad b > 0, \quad b \neq 1$$

Where:

y *ending amount*

a *initial amount*

b *growth/decay factor*

x *time*

Growth: $b > 1$ Decay: $0 < b < 1$

ex 1: From 1997 to 2002 the number n (in millions) of DVD players sold in the United States can be modeled by

$$n = 0.42(2.47)^t$$

a) Does this model represent a growth or decay model? Explain?

$b = 2.47$

growth $b > 1$

ex 1: From 1997 to 2002 the number n (in millions) of DVD players sold in the United States can be modeled by

$$n = 0.42(2.47)^t$$

b) What is the initial amount?

.42 (millions)

420,000 DVD

ex 1: From 1997 to 2002 the number n (in millions) of DVD players sold in the United States can be modeled by

$$n = 0.42(2.47)^t$$

c) What is the growth factor/decay factor?

ex 1: From 1997 to 2002 the number n (in millions) of DVD players sold in the United States can be modeled by

$$n = 0.42(2.47)^t$$

d) What is the annual percent of increase/decrease?

$$\boxed{b = 1 \pm r}$$

$$2.47 = 1 + r$$

$$1.47 = r$$

147%

ex 2: A species of dolphins is decreasing at a rate of 3.1% per year. If there are currently 20,000 dolphins, how many will there be in 30 years? Round to the nearest dolphin.

Decreasing

1 - r

$$y = ab^x$$

$$y = 20{,}000(1 \pm r)^x$$

$$y = 20{,}000(1 - .031)^{30}$$

$$y = 20{,}000(.969)^{30}$$

ex 3: If you buy a new car for $18,000 and cars depreciate at a rate of roughly 7% per year, how much could you sell it for in 3 years?

$$y = 18{,}000(1 - .07)^3$$

$$y = \$14478.43$$

ex 4: If you bought a car 5 years ago for $15,000 and today you can sell it for $7,000, what was its rate of depreciation?

$$7000 = 15000(1-r)^5$$

$$\sqrt[5]{\frac{7}{15}} = \sqrt[5]{(1-r)^5}$$

$$\sqrt[5]{\frac{7}{15}} = 1 - r$$

$$.14 \approx r$$

14%

ex 5: Dinner at your grandfather's favorite restaurant now costs $25.25 and has been increasing steadily at 4% per year. How much did it cost 35 years ago when he was courting your grandmother?

$$25.25 = a(1+.04)^{35}$$

$$a = \$6.40$$

$$10 = 2x$$

$$\frac{10}{2} = x$$

ex 6: If a gallon of milk costs \$3 now and the price is increasing 10% per year, how long before milk costs \$10 a gallon?

$$10 = 3(1+.10)^x$$

$$\log\frac{10}{3} = \log(1.10)^x$$

$$\log\frac{10}{3} = x\log 1.10$$

$$\frac{\log\frac{10}{3}}{\log 1.10} = x$$

$\boxed{12.6 \text{ years}}$

"Other" Models

ex 7: At a local college campus of 7500 students, one student returns from vacation with a contagious and long-lasting virus. The spread of the virus is modeled by $y = \dfrac{7500}{1+7499e^{-0.9t}}$ where y is the total number of students affected after t days. The college will cancel classes when 30% or more of the students are infected.

a) How many students will be infected after 4 days?

"Other" Models

ex 7: At a local college campus of 7500 students, one student returns from vacation with a contagious and long-lasting virus. The spread of the virus is modeled by $y = \frac{7500}{1 + 7499e^{-0.9t}}$ where y is the total number of students affected after t days. The college will cancel classes when 30% or more of the students are infected.

b) After how many days will the college cancel classes?

ex 8: The population P (in thousands) of Pittsburgh from 1990 to 2004 can be modeled by $P = 372.55e^{-0.01052t}$ where t is the year, with t=0 corresponding to 1990.

a) What was the population of Pittsburgh in 2003?

ex 8: The population P (in thousands) of Pittsburgh from 1990 to 2004 can be modeled by $P = 372.55e^{-0.01052t}$ where t is the year, with t=0 corresponding to 1990.

b) According to the model, when will the population be approximately 300,000?

MIXED REVIEW

ex 9: A mouse population is 25,000 and is decreasing in size at a rate of 20% per year. What is the mouse population after 3 years?

MIXED REVIEW

ex 10: If I have $500 in my account after 4 years investing at 2.5% per year, how much money did I start with?

MIXED REVIEW

ex 11: The half-life of a medication is the amount of time for half of the drug to be eliminated from the body. The half-life of Advil or ibuprofen is represented by the equation $R = M(0.5)^{\frac{t}{2}}$, where R is the amount of Advil remaining in the body, M is the initial dosage, and t is time in hours. If a 200 milligram dosage of Advil is taken at 1:00 pm. How many milligrams of the medication will remain in the body at 6:00 pm?

REVIEW

The domain of the function $f(x) = \log_4(5x+3) - 2$ over the set of real numbers is

(A) $(-1.4, \infty)$ (B) $(-0.6, \infty)$ (C) $(-\infty, \infty)$ (D) $(-2.6, \infty)$ (E) $\left(-1\frac{2}{3}, \infty\right)$

REVIEW

ex: Find the inverse.

$$f\left(x\right)=3\log_2\left(x-1\right)+7$$

REVIEW

ex: Sketch.

$$f\left(x\right)=3\log_2\left(x-1\right)+7$$