Name: Key | Date: 4/25/18

CC ALGEBRA 2 | TROICI

UNIT 10 REVIEW: LOGS PART II

P .02 = r n=2

1. The value of an initial investment of $800 at 2% nominal interest compounded *semi-annually* can be modeled using which of the following equations, where *t* is the number of years since the investment was made?

   (1) $A=800(1.01)^{2t}$ (3) $A=800(1.02)^{2t}$

   (2) $A=800(1.01)^{t}$ (4) $A=800(1.02)^{t}$

$$A=P\left(1+\frac{r}{n}\right)^{nt}$$
$$A=800\left(1+\frac{.02}{2}\right)^{2t}$$
$$A=800(1.01)^{2t}$$

2. A local bank makes loans available to customers. Every 30 days, customers are charged 8% interest with compounding. Last year Connor took out a $500 loan. Which expression can be used to calculate the amount he would owe, in dollars, after one year if he did not make payments?

r = .08

P t = 1 (365 days)

T 365 ≈ 12 x a year

increment 30

1) $500\,(.08)^{\frac{30}{365}}$ 3) $500\,(.08)^{\frac{365}{30}}$

2) $500\,(1.08)^{\frac{30}{365}}$ 4) $500\,(1.08)^{\frac{365}{30}}$

$$A=500\left(1+\frac{.08}{\cancel{12}}\right)^{\frac{365}{30}}$$

3. Graph the logarithmic function $y=\log_4(x-2)$.

   a) State the domain of the function

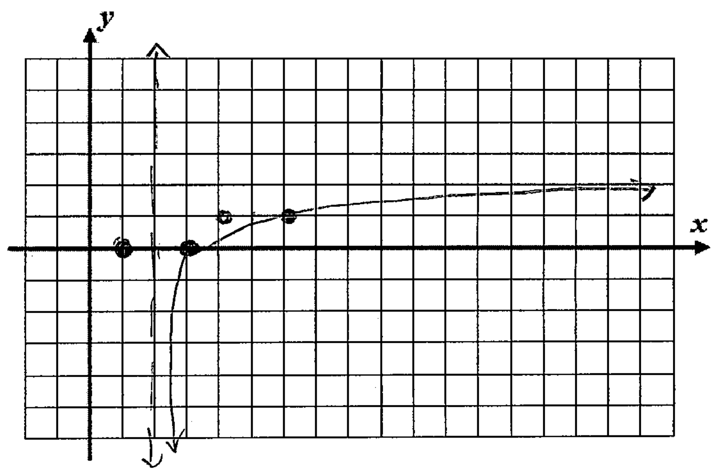
   $(2,\infty)$ or $x>2$

   b) Describe the transformation of this function compared to $y=\log_4(x)$

   Right 2 units

   c) What is the equation of the asymptote?

   $x=2$



P r = ?

4. A population of 50 fruit flies is increasing at some rate per day. Find the rate to the *nearest tenth of a percent*, if it takes 12 days for fruit fly population to double?

T (increment) A = 100

$$100=50(1+r)^{12}$$
$$(2)^{1/12}=\left((1+r)^{12}\right)^{1/12}$$
$$1.0594=1+r \longrightarrow r=.0594 \approx \boxed{5.9\%}$$

$r = .02$

5. A radioactive substance is decaying such that 2% of its mass is lost every year. Originally there were 50 kilograms of the substance present.

P

a) Write an equation for the amount, *A*, of the substance left after *t*-years.

$A = 50(1-.02)^t$

b) Find the amount of time that it takes for only half of the initial amount to remain. Round your answer to the nearest tenth of a year. $A = 25$

$\frac{25}{50} = \frac{50(1-.02)^t}{50}$

$.5 = .98^t$

$\log_{.98} .5 = t$

$\boxed{t = 34.3 \text{ years}}$

$r = .085$

6. ~~Last year~~, the total revenue for Home Depot, increased 8.5% over the previous year. If this trend were to continue, which expression could the company's chief financial officer use to approximate their monthly percent increase in revenue? [*Let m represent months.]

$(1 + .085^{\frac{1}{12}})^{m}$

$(1.00682)^m$

~~(1)~~ $(1.085)^m$	(3) $(1.00682)^{\frac{m}{12}}$
~~(2)~~ $(1.085)^{\frac{12}{m}}$	(4) $(1.00682)^m$

7. Growth of a certain strain of bacteria is modeled by the equation $G = A(2.7)^{0.584t}$

G = final number of bacteria 2500
A = initial number of bacteria 4
t = time (in hours) ?

A

In approximately how many hours will 4 bacteria first increase to 2,500 bacteria? Round your answer to the *nearest hour*.

$\frac{2500}{4} = \frac{4(2.7)^{.584t}}{4}$

$625 = 2.7^{.584t}$

$\log_{2.7} 625 = .584t$

$\frac{6.4814}{.584} = \frac{.584t}{.584}$

$t = 11.0984$

$\boxed{t \approx 11 \text{hrs}}$

8. Since January 1980, the population of the city of Brownville has grown according to the mathematical model $y=720,500(1.022)^x$, where x is the number of years since January 1980.

a) Explain what the numbers 720,500 and 1.022 represent in this model in the context of the problem.

720,500 represents the initial population

$1+r=1.022$ represents that the population is increasing by 2.2% each year.

$-1 \quad -1$

$r=.022$

2.2%

b) If this trend continues, use this model to predict the year during which the population of Brownville will reach 1,548,800.

x=?

y

$$\frac{1548800}{720500}=\frac{\cancel{720500}(1.022)^x}{\cancel{720500}}$$

$$2.1496=1.022^x$$

$$\log_{1.022} 2.1496 = x$$

$$\boxed{\approx 2016}$$

$$x=35.1667$$
$$+1980 = 2015.16678$$

9. Cobalt-60 is a synthetic radioactive isotope of cobalt with a half-life of 5.2714 years. Determine, to the nearest day how long it would take a sample of 50 grams to reach a safe handling level of 20 grams.

A P

increment! $\frac{t}{T}$

$$\frac{20}{50}=\frac{50(\frac{1}{2})^{\frac{t}{5.2714}}}{50}$$

$$.4=(.5)^{\frac{t}{5.2714}}$$

$$\log_{.5} .4 = \frac{t}{5.2714}$$

$$1.3219=\frac{t}{5.2714}$$

$t=6.9684$ years
$\times 365$
2543.4702

$\boxed{2,543 \text{ days}}$

10. Kristy invests $2,500 in a bank. The bank pays 4% interest compounded continuously. To the nearest tenth of a year, how long must she leave the money in the bank for it to double?

t=? P .04=r e! A=5000

$$\frac{5000}{2500}=\frac{2500e^{.04t}}{2500}$$

$$2=e^{.04t}$$

$$\frac{\ln 2}{.04}=\frac{.04t}{.04} \rightarrow t=\boxed{17.3 \text{ years}}$$

11. Suppose that the following table represents the average monthly ambient air temperature, in degrees Fahrenheit, in some subterranean caverns in southeast Australia for each of the twelve months in a year. We wish to model these data with a trigonometric function. **Use t = 1 to represent January.** (Notice that the seasons are reversed in the Southern Hemisphere, so January is in summer, and July is in winter.)

	1	2	3	4	5	6	7	8	9
Month	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**
$^\circ F$	64.02	64.22	61.88	57.92	53.60	50.36	49.10	49.82	52.34

a) Using your calculator, find the sinusoidal equation for a function that could fit this data. (Round to the nearest tenth)

$y = 7.8\sin(.6x + .8) + 56.6$

b) Predict the temperature in the month of December to the nearest degree.

$x = 12$

$y = 7.8\sin(.6(12) + .8) + 56.6$

$y = 57.6855 = \boxed{58°}$

12. The accompanying table shows the enrollment of a preschool from 1980 through 2000.

Year (x)	Enrollment (y)
1980	14
1985	20
1990	22
1995	28
2000	37

a) Find the linear regression equation that models this data.

$y = 1.08x - 2125$

b) Using this equation predict the enrollment of the preschool in the year 2020.

$x = 2020$

$y = 1.08(2020) - 2125$

$y = 56.6 \rightarrow \boxed{56 \text{ preschools}}$

13. Find the solution ***graphically***, to the nearest hundredth, of the following system of equations.

$y = \ln(6 - e^x)$

$y = 2x$

$\boxed{(.69, 1.39)}$

2nd → Trace → int

enter 3x

P r = .0025

14. Cecelia invests $100 in an account that offers 0.25% interest compounded annually. Her friend Jocelyn has $1000 in an account but withdraws $125 per year to purchase clothes. In approximately how many years will they have the same amount of money in their accounts? linear

$100(1+.0025)^t = 1000-125x$

a) 3 c) 7

use calc!

b) 5 d) 10

(7.1855, 101.8103)

↓

time (years)

15. Newton's law of cooling is used to model the temperature of an object placed in an environment of a different temperature. The temperature of the object *t* hours after being placed in the new environment is modeled by the formula

$$T = T_a + (T_0 - T_a)e^{-kt}$$

T_a = the temperature surrounding the object 15°

T_0 = the initial temperature of the object 80

t = the time in hours $\frac{2}{60} = \frac{1}{30}$ hrs

T = the temperature of the object after t hours 50

k = decay constant

A pot of tea is heated to $80^\circ C$. A cup of the tea is poured into a mug and taken outside where the temperature is $15^\circ C$. After 2 *minutes*, the temperature of the cup of tea is approximately $50^\circ C$.

Determine the value of the decay constant, k, rounded to the nearest thousandth.

$50 = 15 + (80-15)e^{-K\cdot\frac{1}{30}}$

$-15 \quad -15$

$\frac{35}{65} = \frac{(65)e^{-\frac{1}{30}K}}{65}$

$.5384 = e^{-\frac{1}{30}K}$

$\frac{\ln .5384}{1} = -\frac{1}{30}K$

$-K = -18.5711$

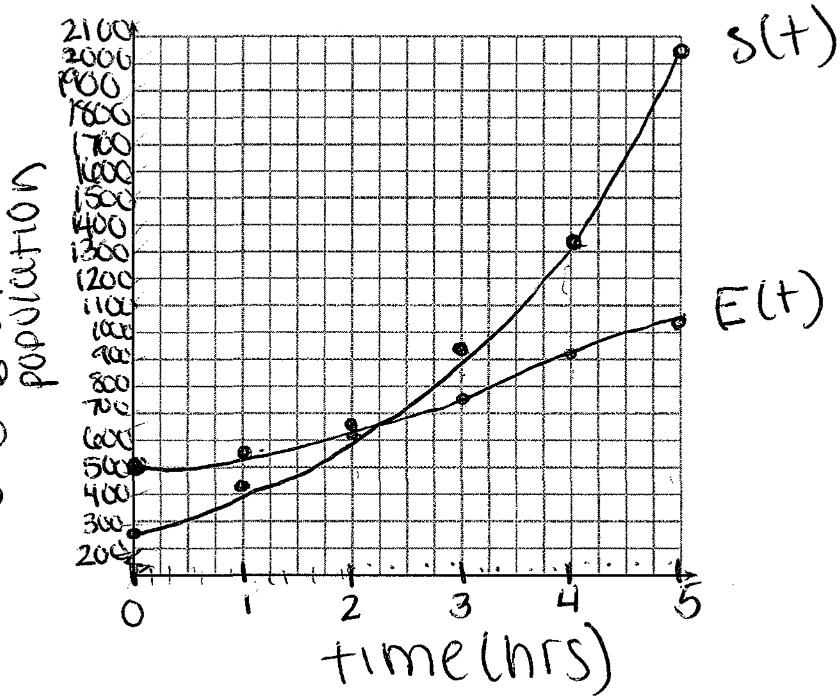
$\boxed{K = 18.5711}$

16. The growth of a population of E. *coli* bacteria can be modeled by the function $E(t) = 500(e)^{.15t}$, and the growth of a population of *Salmonella* bacteria can be modeled by the function $S(t) = 275(e)^{0.4t}$, where t measures time in hours.

a. Graph these two functions on the same set of axes over the interval $0 \le x \le 5$.

E(t)

x	y
0	500
1	580.92
2	674.93
3	784.16
4	911.06
5	1058.5



S(t)

x	y
0	275
1	410.25
2	612.02
3	913.03
4	1362.1
5	2032

b. *Algebraically* determine the number of hours it will take for the amount of *E. coli* bacteria to equal the amount of *Salmonella* bacteria. Round to the *nearest hundredth*.

$$\frac{500e^{.15t}}{275} = \frac{275e^{.4t}}{275}$$

$$\frac{1.8181\,e^{.15t}}{e^{.15t}} = \frac{e^{.4t}}{e^{.15t}}$$

$$1.8181 = e^{.25t}$$

$$\frac{\ln 1.8181}{.25} = \frac{.25t}{.25}$$

$$2.3913 = t$$

$$\boxed{t = 2.39\text{ hrs}}$$

c. Using your calculator, determine the point of intersection and check your solution to part (b).

(2.39, 715.74) ✓

d. Determine how many days, to the *nearest tenth*, it will take the *E. coli* bacteria population to reach 1,000,000.

$$\frac{1{,}000{,}000}{500} = \frac{500e^{.15t}}{500}$$

$$2000 = e^{.15t}$$

$$\frac{\ln 2000}{.15} = \frac{.15t}{.15}$$

$t = 50.6726$ hrs

$\div$ 24 hrs/day

$\boxed{2.1\text{ days}}$