SOLUTIONS

2.2 A first look at exponential equations – Practice exercises

1. The comprehensive fee is \$37,000 at a local private college and is expected to increase 5.8% per year.

   (a) Calculate the annual growth factor. $r = \frac{5.8\%}{100} = .058$

   $g = 1 + r = 1 + .058 = \boxed{1.058}$

   (b) What do you expect the tuition to be in five years?

   $37{,}000 * 1.058^5 = 37{,}000 \times 1.058\text{^}5 =$

   $= 49{,}048.989\ldots \approx \boxed{\$49{,}000}$

   (c) Name the variables, including units, and write an equation describing the dependence.

   Y = time (years) ~ indep

   T = tuition (\$) ~ dep

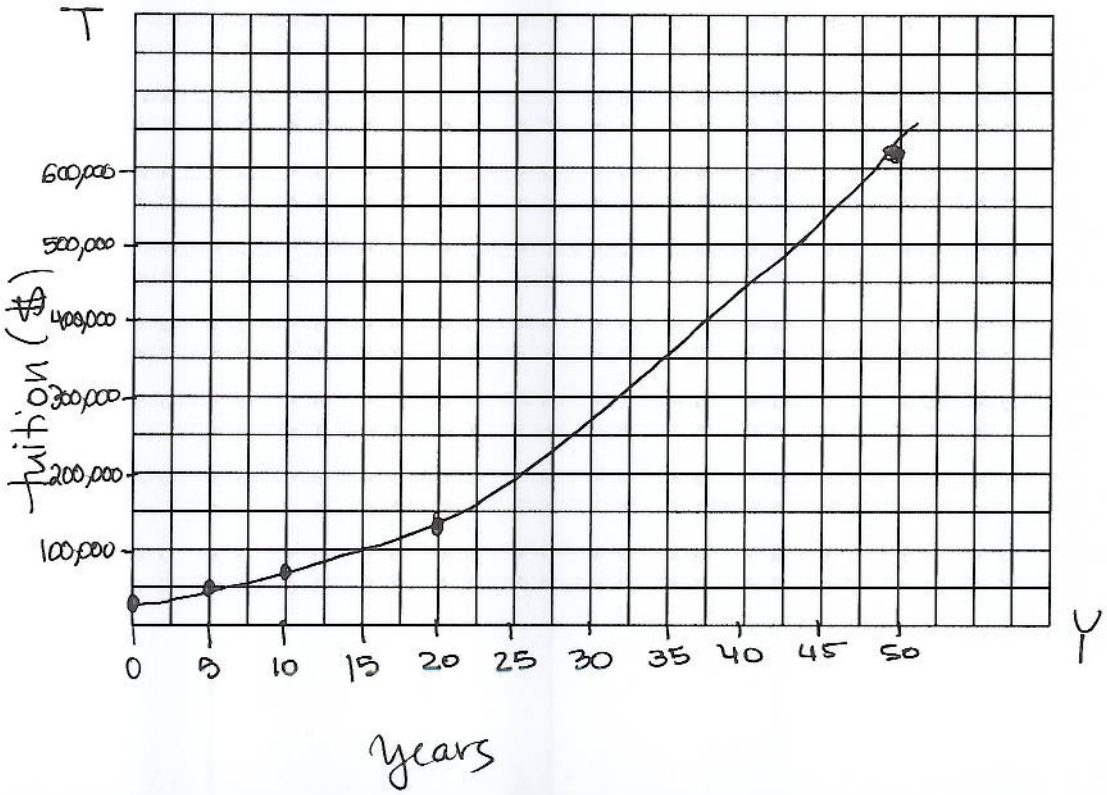
   $\boxed{T = 37{,}000 * 1.058^Y}$

   (d) Make a table of values showing the comprehensive fee now, in 5 years, 10 years, 20 years, and 50 years (even though that's not realistic).

Y	0 (now)	5	10	20	50
T	37,000	49,049	65,022	114,265	620,133

37000 x 1.058^10 = ETC. NO WAY!!

   (e) Draw a graph illustrating the function.



2. Bunnies, bunnies, everywhere. They eat the tops of my tulips in early spring and my lilies all summer long. Back in 2007 there were an estimated 1,800 rabbits in my neighborhood. Rabbits multiply quickly, 13% per year by one estimate.

Story also appears in 5.1#3

(a) Name the variables.

R = number of rabbits in my neighborhood (bunnies) ~dep
Y = time (years since 2007) ~indep

(b) Calculate the annual growth factor.

$r = \frac{13\%}{100} = .13$ $g = 1 + r = 1 + .13 = \boxed{1.13}$

(c) What does this story suggest the rabbit population was in 2010? In 2013?

$2010 \Rightarrow Y = \overset{2010}{-2007} = 3 \Rightarrow R = 1800 * 1.13^3 = 1800 \times 1.13\wedge 3 =$
$= 2,597.21\ldots \boxed{\approx 2,600 \text{ bunnies}}$

$2013 \Rightarrow Y = \overset{2013}{-2007} = 6 \Rightarrow R = 1800 * 1.13^6 = 1800 \times 1.13\wedge 6 =$
$= 3,747.51\ldots \boxed{\approx 3,750 \text{ bunnies}}$

(d) Write an equation relating the variables.

$\boxed{R = 1800 * 1.13^Y}$

3. A flu virus has been spreading through the college dormitories. Initially 8 students were diagnosed with the flu, but that number has been growing 16% per day.

Story also appears in 5.1 #2 and 5.5

(a) Calculate the daily growth factor and use it to write an equation describing the spread of the virus. Don't forget to name the variables too.

$r = \frac{16\%}{100} = .16$ $g = 1 + r = 1 + .16 = \boxed{1.16}$

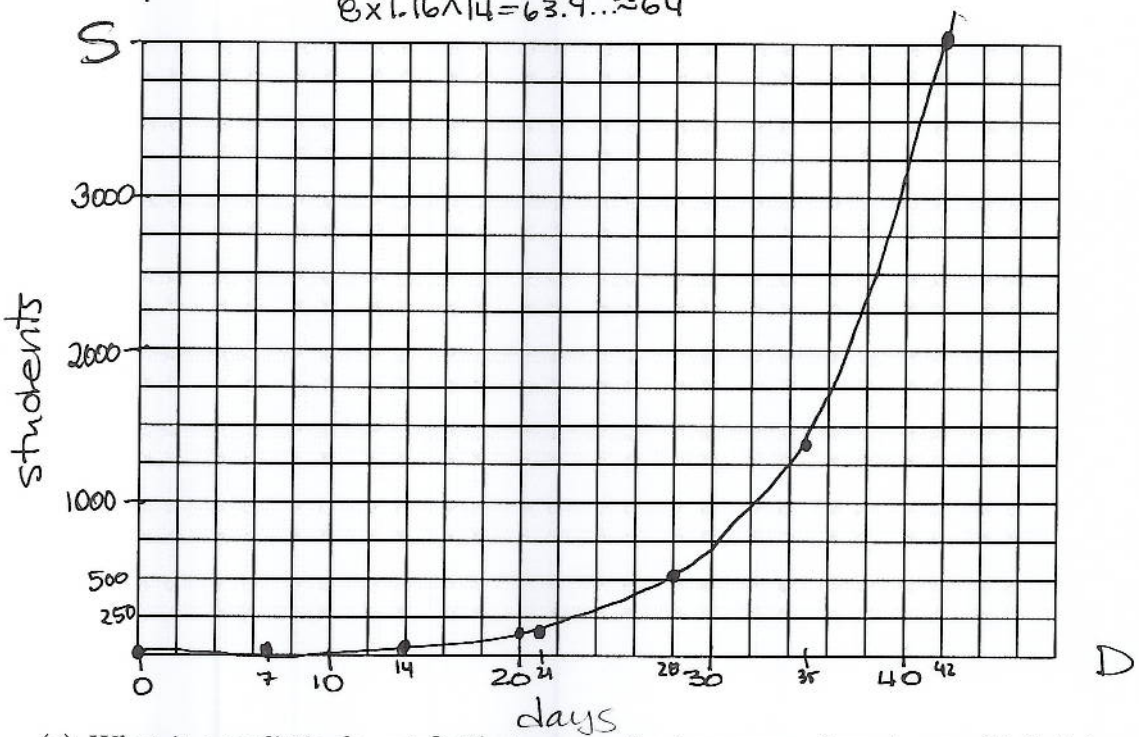
S = students with flu (students) ~dep

D = time (days) ~indep $\boxed{S = 8 * 1.16^D}$

(b) Make a table and graph for the six weeks following the initial diagnosis. (That means use 0, 7, 14, 21, 28, 35, and 42 days.)

D	0	7	14	21	28	35	42
S	8	13	64	181	510	1,443	4,077

$8 \times 1.16 \wedge 14 = 63.9.. \approx 64$



(c) What is a realistic domain? That means, for how many days do you think this model is reasonable? To keep a sense of scale, there are 1,094 students currently living in the dorms.

maybe 1 month?

$\boxed{0 \le D \le 30}$

4. My savings account earns a modest amount of interest, the equivalent of .75% annually. I have \$12,392.18 in the account now.

   (a) How much interest will I earn this year?

   $r = \frac{.75\%}{100} = .0075$ $\quad .0075 \times \$12,392.18 =$

   $92.941\ldots \approx \$92.94$

   (b) What will my balance be in three years, assuming I neither deposit nor withdraw money?

   $g = 1 + r = 1 + .0075 = 1.0075$

   $12,392.18 * 1.0075^3 = 12,392.18 \times 1.0075\text{^}3 =$

   $12,673.1004\ldots \approx \$12,673.10$

   (c) Name the variables and write an equation relating them.

   S = savings account balance (\$) ~ dep

   Y = time (years) ~ indep

   $S = 12,392.18 * 1.0075^Y$

   (d) What would the equation be if I moved all of my money into a certificate of deposit earning the equivalent of .92%?

   $S = 12,392.18 * 1.0092^Y$

   (e) What would the equation be if I moved \$10,000 into that certificate of deposit, and kept the rest in savings?

   Hint: to get the total balance, add the amount in each account.

   $S = 10,000 * 1.0092^Y + 2,392.18 * 1.0075^Y$