Adult Learning Academy
Elementary Algebra Workbook

MODULE 2: APPLICATIONS OF LINEAR EQUATIONS IN ONE VARIABLE, FUNCTION NOTATION

Learning Objectives

By the time you finish this module, you should be able to:

- ☐ Translate verbal expressions to the symbolic language of algebra
- ☐ Use a variety of problem-solving strategies.
- ☐ Solve word problems about unknown numbers that are related to each other.
- ☐ Use a given formula to solve problems.
- ☐ Solve a given formula to isolate a specified variable.
- ☐ Solve distance problems using the formula D = RT
- ☐ Solve problems involving simple interest using the formula I = PRT
- ☐ Solve problems involving ratios and proportions.
- ☐ Solve percent problems.
- ☐ Solve mixture problems.
- ☐ Find the perimeter of a rectangle.
- ☐ Use function f(x) notation to plug a value in for x.

IMPORTANT INFORMATION FROM MODULE 2:

Consecutive integers: x, x + 1, x + 2, x + 3, etc.
Consecutive odd or consecutive even integers: x, x + 2, x + 4, etc.
To DOUBLE a number means to multiply it by 2 (you might write 2x)
Translations: "of" means "multiply"; "is" means "equal"
To solve a proportion, cross multiply.

D = rt (distance = rate x time)
I = PRT (interest = principal x rate x time)
Perimeter of a rectangle = 2L + 2W

Strategies: Draw a diagram! Look for key words. Read the problem several times. Write a variable for the unknown quantity you wish to find. Try some simple numbers to get a feel for what's happening. Make a guess and adjust. Make a table. See what happens one year at a time, one hour at a time, etc. Notice patterns.

f(x) is pronounced "f of x". It means to plug the given number in for x. For example, f(3) means to plug the number 3 in wherever you see an x in the function, and calculate the answer.

Adult Learning Academy
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MODULE 2 VIDEO & EXERCISE LIST

Topic	Website	Videos	Exercises
Expressions	www.khanacademy.org	Evaluate an Expression	Evaluating expressions in 1 var.
and Formulas		Evaluate a Formula using Substitution	
		Age Word Problems 1	
Various Word	www.khanacademy.org	Basic Linear Equation Word Problems	Linear Equation Word Problems
Problem Examples	http://www.youtube.com/watch?v=JNusKkf3wbI&list=PLBUJyzEUI_hyrLI_kbMbWmyKNuZOJ5Nf_		
	http://www.youtube.com/watch?v=Qv0vF0rH1aM&list=PLBUJyzEUI_hyrLI_kbMbWmyKNuZOJ5Nf_		
	http://www.youtube.com/watch?v=bJC4dqEW1gQ&list=PLBUJyzEUI_hyrLI_kbMbWmyKNuZOJ5Nf_		
	http://www.youtube.com/watch?v=FG3bwWhkHTU&list=PLBUJyzEUI_hyrLI_kbMbWmyKNuZOJ5Nf_		
Simple Interest	http://www.youtube.com/watch?v=r3-lyBGlJ98	The Simple Interest Formula	
Ratio and Proportion	www.khanacademy.org	Introduction to Ratios	Expressing Ratios as Fractions
		Ratios as Fractions in Simplest Form	Ratio Word Problems
		Simplifying Rates and Ratios	Writing Proportions
		Writing Proportions	Proportions1
		Understanding Proportions	
Percent Problems	www.khanacademy.org	Representing # as Dec, %, Fraction	Converting Percents to Dec
		Growing by a Percentage	Discount Tax and Tip
		Solving Percent Problems	Markup, Commission
		Solving Percent Problems 2	
Use Proportions	http://www.youtube.com/watch?v=yl0Rb6T09VM		
Use Equations	http://www.youtube.com/watch?v=LkTYkHbUiU4		
Mixture Problems	www.stlcc.edu	Powerpoint: Mixture Problems	
	http://www.youtube.com/watch?v=gD2YfPU-qMM		
	http://www.youtube.com/watch?v=DwEsBCHM_jc		
Functions	http://www.youtube.com/watch?v=VUTXsPFx-qQ		
Function Notation	http://www.youtube.com/watch?v=S1uAy5vM4HI		
	www.khanacademy.org	Understanding Function Notation Ex 1	

Topic	Website	Videos	Exercises
Module 2 Test Review	http://www.youtube.com/watch?v=WQYzOpcnWxs	Helpful System to Solve Word Problems	
	stlcc.edu		Mixture Problem PowerPoint
			Module 2 Review Flashcards

Before you start to panic at the thought of an entire module dedicated to the dreaded word problem, consider this:

The whole point of studying math is to be able to USE it to solve real-life problems.

Real-life situations are expressed in WORDS.

So the goal of math is to be able to solve word problems!

This module will allow you to practice solving the equations from module 1, but in the context of real-life situations. We use the symbols of math to model what's going on in the problem.

There are many tools you can use to help you approach word problems. Not every tool helps with every problem. There are many ways to approach every problem. The more tools you have, the easier the job becomes. Here are some tips:

* **Draw a picture!** You don't have to be an artist. Diagrams are especially useful for problems involving distance, mixtures, area, and perimeter. If you can picture it, you can solve it!

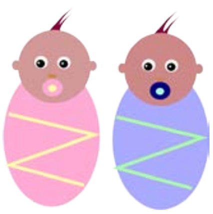
* **Try some simple numbers!** You can often get a feel for a problem by using your own "easy" numbers just to see how they are related. For example, say that a problem asks how many hours it will take to travel 37.5 miles at 22 miles per hour. If you don't know where to start, consider how long it would take to drive 100 miles at 50 miles per hour—that would take 2 hours (the first 50 miles would take one hour, the next 50 miles would take another hour). How can you use 100 and 50 to get 2? Divide! Then go back to the original problem and divide 37.5 by 22.

* **Take a guess!** Some people feel like they are "cheating" if they try to guess the answer, but it can be a great way to start. For example, say you are trying to find two numbers that add up to 99, and one number is twice as big as the other. You might guess that the numbers are 30 and 60, since 60 is twice as big as 30. Those don't add up to 99, but they are close. They are just a little too small. Don't give up because your guess wasn't perfect—adjust your guess! 31 + 62 would be better, but still a bit too small. 32 + 64 would be even closer, but still too small. How about 33 + 66? You've got it!

* **Replace words with algebra!** For example, in the problem above, you were looking for two numbers whose sum is 99, and one number is twice the other. You might write the following:

$\boxed{\text{One number}} + \boxed{\text{The other number}} = 99$

In Algebra, X stands for a number we don't know yet. Replace the number in the first box with X. The "other number" is twice as big as X, so call it 2X. This gives us
X + 2X = 99. You can solve the equation and find out that X = 33.



* **Remember a similar problem!** Try to notice the overall structure of the problems you solve, so you can apply what you've learned to new problems. A problem about a boat instead of a car, or a lady named Gertie instead of a guy named George, or two animals approaching each other instead of leaving each other, or a shopkeeper mixing coffee beans instead of a pharmacist mixing medicines, could be the same basic problem, solved the same way!

* **Go one step at a time!** In a distance problem, what's happening after one hour? After two hours? Three? In an interest problem, how much interest do you have after one year? Two years? Three? If you work step by step, you'll start to see a pattern!

* **Check your answer!** Did you just say that a lady is 325 years old? Or you need 3.27 buses, or a rectangle is -5 feet long? Did a number that was supposed to be larger get smaller? Then chances are you did not solve the problem correctly! Use the common sense that is built into your wonderful brain! Always label your answer and read the question one last time to be sure you answered the question asked, and that your answer is reasonable.

2.2 Formulas

A formula is just an EQUATION with more than one VARIABLE. Formulas express how different amounts are related. As an example, we'll use the distance formula:

D = rt This formula tells you that the distance you travel is equal to your rate (speed), multiplied by the time you travel. You use this formula without even thinking about it. For example, if you have been driving for 2 hours at 60 miles per hour, you know that you have driven 120 miles.

The formula has three variables: **D** to represent Distance, **r** to represent rate (speed), and **t** to represent time. Any word problem involving this formula will give you values to plug in for TWO of the three variables, and will leave one for you to figure out.

Examples: *A car travels at 50 miles per hour for 3 hours. How far does it travel?*
Here, you know the rate and the time, and must find the distance:
D = 50 · 3 = 150 miles.

How long will it take to drive 100 miles at a rate of 20 miles per hour?
Here, you know the distance and the rate, and must find the time:
100 = 20 · t, so t = 5 hours.

I rode my bike for 2 hours and went 20 miles. How fast was I riding?
Here, you know the distance and the time, and must find the rate:
20 = r · 2, so r = 10 miles per hour.

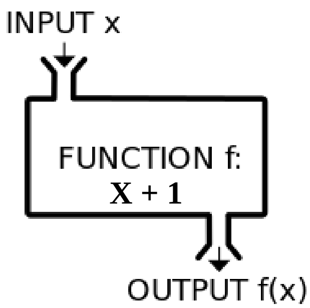
If a formula has 100 variables (don't worry, there are none of those here!), the problem will have to give you values to plug in for 99 of those variables. You'll always have just ONE missing number to find.

Solving a Formula for a particular variable: some problems don't give you any numbers. They just ask you to "solve for" x, or "solve for" some other variable. DO NOT JUST INVENT SOME NUMBERS! The problem is asking you to write the formula with the specified variable all alone on one side of the equation.

Examples: Solve for r: D = rt
We want the r to be alone. The way the formula is written, the r is multiplied by t. To undo that multiplication, divide both sides of the equation by t. This makes our formula $\frac{D}{t} = r$. The r is isolated. Mission accomplished.

Solve this formula for y: 3x + y = 7
We want the y to be alone. The way the formula is written, the y has 3x added to it. To undo that addition, subtract 3x from both sides of the equation. This makes our formula y = 7 – 3x. The y is isolated. Mission accomplished.

You can think of a function as a machine. Every function machine takes whatever number you give it as input, works with that number, and gives you back a number as output. Consider this function, whose job is to always add 1:



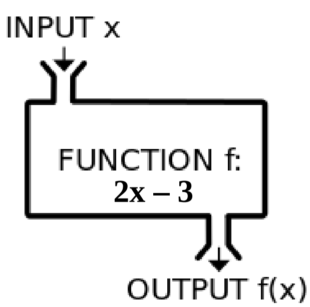
If we stick a 5 into the function machine, it adds 1 and spits out a 6. We write f(5) = 6 and we say "f of 5 equals 6".

If we stick a 99 into the function machine, it adds 1 and spits out a 100. We write f(99) = 100 and we say "f of 99 equals 100".

If we stick a 3.7 into the function machine, it adds 1 and spits out a 4.7. We write f(3.7) = 4.7, and we say "f of 3.7 equals 4.7".

In other words, we can input any value of x we choose, and a new number will come out, always according to the same rule.

Here is another function machine. This one takes whatever number we input, multiplies it by 2, and subtracts 3:



If we input a 5, the machine will take that 5, multiply it by 2, and subtract 3:
$f(5) = 2 \cdot 5 - 3 = 10 - 3 = 7$.
We write f(5) = 7, and we say that "f of 5 equals 7".

If we input a 100, the machine will take that 100, multiply it by 2, and subtract 3:
$f(100) = 2 \cdot 100 - 3 = 200 - 3 = 197$.
We write f(100) = 197, and we say that "f of 100 equals 197".

1. **PRACTICE:**

a. What is f(20)?

b. What is f(0)?

c. What is f(-50)?

Of course, we don't always have to draw the function machine. And not every machine has to be called "f". Let's say we have these functions:

$f(x) = x + 7$	$g(x) = 2x + 5$	$h(x) = x^2$

Let's pick some values for x. Let's see what each function does when x is 3:

$f(3) = 3 + 7$	$g(3) = 2 \cdot 3 + 5$	$h(3) = 3^2$
$f(3) = 10$	$g(3) = 11$	$h(3) = 9$

Now we'll see what each function does if the x is 0:

$f(0) = 0 + 7$	$g(0) = 2 \cdot 0 + 5$	$h(0) = 0^2$
$f(0) = 7$	$g(0) = 5$	$h(0) = 0$

2. <u>PRACTICE</u>: Use the same functions above to calculate the following:

a. $f(2)$	d. $g(2)$	g. $h(2)$
b. $f(-10)$	e. $g(-10)$	h. $h(-10)$
c. $f(8)$	f. $g(8)$	i. $h(8)$

I. WRITING ALGEBRAIC EXPRESSIONS

Use the given information to change the initial number of bees in the colony as described:

1. **Environmental researchers have been observing a colony of 50,000 bees**

   a. If 10,000 bees joined the colony, how many would there be?

   b. If 5,000 of the original bees died, how many would be in the colony?

   c. Double the original number of bees:

   d. Cut the original number of bees in half:

   e. Triple the original number of bees:

   f. Decrease the number of bees by 100:

   g. How many is 200 less than half the original number of bees?

   h. How many is 50 more than twice the original number of bees?

   i. What is the total number of bees in a dozen colonies this size?

   j. The colony produces 5 liters of honey. How much honey is this per bee?

2. **Researchers cannot tell how many bees are in the colony initially. Use the variable X to represent the number.**

   a. If 10,000 bees joined the colony, how many would there be?

   b. If 5,000 of the original bees died, how many would be in the colony?

   c. Double the original number of bees:

   d. Cut the original number of bees in half:

   e. Triple the original number of bees:

   f. Decrease the number of bees by 100:

   g. How many is 200 less than half the original number of bees?

   h. How many is 50 more than twice the original number of bees?

   i. What is the total number of bees in a dozen colonies this size?

   j. The colony produces 5 liters of honey. How much honey is this per bee?

II. FIND THE SECRET NUMBERS!

Be sure to set up an equation, identify your variable, label your answer, and check that you answered the question and your answer makes sense!

3. There are 75 patients on a maternity ward. The number of mothers is twelve less than twice the number of babies. How many mamas and how many babies are on the ward?

4. A pair of twins weigh a total of 63 pounds. Their weights are consecutive integers. How much does each twin weigh?

5. A pair of twins weigh a total of 158 pounds. Their weights are consecutive even integers. How much does each twin weigh?

6. A set of triplets weigh a total of 117 pounds. Their weights are consecutive odd integers. How much does each triplet weigh?

7. The perimeter of a laboratory is 44 feet. The length and width are consecutive even integers. What are the dimensions of the room? (Remember, to find perimeter, add up the lengths of all four sides!)

8. There are 132 researchers at a workshop. Some are biologists, while the rest are chemists. The number biologists is twelve less than twice the number of chemists. How many biologists and how many chemists are at the workshop?

9. Two studies would have taken exactly the same amount of time, but because of an equipment malfunction, one had to extend its observations for 5 days. Altogether, the two studies lasted 195 days. How long was each study?

10. According to GPS, three routes to the same destination have distances that are consecutive odd integers. Driving all three routes would make a total of 117 miles. How far is the most direct route?

11. Three plants have a total height of 83 centimeters. The first is 3 centimeters shorter than the second. The third is 5 centimeters taller than the second. How tall is each plant?

12. According to the Tornado History Project (www.tornadohistoryproject.com), the total number of tornadoes in Missouri in 2012, 2013, and 2014 was 125. The number in 2012 was 20 less than the number in 2013. The number in 2014 was two less than the number in 2013. How many tornadoes hit Missouri each year?

13. Andre spent a total of $1880 to buy a new i-Pad mini and a new MacBook Pro. The MacBook cost $290 more than twice times the cost of the i-Pad. How much did each cost?

III. WORKING WITH FORMULAS

14. KINETIC ENERGY FORMULA

    Kinetic Energy, or KE, is energy of motion. If the mass and velocity of a body are known, the kinetic energy can be determined by this formula:

    $$\mathbf{KE = \frac{mV^2}{2}}$$

    where KE = Kinetic Energy in Joules
    m = mass in kilograms
    V = velocity in meters/sec

    a. Calculate the kinetic energy of a brown bear with a mass of 317 kg that runs at 15.5 meters/sec.

    b. The Kinetic Energy of a 650-kg roller coaster car is 105,300 Joules. How fast is the car rolling?

c. The kinetic energy of a boat is 52,000 Joules. The boat is moving at 1.63 meters/sec. What is the boat's mass?

d. The Lockheed SR-71 Blackbird, a high-altitude spy plane, has a mass of 77,000 kg, and at top speed it has a kinetic energy of 37,000,000,000 J. What is the top speed of the SR-71?

e. How fast is a 65-kilogram skydiver falling if her kinetic energy is 704,000 Joules?

f. Solve the formula above for mass (that is, get the variable m by itself on one side of the equation).

15. TEMPERATURE CONVERSION FORMULAS

In the United States, most people use a Fahrenheit temperature scale. Along with the rest of the world, however, the Federal Aviation Administration (FAA) uses the Metric temperature scale for weather reports, to temperature is measured in degrees Celsius. You can use these two formulas to convert between the two:

$$\boldsymbol{degrees\ F = \frac{9}{5}\ C + 32} \qquad\qquad \boldsymbol{degrees\ C = \frac{5}{9}\ (F - 32)}$$

a. Water freezes at 32° Fahrenheit. What is this in Celsius?

b. Water boils at 212° Fahrenheit. What is this in Celsius?

c. Normal human body temperature is 98.6° Fahrenheit. What is this in Celsius?

d. In sub-freezing temperatures, the wings of a plane must be deiced. The deicing chemical glycol works like antifreeze in a car, reducing the freezing point of water to as low as -50 degrees Celsius. What is this temperature in Fahrenheit?

e. The hottest day ever in Missouri reached 47.8 degrees Celsius. What is this in Fahrenheit?

f. The coldest day ever in Missouri reached -40 degrees Fahrenheit. What is this in Celsius? WHAT DO YOU NOTICE???

16. DISTANCE FORMULA

Use the distance formula **(d = rt)** to solve the problems below.

The Shinkansen Bullet Train in Japan travels at a rate of up to 200 miles per hour.

a. At this rate, how long would it take to travel 800 miles?

b. At this rate, how long would it take to travel 1100 miles?

c. At this rate, how far could you travel in 8 hours?

d. If we had a similar train, how long would it take to travel the 300 miles from St. Louis to Chicago?

e. In a car traveling 60 miles per hour, how long does it take to travel the 300 miles from St. Louis to Chicago?

f. A car leaves St. Louis and heads for Chicago at 55 miles per hour. Another car leaves Chicago and heads for St. Louis at 45 miles per hour. How long will it take them to meet? (Remember, it's about 300 miles between the two cities.)

g. Two trains leave the same station at noon, but one goes north and the other goes south. One train is traveling twice as fast as the other. By 5:00 pm, the trains are 450 miles apart. How fast are the trains going?

h. Solve the formula D= rt for time (that is, get *t* by itself on one side of the equation).

17. SIMPLE INTEREST FORMULA

Solve each problem, using the formula:

I = PRT, where I = the amount of interest in dollars
P = the principal in dollars
R = the interest rate written as a decimal
T = time in years

a. Solve the formula above for P (that means get the variable P by itself on one side of the equation).

b. If you borrow $5000 for training expenses at 3% simple interest for 2 years, how much money will you pay in interest?

c. You invested \$7000 at 3.5% simple interest. How long will it take you to earn \$1225 in interest?

d. You invested some money at 3.25% simple interest for 5 years and earned \$1218.75 in interest. How much did you invest?

e. You invested your inheritance in two funds. You put some money in an account that pays 5% simple interest, and twice as much money in account paying 7% simple interest. After 2 years you earned \$ 570. How much was your inheritance?

IV. Ratios and Proportions

18. Gear ratio is the number of teeth each gear represents when two gears are used in a machine. For example, a pinion gear has 8 teeth and a spur gear has 28 teeth. The gear ratio is 8:28, which simplifies to 1:7. Simplify ratio below:

a. 40:4 _______________

b. 55:11 _______________

c. 168:14 _______________

d. 52:13 _______________

e. 15:10 _______________

f. ½: 1/3 _______________

g. ½ : 5 _______________

h. ½ : ¾ _______________

19. Which car below gets the highest MPG, or miles per gallon?

Honda Civic
Drove 224 miles on 7 gallons

Toyota Corolla
Drove 335 miles on 15 gallons

Ford Fiesta
Drove 620 miles on 20 gallons

20. 1 mole of carbon has a mass of 12 grams. What is the mass of 5.5 moles of carbon?

21. It is estimated that a 40-milliliter pond water sample contains 10,700 paramecia. How many paramecia would be found in 2000 milliliters of this water?

22. The ratio of male to female elephants in a herd is usually about 1:6. There are 300 elephants in the herd. About how many would you expect to be female?

23. 1 gram of Agarose is required to make 60 milliliters of Agarose Gel solution. How much Agarose is needed to make 865 milliliters?

24. In 1 kilogram of river sediment, there are about 156,000 insect larvae. How many larvae would be in .07 kilograms of this sediment?

25. Two tablets of ulcer medication contain 250 milligrams of medication. How many milligrams are in eight tablets?

26. The scale on a map is a ratio of actual distance to distance shown on the map. On a particular map, 1 inch = 50 miles.

a. The distance from Point A to Point B on the map is 3 inches. What is the actual distance? Could you do this in your head?

b. The distance from Point B to Point C on the map is .5 inches. What is the actual distance? Could you do this in your head?

c. The actual distance across town is 22 miles. How will this distance appear on the map?

27. Convert the following, knowing that **1 kilogram = 2.2 pounds**

a. A male orca can weigh up to 19,000 pounds = __________________ kilograms

b. An adult tiger weighs 675 pounds = _______________ kilograms

c. A newborn giraffe weighs 100 kilograms = __________________ pounds.

V. PERCENT PROBLEMS

28. When viewing sea urchin embryonic cells undergoing mitosis, you record the following number of cells in each phase of the cell cycle. Fill in the percentages:

Phase of Cell Cycle	Number of Cells in that Phase	% of all cells viewed that are in that phase
Interphase	54	
Prophase	13	
Metaphase	5	
Anaphase	2	
Telophase	1	

29. According to www.textinganddriving.com, in 2011, nationally 23% of all auto collisions involved cell phones.

    a. A total of 1.3 million collisions in the United States in 2011 involved cell phones. How many collisions were there all together?

    b. 1 in 5 drivers say they have surfed the web while driving. What percent is this?

    c. 10 states prohibit cell phone use while driving. What percent is this?

    d. 78% of the states prohibit texting while driving. How many states is this?

30. According to a 2013 U.S. Census Bureau (www.census.gov) report, 92.1% of the 22,331 households with occupants under 35 years of age had some type of computer. How many households is this?

31. An 18-wheeler requires 40% more time to stop than a car. If a car traveling at 60 mph takes 6.87 seconds to stop, how long would it take the 18-wheeler to stop?

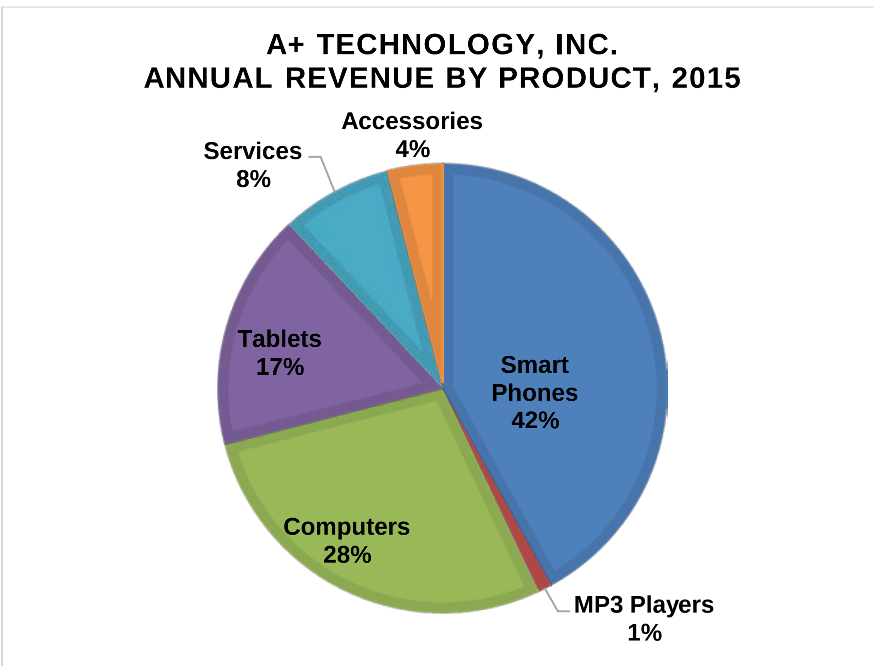
32. According to the Missouri Department of Conservation, the number of hellbender salamanders in Missouri has declined about 75% since the 1980's, and are on course to become extinct in the next 20 years. If a particular river had 300 hellbenders in the 1980's, how many would it have now?

33. The global human population has grown from 1 billion in the 1800's to over 7 billion in 2012. What is the percent increase over this period?

34. The population of gray wolves in a particular area increased from 1200 to 1700. What was the percent increase?

35. According to the Orangutan Conservancy (www.orangutan.com), the population of orangutans in Borneo and Sumatra has decreased from about 60,000 to about 40,000 in the last decade. What percent decrease is this?

36. Use the following pie graph to answer the questions below:



a. A+ Technology, Inc. made $42.85 billion in revenue in 2014. How much of that revenue came from smartphones?

b. How much revenue came from MP3 players?

c. What percent of revenue came from services and accessories, as opposed to the products themselves?

VI. Mixture Problems

37. How many liters of a 5%-saline solution would have to be mixed with 150 liters of a 20%-saline solution to create a mixture that is 10% saline?

38. A super-strength cleaning chemical must be watered down to be safe for the surface to be cleaned. How many ounces of water should be added to 8 ounces of a chemical that is 30% water to create a solution that is 80% water?

39. A wing deicer is 18% glycol. How much pure glycol and how much deicer must be added to create 100 liters of a 30%-glycol deicer?

40. How many pounds of a metal containing 45% nickel must be combined with 10 pounds of a metal containing 75% nickel to create a metal that is 60% nickel?

41. Sand that cost $2.50 per kilogram is being mixed with specially treated soil worth $7.00 per kilogram. How much of each should be used to create 100 kilograms of a mixture worth $5.00 per kilogram?

VII. FUNCTION NOTATION

42. St. Louis Community College charges \$101 per credit hour, plus \$12 in fees. If x = the number of credit hours a student takes, and T(x) = Total paid, the following function describes the situation:

$$T(x) = 101x + 12$$

a. Calculate T(3), the total cost for a 3-credit course.

b. Calculate T(15), the total cost to be a full-time student taking 15 credit hours.

c. Debbie paid \$921 for this semester at the Community College. How many credit hours did she take?

d. Nancy paid \$1224 for her semester. How many credit hours did she take?

e. If you have a \$600 budget, how many credit hours can you take?

43. It has been observed that the number of chirps a cricket makes per minute depends on the air temperature! Here is the function relating the temperature in degrees Fahrenheit, *t*, to the number of chirps, C(t).

$$C(t) = 4t - 160$$

a. Calculate C(60), the number of chirps per minute when the air temperature is 60° F.

b. Calculate C(80), the number of chirps per minute when the temperature is 80° F.

c. You hear 40 chirps per minute. What is the temperature?

d. You hear 60 chirps per minute. What is the temperature?

e. At what temperature do you hear NO chirping from the crickets?

RESOURCES

Images used in section VI, question 2

Honda Civic 1.6 i-DTEC Elegance (IX, Facelift) by © M 93 is licensed under CC-BY-SA-3.0 (DE)

2014 Toyota Corolla 1.8 LE (ZRE172), front left by Mr.choppers is licensed under CC BY-SA 3.0

2009-2010 Ford Fiesta (WS) Zetec 3-door hatchback 01 is available in the public domain

MoSTEMWINs

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2.3 Function Notations

1a. $f(20) = 2(20) - 3$
$= 40 - 3$
$= \mathbf{37}$

1b. $f(0) = 2(0) - 3$
$= 0 - 3$
$= \mathbf{-3}$

1c. $f(-50)$
$= 2(-50) - 3$
$= -100 - 3$
$= \mathbf{-103}$

2a. $f(2) = 2 + 7$
$= \mathbf{9}$

2b. $f(-10) = -10 + 7$
$= \mathbf{-3}$

2c. $f(8) = 8 + 7$
$= \mathbf{15}$

2d. $g(2) = 2(2) + 5$
$= 4 + 5$
$= \mathbf{9}$

2e. $g(-10) = 2(-10) + 5$
$= -20 + 5$
$= \mathbf{-15}$

2f. $g(8) = 2(8) + 5$
$= 16 + 5$
$= \mathbf{21}$

2g. $h(2) = 2^2$
$= \mathbf{4}$

2h. $h(-10) = -10^2$
$= \mathbf{100}$ **Check this one carefully!**

2i. $h(8) = 8^2$
$= \mathbf{64}$

2.4 Career Applications: STEM

1a. **60,000**
1b. **45,000**
1c. **100,000**
1d. **25,000**
1e. **150,000**
1f. **40,000**
1g. **24,800**
1h. **100,050**
1i. **600,000**
1j. 5/50,000 = 1/10,000 = **.0001 liter**

2.4 Career Applications: STEM (cont.)

2a. **x + 10,000**
2b. **x – 5,000**
2c. **2x**
2d. **1/2x**
2e. **3x**
2f. **x - 100**
2g. **1/2x – 200**
2h. **2x + 50**
2i. **12x**
2j. **5/x liters**

3. *let* x = the number of babies **= 29**
So 2x - 12 = the number of mothers **= 46**
x + 2x - 12 = 75
3x – 12 **+ 12** = 75 **+ 12**
3x/**3** = 87/**3** **x = 29**

4. *let* x = the lighter twin **= 31 lbs.**
So x + 1 = the heavier twin **= 32 lbs.**
x + x + 1 = 63
2x + 1 **– 1** = 63 **– 1**
2x/**2** = 62/**2** **x = 31**

5. *let* x = the lighter twin **= 78 lbs.**
So x + 2 = the heavier twin **= 80 lbs.**
x + x + 2 = 158
2x + 2 **– 2** = 158 **– 2**
2x/**2** = 156/**2** **x = 7**

6. *let* x = the lightest triplet **= 37 lbs.**
so x + 2 = the middle triplet **= 39 lbs.**
and x + 4 = the heaviest triplet **= 41 lbs.**
x + x + 2 + x + 4 = 117
3x + 6 **– 6** = 117 **– 6**
3x/**3** = 111/**3** **x = 37**

7. *Perimeter = sum of all 4 sides*
let x = the width **= 10 ft.**
so x + 2 = the length **= 12 ft.**
x + x + x + 2 + x + 2
4x + 4 **– 4** = 44 **– 4**
4x/**4** = 40/**4** **x = 10**

8. *let* x = the number of chemists **= 48**
so 2x – 12 = the number of biologists **= 84**
x + 2x – 12 = 132
3x -12 **+ 12** = 132 **+ 12**
3x/**3** = 144/**3** **x = 48**

2.4 Career Applications: STEM (cont.)

9. *let* x = the length of shorter study **= 95 days**
so x + 5 = the length of the longer study **= 100 days**
x + x + 5 = 195
2x + 5 **– 5** = 195 **– 5**
2x/**2** = 190/**2** **x = 95**

10. *let* x = the shortest route **= 37 miles**
so x + 2 = the middle route **= 39 miles**
and x + 4 = the longest route **= 41 miles**
x + x + 2 + x + 4 = 117
3x + 6 **– 6** = 117 **– 6**
3x/**3** = 111/**3** **x = 37**

11. *let* x = the second plant **= 27 cm**
so x - 3 = the first plant **= 24 cm**
and x + 5 = the third plant **= 32 cm**
x + x – 3 + x + 5 = 83
3x + 2 **– 2** = 83 **– 2**
3x/**3** = 81/**3** **x = 27**

12. *let* x = 2013 **= 49**
so x - 20 = 2012 **= 29**
and x – 2 = 2014 **= 47**
x + x – 20 + x – 2 = 125
3x – 22 **+ 22** = 125 **+ 22**
3x/**3** = 147/**3** **x = 49**

13. *let* x = cost of iPad **= $530**
so 2x + 290 = MacBook **= $1350**
x + 2x + 290 = 1880
3x + 290 **– 290** = 1880 **– 290**
3x/**3** = 1590/**3** **x = 530**

14a. **about 38,079.6 Joules**
14b. V^2 = 324, so V= the square root of 324
so **18 meters/sec**
14c. **about 34,143.4 kilograms**
14d. **about 980.3 meters/sec**
14e. **about 147.2 meters/sec**
14f. $\mathbf{m} = \frac{2\,KE}{V^2}$

15a. **0° C**
15b. **100° C**
15c. **37° C**
15d. F = 9/5(-50) + 32 = **-58 degrees F**
15e. F = 9/5(47.8) + 32 = **118.04 degrees F**
15f. **-40 degrees** – they are the SAME!

16a. **4 hours**
16b. 1100 = 200t, so **t = 5.5 hours**
16c. **1600 miles**
16d. **1.5 hours**
16e. **5 hours**
16f. combined rate = 100mph, so about **3 hours**
16g. r = slower train **= 30mph**
2r = faster train **= 60mph**
450 = 3r(5) **450 = 15r** **r = 30**
16h. **t = D/r**

17a. $P = \frac{I}{RT}$
17b. I = 5000(.03)2
I = $300
17c. 1225 = 7000(.035)t
1225 = 245t
t = $300
17d. 1218.75 = P(.0325)(5)
1218.75 = .1625P
t = $7500
17e. *let* x = the amount you invested in 5% fund
So 2x = the amount you invested in 7% fund
570 = .05(2)(x) + .07(2)(2x)
570 = .1x + .28x = .38x
x = $1500 in 5% fund
so 2x **= $3000 in 7% fund, and total $4500**

18a. **10:1**
18b. **5:1**
18c. **12:1**
18d. **4:1**
18e. **3:2**
18f. $\frac{1}{2} \div \frac{1}{3} = \frac{1}{2} \cdot \frac{3}{1} = \frac{3}{2} = \mathbf{3:2}$
18g. $\frac{1}{2} \div \frac{5}{1} = \frac{1}{2} \cdot \frac{1}{5} = \frac{1}{10} = \mathbf{1:10}$
18h. $\frac{1}{2} \div \frac{3}{4} = \frac{1}{2} \cdot \frac{4}{3} = \frac{2}{3} = \mathbf{2:3}$

19. **Honda = 224/7 = 32 mpg is highest**
Toyota = 335/15 = 22.3 mpg
Ford = 620/20 = 31 mpg

20. $\frac{1\text{ mole}}{12\text{ grams}} = \frac{5.5}{x\text{ grams}}$
x = 5.5(12) = **66 grams**

21. $\frac{\mathbf{40\ ml}}{\mathbf{10{,}700\ paramecia}} = \frac{\mathbf{2000\ ml}}{\mathbf{x\ paramecia}}$
40x = 21,400,000
x = **535,000 paramecia**

22. $\frac{6\text{ female}}{7\text{ total elephants}} = \frac{x\text{ females}}{300\text{ total elephants}}$
7x = 1800
x = about **257 female elephants**

2.4 Career Applications: STEM (cont.)

23. $\frac{1 \text{ gram}}{60 \text{ ml}} = \frac{x \text{ grams}}{865 \text{ ml}}$

60x = 865

x = about **14.4 grams Agarose**

24. $\frac{1 \text{ kg}}{156{,}000 \text{ larvae}} = \frac{.07 \text{ kg}}{x \text{ larvae}}$

x = **10,920 larvae**

25. $\frac{2 \text{ tablets}}{250 \text{ mg}} = \frac{8 \text{ tablets}}{x \text{ mg}}$

2x = 2000, x = **1000 mg**

26a. $\frac{1 \text{ inch}}{50 \text{ miles}} = \frac{3 \text{ inches}}{x \text{ miles}}$

x = **150 miles**

26b. $\frac{1 \text{ inch}}{50 \text{ miles}} = \frac{.5 \text{ inches}}{x \text{ miles}}$

x = **25 miles**

26c. $\frac{1 \text{ inch}}{50 \text{ miles}} = \frac{x \text{ inches}}{22 \text{ miles}}$

50x = 22, **x = *about* .4 inches**

27a. $\frac{1 \text{ kg}}{2.2 \text{ lbs}} = \frac{x \text{ kg}}{19{,}000 \text{ lbs}}$

2.2x = 19000, **x = *8636.4 kilograms***

27b. $\frac{1 \text{ kg}}{2.2 \text{ lbs}} = \frac{x \text{ kg}}{675 \text{ lbs}}$

2.2x = 675, **x = 306.8 kilograms**

27c. $\frac{1 \text{ kg}}{2.2 \text{ lbs}} = \frac{100 \text{ kg}}{x \text{ lbs}}$

x = 220 pounds

28.

Phase	# Cells	% of All Cells
Interphase	54	54/75 = **72%**
Prophase	13	13/75 = **17.3%**
Metaphase	5	5/75 = **6.7%**
Anaphase	2	2/75 = **2.7%**
Telophase	1	1/75 = **1.3%**

29a. 1.3 = 23% of the total accidents

1.3 = .23x

x = about 5.65 million accidents

29b. 1/5 = **20%**

29c. 10/50 = 1/5 = **20%**

29d. .78(50) = **39 states**

30. .921(22,331) = **about 20,567**

31. 6.87 + .4(6.87) = **about 9.62 seconds**

32. 300 - .75(300) = **75 hellbenders left**

33. Amount of increase = 6 billion.

6 = x(1)

x = 6, so 600% increase

34. Amount of increase = 500

500 is what percent of 1200?

500 = x(1200)

x = 500/1200 = .4166

= about 42% increase

35. Amount of decrease = 20,000

20,000 is what percent of 60,000?

20000 = x(60000)

x = 20000/60000 = .3333

= about 33% decrease

36a. 42% of 42.85 billion

= .42(42.85) = **almost $18 billion**

36b. 1% of 42.85 billion

= .01(42,850,000,000) = **$428,500,000**

36c. 8% + 4% **= 12%**

37. *let* x = the number liters of 5% solution

final solution will have 150 + x liters

.05x + .2(150) = .1(150 + x)

.05x + 30 = 15 + .1x

15 = .05x

x = 15/.05

x = 300 liters of 5% saline solution

38. *let* x = the number of ounces of water

final solution will have x + 8oz

Remember that pure water contains 100% water, which = 1

.3(8) + 1x = .8(x + 8)

2.4 + x = .8x + 6.4

.2x = 4

x = 20 ounces of water

39. *let* x = the number of liters of pure (100%) glycol

We need 100 liters total, so we'll need (100-x) liters of deicer

1x + .18(100 – x) = .3(100)

x + 18 – .18x = 30

.82x = 12

x = 12/.82 = 14.63

x = about 14.5 liters of glycol

100 –x = about 85.5 liters of deicer

40. *let* x = the number of pounds of 45% nickel

10 + x = the number of pounds in the alloy being created

.45x + .75(10) = .6(10 + x)

.45x + 7.5 = 6 + .6x

1.5 = .15x

x = 1.5/.15 = 10

x = 10 lbs. of 45% nickel

This makes sense, because using equal amounts of each material will create a percent nickel that is halfway between 45% and 75%

2.4 Career Applications: STEM (cont.)

41a. *let* x = the number of kilograms of sand
100 – x = the number of kilograms of soil
$2.5x + 7(100 - x) = 5(100)$
$2.5x + 700 - 7x = 500$
$-4.5x + 700 = 500$
$200 = 4.5x$
$x = 200/4.5 = 44.44$
x = about 44 kilograms of sand
100 – x = about 56 kilograms of soil

42a. $T(3) = 101(3) + 12$
$T(3) = 303 + 12 =$ **$315**

42b. $T(15) = 101(15) + 12$
$T(15) = 1515 + 12 =$ **$1527**

42c. $921 = 101(x) + 12$
$921 - 12 = 101x$
$101x = 909$
x = 9 credit hours

42d. $1224 = 101(x) + 12$
$1224 - 12 = 101x$
$101x = 1212$
x = 12 credit hours

42d. $600 = 101(x) + 12$
$600 - 12 = 101x$
$101x = 588$
x = 5.88 so 5 credit hours

43a. $C(60) = 4(60) - 160$
$C(60) = 240 - 160 =$ **80 chirps per minute**

43b. $C(80) = 4(80) - 160$
$C(80) = 320 - 160 =$ **160 chirps per minute**

43c. $40 = 4t - 160$
$4t = 40 + 160$
t = 50 degrees Fahrenheit

43c. $60 = 4t - 160$
$4t = 60 + 160$
t = 55 degrees Fahrenheit

43c. $0 = 4t - 160$
$4t = 0 + 160$
t = 40 degrees Fahrenheit

MoSTEMWINs

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