Adult Learning Academy
Pre-Algebra Workbook

UNIT 1: WHOLE NUMBERS

LEARNING OBJECTIVES

1. **Place Value:**
   - ☐ Write and describe whole numbers up to billions
   - ☐ Order and compare whole numbers
   - ☐ Round whole numbers to the correct place value
2. **Operations with Whole Numbers:**
   - ☐ Add multi-digit whole numbers, with carrying
   - ☐ Subtract multi-digit whole numbers, with borrowing
   - ☐ Multiply multi-digit whole numbers, with carrying
   - ☐ Divide multi-digit whole numbers, with remainders
   - ☐ Follow order of operations rules when performing calculations
3. **Factors and Multiples:**
   - ☐ List the factors and multiples of whole numbers
   - ☐ Identify the prime factors of whole numbers
4. **Averages:**
   - ☐ Find the mean, median and mode for a given set of numbers
5. **Military Time:**
   - ☐ Perform conversions between standard time (12-hour clock) and military time (24-hour clock)
6. **Word Problems:**
   - ☐ Solve basic word problems using whole number arithmetic, including those involving area and perimeter, and applications to career pathway.

St. Louis Community College

Adult Learning Academy
Pre-Algebra Workbook
UNIT 1 VIDEO & EXERCISE LIST

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Topic	Website	Videos	Exercises
Place Value	www.khanacademy.org	Place Value 1	Place Value
		Place Value 2	
		Place Value 3	
Addition	www.khanacademy.org	Addition 4	4-digit addition with carrying
Subtraction	www.khanacademy.org	Level 4 Subtraction	Subtraction with borrowing
			4-digit subtraction w/ borrowing
Multiplication	www.khanacademy.org	Multiplication 2: Mult. Tables	Basic Multiplication
		Example: Two-digit multiplication	Multiplication with Carrying
		Example: 2-digit times 2-digit	Multiplying 3 digits by 2 digits
			Multi-digit multiplication
Division	www.khanacademy.org	Division 2	Basic Division
		Ex: Expressing Division in Multiple Ways	Mult & Div Word Problems
Dividing by Zero	http://www.youtube.com/watch?v=2bjYoya_inQ		
Symbols and Properties	www.khanacademy.org	Commutative Law of Addition	Properties of Numbers 1
		Commutative Law of Multiplication	Distributive Property
		Distributive Property	
Greater Than (dots tech.)	http://www.youtube.com/watch?v=KHJyNzGGYLI		
	www.stlcc.edu	Blackboard Powerpoint	"Inequalities Game"
Factors and Multiples	www.khanacademy.org	Divisibility Tests for 2, 3, ...	Divisibility Tests
		Recognizing Divisibility	Divisibility 0.5
		Finding Factors of a number	Prime Numbers
		Prime Numbers	Composite Numbers
		Recognizing Prime Numbers	Prime Factorization
		Prime Factorization	Least Common Multiple
		Least Common Multiple (LCM)	Worksheet: Factors and multiples

Topic	Website	Videos	Exercises
Rounding Whole Numbers	www.khanacademy.org	Rounding Whole Numbers 1	Rounding Whole Numbers
		Rounding Whole Numbers 2	
		Rounding Whole Numbers 3	
Order of Operations	www.khanacademy.org	Introduction to Order of Operations	Order of Operations
		Order of Operations 1	Worksheet: Order of Operations
		More complicated Order of op ex.	
Military Time	http://www.youtube.com/watch?v=-Rf1qtdk5ag		Worksheet: Military Time
Averages	www.khanacademy.org	Statistics Intro:Mean, Median, Mode	Mean, Median, and Mode
		Example: Finding Mean, Med, Mode	Average Word Problems
Review of Unit 1	www.stlcc.edu	Blackboard Powerpoint	"Unit 1 Review Flashcards"
Compass Practice	http://www.hostos.cuny.edu/oaa/compass/pre-alg_prac13.htm		Measures of Central Tendency

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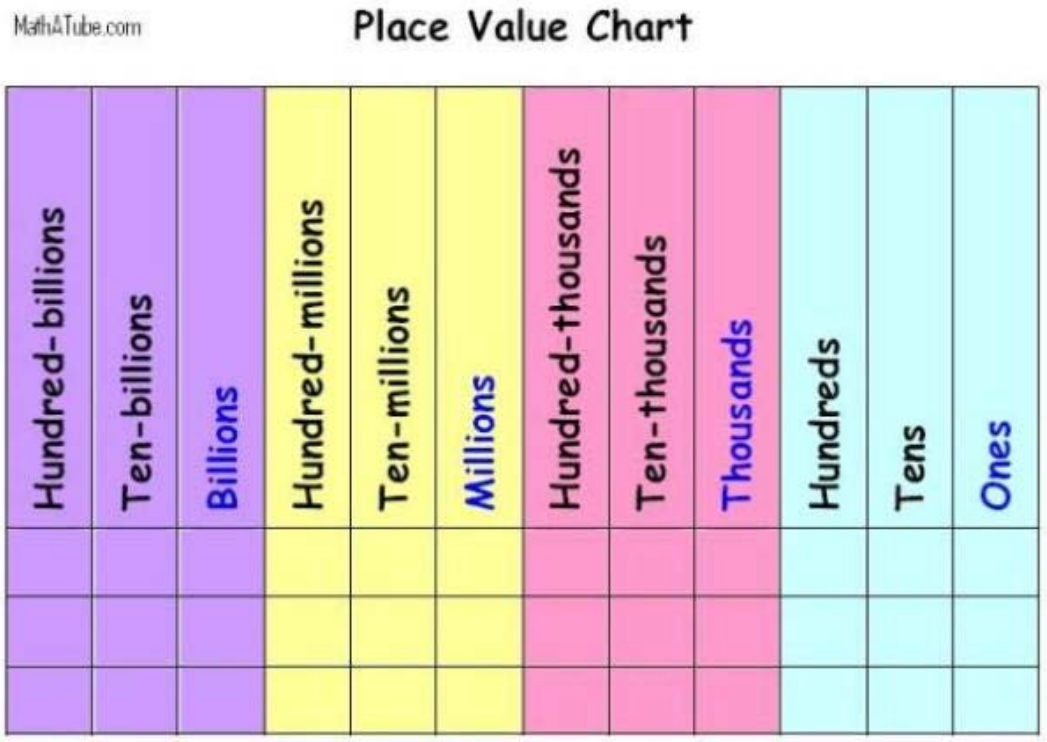


1. **Write the words for these numbers:**

   a. 3,257,012

   b. 507,392,005

2. **Write the numbers:**

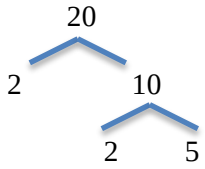
   a. ten billion, five hundred million, twenty-thousand three

   b. four million, four thousand, forty

Complete the following table.
You may use the completed table during your unit tests.

	0	1	2	3	4	5	6	7	8	9	10	11	12
0													
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													

The **FACTORS** of 20 are 1, 2, 4, 5, 10, and 20.
The **MULTIPLES** of 20 are 20, 40, 60, 80, 100, 120, etc.
If we break 20 down into **PRIME FACTORS**, 20 = 2 x 2 x 5, or 2^2 x 5



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1. What are the FACTORS of 12? _____
2. What are the MULTIPLES of 12? _____
3. Break 12 into its PRIME FACTORS by drawing a factor tree like the one above:

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4. What are the FACTORS of 100? _____
5. What are the MULTIPLES OF 100? _____
6. Break 100 into its PRIME FACTORS by drawing a factor tree:

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7. What are the FACTORS of 30? _____
8. What are the MULTIPLES of 30? _____
9. Break 30 into its PRIME FACTORS by drawing a factor tree:

Divisibility Rules Chart

A number is divisible by. . .		Divisible	Not Divisible
2	if the last digit is even (0, 2, 4, 6, or 8).	3,978	4,975
3	if the sum of the digits is divisible by 3.	315	139
4	if the last two digits form a number divisible by 4.	8,512	7,518
5	if the last digit is 0 or 5.	14,975	10,978
6	if the number is divisible by both 2 and 3	48	20
9	if the sum of the digits is divisible by 9.	711	93
10	if the last digit is 0.	15,990	10,536

Is the number 3,647,541 divisible by:

a. 2?

b. 3?

c. 4?

d. 5?

e. 6?

f. 9?

g. 10?

Simplify each expression. Each answer in the first column should match an answer in the second column.

$(8 - 5)^2$	$10 \div 10 \times 10$
$100 - 9(6 + 4)$	$(10 - 10)^5$
$100 \div 10 \bullet 2$	$5^2 - 6$
$10 - 5 \bullet 2$	$10 - 4 + 3$
$3^2 - 2^3$	$2 \times 5^2 - 1$
$5 + 2(10 - 3)$	$10^2 \div (10 \times 10)$
$(3 + 4)^2$	$20(10 - (4 + 5))$

1. Carefully evaluate each expression, noticing similarities and differences within pairs of problems:

   a. $2^3 + 10 \cdot 3 - 16 \div (4 - 2)$

   b. $2^3 + 10 \cdot 3 - 16 \div 4 - 2$

   c. $63 - 5[9 - 4(10 - 8)]$

   d. $63 - 5[(9 - 4)(10 - 8)]$

   e. $(5 + 3)^2$

   f. $5^2 + 3^2$

2. Insert parentheses (if necessary) to make the expression equal the given value:

   a. Make this equal 29:

   $36 - 24 \div 3 + 1$

   b. Make this equal 5:

   $36 - 24 \div 3 + 1$

   c. Make this equal 30:

   $36 - 24 \div 3 + 1$

Fill in the table so that each time is shown both ways. The first row is done for you.

Standard Time	Military Time
1:00 pm	1300
3:15 am	
	2310
5:27 pm	
	0900
7:30 am	
	1439
9:38 pm	
	1321
1:10 am	

Match each expression in the first column with an equivalent expression from the second column:

1. _____ 47 + 53	A. 49 • 2
2. _____ 800 – 799	B. 110 – 3
3. _____ 10 + 0	C. 348 – 98
4. _____ 6 • 8	D. 0 • 10
5 _____ 25 • 10	E. 1000 – 990
6. _____ 648 – 648	F. 4 • 12
7. _____ 99 + 8	G. 27 • 3
8. _____ 3 • 3 • 3 • 3	H. 3 + 3 + 3 + 3 + 3
9. _____ 5 • 3	I. 432 – 431
10. _____ 100 – 2	J. 4 • 25

1. A lab experiment requires the research technician to count the number of bacteria colonies in a culture every three hours for 12 hours. The first observation is done at 9:30 am. Record the time for each observation using 24-hour (military) time.

Observation Time (military time)	# of colonies of bacteria
1.	3
2.	120
3.	400
4.	1032
5.	

a. How many new colonies did the technician find at 12:30 pm?

b. How many new colonies did the technician find at 3:30 pm?

c. During which three-hour period shown did the most new bacteria appear?

d. If the technician observed 3890 new bacteria colonies on the final observation, what was the final number of colonies observed?

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2. A medical technician records vital signs every hour. A patient's pulse is 125 when she arrives, but as she rests, it goes down to 97, 89, 86, and then 80.

a. What is the patient's mean heart rate? _____

b. What is the patient's median heart rate? _____

c. Is there a mode for the patient's heart rate? Why or why not?

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3. Several computer applications require 233, 198, and 307 megabytes of memory. The computer has 700 megabytes of memory available. Can you download all three applications? Show your work!

4. At weigh stations, the weight of a truck's cargo is divided by the number of axles on the truck to find the number of pounds being carried per axle. Fill in the following table for the four trucks at a Missouri weigh station:

Truck	Cargo weight (lbs.)	# of Axles	Weight per axle (lbs.)
A	42,075	5	
B	30,500	5	
C	75,205		15,041
D		7	3,060

   a. What is the total cargo weight being carried by the four trucks? _____

   b. What is the mean cargo weight being carried by the four trucks? _____

   c. What is the median weight per axle? _____

   d. Round the cargo weight of truck A (42,075 lbs.) to the nearest:

      ten pounds:_____ hundred pounds: _____ thousand pounds: _____

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5. A computer can perform 600,000 operations in a second! How many operations can that computer perform in a minute? In an hour? Show how you figure this out!

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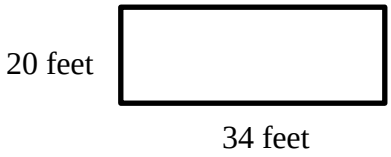
6. A lab receives a grant for $10,000 for a 4-month project.

   a. If the same amount of money is allocated for each month, how much money can be spent each month?

   b. The first month involves some extra, unanticipated startup costs, so the group spends $3500 the first month. How much will be left for each remaining month?

   c. The project ends up costing $3500 the first month and $2250 for each of the other three months. Did the project spend all of its grant? Did they overspend? Is there money left over? How much?

7. A crime scene measures 20 feet by 34 feet.



a. You need to cordon off the scene with crime scene tape around the edge to allow investigators to work. How many feet of tape will you need? (*Note: You are finding the PERIMETER of the rectangle. You can find it by adding up the lengths of ALL four of the sides*.)

b. Crime scene tape costs 39 cents per foot. How much will it cost to put tape around this scene?

c. You also need to have the canine unit sniff the scene for drugs. How many square feet does this crime scene have? (*Note: You are finding the AREA of a rectangle. You can find it by multiplying the length of the rectangle by its width. Area is always measured in square units.)*

d. A drug-sniffing dog needs about 17 seconds for each square foot of area. How long would it take a dog to sniff this crime scene?

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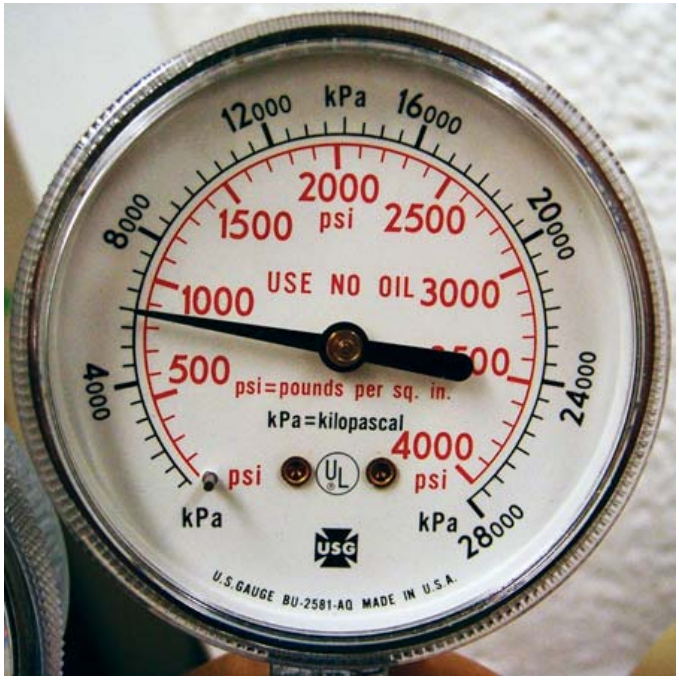
8. You need to decide which medical chart software will be a better deal for your office. Three companies are bidding for your business. Here are their quotes:

Company	Initial Purchase Price	Monthly Service Cost	Total for a one year contract
Healthtech	$ 5000	$ 250	
AccuHealth	$ 4350	$ 275	
ChartCare	$ 3900	$ 319	

Calculate the first-year cost of each company's product. Which company is the least expensive?

9. Graphics Practice



This gauge measures pressure two ways.

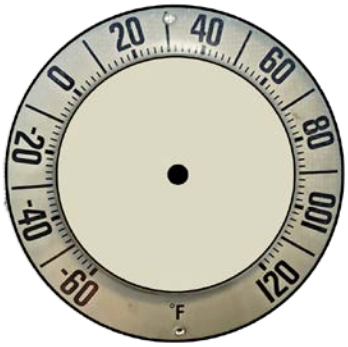
a. On the outer ring, what is the pressure in kilopascals?

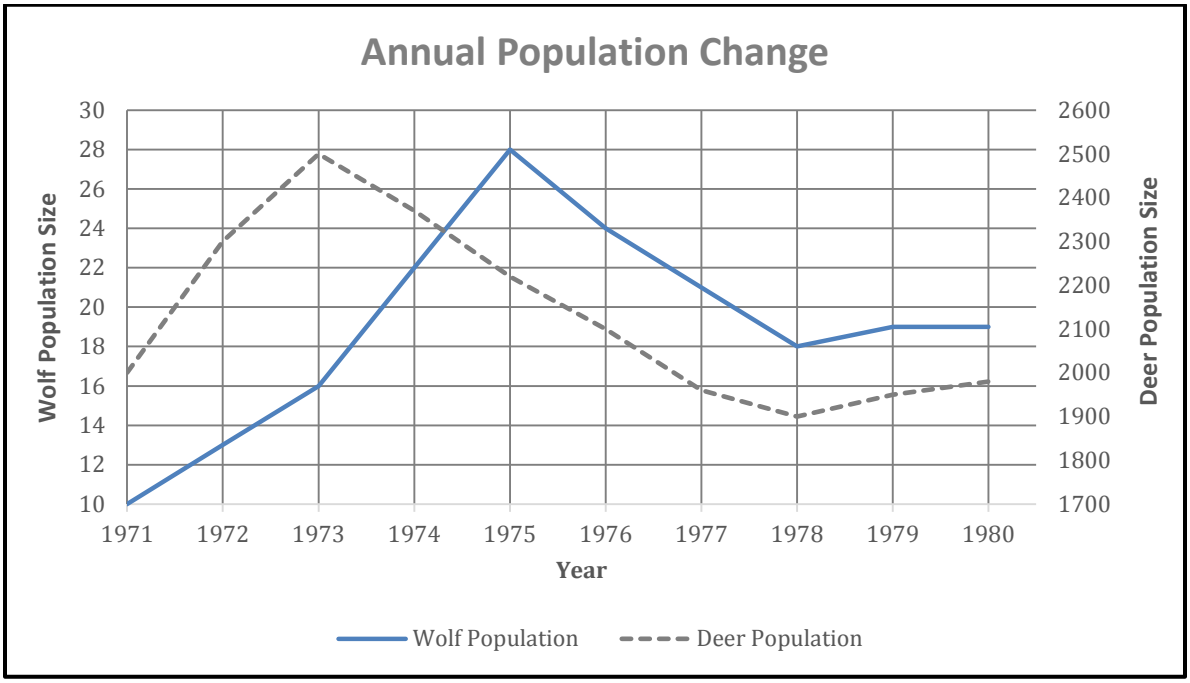
b. On the inner ring, what is the pressure in pounds per square inch?

c. How far has this car driven?
Write your answer in WORDS!

d. How fast is this car going? Your answer will be labeled “miles per hour”.

e. On this thermometer, draw the needle pointing to a temperature of 82 degrees.





Using the graph above, answer these questions about deer and wolf populations:

f. During what year was each population at its peak? What was the population of each type of animal at its peak?

g. What has happened to these animal populations in the 10-year period shown? Describe the basic shape of the graphs, and the trends you see.

h. Based on what you see in the graph, what would you expect the wolf and deer populations to look like in the year 2000?

RESOURCES

Image used in questions 9a. and 9b.
dial2 by leapingllamas, is licensed under CC-BY 2.0

Image used in question 9c.
151517 by Scott (Skippy) is licensed under CC BY-SA 2.0; Modifications: Image lightened, red square added

Image used in question 9d.
Free Speedometer Vector by 123freevectors.com is licensed under CC BY-SA 3.0

Image used in question 9e. is a derivative of:
Muy Caliente! by corydalus which is licensed under CC BY-NC-SA 2.0

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1.1 Place Value and Whole Numbers

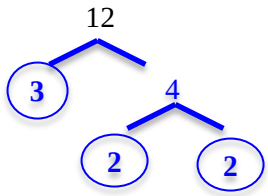
1a. **three million, two hundred fifty-seven, twelve**
1b. five hundred seven million, three hundred ninety-two thousand five
2a. 10,500,020,003
2b. 4,004,040

1.2 Multiplication Table

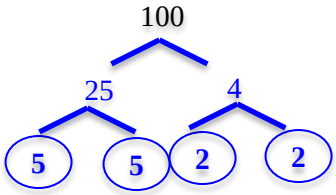
X	0	1	2	3	4	5	6	7	8	9	10	11	12
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9	10	11	12
2	0	2	4	6	8	10	12	14	16	18	20	22	24
3	0	3	6	9	12	15	18	21	24	27	30	33	36
4	0	4	8	12	16	20	24	28	32	36	40	44	48
5	0	5	10	15	20	25	30	35	40	45	50	55	60
6	0	6	12	18	24	30	36	42	48	54	60	66	72
7	0	7	14	21	28	35	42	49	56	63	70	77	84
8	0	8	16	24	32	40	48	56	64	72	80	88	96
9	0	9	18	27	36	45	54	63	72	81	90	99	108
10	0	10	20	30	40	50	60	70	80	90	100	110	120
11	0	11	22	33	44	55	66	77	88	99	110	121	132
12	0	12	24	36	48	60	72	84	96	108	120	132	144

1.3 Place Value and Whole Numbers

1. 1, 2, 3, 4, 6, and 12 (any order)
2. 12, 24, 36, 48, 60, etc.
3. Prime factors = **3 x 2 x 2** (or 3 x 2^2)

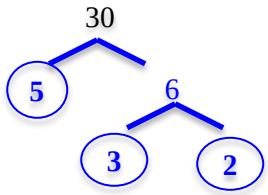


4. 1, 2, 4, 5, 10, 20, 25, 50, 100 (any order)
5. 100, 200, 300, 400, 500, 600, etc.
6. Prime factors = **2 x 2 x 5 x 5** (There are many different ways to break down the tree but all will result in the same prime factors.)



1.3 Place Value and Whole Numbers (cont.)

7. 1, 2, 3, 5, 6, 16, 30 (any order)
8. 30, 60, 90, 120, etc.
9. Prime factors = **2 x 3 x 5** (Many different ways to break down tree, but always the same prime factors)



1.4 Divisibility Rules

a. No, since 3,647,541 does not end in 0, 2, 4, 6, or 8
b. Yes, since 3 + 6 + 4 + 7 + 5 + 4 + 1 = 30, which is divisible by 3
c. No, since 41 is not divisible by 4
d. No, since 3,647,541 does not end in 0 or 5
e. No, since the number is not divisible by BOTH 2 and 3
f. No, since 3 + 6 + 4 + 7 + 5 + 4 + 1 = 30, which is not divisible by 9
g. No, since the number does not end in 0

1.5 Order of Operations Matching

$(8 - 5)^2 = \mathbf{9}$	$10 \div 10 \times 10 = 1 \times 10 = \mathbf{10}$
$100 - 9(6 + 4) = \mathbf{10}$	$(10 - 10)^5 = \mathbf{0}$
$100 \div 10 \bullet 2 = \mathbf{20}$	$5^2 - 6 = 25 - 6 = \mathbf{19}$
$10 - 5 \bullet 2 = \mathbf{0}$	$10 - 4 + 3 = 6 + 3 = \mathbf{9}$
$3^2 - 2^3 = 9 - 8 = \mathbf{1}$	$2 \times 5^2 - 1 = \mathbf{49}$
$5 + 2(10 - 3) = 5 + 14 = \mathbf{19}$	$10^2 \div (10 \times 10) = \mathbf{1}$
$(3 + 4)^2 = \mathbf{49}$	$20(10 - (4 + 5)) = \mathbf{20}$

1.6 Order of Operations Practice

1a. $2^3 + 10 \bullet 3 - 16 \div (4 - 2)$
$2^3 + 10 \bullet 3 - 16 \div 2$
$8 + 10 \bullet 3 - 16 \div 2$
$8 + 30 - 8$
$= \mathbf{30}$

1.6 Order of Operations Practice (cont.)

1b. $2^3 + 10 \bullet 3 - 16 \div 4 - 2$
8 + 10 • 3 – 16 ÷ 4 – 2
8 + **30** – **4** – 2
= **32**

1c. 63 – 5[9 – 4(10 – 8)]
63 – 5[9 – 4(2)]
63 – 5[9 – 8]
63 – 5(1)
= **58**

1d. 63 – 5[(9 – 4)(10 – 8)]
63 – 5[5 • 2]
63 – 5(10)
= **13**

1e. $(5 + 3)^2 = 8^2 =$ **64**

1f. $5^2 + 3^2 = 25 + 9 =$ **34**

2a. 36 – **(**24 ÷ 3**)** + 1 (or no parenthesis)

2b. **(**36 – 24**)** ÷ 3 + 1

2c. 36 – 24 ÷ **(**3 + 1**)**

1.7 Military Time

1:00 pm	1300
3:15 am	**0315**
11:10 pm	2310
5:27 pm	**1727**
9:00 am	0900
7:30 am	**0730**
2:39 pm	1439
9:38 pm	**2138**
1:21 pm	1321
1:10 am	**0110**

1.8 Unit 1 Quiz

1. **J**
2. **I**
3. **E**
4. **F**
5. **C**
6. **D**
7. **B**
8. **G**
9. **H**
10. **A**

1.9 Career Applications: STEM

1.

Observation Time	# of Colonies of Bacteria
1. **0930**	3
2. **1230**	120
3. **1530**	400
4. **1830**	1032
5. **2130**	**4922**

1a. 120 – 3 = **117**
1b. 400 -120 = **280**
1c. From **6:30 – 9:30 pm**
1d. 3890 + 1032 = **4922**

2a. (125 + 97 + 89 + 86 + 80) / 5 = 477/5 = **95r2**
2b. 80, 86, 89, 97, 125. **89** is the median
2c. No – each number appears only once

3. 233 + 198 + 307 = **738**, which is more than 700. So **no**, you cannot download all three applications with the memory available.

4.

Truck	Cargo weight	# of Axles	Weight per axle
A	42,075	5	**8415** (divide)
B	30,500	5	**6100** (divide)
C	75,205	**5** (divide)	15,041
D	**21,420** (mult.)	7	3,060

4a. **169,200 lbs**.
4b. **42,300 lbs**.
4c. **7257 ½ lbs. (or 7257.5)** – fractions and decimals to be studied in future units!
4d. ten pounds: **42,080** hundred pounds: **42,100** thousand pounds: **42,000**
4e. 80,000 – 42075 = **37,925 lbs**.

5. Every minute has 60 seconds: 600,000 x 60 = 36,000,000 calculations in a minute.
Every hour has 60 minutes: 36,000,000 x 60 = **2,160,000,000 calculations in an hour**

6a. 10,000 divided by 4 = **$2500 per month**
6b. 10,000 – 3,500 = 6,500 to spread over 3 months: 6500 / 3 = **$2166.67 per month**
6c. 3500 + 2250(3) = 3500 + 6750 = **10,250**, which is **$250 over budget.**

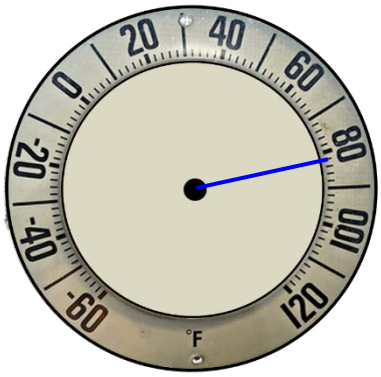
7a. 20 + 34 + 20 + 34 = **108 feet**
7b. 108 x 39 = **4212 cents**, or **$42.12**
7c. 20(34) = **680 square feet**
7d. 680 x 17 = 11,560 seconds or 192.7 minutes (over 3 hours)

1.9 Career Applications: STEM (cont.)

8. **AccuHealth** is the least expensive

Company	Initial Purchase Price	Monthly Service Cost	Total for a one year contract
Healthtech	$ 5000	$ 250	**5000 + 12(250) = $8000**
AccuHealth	$ 4350	$ 275	**4350 + 12(275) = $7650**
ChartCare	$ 3900	$ 319	**3900 + 12(319) = $7728**

9a. **6000**
9b. about **850**
9c. **one hundred fifty one thousand five hundred seventeen**
9d. about **64 miles per hour**
9e. Each tiny line is 2 degrees, so your needle should point one tiny line past 80 degrees



9f. **Deer = 1973** (2500 deer); **Wolves = 1975** (28 wolves)
9g. The shapes are similar, but the deer seem to be 2 years in advance. Both populations have fallen sharply, but may be starting to grow again.
9h. answers will vary

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