GEOMETRY - MEASUREMENT

Grade Level: Middle School, Science and Math
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Length of Unit: Six class periods

I. ABSTRACT

This unit could be taught as two separate projects. Lessons One-Three deal with choosing appropriate types of measurements for given situations and converting within and between systems of measurement. Lessons Four-Six address perimeter, area, and volume of 2- and 3-dimensional objects.

II. OVERVIEW

A. Concept Objectives
   1. Students use geometric concepts, properties, and relationships in problem solving situations and communicate the reasoning used in solving these problems *(Colorado Mathematics State Standard Grade 7, 4).*
   2. Students use a variety of tools and techniques to measure, apply the results in problem-solving situations, and communicate the reasoning involved in solving these problems *(Colorado Mathematics State Standard Grade 7, 5).*

B. Content from the *Core Knowledge Sequence*
   1. Choose appropriate units of measure and use ratios to convert within and between measurement systems to solve problems.
   2. Compare weights, capacities, geometric measures, times, and temperatures within and between measurement systems (for example, miles per hour and feet per second, cubic inches to cubic centimeters).
   3. Use measures expressed as rates (for example, speed, density) and measures expressed as products (for example, person-days) to solve problems; check the units of solutions; and use dimensional analysis to check the reasonableness of the answer.
   4. Compute the perimeter, area, and volume, of common geometric objects \and use the results to find measures of less common objects.
   5. Know how perimeter, area, and volume are affected by changes of scale.
   6. Estimate and compare the area of more complex or irregular two- and three-dimensional figures by breaking the figures down into more basic geometric objects.
   7. Relate the changes in measurement with a change of scale to the units used (for example, square inches, cubic feet) and to conversions between units (1 square foot = 144 square inches [$1ft^2 = 144\ cm^2$], 1 cubic inch is approximately 16.38 cubic centimeters [$1in^3 = 16.38\ cm^3$]).

C. Skill Objectives
   1. Students will understand how the metric system of measurement works.
   2. Students will be able to pick appropriate units (metric and English) for a given situation.
   3. Students will be able to use dimensional analysis/factor label method to solve problems.

4. Students will use dimensional analysis/factor label method to carry out multi-step conversion problems.
5. Students will be able to find the perimeter of polygons and circles.
6. Students will be able to find the area of polygons and circles.
7. Students will be able to appropriately label units of perimeter and area.
8. Students will be able to find the volume of a right solid.
9. Students will be able to appropriately label units related to volume.
10. Students will be familiar with how changes of scale affect an object's perimeter, area, and volume.

III. BACKGROUND KNOWLEDGE

A. For Teachers
   1. Abbgy, Theodore S. *How the Scientist Works*. Gold Apple, 1998. ISBN 0-76820106-3.
   2. Richards, Thomas J. *Math Grade 8*. McGraw-Hill Consumer Products, 1999. ISBN 1-57768-408-7.
   3. *100 Reproducible Activities Chemistry*. Instructional Fair Reproducibles, 1995. IBSN 1-56822-187-8.

B. For Students
   1. Students should have a basic understanding of the properties of geometric shapes like circles, triangle, and rectangles.

IV. RESOURCES

A. Abbgy, Theodore S. *How the Scientist Works*. Gold Apple, 1998. ISBN 0-76820106-3.

B. Richards, Thomas J. *Math Grade 8*. McGraw-Hill Consumer Products, 1999. ISBN 1-57768-408-7.

C. *100 Reproducible Activities Chemistry*. Instructional Fair Reproducibles, 1995. IBSN 1-56822-187-8.

V. LESSONS

Lesson One: Metric and English Systems of Measurement

A. *Daily Objectives*
   1. Concept Objective(s)
      a. Students use geometric concepts, properties, and relationships in problem solving situations and communicate the reasoning used in solving these problems.
      b. Students use a variety of tools and techniques to measure, apply the results in problem-solving situations, and communicate the reasoning involved in solving these problems.
   2. Lesson Content
      a. Teacher lead discussion on the metric system of measurement, what it is and how it works.
      b. Teacher lead discussion on the English system of measurement.
      c. Discussion on importance of using appropriate and correct units.

3. Skill Objective(s)
    a. Students will understand how the metric system of measurement works.
    b. Students will be able to pick appropriate units (metric and English) for a given situation.

B. *Materials*
1. Appendix A – to be used throughout the unit; it would be nice to have one for each student and a laminated class set to stay in the room
2. Appendix B – homework

C. *Key Vocabulary*
1. Distance: length, width, and height
2. Mass: the amount of stuff
3. Volume: how much space something takes up

D. *Procedures/Activities*
1. Make copies of Appendix A for every student. It may be beneficial to have a laminated class set of Appendix A for use in the classroom.
2. Make copies of Appendix B for each student, this will be their homework assignment.
3. There five quantities that we measure. Distance – this refers to length, width, and height. Mass deals with the amount of stuff. Volume, we want to find how much space something takes up. Temperature tells how hot or cold something is. Time let's us know how long something takes.
4. When choosing measurement units, it is important to know which system of measurement you are using. There are two main measurement systems that are used in today's world. One system, the English system, is the main system used in the United States. The other system, the metric system, is used by the scientific community throughout the world and has been adopted by many countries.
5. Pass out one copy of Appendix A to each student. Tell them that this sheet contains many formulas and information that will be used in upcoming class periods. They will want to hang on to this.
6. The metric system is easy to learn. It consists of a number of prefixes that are combined with three basic units depending on what is being measured. The basic unit that is used to measure distance is the meter, the basic unit of volume measure is the liter, and the basic unit of mass is the gram.
7. The prefixes that are added to these suffixes all relate to powers of ten. Appendix A, the metric conversion table, contains a table that explains the value of each prefix in relation to the standard units. The table shows how many basic units equal the base unit plus the suffix. For example, in 1 kilogram, there are 1,000 grams. A centigram is 1/100 of a gram (or 100 centigram = 1 gram).
8. One of the major appeals of the metric system is the base units and their prefixes. By just knowing a few things, we can describe a lot. Another advantage to the metric system is reliance on powers of ten. This makes it very easy to transfer between units.

9. The English system of measurement is a little messier that the metric system. The four main units of length used by the English system you are already familiar with. They are the mile, the yard, the foot, and the inch. This system is not as easy to convert between. One mile is equivalent to 6,280 feet and 3 feet equals 1 yard. We also know that 12 inches are equal to 1 foot. The English system is filled with crazy conversion units like this.
10. A little history for you: George Washington tried to get the United States to adopt the metric system when he was president, but he was voted down!
11. Pass out Appendix B, which contains30 questions relating to choosing appropriate units with in both the metric and English systems.

E. *Assessment/Evaluation*

1. Check Appendix B.

Appendix B answers

1	Meter	9	Hectoliter	17	10	25	Gallon
2	Volume	10	Centigram	18	Pound	26	Pounds
3	Gram	11	Meter	19	10	27	100
4	Pound	12	Mile	20	Decimeter	28	Kilometer
5	mg	13	1,000	21	3	29	Kilogram
6	Volume	14	1/100	22	Miles	30	Gallon
7	kL	15	Volume	23	5,280		
8	10	16	Kilometer (meter)	24	Foot		

Lesson Two: Unit Conversions

A. *Daily Objectives*

1. Concept Objective(s)
   a. Students use geometric concepts, properties, and relationships in problem solving situations and communicate the reasoning used in solving these problems.
   b. Students use a variety of tools and techniques to measure, apply the results in problem-solving situations, and communicate the reasoning involved in solving these problems.
2. Lesson Content
   a. Teacher instruction on using dimensional analysis/factor label method to solve problems.
3. Skill Objective(s)
   a. Students will be able to use dimensional analysis/factor label method to solve problems.

B. *Materials*

1. Appendix C – student homework
2. Appendix D – homework key

C. *Key Vocabulary*

1. Dimensional analysis: system used to convert from one kind of unit to another; this is also called the factor-label method
2. Conversion factor: fraction used to convert one unit to another

D. *Procedures/Activities*

1. Have enough copies of Appendix C for each student to have one. This will be their homework.

2. Today we are going to learn how to convert one unit of measure to another unit of measure. We are going to use a process called dimensional analysis or the factor label method to do this.
3. Dimensional analysis is the relationship of one unit to another. Dimensional analysis has four basic steps.
    a. Write a given number and unit.
    b. Write a conversion factor to multiply the given number by.
    c. Cancel units.
    d. Solve the problem.
4. It doesn't get much tougher than that! Well – a little tougher, we have to be sure to choose the correct conversion factor. We will follow these steps to find the right conversion factor.
    a. Place the give units on the bottom (in the denominator).
    b. Place the desired units on the top (in the numerator).
    c. Place a 1 in front of the larger unit.
    d. Determine the number of smaller unit needed to make a bigger unit.
5. An example: John ran 12 meters. How many centimeters did he run?
    a. Write then given number and the units.
    12 m
    b. Write a conversion factor.
    $12 \text{ m} \times \frac{100 \text{ cm}}{1 \text{ m}}$
    We want meter to be on the bottom of our conversion factor, because it is our given unit. Centimeters go on top, it is what we want to find. Meters are larger than centimeters, so place a 1 in front of meters. From Appendix A, we see that a centimeter is 1/100 of a meter. This means that it takes 100 centimeters to equal 1 meter.
    c. Cancel units.
    $12 \cancel{\text{m}} \times \frac{100 \text{ cm}}{1 \cancel{\text{m}}}$
    We no longer are dealing with meters, but centimeters.
    d. Solve the problem.
    $12 \cancel{\text{m}} \times \frac{100 \text{ cm}}{1 \cancel{\text{m}}} = 1{,}200 \text{ cm}$
    12 meters is equal to 1,200 centimeters
6. Pass out one copy of Appendix C to each student. Appendix C contains many problems for the students to complete using the factor-label method and dimensional analysis.

E. *Assessment/Evaluation*

1. Use Appendix D to grade student work. The students have been asked to state their answers in the form of a sentence, this is only an option.

Lesson Three: Multi-Step Unit Conversions

A. *Daily Objectives*

1. Concept Objective(s)
   a. Students use geometric concepts, properties, and relationships in problem solving situations and communicate the reasoning used in solving these problems.
   b. Students use a variety of tools and techniques to measure, apply the results in problem-solving situations, and communicate the reasoning involved in solving these problems.
2. Lesson Content
   a. Teacher guided examples of solving multi-step conversion problems.
3. Skill Objective(s)
   a. Students will use dimensional analysis/factor label method to carry out multi-step conversion problems.

B. *Materials*

1. Appendix E - *Multi-Step Conversion Problems*
2. Appendix F – *Multi-Step Conversion Problems* Answer Key

C. *Key Vocabulary*

None

D. *Procedures/Activities*

1. Have one copy of Appendix E for each student.
2. Collect yesterday's homework (Appendix C).
3. Ask if anyone in the class was able to answer the Bonus question. Take answers to see if anyone came up with the correct answer, 1.83 meters.
4. To find this answer it is necessary to use multiple conversion factors. That is what we are going to talk about today.
5. Go over how to complete the bonus problem.
   a. The Problem: Miss Edwins loves to play volleyball and wished she was 6 feet tall so she could spike the ball better. How many meters tall would she be if is she was 6 feet tall?
   b. Step 1: write the given number and units
      6 ft
   c. Step 2: write conversion factors
      In this problem we are staring with feet and want to end up with meters. We do not have a conversion factor that directly relates feet to meters. However, we can get there by using a number of conversion factors. We are also changing systems of measurement. We need to have one conversion factor that allows us go from the English system to the metric system. We have this – we know that 2.54 cm = 1 in. We also know how to convert feet to inches, and centimeters to meters. The problem now should look something like this:
      $$6 \text{ ft} \times \frac{12 \text{ in}}{1 \text{ ft}} \times \frac{2.54 \text{ cm}}{1 \text{ in}} \times \frac{1 \text{ m}}{100 \text{ cm}}$$
   d. Step 3: cancel units

$$6\ \cancel{ft} \times \frac{12\ \cancel{in}}{1\ \cancel{ft}} \times \frac{2.54\ \cancel{cm}}{1\ \cancel{in}} \times \frac{1\ m}{100\ \cancel{cm}}$$

e. Step 4: solve the problem

$$6\ \cancel{ft} \times \frac{12\ \cancel{in}}{1\ \cancel{ft}} \times \frac{2.54\ \cancel{cm}}{1\ \cancel{in}} \times \frac{1\ m}{100\ \cancel{cm}} = 1.83\ m$$

Miss Edwins wishes she was 1.83 meters tall.

6. Another type of conversion problem we can do with this is to convert square and cubed units to other units. This can be a little tricky. Let's do an example. We will still follow the same basic pattern.
   a. The problem: convert 1 ft^2 into in^2.
   b. Step 1: write the given number and units
      1 ft^2 = 1 ft ft
   c. Step 2: write conversion factors
      In this problem we are staring with feet squared and want to end up with square inches. Another way to write ft^2 is to say ft x ft. When written this way, it is easy to see that there are 2 units of feet that need to be canceled out. We know that there is 12 inches in one foot. We will use 2 conversion factors like this in order to change our 1 ft^2 to in^2.

      $$1\ ft\ ft \times \frac{12\ in}{1\ ft} \times \frac{12\ in}{1\ ft}$$

   d. Step 3: cancel units

      $$1\ \cancel{ft}\ \cancel{ft} \times \frac{12\ in}{\cancel{1\ ft}} \times \frac{12\ in}{\cancel{1\ ft}}$$

   e. Step 4: solve the problem

      $$1\ \cancel{ft}\ \cancel{ft} \times \frac{12\ in}{\cancel{1\ ft}} \times \frac{12\ in}{\cancel{1\ ft}} = 144\ in\ in = 144\ in^2$$

   f. 1 square foot is equal to 144 square inches.
7. It is possible to use only one conversion factor to complete the above problem. Let's see how.
   a. The problem: convert 1 ft^2 into in^2.
   b. Step 1: write the given number and units
      1 ft^2
   c. Step 2: write conversion factors
      Before we used the conversion factor 12in/1ft twice. We know that when we multiple a number (or a unit) by itself, it is the same as taking the number (or unit) to a power. The power is equal to the number of times the number (or unit) is multiplied by itself. Let's use powers to solve this problem.

      $$1\ ft^2 \times \frac{(12\ in)^2}{(1\ ft)^2} = 1\ ft^2 \times \frac{12^2\ in^2}{1^2\ ft^2}$$

      It is very important to notice that 12 and 1 *as well* as inches are squared when using this method. The biggest mistake students make when using only conversion factor to solve this type of problem is to forget to square the number. Conventionally, the

square is left off the 1 when dong his type of problem. Why? $1^2 = 1$, but students need to see that we treat all the numbers the same.

d. Step 3: cancel units

$$1\cancel{ft^2} \times \frac{12^2\ in^2}{1^{\cancel{2}}\ ft^{\cancel{2}}}$$

e. Step 4: solve the problem

$$1\cancel{ft^2} \times \frac{12^2\ in^2}{1^{\cancel{2}}\ ft^{\cancel{2}}} = 144\ in^2$$

f. 1 square foot is equal to 144 square inches.

8. We can use the same process to do conversions with cubed units. Be sure that the numbers are cubed when doing this type of a problem.
9. Pass out Appendix E - *Multi-Step Conversion Problems* containing homework problems for the students to complete that use multiple conversion factors.
10. If the students are struggling with the concept of using more than one conversion factor, it will be very beneficial to do more problems with them. Have the students try one on their own and then go over it as a class. If the students can master this concept, it will be of great use to them in future math and science classes, chemistry and physics especially.

E. *Assessment/Evaluation*

1. Collect homework tomorrow. Use Appendix F to correct the students' homework.

Lesson Four: Perimeter and Area

A. *Daily Objectives*

1. Concept Objective(s)
   a. Students use geometric concepts, properties, and relationships in problem solving situations and communicate the reasoning used in solving these problems.
   b. Students use a variety of tools and techniques to measure, apply the results in problem-solving situations, and communicate the reasoning involved in solving these problems.
2. Lesson Content
   a. Teacher guided discussion of how to find the perimeter of an object.
   b. Teacher guided discussion of how to find the area of an object.
   c. Discussion on how to appropriately label units of perimeter and area.
3. Skill Objective(s)
   a. Students will be able to find the perimeter of polygons and circles.
   b. Students will be able to find the area of polygons and circles.
   c. Students will be able to appropriately label units of perimeter and area.

B. *Materials*

1. Appendix H – *Perimeter and Area Problems*
2. Appendix I – *Perimeter and Area Problems* Answer Key

3. Calculators (optional)

C. *Key Vocabulary*
   1. Polygon: a closed figure whose sides are line segments
   2. Perimeter: the distance around a polygon
   3. Area: the number of square units inside a polygon
   4. Height: of a triangle refers to a line segment that starts at any vertex of the triangle and is perpendicular to the opposite side or base
   5. Base: the opposite side of a triangle vertex where the height is drawn from

D. *Procedures/Activities*
   1. Have one copy of Appendix H - *Perimeter and Area Problems* for each student.
   2. Collect yesterday's homework.
   3. Go over the bonus problem as a class. This problem is a little more complicated than the other problems so far because we are changing units on both the top and the bottom. However, it can still be done in the same manner. I have changed hours into seconds with the first conversion factor and used the last 4 conversion factors to change miles to meters.
      $$75 \frac{\text{mi}}{\text{hr}} \times \frac{1\text{ hr}}{60\text{ sec}} \times \frac{5{,}280\text{ ft}}{1\text{ mi}} \times \frac{12\text{ in}}{1\text{ ft}} \times \frac{2.54\text{ cm}}{1\text{ in}} \times \frac{1\text{ m}}{100\text{ cm}} = 33.528 \frac{\text{m}}{\text{sec}}$$
   4. Changing gears, the perimeter of an object is relatively easy to find. All you need to do is add up the length of each side. The value of an object's perimeter should be given with a unit label. This is very important, for example, let's say you know that the perimeter of the park is 12. Well 12 can mean a great deal, is it 12 miles, 12 feet, 12 meter, so on and so forth. If problems dealing with perimeter are not labeled correctly they will be marked wrong. To find the area of a circle is a little tough but manageable. The perimeter of a circle is called its circumference. It is found by using the following formula $C = \Pi d$, where d is the diameter of the circle, and $\Pi = 3.14$.
   5. To find the area of an object is a little more complicated than finding the perimeter. How we find the area depends what the object is.
   6. To find the area of a rectangle, multiple the length times the width ($A = lw$).
   7. To find the area of a triangle, multiple ½ times the height times the base. The height of a triangle equal to the length of a line segment that starts at any vertex of the triangle and is perpendicular to the opposite side. This "opposite side" is called the base of the triangle. ($A = ½ bh$)
   8. To find the area of a circle multiply pi times the radius of the circle squared ($A = \Pi r^2$).
   9. We also will be finding the area of some irregular objects. When doing this, break the object into pieces that we can find the area of (rectangles, semicircle, etc.). The total area will equal the sum of the areas of each piece.
   10. Units that represent area are **always squared**.
   11. Appendix A contains a chart with formulas to find the area of different objects.

12. A page of perimeter and area problems is included in Appendix H.

E. *Assessment/Evaluation*

1. Appendix I contains an answer key for Appendix H. When looking at the answer key, some of the numbers on the diagrams have been changed to show what is necessary to get the required answer. When this has been done, those numbers are shown in ***bold italics***.

Lesson Five: Volume

A. *Daily Objectives*

1. Concept Objective(s)
   a. Students use geometric concepts, properties, and relationships in problem solving situations and communicate the reasoning used in solving these problems.
   b. Students use a variety of tools and techniques to measure, apply the results in problem-solving situations, and communicate the reasoning involved in solving these problems.
2. Lesson Content
   a. Teacher guided discussion of how to find the volume of a right solid.
   b. Discussion of appropriate units for volume.
3. Skill Objective(s)
   a. Students will be able to find the volume of a right solid.
   b. Students will be able to appropriately label units related to volume.

B. *Materials*

1. Appendix K – *Volume Problems*
2. Appendix L – *Volume Problems* Answer Key

C. *Key Vocabulary*

1. Right solid: a solid whose sides are perpendicular to its top

D. *Procedures/Activities*

1. Have enough copies of Appendix K - *Volume Problems* for each student in the class.
2. Go over any questions students have from yesterday's homework. Collect homework (Appendix H).
3. Today we are going to discuss and learn how to find the volume of common and uncommon right solids.
4. The simplest kind of objects to find the volume of are right solids. A right solid is a solid whose sides are perpendicular to its top. The easiest type of right solid to find the volume of is a rectangular solid. A rectangular solid is shaped like a box. The volume of this figure is simply its length time width time height ($V = lwh$).
5. There are two other solids we will find the volume of. One is a rectangular solid. This kind of a solid is any solid whose sides are perpendicular to its top. To find the volume of this figure, simply multiply the area of the base times the height ($V = A_b h$).
6. The other kind of solid we will be finding the volume of is a sphere. To find this, take 4/3 times pi time the radius cubed.

7. Units connected with volume are **always cubed**.

E. *Assessment/Evaluation*

1. Appendix L contains an answer key for Appendix K. When looking at the answer key, some of the numbers on the diagrams have been changed to show what is necessary to get the required answer. When this has been done, those numbers are shown in ***bold italics***.

Lesson Six: Changes of Scale

A. *Daily Objectives*

1. Concept Objective(s)
   a. Students use geometric concepts, properties, and relationships in problem solving situations and communicate the reasoning used in solving these problems.
   b. Students use a variety of tools and techniques to measure, apply the results in problem-solving situations, and communicate the reasoning involved in solving these problems.
2. Lesson Content
   a. Discussion of how changes of scale effect an object's perimeter, area, and volume.
3. Skill Objective(s)
   a. Students will be familiar with how changes of scale affect an object's perimeter, area, and volume.

B. *Materials*

None

C. *Key Vocabulary*

None

D. *Procedures/Activities*

1. Answer any questions students may have from yesterday's homework.
2. After all questions have been answered, collect homework.
3. Today we are going to talk about how changes of scale affect the perimeter, area, and volume of an object. This is a relatively simple concept and students will only be exposed to it in today's lesson.
4. Let's look at a rectangle with a length of 12 meters and a width of 6 meters. Find the perimeter of the rectangle.
   $P = 12m + 6m + 12m + 6m$
   $P = 36m$
5. Find the area of the rectangle.
   $A = lw$
   $A = (12m)(6m)$
   $A = 72m^2$
6. If the rectangle has a height of 2 m, what would its volume be?
   $V = lwh$
   $V = (12m)(6m)(2m)$
   $V = 144m^3$

7. Now let's look at what happens when we double the size of the figure. When the size of the figure is doubled, each dimension is increased by a factor of 2.
   l = 2(12m) w = 2(6m) h = 2(2m)
   l = 24m w = 12m h = 4m
8. Find the new perimeter (P_2), area (A_2), and volume (V_2) of the figure with increase size.
   P_2 = 24m + 12m +24m + 12m A_2 = (24m)(12m) V_2 = (24m)(12m) (4m)
   P_2 = 72m $A_2 = 288m^2$ $V_2 = 1152m^3$
9. Compare the new values to the old ones.
   P = 36m A = $72m^2$ V = $144m^3$
   P_2 = 72 m A_2= $288m^2$ V_2 = $1152m^3$
   P_2 = P x 2 A_2 = A x 4 V_2 = V x 8
   $P_2 = P \times 2^1$ $A_2 = A \times 2^2$ $V_2 = V \times 2^3$
10. Help the students see the connection between the increase in scale factor and the result it has on the perimeter, area, and volume of the figure.

E. *Assessment/Evaluation*
None

VI. HANDOUTS/WORKSHEETS

A. Appendix A: Formulas and Information for Unit
B. Appendix B: Student Homework Sheet
C. Appendix C: Student Homework Sheet
D. Appendix D: Student Homework Sheet Answer Key
E. Appendix E: Multi-Step Conversion Problems
F. Appendix F: Multi-Step Conversion Problems Answer Key (two pages)
G. Appendix H: Perimeter and Area Problems
H. Appendix I: Perimeter and Area Problems Answer Key (two pages)
I. Appendix K: Volume Problems
J. Appendix L: Volume Problems Answer Key

VII. BIBLIOGRAPHY

A. Abbgy, Theodore S. *How the Scientist Works*. Gold Apple, 1998. ISBN 0-76820106-3.
B. Richards, Thomas J. *Math Grade 8*. McGraw-Hill Consumer Products, 1999. ISBN 1-57768-408-7.
C. *100 Reproducible Activities Chemistry*. Instructional Fair Reproducibles, 1995. IBSN 1-56822-187-8.

Appendix A-Geometry-Measurement

Metric unit table

Measure	Unit	Symbol	Definition
Distance	Meter	m	length, width, and height
Volume	Liter	L	how much space
Mass	Gram	g	amount of stuff

Metric conversion table

	Kilo	hecto	deca	Deci	centi	Milli
Abbreviation	K	h	da	D	c	M
How many base units = given unit	1,000	100	10	.1	.01	.001

Some English Units (there are many that are not listed here)

Measure	Unit	Symbol	Unit	Symbol	Unit	Symbol
Distance	Foot	ft	mile	mi	Yard	yd
Volume	gallon	gal	ounces	oz	Quart	qt
Mass	Ton	T	pound	lb	Ounce	oz

Some English Conversions and English to Metric Conversions

Distance	Volume	Mass
12 in = 1 ft	16 oz = 1 pt	16 oz = 1 lb
1 ft = 3 yd	2 pt = 1 qt	2000 lb = 1 ton
1 mi = 5,280 ft	4 qt = 1 gal	
		2.2 lb = 1 kg

2.54 cm = 1 in

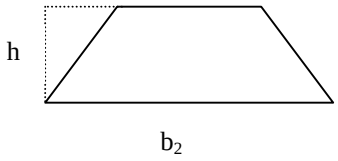
in = inch

Circumference (C) of a circle = $2\Pi r$

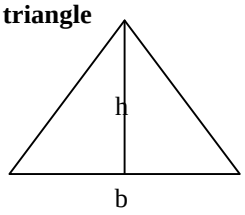
$\Pi = 3.14$

	Area
Triangle	½ bh
Rectangle	lw
Circle	Πr^2
Trapezoid	½ $(b_2 - b_1)h$

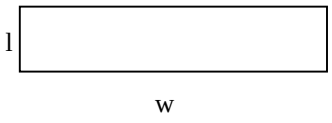
trapezoid



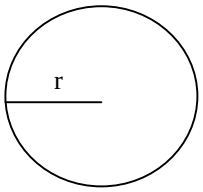
triangle



rectangle



circle



	Volume
Rectangular solid	lwh
Sphere	$4/3\Pi r^2$
Right Solid	Area base x height

Appendix B-Geometry-Measurement

Name: _____

1. What metric unit would you use to measure the length of this room? _____

2. What would you be finding if you found what your coffee cup will hold? _____

3. Metric unit to find the mass of your dog? _____

4. What English unit would you use to find the mass of your lunch? _____

5. How do you abbreviate milligrams? _____

6. What is measured by liters? _____

7. Abbreviation for a kiloliter? _____

8. How many meters in 1 decameter? _____

9. What is represented by hL? _____

10. What does cg represent? _____

11. What metric unit should used to measure your height? _____

12. What English unit could you measure the distance you ran? _____

13. How many grams in a kilogram? _____

14. What part of a meter is a centimeter? _____

15. What are you measuring when you find how much air is in a soccer ball? _____

16. Metric unit to find the distance from Denver to Minneapolis? _____

17. How many deciliters make a liter? _____

18. What English unit would you use to find the mass of your pencil? _____

19. How many grams in a decagram? _____

20. What is represented by dm? _____

21. How many feet in a yard? _____

22. English unit to find the distance from Denver to Des Moines? _____

23. How many feet make a mile? _____

24. What English unit is used to find the length of your pencil? _____

25. What is an English unit of volume? _____

26. What English unit would measure your weight? _____

27. How many centimeters in a meter? _____

28. Metric unit used to find the distance from Denver to Minneapolis? _____

29. What metric unit would you use to find your mass? _____

30. With what unit would you measure Kool-aid in the English system? _____

Appendix C-Geometry-Measurement

Complete the following problems using a separate sheet of paper. All work must be shown in order to receive full credit. Please state your answer in sentence form.

1. Joe thought it would be neat to be 96 inches tall. How many feet would that equal?

2. How many centimeters tall does Joe hope to be?

3. Sara is 2 yards tall, how many feet tall is she?

4. Miss Edwins live 40 miles from school. How many feet does she drive to get to school each day?

5. Stacy weighs 40 kilograms. How many grams does Stacy weigh?

6. How many pounds does Jim's dog weigh if his dog weighs 15 kilograms?

7. You told all your friends that you could down 2 liters of Mountain Dew. How many kiloliters is that?

8. Your mom finds out that you have been learning how to convert units in Math class. She asks you for help figure out how many cups of water she drinks each day. She tells you that she drinks 36 ounces of water a day. How many cups is that?

9. Your friend Bob is bragging that he can bench 50 decagrams. You are skeptical that Bob actually has something to brag about. If hard for you to imagine what a decagram is, but you know that a paper clip is weighs about a gram. How many grams and paper clips is Bob able to bench press?

10. An NFL football field is 120 yards long from end zone to end zone. How many feet is that?

Bonus

Miss Edwins loves to play volleyball and wished she was 6 feet tall so she could spike the ball better. How many meters tall would she be if she were 6 feet tall?

Appendix D-Geometry-Measurement

Conversion Problems Key

1. $96 \text{ in} \times \frac{1 \text{ ft}}{12 \text{ in}} = 8 \text{ ft}$ — Joe wishes he was 8 feet tall.

2. $96 \text{ in} \times \frac{2.54 \text{ cm}}{1 \text{ in}} = 243.84 \text{ cm}$ — If Joe was 96 inches tall, he would be 243.84 centimeters tall.

3. $2 \text{ yd} \times \frac{3 \text{ ft}}{1 \text{ yd}} = 6 \text{ ft}$ — Sara is 6 feet tall.

4. $40 \text{ mi} \times \frac{5{,}280 \text{ ft}}{1 \text{ mi}} = 211{,}200 \text{ ft}$ — Miss Edwins lives 211,200 feet from school.

5. $40 \text{ kg} \times \frac{1{,}000 \text{ g}}{1 \text{ kg}} = 40{,}000 \text{ g}$ — Stacy weighs 40,000 grams.

6. $15 \text{ kg} \times \frac{2.2 \text{ lb}}{1 \text{ kg}} = 33 \text{ lb}$ — Jack's dog weigh 33 pounds.

7. $2 \text{ L} \times \frac{1 \text{ kL}}{1{,}000 \text{L}} = 0.002 \text{ kL}$ — You can only down 0.002 kiloliters.

8. $36 \text{ oz} \times \frac{1 \text{ c}}{8 \text{ oz}} = 6 \text{ c}$ — Your mom drinks 6 cups of water every day.

9. $50 \text{ dg} \times \frac{10 \text{ g}}{1 \text{ dg}} = 500 \text{ g}$ — Bob can only bench 500 grams, the weight of merely 500 paper clips.

10. $120 \text{ yd} \times \frac{3 \text{ ft}}{1 \text{ yd}} = 360 \text{ ft}$ — A NFL football field is 360 feet long.

Bonus $6 \text{ ft} \times \frac{12 \text{ in}}{1 \text{ ft}} \times \frac{2.54 \text{ cm}}{1 \text{ in}} \times \frac{1 \text{ m}}{100 \text{ cm}} = 1.83 \text{ m}$ — If Miss Edwins was 6 feet tall she would be 1.83 meters tall.

Multi-Step Conversion Problems

Solve the following problems. Show all your work on a separate sheet of paper and express your answers in sentence form.

1. How many millimeters are in a kilometer?

2. One mile equals how many inches?

3. How many kilometers are in 1 mile?

4. Your room at home is 64 ft^2. How many in^2 is that?

5. How many centimeters cubed are in one meter cubed?

6. A football field is 120 yards long. How many centimeters is that?

7. You uncle buys a new one-ton pick up truck. How many kilograms is the truck equal to?

8. How many ounces are in a gallon?

9. Miss Edwins drives 40 miles to school. How many kilometers is that?

10. Josh is 125 cm tall. He must be less than four feet tall to enter the playground at the Rockies game. Can he get in? Justify your answer.

BONUS:
The speed limit on I-25 is 75 miles per hour. How fast is this in meters per second?

Multi-Step Conversion Problems Answer Key

1. 1 km = ? mm

$1\text{km} \times \frac{1{,}000\text{ m}}{1\text{ km}} \times \frac{100\text{cm}}{1\text{ m}} \times \frac{10\text{ mm}}{1\text{ cm}} = 1{,}000{,}000\text{ mm}$

One kilometer is equal to one million millimeters.

2. 1 mi = ? in

$1\text{ mi} \times \frac{5{,}280\text{ ft}}{1\text{ mi}} \times \frac{12\text{ in}}{1\text{ ft}} = 63{,}360\text{ in}$

One mile is equal to 63, 360 inches.

3. ? km = 1 mi

$1\text{ mi} \times \frac{5{,}280\text{ ft}}{1\text{ mi}} \times \frac{12\text{ in}}{1\text{ ft}} \times \frac{2.54\text{ cm}}{1\text{ in}} \times \frac{1\text{ m}}{100\text{ cm}} \times \frac{1\text{ km}}{1{,}000\text{ m}} = 1.609\text{ km}$

There is only 0.6338 kilometer in 1 mile.

4. $64\text{ ft}^2 = ?\text{ in}^2$

$64\text{ ft}^2 \times \frac{(12\text{ in})^2}{(1\text{ ft})^2} = 64\text{ ft}^2 \times \frac{12^2\text{ in}^2}{1\text{ ft}^2} = 9{,}216\text{ in}^2$

My room at home is 9,216 inches squared.

5. $?\text{ cm}^3 = 1\text{ m}^3$

$1\text{ m}^3 \times \frac{(100\text{ cm})^3}{(1\text{ m})^3} = 1\text{ m}^3 \times \frac{100^3\text{ cm}^3}{1\text{ m}^3} = 10{,}000\text{ cm}^3$

There are ten thousand cubic centimeters in one meter cubed.

6. 120 yd = ? cm

$120\text{ yd} \times \frac{3\text{ ft}}{1\text{ yd}} \times \frac{12\text{ in}}{1\text{ft}} \times \frac{2.54\text{ cm}}{1\text{ in}} = 10{,}972.8\text{ cm}$

A football field is 10,975.8 centimeters long.

7. 1 ton = ? kg

$1\text{ ton} \times \frac{2{,}000\text{ lb}}{1\text{ ton}} \times \frac{1\text{ kg}}{2.2\text{ lb}} = 907.2\text{ kg}$

My uncle new one tone pick up truck weighs about 907.2 pounds.

8. 1 gal = ? oz

$1\text{ gal} \times \frac{4\text{ qt}}{1\text{ gal}} \times \frac{2\text{ pt}}{1\text{ qt}} \times \frac{16\text{ oz}}{1\text{ pt}} = 128\text{ oz}$

There are 128 ounces in one gallon.

9. Miss Edwins drives 40 miles to school. How many kilometers is that?

$$40 \text{ mi} \times \frac{5{,}280 \text{ ft}}{1 \text{ mi}} \times \frac{12 \text{ in}}{1 \text{ ft}} \times \frac{2.54 \text{ cm}}{1 \text{ in}} \times \frac{1 \text{ m}}{100 \text{ cm}} \times \frac{1 \text{ km}}{1{,}000 \text{ m}} = 64.37 \text{ km}$$

Miss Edwins drive 64.37 kilometers to school.

10. Josh is 125 cm tall. He must be less than four feet tall to enter the playground at the Rockies game. Can he get in? Justify your answer.

There are 2 ways to do this problem.

(1) Convert 125 cm to feet and compare with 4 feet.

$$125 \text{ cm} \times \frac{1 \text{ in}}{2.54 \text{ cm}} \times \frac{1 \text{ ft}}{12 \text{ in}} = 4.01 \text{ ft}$$

$4.01 \text{ ft} > 4 \text{ ft}$

(2) Convert 4 feet to cm and compare with 125 cm.

$$4 \text{ ft} \times \frac{12 \text{ in}}{1 \text{ ft}} \times \frac{2.54 \text{ cm}}{1 \text{ in}} = 121.92 \text{ cm}$$

$121.92 \text{ cm} < 125 \text{ cm}$

Josh is taller than 4 feet. Four feet is equal to 121.9 centimeters, Josh is 125 cm. 125 centimeters is the same as 4.01 feet.

BONUS

75 mi/hr = ? m/s

$$75 \frac{\text{mi}}{\text{hr}} \times \frac{1 \text{ hr}}{60 \text{ sec}} \times \frac{5{,}280 \text{ ft}}{1 \text{ mi}} \times \frac{12 \text{ in}}{1 \text{ ft}} \times \frac{2.54 \text{ cm}}{1 \text{ in}} \times \frac{1 \text{ m}}{100 \text{ cm}} = 33.528 \frac{\text{m}}{\text{sec}}$$

You can legally travel 33.528 m/sec on I-25.

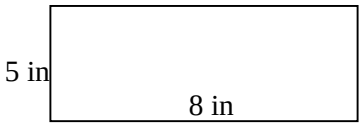
Appendix H-Geometry-Measurement
Perimeter and Area Problems

Name: _____

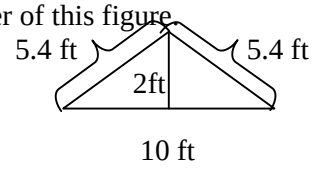
Use Π = 3.14

Show all your work on a separate sheet of paper.

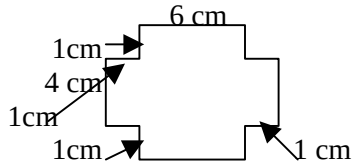
1. Find the perimeter of this figure.



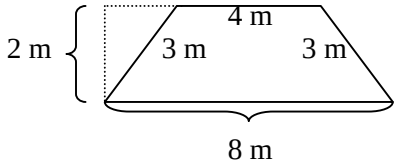
2. Find the perimeter of this figure.



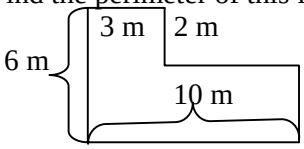
3. Find the perimeter of this figure.



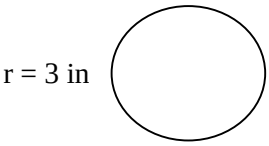
4. Find the perimeter of this figure.



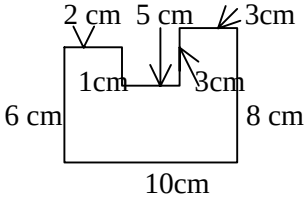
5. Find the perimeter of this figure.



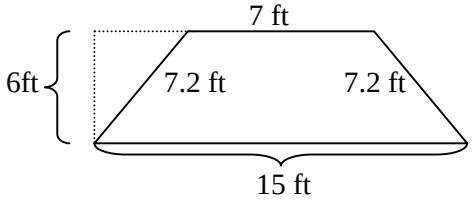
6. Find the circumference of this figure.



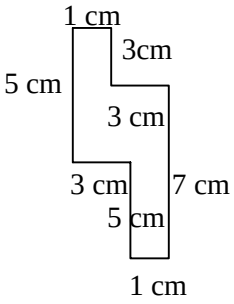
7. Find the perimeter of this figure.



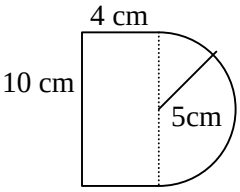
8. Find the perimeter of this figure.



9. Find the perimeter of this figure.



10. Find the perimeter of this figure.



11. Find the area of the figure in problem 1.

12. Find the area of the figure in problem 2.

13. Find the area of the figure in problem 3.

14. Find the area of the figure in problem 4.

15. Find the area of the figure in problem 5.

16. Find the area of the figure in problem 6.

17. Find the area of the figure in problem 7.

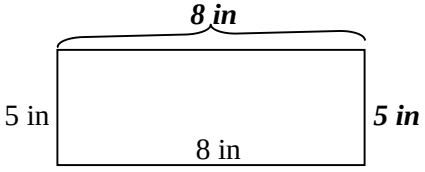
18. Find the area of the figure in problem 8.

19. Find the area of the figure in problem 9.

20. Find the area of the figure in problem 10.

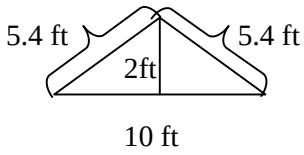
Appendix I, page 1-Geometry-Measurement
Perimeter and Area Problem Answer Key

1. P = ?



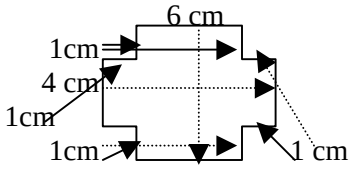
P = 5 in + 8 in + 5 in + 8 in
P = 26 in

2. P = ?



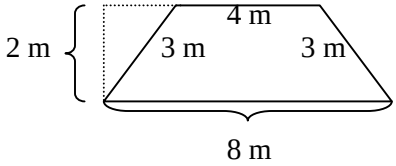
P = 5.4 ft + 5.4 ft + 10 ft
P = 20.8 ft

3. P = ?



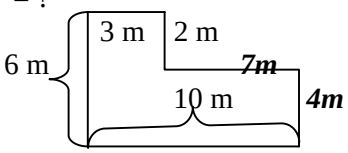
P = 4cm +1cm +1cm +6cm +1cm +1cm +
4cm +1cm +1cm +6cm +1cm +1cm
P = 28 cm

4. P = ?



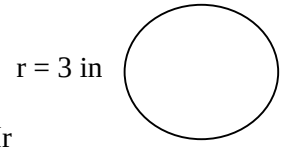
P = 3m + 4m + 3m + 8m
P = 18m

5. P = ?



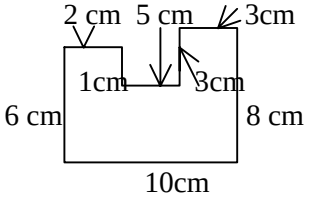
P = 6m + 3m + 2m + 7m + 4m + 1m
P = 32 m

6. C = ?



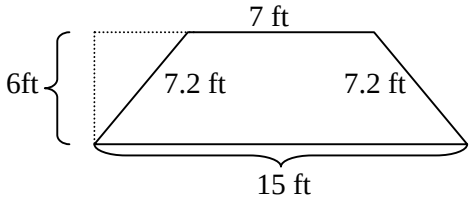
C = 2Πr
= 2(3.14)(3in)
C = 18.84 in

7. P = ?



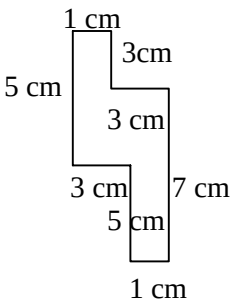
P =
6cm+2cm+1cm+5cm+3cm+3cm+8cm+10cm
P = 38cm

8. P = ?



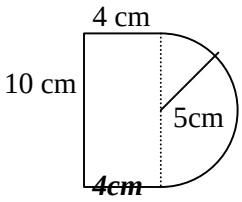
P = 7.2ft + 7ft + 7.2ft + 15ft
P = 36.4ft

9. P = ?



P=(5 + 1 + 3 + 3 + 7 + 1 + 5 + 3)cm
P = 28cm

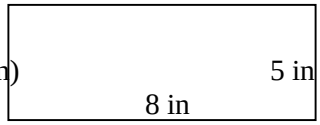
10. P = ?



P = 4cm + 10cm + 4cm + ½(2Π5cm)
= 18cm +1(3.14)(5)cm
= 18cm + 15.7cm
P = 33.7cm

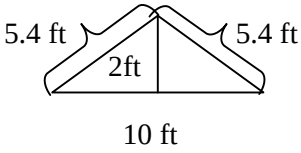
Appendix I, page 2-Geometry-Measurement
Perimeter and Area Problems Answer Key, cont.

11. A = ?



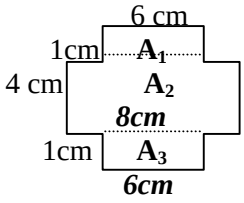
A = lw
A = (5in)(8in)
A = 40in^2

12. A = ?



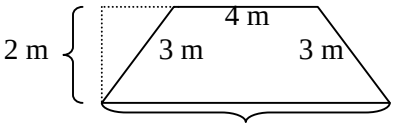
A = ½ bh
A = ½ (10ft)(2ft)
A = 10ft^2

13. A = ?



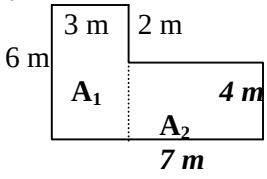
A = $A_1 + A_2 + A_3$
A = [(1cm)(6cm)] + [(4cm)(8cm)] + [(1cm)(6cm)]
A = 6cm^2 + 32cm^2 + 6cm^2
A = 44cm^2

14. A = ?



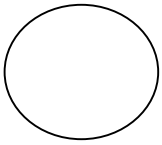
A = ½ ($b_2 - b_1$)h
A = ½ (8m – 4m)2m
A = 4m^2

15. A = ?



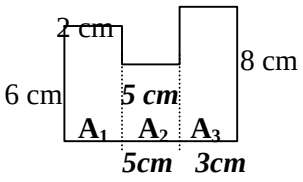
A = $A_1 + A_2$
A = [(3m)(6m)] + [(7m)(4m)]
A = 18m^2 + 28m^2
A = 46m^2

16. A = ?



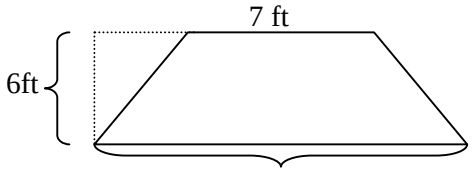
A = Πr^2
A = 3.14(3in)^2
A = 3.14(9)in^2
A = 28.26in^2

17. A = ?



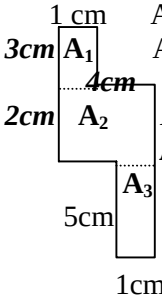
A = $A_1 + A_2 + A_3$
A = (6cm)(2cm)+ (5cm)(5cm)+ (3cm)(8cm)
A=12cm^2 + 25cm^2+24cm^2
A = 61cm^2

18. A = ?



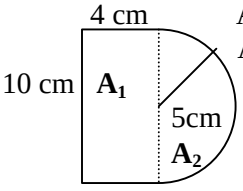
A = ½ ($b_2 - b_1$)h
A = ½ (15ft – 7ft)6ft
A = ½ (8ft)(6ft)
A= 24ft^2

19. A = ?



A = $A_1 + A_2 + A_3$
A = (1cm)(3cm) + (4cm)(2cm)+(5cm)(1cm)
A = 3cm^2 + 8cm^2 + 5cm^2
A= 16cm^2

20. A = ?



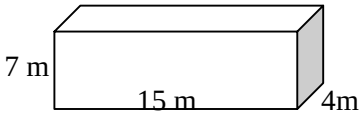
A = $A_1 + A_2$
A = lw + ½ Πr^2
A = (4cm)(10cm)+ ½ Π(5cm)^2
A = 40cm^2 + ½ Π25cm^2
A = 40cm^2 + 39.25cm^2
A = 79.25cm^2

Appendix K-Geometry-Measurement
Volume Problems

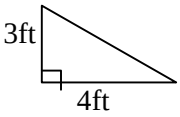
Name: _____

Find the volume of the following objects. Use Π = 3.14
Please show all you work on a separate sheet of paper.

1. Find the volume.

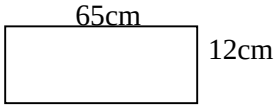


2. Find the volume. Height = 6ft

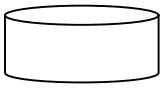


3. Find the volume of a sphere with a radius of 6in.

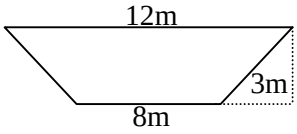
4. Find the volume. Height = 5cm



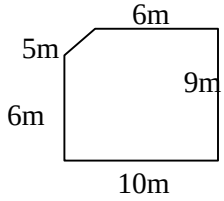
5. Find the volume. Height = 4in, radius = 7in



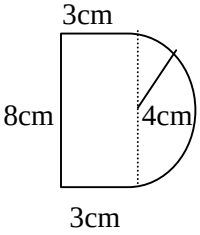
6. Find the volume. Height = 6m



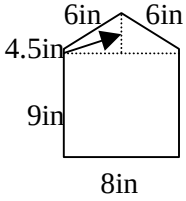
7. Find the volume. Height = 5m



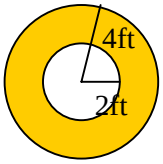
8. Find the volume. Height = 12cm



9. Find the volume. Height = 10in

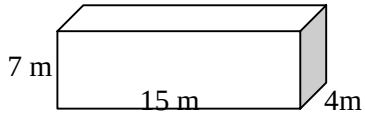


10. Find the volume of the shaded portion. Height = 8ft



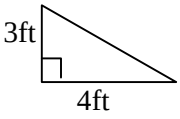
Appendix L-Geometry-Measurement
Volume Problems Answer Key

1. Find the volume.



V = lwh
V=(7m)(15m)(4m)
V= 420m^3

2. Find the volume. Height = 6ft

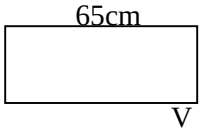


V = A_bh
V = (½ bh)h
V = ½ (4ft)(3ft)(6ft)
V = 36ft^3

3. Find the volume of a sphere with a radius of 6in.

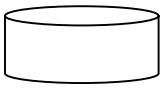
V = 4/3Πr^3
V = 4/3(3.14)(6in)^3
V = (4.187)(216)in^3
V = 904.32in^3

4. Find the volume. Height = 5cm



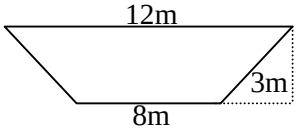
V = lwh
V = (65cm)(12cm)(5cm)
V = 3900cm^3

5. Find the volume. Height = 4in, radius = 7in



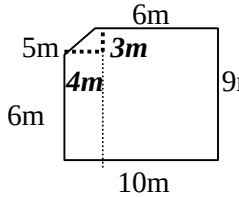
V = A_bh
V = Πr^{2}h
V = (3.14)(7in)^{2}4in
V = 615.44 in^3

6. Find the volume. Height = 6m



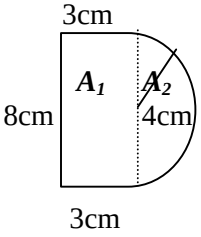
V = A_bh
V = [½ (b_2-b_1)]h
V =[½ (12m-8m)]6m
V = 18m^3

7. Find the volume. Height = 5m



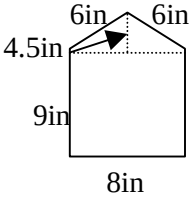
V =A_bh
V = [A_1+A_2+A_3]h
V =[½(3m)(4m) + (4m)(6m) + (6m)(9M)]5m
V=[6m^2+24m^2+2m^2]5m
V = 420m^3

8. Find the volume. Height = 12cm



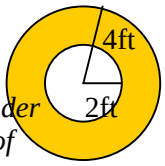
V = A_bh
V = (A_1 + A_2)
V = [(8cm)(3cm) + ½ Π(4cm)^2](12cm)
V=(24cm^2+25.12cm^2)12cm
V = 589.44cm^3

9. Find the volume. Height = 10in



V = A_bh
V = [½(8in)(4.5in) + (9in)(8in)]10in
V= [18in^2 + 72in^2]10in
V = 900in^3

10. Find the volume of the shaded portion. Height = 8ft



To find the area of the shaded region, find the volume of the whole cylinder and subtract the volume of the inner cylinder.

$V_s = V_w - V_i$
$V_s = A_wh - A_ih$
V_s = Π(4ft)^{2}8ft - Π(2ft)^{2}8ft
V_s = 3.14(128)ft^3 – 3.14(32)ft^3
V_s = 401.92 ft^3 – 100.48ft^3
V_s = 301.44ft^3