Geometry & Measurement

Definitions

A **plane** is a flat surface that extends indefinitely.
Space extends in all directions indefinitely.
The most basic concept of geometry is the idea of a point in space. A **point** has no length, no width, and no height, but it does have location.

Lines

A **line** is a set of points that extend infinitely in two directions.
A **line segment** is a part of a line, it has two endpoints.
A **ray** is a part of a line that has one endpoint, the other end extends infinitely.

Angles

An **angle** is made up of two rays that share the same endpoint called a vertex. An angle can be named by naming points on the rays with the vertex in the middle or just the vertex.
An angle can be measured in **degrees**. There are 360^0 (degrees) in a full revolution or full circle.
Two angles that have a sum of 90° are called **complementary angles**.
Two angles that have a sum of 180° are called **supplementary angles**.

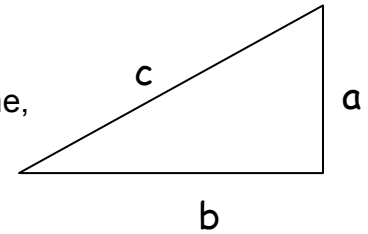
Classifying Angles

Name	Angle Measure	Examples
Acute Angle	Between 0° and 90°	
Right Angle	Exactly 90°	
Obtuse Angle	Between 90° and 180°	
Straight Angle	Exactly 180º	

Triangles

The sum of the measures of the angles of any triangle is 180°.
A right triangle is a triangle in which one of the angles is a right angle, or measures 90º (degrees).
The hypotenuse of a right triangle is the side opposite the right angle. The legs of a right triangle are the other two sides. The sum of the two acute angles in a right triangle is 90°.
Pythagorean Theorem: If a & b are the lengths of the legs of a right triangle & c is the length of the hypotenuse, then: $a^2 + b^2 = c^2$.

Some Uses:
1) the shortest distance between 2 points is a straight line, so for calculating driving directions.
2) The size of a TV screen or computer monitor is the diagonal(hypoteneuse)
3) The height of an object



Distance Formula (related to Pythagorean Theorem): If $P_1(x_1, y_1)$ & $P_2(x_2, y_2)$ are 2 points in the plane, then the distance d between the two points is given by:

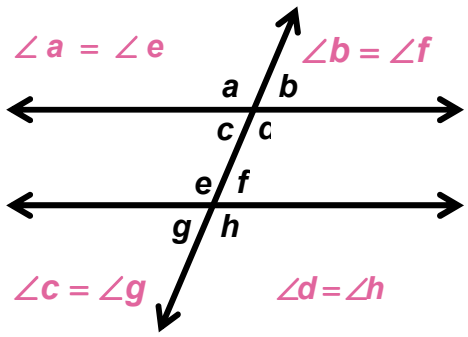
$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Parallel & Perpendicular Lines

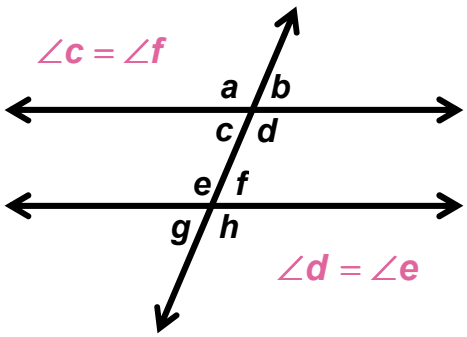
Two lines in a plane are **parallel** lines if they never meet. The symbol $\parallel$ is used to denote "is parallel to." Two lines are **perpendicular** if they form right angles when they intersect. The symbol $\perp$ is used to denote "is perpendicular to."

When two lines intersect, four angles are formed. Two of these angles that are opposite each other are called **vertical angles**. Vertical angles have the same measure. Two angles that share a common side are called **adjacent angles**. Adjacent angles formed by intersecting lines are supplementary. That is, they have a sum of 180 °.

A line that intersects two or more lines at different points is called a **transversal**.



If two parallel lines are cut by a transversal, then the measures of corresponding angles are equal and alternate interior angles are equal.



Alternate interior angles are angles on opposite sides of the transversal between the two parallel lines.

U.S. Units of Length

12 inches (in.) = 1 foot (ft) → $\frac{12in}{1ft} = \frac{1ft}{12in} = 1$ 3 feet = 1 yard (yd) → $\frac{3ft}{1yd} = \frac{1yd}{3ft} = 1$

5280 feet = 1 mile (mi) → $\frac{5280ft}{1mi} = \frac{1mi}{5280ft} = 1$

Metric Units of Length

The basic unit of length in the metric system is the meter. A meter is slightly longer than a yard. It is approximately 39.37 inches long. Like the decimal system, the metric system uses powers of ten to define units.

Metric System of Measurement

Prefix	Meaning	Metric Unit of Length
kilo	1000	1 kilometer (km) = 1000 meters (m)
hecto	100	1 hectometer (hm) = 100 m
deka	10	1 dekameter (dam) = 10 m
		1 meter (m) = 1 m
deci	1/10	1 decimeter (dm) = 1/10 or 0.1 m
centi	1/100	1 centimeter (cm) = 1/100 or 0.01 m
milli	1/1000	1 millimeter (mm) = 1/1000 or 0.001 m

The most commonly used measurements of length in the metric system are the meter, millimeter, centimeter, and kilometer. Since all units of length are powers of 10 of the meter, converting from one unit of length to another is as simple as moving the decimal point.

Physical Concepts (Formulae are listed on the last page.)

Perimeter: the distance around a plane figure called the **perimeter** or **circumference**. Perimeter is always measured in units. Formulas are listed on the last page.

Area: Area is measured in square units. A square unit is a square one unit on each side. When finding the area of figures, check to make sure that all measurements are the same units before calculations are made. Formulas are listed on the last page.

Volume: Volume measures the number of cubic units that fill the space of a solid. The volume of a box or can is the amount of space inside. The volume of a solid is the number of cubic units in the solid. Formulas are listed on the last page.

Surface Area: Surface Area is the area of each side of a solid. For a cube, box or similar, you need to find the area of the top, the bottom and each of the 4 sides.

Weight: the amount or quantity of heaviness of an object; the force that gravitation exerts upon a body, equal to the mass of the body times the local acceleration of gravity. Your weight on the Moon is less than on Earth. – units: ounces, pounds, stones(UK)

Mass: the quantity of matter of an object. The mass of an object does not change. Your mass on the Moon is the same as on Earth. – units: gram, kg, …

Capacity: the volume that a container can hold. - units: cup, pint, quart, gallon, liter, milliliter, …
1 cc = 1 cubic centimeter of water at 4 degree **Celsius** = 1 gram = 1 ml = 1 milliliter

Temperature: a measure of the warmth or coldness of an object or substance with reference to some standard value. – units: Fahrenheit, Celsius, Kelvin(not a common one).

$$\text{F} \rightarrow \text{C: } C = \frac{5}{9}(F - 32) \qquad \text{C} \rightarrow \text{F: } F = \frac{9}{5}C + 32$$

Definitions are from www.dictionary.com

Some conversion factors between US & Metric

Length

1 m ≈ 1.09 yd	2.54 cm ≈ 1 in
1 m ≈ 3.28 ft	.30 m ≈ 1 ft
1 km ≈ .62 mi	1.61 km ≈ 1 mi

Capacity

1 L ≈ 1.06 qt	3.79 L ≈ 1 gal
1 L ≈ .26 gal	.95 L ≈ 1 qt
	29.57 mL ≈1 fl oz

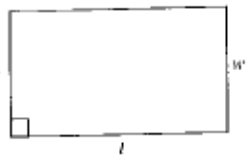
Weight (Mass)

1 kg ≈ 2.20 lb	.45 kg ≈ 1 lb
1 g ≈ .04 oz	28.35 g ≈ 1 oz

A detailed list can be found at
http://www.wsdot.wa.gov/reference/metrics/factors.htm

Geometric Formulas

Rectangle

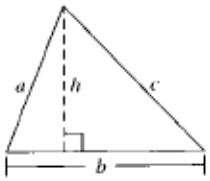


Perimeter: $P \approx 2l + 2w$
Area: $A \approx lw$

Square

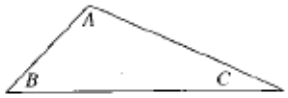
Perimeter: $P = 4s$
Area: $A = s^2$

Triangle



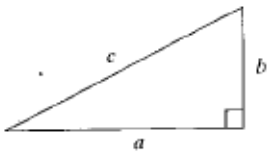
Perimeter: $P = a + b + c$
Area: $A = \frac{1}{2}bh$

Sum of Angles of Triangle



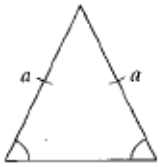
$A + B + C = 180°$
The sum of the measures of the three angles is 180°.

Pythagorean Theorem (for right triangles)



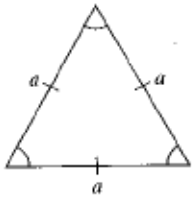
$(a)^2 + (b)^2 = (c)^2$
One 90° (right) angle

Isosceles Triangle



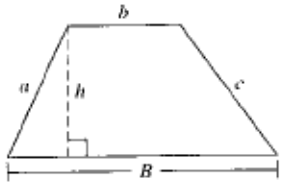
Triangle has:
two equal sides and
two equal angles.

Equilateral Triangle



Triangle has:
three equal sides and
three equal angles.
Measure of each angle
is 60°.

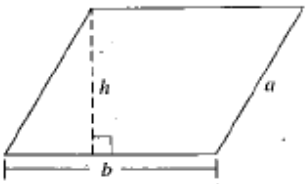
Trapezoid



Perimeter:
$P = a + b + c + B$

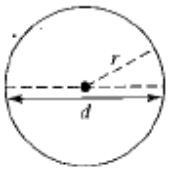
Area: $A = \frac{1}{2}h(B + b)$

Parallelogram



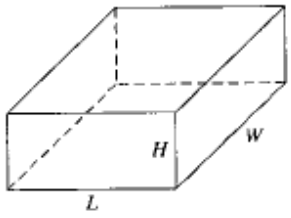
Perimeter: $P = 2a + 2b$
Area: $A = bh$

Circle



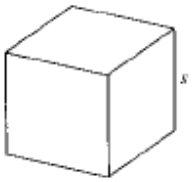
Circumference:
$C = \pi d$
$C = 2\pi r$
Area: $A = \pi r^2$

Rectangular Solid



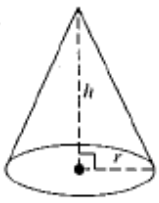
Volume: $V = LWH$
Surface Area:
$S = 2LW + 2HL + 2HW$

Cube



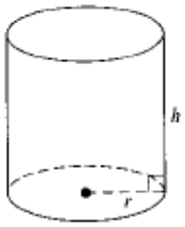
Volume: $V = s^3$
Surface Area: $S = 6s^2$

Cone



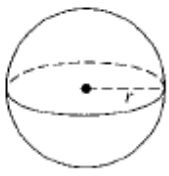
Volume: $V = \frac{1}{3}\pi r^2 h$

Right Circular Cylinder



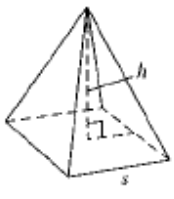
Volume: $V = \pi r^2 h$
Surface Area:
$S = 2\pi r^2 + 2\pi rh$

Sphere



Volume: $V = \frac{4}{3}\pi r^3$
Surface Area: $S = 4\pi r^2$

Square-Based Pyramid



Volume: $V = \frac{1}{3} \cdot s^2 \cdot h$