---a reference guide to---
Weights & Measures

CONTENTS

Common Kitchen Measurements

STANDARD	EQUIVALENT
One pinch or dash	1/16 teaspoon
3 teaspoons	1 tablespoon (1/2 ounce liquid)
4 tablespoons	1/4 cup (2 ounces liquid)
1/3 cup	5 tablespoons plus 1 teaspoon
1/2 cup	8 tablespoons (4 ounces liquid)
1 gill	1/2 cup (4 ounces liquid)
1 cup	16 tablespoons (8 ounces liquid)
2 cups	1 pint (16 ounces liquid)
2 pints	1 quart (32 ounces liquid)
4 quarts	1 gallon
8 quarts	1 peck
4 pecks	1 bushel
16 ounces	pound (dry measure)
1 pound of butter	2 cups

NOTE: All measurements quoted are level.

Linear Measure

STANDARD	EQUIVALENT
One pinch or dash	1 foot
4 inches	1/3 foot = 1 hand
9 inches	1 span
3 feet	1 yard
5.5 yards	16.5 feet = 1 rod, pole or perch
40 poles	220 yards = 1 furlong
8 furlongs	1760 yards = 5280 feet = 1 mile
3 miles	1 league
69 1/8 miles	1 degree
320 rods	1 mile

Nautical Measure

STANDARD	EQUIVALENT
6,028 feet	1 nautical mile
6 feet	1 fathom
120 fathoms	1 cable length
1 nautical mile per hour	1 knot of speed

Square or Area Measure

144 square inches = 1 square foot
9 square feet = 1 square yard
30.25 square yards = 1 square rod, pole or perch
160 square rods = 1 acre
10 square chains = 1 acre = 43,560 sq. ft.
640 acres = 1 Square mile = 1 "section" of U.S.
Government surveyed land

Cubic or Volume Measure

A legal cord of wood is the amount of wood which is contained in a space of 128 cubic feet, such as a stack 4x4x8, 2x4x16, etc.

A rick of wood is usually 4 feet high, and 8 feet long. The length of the log is agreed upon by the buyer and seller.

1,728 cubic inches = 1 cubic foot
27 cubic feet = 1 cubic yard
1 cord of wood = 128 cubic feet
1 board foot = 144 cubic inches = 1 1/12 cubic foot
1 perch of stone or brick = 24.75 cubic feet
(May vary from 16.5 to 25 cubic feet)

Number of board feet in log = [.25(d-4)]2L; where "d" is the diameter of a log (taken inside the bark at the small end) in inches; and L=length of log in feet. The 4 inches subtracted are an allowance for slab. Remember to square the formula before multiplying by the length.

Liquid or Fluid Measure

STANDARD	EQUIVALENT
4 ounces(oz.)	1 gill
2 gills	1 cup
2 cups	1 pint(pt.)
2 pints	1 quart(qt.)
4 quarts	1 gallon(gal.)
31.5 gallons	1 barrel(bbl.)
2 barrels	2 hogshead(hhd.)

Dry Measure

STANDARD	EQUIVALENT
2 pints	1 quart
8 quarts	1 peck
4 pecks	1 bushel(bu.)

Measures of Weight

Avoirdupois

16 drams	437.5 grains = 1 ounce(oz.)
16 ounces	7000 grains = 1 pound(lb.)
100 pounds	1 central = 1 hundredweight(c wt.)
2000 pounds	1 short ton(T.)
2240.6 pounds	1 long ton or metric ton
Also(in Great Britain)	
14 pounds	1 stone
2 stones	1 quarter
4 quarters	112 lbs. = 1 hundredweight
20 hundredweight	1 long ton

Troy (Precious Metals)

24 grains	1 pennyweight(dwt.)
20 pennyweights	480 grains = 1 ounce
12 ounces	5760 grains = 1 pound

Precious Stones

100 points	1 carat
Pure Gold	24 carats
Good jewelry	14 carats

Apothecaries'

20 grains	1 scruple
3 scruples	1 dram
8 drams	1 ounce
12 ounces	5,760 grains = 1 pound

METRIC UNITS

The three main units; meter, liter, and gram, can be changed to more convenient sized units for specific purposes by means of several well known prefixes. Milli means 1/1000, centi means 1/100, deci means 1/10, and kilo means 1000. One merely learns the main units and the value of the most commonly used prefixes. The symbols for metric units are the

Quantity	Unit	Symbol	Relationship of Units
	millimeter	mm	1 mm = 0.001 m
	centimeter	cm	1 cm = 10 mm
Length	decimeter	dm	1 dm = 10 cm
	meter	m	1 m = 100 cm
	kilometer	km	1 km = 1000 m
	square centimeter	cm^2	$1\ cm^2 = 100\ mm^2$
	square decimeter	dm^2	$1\ dm^2 = 100\ cm^2$
Area	square meter	m^2	$1\ m^2 = 100\ dm^2$
	are	a	$1\ a = 100\ m^2$
	hectare	ha	1 ha = 100 a
	square kilometer	km^2	$1\ km^2 = 100\ ha$
	cubic centimeter	cm^3	1 cm = 0.001 L
	milliliter	ml	1 ml = 0.001 L
Volume	cubic decimeter	dm^3	$1\ dm^3 = 1000\ mL$
	liter	L	1 L = 1000 mL
	cubic meter	m^3	$1\ m^3 = 1000\ L$
	milligram	mg	1 mg = 0.001 g
	gram	g	1 g = 1000 mg
Mass*	kilogram	kg	1 kg = 1000 g
	metric ton	t	1 t = 1000 kg

same for single and plural amounts and are not followed by a period. Rates are usually show by the use of a slash as in m/s.

The Metric System simply and logically coordinates the measurements of length, area, volume, and mass into one decimalized system. United States currency, with its unexcelled convenience, was the first large scale national use of a decimal system. The ratio between units of the series – dollars, dimes, cents, and mills – is ten. Additions and other numerical operations are simple. Calculations with metric units require no conversion from unit to unit, as for example between inches and feet or ounces and pounds.

In the the Metric System there is one series of units for length, one for area, one for volume or capacity, and one for mass.

* Mass is the quantity of matter; whereas weight is a force, Earth's attraction for a given mass. Generally, the term mass is meant when we use weight.

LENGTH = The common metric units of length are the millimeter (mm) for small dimensions, the centimeter(cm) for daily practical use, the meter(m) for expressing dimensions of larger objects and short distances and the kilometer(km) for longer distances. The centimeter is about four-tenths of an inch. The meter is about forty inches and the kilometer about six-tenths of a mile. When drawing to metric scale, engineering and product dimensions are in millimeters, while architectural drawings can be in millimeters or centimeters. On land surveys the unit is the meter, whereas for maps the kilometer is used.

AREA = Small areas are usually measured in square centimeters(cm^2) In building and construction the square meter(m^2) is used and is about 20 percent larger than a square yard. The hectare(ha) is used for land surveys and is about 2.5 acres.

VOLUME = For volume the most convenient unit is the cubic decimeter(dm^3) which is commonly referred to as the liter(L). The liter is slightly larger than the U.S. liquid quart but smaller than the U.S. dry quart and the British Imperial quart. The preferred unit for dispensing drugs and for scientific work is the cubic centimeter (cm^3) or milliliter(ml) as it is also called. For measuring amounts of concrete and excavations the cubic meter(m^3) is used.

MASS = In pharmaceutical and scientific work the gram(g) is the most convenient unit. There are slightly less than 30 grams in one avoirdupois ounce. For most other uses the kilogram(kg) is convenient and is approximately 2.2 pounds. The metric ton(t), 100 kg, is used for farm commodities, minerals, and large shipments. It is convenient that a liter of pure water at standard temperature and pressure has a mass of one kilogram (discrepancy less than one part in 10,000). This relationship makes it easy to

determine the mass of any known volume of water, or of any other liquid if its specific gravity is known.

TEMPERATURE = All countries using the Metric System of weights and measure also use the Celsius (^{o}C) scale (formerly called centigrade) for ordinary measurement of temperature. On the Celsius scale pure water at standard atmospheric pressure freezes at 0° and boils at 100°. Normal human body temperature is 37°, while a comfortable room temperature is about 22°. The preferred temperature scale for engineering and physics is the Kelvin (K) which has the same units as the Celsius and where the freezing point of pure water is 273.15 K.

METRIC EQUIVALENTS, LIQUID OR FLUID MEASURE

1 centiliter(cl)	.6102 cu. in. = .338 oz.
1 deciliter(dl) (10 cl)	6.102 cu. in. = .845 gill.
1 liter (1) 10 (dl)	.908 qt. = 1.0567 qt.
1 dekaliter(dal)	9.08 qt. = 2.64 gal.

Linear

1 millimeter (mm)	.0394 in.
1 centimeter (cm)	.3937 in.
1 decimeter (dm)	3.937 in.
1 meter	39.37 in. = 1.1 yard
1 decameter	393.7 in. = 10 yd. 2.8 ft.
1 hectometer	328 ft. 1 in.
1 kilometer	3,280 ft. 1 in.

Square

1 square millimeter	.00155 sq. inches
1 square centimeter	.155 sq. inches
1 square meter	10.764 sq. ft. or 1.196 sq. yd.
1 square kilometer	.3861 sq. mile
1 are	100 sq. meters = 119.6 sq. yard = basic unit in measuring land

Metric Weights

1 milligram	0.0015 grain
1000 milligrams	1 gram(0.035 oz.)
1000 grams	1 kilogram(2.205)
1000 kilograms	1 metric ton

Cubic

1 cubic millimeter	.000061 cubic inches
1 cubic centimeter	0610 cubic inches
1 cubic meter	35.314 cubic feet = 1.3079 cubic yards

COMMON EQUIVALENTS (approximate)

1 bushel	2150 cubic inches = 1 1/4 cubic feet
1 gallon	231 cubic inches
1 cubic foot	7.5 gallons
1 cubic foot of water	62.5 pounds
1 gallon of water	8 1/3 pounds
1 cubic foot of ice	57.5 pounds
1 barrel flour	196 pounds
1 ton hay	500 cubic feet
1 ton hard coal	35 cubic feet
1 ton soft coal	42 cubic feet

ANGLES AND ARCS

60 second (″)	1 minute(′)
60 minutes	1 degree(º)
90 degrees	1 right angle
360 degrees of an arc (circle)	1 circumference
360 degrees of an angle	1 complete rotation

Paper

24 sheets	1 quire
20 quires	1 ream*
500 sheets	1 ream*
10 reams	1 bale

*20 quires = 480 sheets. This is a short ream. When bought by the ream, 500 sheets are obtained.

How to Figure Areas

Rectangle

The area of a rectangle equals the product of the numbers which measure the length and the width. Area = L x W.

Triangle

The area of a triangle is equal to half the product of its base and height. Area = 1/2 b x h.

Circle

The area of a circle is found by multiplying the square of its radius by pi (3.1416). Area = piR^2

The circumference of a circle is approximately 3 1/7 or 3.1416 times as large as its diameter. C = (pi)d.

How to Figure Volumes

Cylinder

The volume of a cylinder is found by multiplying the area of its base by its height, or V = $(pi)r^2$ x h

Cube

The volume of a cube is found by multiplying the length by width by height or V = E^3.

Oblong

The volume of an oblong is found by multiplying the length by width by height, or (L x W x H)

Miscellaneous

Speed per second acquired by falling body: v = 32t, in which t is the time in seconds.

Distance in feet traveled by falling body: d = 16t, in which t is the time in seconds.

Miscellaneous Continued

Cost per hour of operation of electrical device: C=Wtc/1000, in which W is the number of watts, t is the time in hours and c is the cost per kilowatt-hour.

Conversion of matter into energy (Einstein's Theorem) : $E=mc^2$ in which E is the energy in ergs, m is the mass of the matter in grams, and c is the speed of light in centimeters per second ($c^2=9 \times 10^{20}$).

Decimal Equivalents of Common Fractions

1/2.=5000	1/32=.0313	3/11=.2727	6/11=.5455
1/3=.3333	1/64=.0156	4/5=.8000	7/8=.8750
1/4=.2500	2/3=.6667	4/7=.5714	7/9=.7778
1/5=.2000	2/5=.4000	4/9=.4444	7/10=.7000
1/6=.1667	2/7=.2857	4/11=.3636	7/11=.6364
1/7=.1429	2/9=.2222	5/6=.8333	7/12=.5833
1/8=.1250	2/11=.1818	5/7=.7143	8/9=.8889
1/9=.1111	3/4=.7500	5/8=.6250	8/11=.7273
1/10=.1000	3/5=.6000	5/9=.5556	9/10=.9000
1/11=.0909	3/7=.4286	5/11=.4545	9/11=.8182
1/12=.0833	3/8=.3750	5/12=.4167	10/11=.9091
1/16=.0625	3/10=.3000	6/7=.8571	11/12=.9167

Converting Inches and Fractions of an Inch to Decimals of a Foot

Inches	1	2	3	4	5	6	7	8	9
Feet	.0833	.1667	.25	.333	.4167	.5	.5833	.667	.75

Inches	10	11	1/8	1/4	3/8	1/2	5/8	3/4	7/8
Feet	.833	.9167	.0104	.0208	.0313	.0417	.0521	.0625	.0729

Thermometers - Comparative Scales

      To convert Fahrenheit to Centigrade, subtract 32 degrees and multiply by 5/9; to convert Centigrade to Fahrenheit, multiply by 9/5 and add 32 degrees.

Important Temperatures:
100^oC / 212^oF is the temperature at which water boils at sea level.
75^oC / 167^oF is the temperature at which alcohol boils.
52.8^oC / 127^oF is the temperature at which tallow melts
36.7^oC / 98^oF is the temperature of body heat
15.5^oC / 60^oF is temperate
0^oC / 32^oF is the temperature at which water freezes

Weight of Water

1 cubic inch	.0360 pound
12 cubic inches	.433 pound
1 cubic foot	62.3 pounds
1.8 cubic feet	112.0 pounds
35.96 cubic feet	2240.0 pounds
1 imperial gallon	10.0 pounds
11.2 imperial gallons	112.0 pounds
224 imperial gallons	2240.0 pounds
1 U.S. gallon	8.33 pounds
13.45 U.S. gallon	112.0 pounds
269.0 U.S. gallon	2240.0 pounds

Winds, their Force and Official Designation

Designation	Miles Per Hour
Calm	Less than 1
Very Light	1 to 3
Light	4 to 7
Gentle	8 to 12
Moderate	13 to 18
Fresh	19 to 24
Strong	25 to 38
Gale	39 to 54
Whole Gale	55 to 72
Hurricane	Above 72

Gasoline Mileage

      Start with a *full* tank. Note mileage reading. After driving at least 150 miles, *fill* tank. Note mileage reading. Note number of gallons added. Miles traveled (second reading less "start" reading) divided by gallons added equals miles per gallon. Example: Mileage at end of trip=10,459; Mileage at start=10,225; Miles traveled 234; Gallons added=13;
234 Miles traveled / 13 gallons added = 18 miles per gallon.

Roman Numerals

Letter			Value
I	1	LX	60
II	2	LXX	70
III	3	LXXX	80
IV	4	XC	90
V	5	C	100
VI	6	D	500
VII	7	M	1000
VIII	8	V *	5000
IX	9	X *	10,000
X	10	L *	50,000
XX	20	C *	100,000
XXX	30	D *	500,000
XL	40	M *	1,000,000

*These Roman numerals require horizontal lines over the letter

A letter repeated one or twice repeats its value that many times. One or more letters placed after another letter of greater value increases the greater value by the amount of the smaller. A letter placed before another letter of greater value decreases the greater value by the amount of the smaller value.

Standard Measurements in Sports

Baseball
Home plate to pitcher's box – 60 feet 6 inches
Plate to second base – 127 feet 3 3/8 inches.
Distance from base to base (home plate included) – 90 feet
Batter's box – 6 feet by 4 feet.
Weight of ball – Not less than 5 ounces nor more than 5.25 ounces
Bat – must be round, not over 2.75 inches in diameter at the thickest part, nor more than 42 inches in length, and of hardwood in one piece or laminated.

Football
Length of field – 120 yards*
Width of field – 53 1/3 yards (160 feet).
Height of goal posts – 20 feet.
Height of crossbar – 10 feet.
Width of goal posts – 18 feet 6 inches, inside to inside, not more than 19 feet 2 inches, outside to outside.
*Includes 10 yards of end zone on either side.

Tennis
Size of court – Rectangle 78 feet long and 27 feet wide (singles); 78 feet long and 36 feet wide (doubles).
Service line – 21 feet from the net.
Height of the net – 3 feet in the center, gradually rising to reach 3-foot 6-inch Posts at each side of court.

Basketball
Playing court – 94 feet long by 50 feet wide (maximum dimensions); 74 feet long by 42 feet wide (minimum dimensions).
Baskets – Rings 18 inches in inside diameter, with white cord nets, 15 to 18 inches in length. Each ring is made of metal and is not more than 5/8 of an inch in diameter
Height of basket ring – 10 feet.
Free-throw line – 15 feet from the face of the backboard

Baseball (Little League)
Home plate to pitcher's box – 46 feet
Plate to second base – 84 feet 10 inches
Distance from base to base(home plate included) – 60 feet
Batter's box – 5 feet 6 inches by 3 feet
Weight of ball – Not less than 5 oz. nor more than 5.25 ounces
Bat – must be round. Not more than 33 inches in length, and made of wood. Not more than 2.25 inches in diameter at thickest part, and not less than 1-1/16 inches in diameter at its smallest part. Bats may be taped for a distance not exceeding 16 inches from the smallest end.

Horseshoe Court
Length between pegs – 40 feet
Boxes – 6 feet by 6 feet
Length – Over-all 50 feet

Mens' Volley Ball
Length – 60 feet
Width – 30 feet
Height of net from ground – 8 feet (7.5 feet for girls)
Bottom of net from ground – 5 feet

Single Handball Court
Length – 34 feet
Width – 20 feet
Service line – 16 feet from front wall