SPARKCHARTS™

WEIGHTS & MEASURES

SPARK CHARTS™

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INTRODUCTION

SI/METRIC SYSTEM

The Metric system, also known as the SI, is based upon principal units of measurement that are made smaller or bigger by different prefixes. Prefixes are based on a multiple or sub-multiple of 1000, providing a standard that is easily converted within unit. For example, there are 1,000 milliUNITS in every UNIT, and this is true for all linear units within the metric system.

ENGLISH/IMPERIAL SYSTEM

The English system, also known as the Imperial system, was originally defined by three standard measures—the yard, the pound, and the gallon—which were held in London. They are now defined by reference to the SI measures of the meter, the kilogram, and the liter. The English system's cumbersome conversions have made most industrial nations adopt the SI as their standard, and the U.S. is the one major exception to this trend.

PREFIXES IN THE METRIC SYSTEM

Multiplication Factor	Prefix	Symbol	Multiplication Factor	Prefix	Symbol
$1{,}000{,}000{,}000 = 10^9$	giga	G	$0.000000001 = 10^{-9}$	nano	n
$1{,}000{,}000 = 10^6$	mega	M	$0.000001 = 10^{-6}$	micro	μ
$1{,}000 = 10^3$	kilo	k	$0.001 = 10^{-3}$	milli	m
$100 = 10^2$	hecta	h	$0.01 = 10^{-2}$	centi	c
$10 = 10^1$	deka	da	$0.1 = 10^{-1}$	deci	d
$1 = 10^0$	UNIT	—	$1 = 10^0$	UNIT	—

LENGTH

Metric

The basic unit of length in metrics is the meter (m).

English

The basic units of length in the English system are inches, feet, yards, and miles.

LENGTH—METRIC

1 centimeter (cm)	=	.01 meter
1 decimeter (dm)	=	.1 meter
1 meter (m)	=	1 meter
1 dekameter (dam)	=	10 meters
1 hectometer (hm)	=	100 meters
1 kilometer (km)	=	1000 meters

LENGTH—ENGLISH

1 angstrom (Å)	=	4×10^{-9} inches
1 point (pt)	=	0.0138 inches
1 pica (p)	=	12 points
1 hand	=	4 inches
1 foot (ft)	=	12 inches
1 yard (yd)	=	3 feet
1 fathom (fm)	=	6 feet
1 rod	=	16.5 feet
1 cable (cb)	=	720 feet
1 chain (surveyor's) (chG)	=	22 yards
1 furlong	=	10 chains
1 statute (land) mile	=	8 furlongs
1 statute mile (mi)	=	5,280 feet
1 nautical mile (nmi)	=	6,076 feet
1 league	=	3 statute miles

CONVERSION FACTORS

to convert from	to	multiply by
centimeters	inches	0.394
chains (surveyor's)	meters	20.117
fathoms	feet	6
fathoms	meters	1.83
feet	fathoms	0.167
feet	meters	0.3048
furlongs	meters	201.17
inches	centimeters	2.54
inches	meters	0.0254
inches	millimeters	25.4
kilometers	miles (land)	0.621
meters	chains (surveyor's)	0.04971
meters	fathoms	0.547
meters	feet	3.281
meters	furlongs	0.005
meters	inches	39.4
meters	yards	1.094
miles (land)	kilometers	1.6093
miles (land)	miles (nautical)	0.869
miles (nautical)	miles (land)	1.15
millimeters	inches	0.0394
yards	meters	0.9144

MASS & WEIGHT

MASS & WEIGHT*

Metric

The basic unit of mass in metrics is the gram (g).

English

The basic units of weight in the English system are ounces, pounds, and tons.

MASS—METRIC

1 centigram (cg)	=	.01 gram
1 decigram (dg)	=	.1 gram
1 gram (g)	=	1 gram
1 dekagram (dag)	=	10 grams
1 hectogram (hg)	=	100 grams
1 kilogram (kg)	=	1,000 grams
1 metric ton (mt)	=	1,000 kilograms

WEIGHT—ENGLISH

1 grain (gr)	=	0.00229 ounces (oz)
1 pennyweight (dwt)	=	0.05486 ounces
1 dram (dr)	=	0.0625 ounces
1 pound (lb)	=	16 ounces
1 stone (st)	=	14 pounds
1 ton (t)	=	2000 lbs

CONVERSION FACTORS

to convert from	to	multiply by
grams	ounces	0.0353
kilograms	pounds	2.205
ounces	grams	28.349
ounces	pounds	0.0625
pounds	kilograms	0.454
pounds	ounces	16
pounds	tons (t)	0.0004434
pounds	tons (metric) (mt)	0.0004536
tons	pounds	2000
tons (metric)	pounds	2205

**Mass measures the amount of matter within an object, whereas weight measures gravity's pull on an object. For many purposes, the two quantities are interchangeable.*

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"A FOOT CAN BE TOO LONG AND AN INCH CAN BE LONG ENOUGH."

CHINESE PROVERB

AREA

AREA

Metric

The basic unit of area in metrics is the square meter (m^2).

English

The basic units of area in the English system are square inches (in^2), square feet, square yards, and acres.

AREA—METRIC

1 sq. centimeter (cm^2)	=	100 sq. millimeters (mm^2)
1 sq. meter (m^2)	=	10,000 sq. centimeters
1 are (a)	=	100 sq. meters
1 hectare (ha)	=	10,000 sq. meters
1 hectare	=	200 ares
1 hectare	=	1 sq. hectometer
1 sq. kilometer (km^2)	=	10,000 ares
1 sq. kilometer	=	100 sq. hectometers
1 sq. kilometer	=	100 hectacres

AREA—ENGLISH

1 sq. foot (ft^2)	=	144 sq. inches (in^2)
1 sq. yard (yd^2)	=	9 sq. feet
1 sq. yard	=	1,296 sq. inches
1 sq. rod (rd^2)	=	272.25 sq. feet
1 sq. mile (mi^2)	=	640 acres
1 sq. mile	=	27,878,400 sq. feet
1 sq. mile	=	3,097,600 sq. yards
1 acre (A)	=	43,560 sq. feet
1 acre	=	4,840 sq. yards

CONVERSION FACTORS

to convert from	to	multiply by
acres	hectares	**0.405**
acres	sq. meters (m^2)	**4046.856**
acres	sq. miles (mi^2)	**0.00156**
hectares	acres	**2.471**
hectares	sq. meters	**10,000**
hectares	sq. miles	**0.00385**
sq. centimeters (cm^2)	sq. inches (in^2)	**0.155**
sq. feet (ft^2)	sq. meters	**0.0929**
sq. feet	sq. yards (yd^2)	**0.111**
sq. inches	sq. centimeters	**6.452**
sq. kilometers	sq. miles	**0.386**
sq. meters	acres	**0.000247**
sq. meters	hectares	**0.0001**
sq. meters	sq. feet	**10.764**
sq. meters	sq. rods	**0.03954**
sq. meters	sq. yards	**1.196**
sq. miles	acres	**640**
sq. miles	hectares	**258.999**
sq. miles	sq. kilometers	**2.59**
sq. rods	sq. meters	**25.293**
sq. yards	sq. feet	**9**
sq. yards	sq. meters	**0.836**

VOLUME

DRY VOLUME

Metric

The basic unit of dry volume in metrics is the cubic centimeter (cm^3).

English

The basic units of volume in the English system are cubic inches, cubic feet, cubic yards, pints, quarts, pecks, and bushels.

DRY VOLUME—METRIC

1 cu cm (cm^3)	=	1,000 mm^3
1 cu decimeter (dm^3)	=	1,000 cm^3
1 cu meter (m^3)	=	1,000 dm^3

DRY VOLUME—ENGLISH

1 quart (qt)	=	2 pints (pt)
1 peck (pk)	=	8 quarts
1 bushel (bu)	=	4 pecks
1 cu foot (ft^3)	=	1728 cu inches
1 cu yard (yd^3)	=	27 cu feet

FLUID VOLUME

Metric

The basic unit of liquid volume in metrics is the liter (L).

English

The basic units of volume in the English system are fluid ounces (fl. oz.), pints (pt), quarts (qt), and gallons (gal).

FLUID VOLUME—METRIC

1 centiliter (cl)	=	.01 liter
1 deciliter (dl)	=	.1 liter
1 liter (l)	=	1 liter
1 dekaliter (dal)	=	10 liters
1 hectoliter (hl)	=	100 liters
1 kiloliter (kl)	=	1000 liters

FLUID VOLUME—ENGLISH

1 dram (dr)	=	0.125 fluid ounces (fl. oz)
1 cup (c)	=	8 fluid ounces
1 pint (pt)	=	16 fluid ounces
1 pint (pt)	=	2 cups
1 quart (qt)	=	32 fluid ounces
1 quart	=	4 cups
1 quart	=	2 pints
1 gallon (gal)	=	16 cups
1 gallon	=	8 pints
1 gallon	=	4 quarts

CONVERSION FACTORS

DRY VOLUME

to convert from	to	multiply by
bushels	pecks	**4**
cu. centimeters (cm^3)	cu. inches (in^3)	**0.061**
cu. feet (ft^3)	cu. inches	**1728**
cu. feet	cu. meters (m^3)	**0.028**
cu. feet	cu. yards (yd^3)	**0.037**
cu. inches	cu. centimeters	**16.387**
cu. inches	cu. feet	**0.000579**
cu. meters	cu. feet	**35.315**
cu. meters	cu. yards	**1.308**
cu. yards	cu. feet	**27**
cu. yards	cu. meters	**0.765**
pecks	bushels	**0.25**
pecks	quarts (qt)	**8**
pints	quarts	**0.5**
quarts	pecks	**0.125**
quarts	pints	**2**

FLUID VOLUME

to convert from	to	multiply by
gallons	liters	**3.786**
liters	gallons	**0.264**
liters	ounces	**33.8**
liters	pints	**2.113**
liters	quarts	**1.057**
milliliters	ounces	**0.0338**
ounces	liters	**0.0296**
ounces	milliliters	**29.6**
pints	liters	**0.473**
quarts	liters	**0.946**

CONTINUED ON OTHER SIDE

SPEED

SPEED

Speed measures distance traveled over a given period of time and is represented by *d* distance divided by *t* time. In the Metric system, speed is usually measured in meters/second or kilometers/hour, while the English system measures speed in feet/second or miles/hour.

SPEED		
1 meter / second	=	3.6 kilometers / hour
1 kilometer / hour	=	0.278 meters / second
1 foot / second	=	0.682 miles / hour
1 mile / hour	=	1.467 feet / second
1 knot	=	1.151 miles / hour
1 knot	=	1.852 kilometers / hour

CONVERSION FACTORS		
to convert from	to	multiply by
feet per second	kilometers per hour	1.097
feet per second	meters per second	0.3048
kilometers per hour	feet per second	0.9114
kilometers per hour	miles per hour	0.6214
meters per second	feet per second	3.280
meters per second	miles per hour	2.236
miles per hour	kilometers per hour	1.609
miles per hour	meters per second	0.447

TIME

TIME

The units for time are seconds, minutes, and hours.

CONVERSION FACTORS		
To convert from	to	multiply by
hours (hr)	minutes (min)	60
hours	seconds (s)	3600
minutes	hours	0.0166
minutes	seconds	60
seconds	hours	2.777×10^{-4}
seconds	minutes	0.0166

TIME		
1 minute (min)	=	60 seconds (s)
1 hour (hr)	=	60 minutes

ENERGY & POWER

ENERGY AND POWER

The Metric unit for energy is the joule.

The English unit for energy is the calorie. A Calorie (with capital "C") refers to the metric quantity of a kilocalorie, or 1,000 calories. Calories are found on nutrition charts for dietary concerns in the U.S.

Power is the rate at which work gets done, Work/Time, measured in watts (W) and sometimes in horsepower (hp).

ENERGY AND POWER		
1 joule/sec	=	1 watt (W)
746 watts	=	1 horsepower (hp)
1 calorie	=	4.1855 joules (J)
1,000 calories	=	1 kilocalorie or 1 Calorie

COOKING MEASUREMENTS

TABLE OF DRY MEASURES

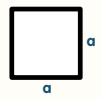
cups	fl oz	tablespoons	teaspoons	milliliters
1	8	16	48	237
3/4	6	12	36	177
2/3	5 1/3	10 2/3	32	158
1/2	4	8	24	118
1/3	2 2/3	5 1/3	16	79
1/4	2	4	12	59
1/8	1	2	6	30
1/16	1/2	1	3	15
1/48	1/6	1/3	1	5

TABLE OF LIQUID MEASURES

gallons	quarts	pints	cups	fl oz	milliliters	tablespoons	teaspoons
1	4	8	16	128	3790		
1/2	2	4	8	64	1890		
1/4	1	2	4	32	950		
	1/2	1	2	16	470		
	1/4	1/2	1	8	240		
			1/2	4	120	8	24
			1/4	2	60	4	12
			1/8	1	30	2	6
				1/2	15	1	3

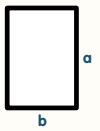
GEOMETRY EQUATIONS

square



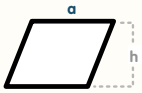
$A_{square} = a^2$

rectangle



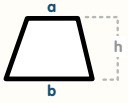
$A_{rectangle} = ab$

parallelogram



$A_{parallelogram} = ha$

trapezoid

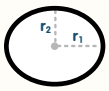


$A_{trapezoid} = (a+b)/2 \times h$

circle

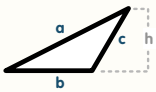
$A_{circle} = \pi r^2$

ellipse



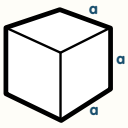
$A_{ellipse} = \pi r_2 r_1$

triangle



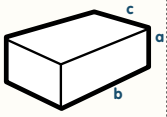
$A_{triangle} = (1/2)bh$

cube



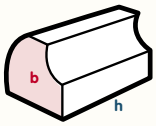
$V_{cube} = a^3$

rectangular prism



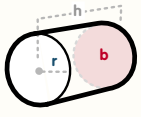
$V_{rec.\ prism} = abc$

irregular prism



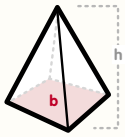
$V_{irr.\ prism} = bh$

cylinder



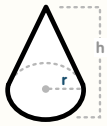
$V_{cylinder} = bh = \pi r^2 h$

pyramid



$V = (1/3)bh$

cone

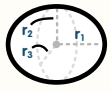


$V_{cone} = 1/3\pi r^2 h$

sphere

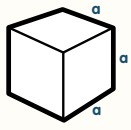
$V_{sphere} = 4\pi r^3/3$

ellipsoid



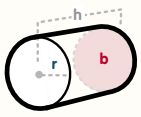
$V_{ellipsoid} = (4/3)\pi r_1 r_2 r_3$

cube



$SA_{cube} = 6a^2$

cylinder



$SA_{cylinder} = 2\pi r^2 + 2\pi rh$

sphere

$SA_{sphere} = 4\pi r^2$

°Fahrenheit	°Celsius
212	100
210	98.9
205	96.1
200	93.3
195	90.5
190	87.8
185	85
180	82.2
175	79.4
170	76.7
165	73.9
160	71.1
155	68.3
150	65.5
145	62.8
140	60
135	57.2
130	54.4
125	51.7
120	48.9
115	46.1

°Fahrenheit	°Celsius
110	43.3
105	40.5
104	40
103	39.4
102	38.9
101	38.3
100	37.8
99	37.2
98.6	37
98	36.7
97	36.1
96	35.5
95	35
94	34.4
92	33.3
90	32.2
88	31.1
86	30
85	29.4
84	28.9
82	27.8

°Fahrenheit	°Celsius
80	26.7
78	25.5
76	24.4
75	23.9
74	23.3
72	22.2
70	21.1
68	20
66	18.9
65	18.3
64	17.8
62	16.7
60	15.5
58	14.4
56	13.3
55	12.8
54	12.2
52	11.1
50	10
48	8.9
46	7.8

°Fahrenheit	°Celsius
45	7.2
44	6.7
42	5.5
40	4.4
38	3.3
36	2.2
35	1.7
34	1.1
32	0
30	-1.1
28	-2.2
26	-3.3
25	-3.9
24	-4.4
22	-5.5
20	-6.7
18	-7.8
16	-8.9
15	-9.4
14	-10
12	-11.1

°Fahrenheit	°Celsius
10	-12.2
8	-13.3
6	-14.4
5	-15
4	-15.5
2	-16.7
0	-17.8
-5	-20.6
-10	-23.3
-15	-26.1
-20	-28.9
-25	-31.7
-30	-34.4
-35	-37.2
-40	-40
-45	-42.8
-50	-45.6
-55	-48.3
-60	-51.1
-65	-53.9
-70	-56.7

TEMPERATURE

The Metric units for temperature are kelvin (K) and the degree Celsius (°C).
0 K (absolute 0) = -273.15°C
0°C = 273.15 K

The English unit for temperature is the degree Fahrenheit (°F).

CONVERSIONS

degrees Celsius and degrees Fahrenheit:
T_C(temperature in degrees Celsius) = (T_F - 32) / 1.8

$T_F = T_C \times 1.8 + 32$

INDEX OF WIND CHILL FACTORS (in degrees Fahrenheit—°F)

mph	45°F	40°	35°	30°	25°	20°	15°	10°	5°	0°	-5°	-10°	-15°	-20°	-25°	-30°
0	45	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30
5	43	37	32	27	22	16	11	6	0	-5	-10	-15	-21	-26	-31	-36
10	34	28	22	16	10	3	-3	-9	-15	-22	-27	-34	-40	-46	-52	-58
15	29	23	16	9	2	-5	-11	-18	-25	-31	-38	-45	-51	-58	-65	-72
20	26	19	12	4	-3	-10	-17	-24	-31	-39	-46	-53	-60	-67	-74	-81
25	23	16	8	1	-7	-15	-22	-29	-36	-44	-51	-59	-66	-74	-81	-88
30	21	13	6	-2	-10	-18	-25	-33	-41	-49	-56	-64	-71	-79	-86	-93
35	20	12	4	-4	-12	-20	-27	-35	-43	-52	-58	-67	-74	-82	-89	-97
40	19	11	3	-5	-13	-21	-29	-37	-45	-53	-60	-69	-76	-84	-92	-100
45	18	10	2	-6	-14	-22	-30	-38	-45	-54	-62	-70	-78	-85	-93	-102

Wind Chill (in °F) = 35.74 + 0.6215*T* - 35.75(0.16*V*) + 0.4275T(0.16*V*); where ***T*** = air temperature in °F, and ***V*** = wind speed in mph
Wind chill factors of -18°F or below: Frostbite occurs in 15 minutes of exposure or less.

HEAT INDEX (in degrees Fahrenheit—°F)

HUMIDITY	70°	75°	80°	85°	90°	95°	100°	105°	110°
0%	64	69	73	78	83	87	91	95	99
10%	65	70	75	80	85	90	95	100	105
20%	66	72	77	82	87	93	99	105	112
30%	67	73	78	84	90	96	104	113	123
40%	68	74	79	86	93	101	110	123	137
50%	69	75	81	88	96	107	120	135	150
60%	70	76	82	90	100	114	132	149	
70%	70	77	85	93	106	124	144	163	
80%	71	78	86	97	113	136	157	180	
90%	71	79	88	102	122	150	170	199	
100%	72	80	91	108	133	166	184		

Heat index 85 - 90: A significant amount of people feel uncomfortable.
Heat index 90 - 104: Sunstroke, heat cramps and heat exhaustion possible with above average exposure and strenuous physical activity.
Heat index 105 - 129: Sunstroke, heat cramps, or heat exhaustion likely. Heatstroke probable with above average exposure and strenuous physical activity.
Heat index 130 or higher: Heatstroke or sunstroke very likely.

SPARKCHARTS™
Contributor: Dennis Quinio
Design: Dan O. Williams
Illustration: Dan O. Williams
Series Editors: Sarah Friedberg, Justin Kestler
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