MEASUREMENTS & CONVERSIONS

A Complete Guide

RUNNING PRESS

GEM

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Foreword

Measurements are used to help establish the size of something. How far is it to the Moon? What is the page size of this book? How strong is the wind? So that these questions may be answered, many standards of measurement have been developed, encompassing things as diverse as radio wavelengths, wind speeds, earthquakes, and laundry codes. Different standards have been created around the world, and units based on both the US units/UK imperial and metric systems of measurement are now encountered. As a result, knowledge is needed of how to convert values from one system to another. The simple need to measure has created a complex web of units that now affects every aspect of life.

Measurements & Conversions is a uniquely useful guide to this world of measures. The book is divided into twelve sections, each providing essential information on the main units of measurement or features of a particular topic. When relevant, individual sections have conversion formulas, e.g. for metric and US units/UK imperial conversion equivalents, with conversion tables to provide immediate visual reference.

Measurements & Conversions is an indispensable, handy-sized guide to the international variety in units of measurement. It is an essential companion, whether for school, office, or home.

Contents

How to use this book

Measurements & Conversions is divided into 12 sections, each of which is devoted to a particular category of facts and figures. If you know which category you wish to explore, merely turn to the table of contents to find the relevant page number.

Unit conversion index

In this book, there are tables for converting units from the US units/UK imperial system of measurement to the metric system (and vice versa), and for converting one type of unit to another within the same system. The Unit Conversion Index enables you to refer quickly to the tables in which a particular unit is converted.

Formulas

Within each section, you will find a selection of conversion formulas. These are easy-to-use formulas for common conversions; you will need to use a calculator for most of them, although many are simple, approximate conversions.

Conversion tables

Each group of units has its conversion tables: pages of quick-reference tables for all US units/UK imperial and metric measurements from meters to feet, grains to grams. These are particularly handy if you do not have a calculator. It would be impossible to accommodate tables listing every possible conversion, so the material included is not exhaustive.

You can use the following to convert figures larger than those in the table:

(a) separate the total into its parts: e.g., to convert 1,536

units of something, first convert the largest part in the table (1,000) and then each remaining part (500, 30, and 6). Then add these separate conversions together to find the total conversion; or

(b) move the decimal point in your original figure until it is at the same decimal place as those in the table. Look for the nearest number to this in the table and record the appropriate conversion. Then move the decimal point the same number of places in the opposite direction to give an approximate conversion of your original number.

Note also that the figures in the conversion tables are rounded up or down to the third decimal place, and so are not always exact.

Unit conversion index

Glossary

acre A measure of land: originally the amount of land that a yoke of oxen could plough in a day. Equal to 4,840 yd^2.

amu *see* Atomic mass unit.

ampere (A) The unit for measuring electric current.

ångström (Å) A unit of length, used mainly to measure the wavelength of light. Named for the Swedish physicist A.J. Ångström (1814–74). Equal to 10^{-10} m (10^{-8} cm).

apothecaries' system A system of weights used especially by pharmacists.

are (a) A unit of measure equal to an area of 10 × 10 m (1 a = 100 m^2). *See also* Hectare (ha): 100 a = 1 ha.

astronomical unit (au or AU) A unit of measure based on the distance between the Earth and the Sun. Approximately equal to 1.5×10^8 km.

atomic mass unit (amu)

chemical A unit of mass equal to 1/16 of the weighted mass of the three naturally occurring neutral oxygen isotopes.
1 amu chemical = $(1.660 \pm 0.00005) \times 10^{-27}$ kg.
Formerly called the atomic weight unit.

international A unit of mass equal to 1/12 of the mass of a neutral carbon-12 atom. 1 amu international = $(1.66033 \pm 0.00005) \times 10^{-27}$ kg.

physical A unit of mass equal to 1/16 of the mass of an oxygen atom. 1 amu physical = 1.660×10^{-27} kg.

atto- In the US, a prefix meaning a quintillionth (10^{-18}); in the UK, meaning a trillionth (10^{-18}). For example, in

the US, 1 attometer = 1 quintillionth of a meter, in the UK 1 attometer = 1 trillionth of a meter.
avoirdupois system A system of weights based on the 16-ounce pound and the 16-dram ounce.

baker's dozen A counting unit equal to 13.
barleycorn A unit of measure of length equal to ⅓ in.
billion (bil) In the US, equal to 10^9; in UK, equal to 10^{12}. Commonly now also used in the UK to mean 10^9.
bolt A measure of length, usually for fabric. In the US, a bolt of wallpaper equals 16 yd and a bolt of cloth equals 40 yd; in the UK, a bolt of cloth equals 42 yd.
British thermal unit (Btu) Measure of heat needed to raise the temperature of 1 lb of water by 1 °F. Equal to 252 calories.
bushel (bu) A measure of dry volume. In the US, 1 bu = 8 gal (64 US pt); in the UK, 1 bu = 8 gal (64 UK pt). The measures are not to be confused: 1.03 US bu = 1 UK bu.

caliber A unit of length used to measure the diameter of a tube or the bore of a firearm, in 1/100 in or 1/1000 in increments.
calorie (cal) A measure of heat energy representing the amount of heat needed to raise 1 g of water by 1 °C. Also called "small calorie": 1,000 cal = 1 kcal or Cal. *See also* Joule; Kilocalorie.
carat A unit of weight equal to 200 mg (3.1 grains). Also used as a measure of gold purity (per 24 parts gold alloy).
centi- Prefix meaning a 100 or 1/100; e.g., a centiliter (cl) is a unit of volume equal to 1/100 (0.01) liter.

centrad A measure of a plane angle, especially used to measure the angular deviation of light through a prism. 1 centrad = 1/100 (0.01) radian.
century A measure of time equal to 100 years.
chain A measure of length equal to 22 yd. Also known as Gunter's chain.

engineer's chain A measure of length equal to 100 ft.

nautical chain A measure of length equal to 15 ft.

square chain A measure of area equal to 484 yd^2.

chaldron A measure of volume. In the US, 1 chaldron = 36 US bu; in the UK, 1 chaldron = 36 UK bu (288 gal).
cord A unit of dry volume, especially used for timber. Equal to 128 ft^3.
cubic units (cu or ^{3}) These are arrived at by multiplying a number by itself twice. With a three dimensional object, the height, width, and length are multiplied togther to give its volume, which is measured in cubic units.
cubit A unit of length approximately equal to 18 in. Originally based on the distance from the tip of the middle finger to the elbow.
cup A measure of volume (either liquid or solid) used especially in cooking. In the US, 1 cup = ½ US pt (16 tbsp); in the UK, 1 cup = ½ UK pt (16 tbsp). The two should not be confused: 1⅛ US cups = 1 UK cup.

day

mean solar day A measure of time representing the interval between consecutive passages of the Sun across the meridian, averaged over 1 year.

1 day = 24 hr (86,400 s).

sidereal day A measure of time approximately equal to 23 hr, 56 min, 4.09 s. A sidereal day represents the time needed for one complete rotation of the Earth on its axis.

deca- Prefix meaning ten; e.g., a decameter is a measure of length equal to 10 m.

decade A measure of time equal to 10 years.

deci- Prefix meaning $\frac{1}{10}$; e.g., a deciliter (dl) is a measure of liquid volume equal to $\frac{1}{10}$(0.01) liter.

decibel (dB) A measure of relative sound intensity.

deka- *see* Deca-.

degree (°)

geometrical A unit of measure of plane angle equal to $\frac{1}{360}$ of the circumference of a circle (1 circle = 360°).

temperature A measure of temperature difference representing a single division on the temperature scale. The centigrade scale has 100 equal degrees; the Fahrenheit scale has 212 equal degrees.

digit One of ten Arabic symbols representing numbers 0 to 9. Also used in astronomy as a unit of measure equal to $\frac{1}{12}$ the diameter of the Sun or Moon. Used in ancient Egypt as a measure of length: 1 digit = 1 finger width.

douzieme A unit of length equal to $\frac{1}{12}$ line.

dozen A counting unit equal to 12.

drachm A unit of mass in the apothecaries' system. 1 drachm = $\frac{1}{8}$ apothecaries' ounce (60 grains).

dram (dr) A unit of mass equal to $\frac{1}{16}$ oz.

fluid dram A unit of liquid volume. In the US, 1 fl dr = $\frac{1}{8}$ US fl oz; in the UK, 1 fl dr = $\frac{1}{8}$ UK fl oz. The two should not be confused: 0.960759 US fl dr = 1 UK fl dr.

dry Used in US to distinguish measures of dry (solid) volume as opposed to liquid (fluid) volume. For example, in the US, 1 fl pt = ⅛ US gal; 1 dry pt = 1/64 US bu. 1 US dry pt ≈ 0.969 UK pt ≈ 1.163 US fl pt. In the UK, the pint measures both dry and liquid volume.
dyne A unit of force equal to that needed to produce acceleration of 1 cm per second in a mass of 1 g. Replaced by the newton (N): 1 dyne = 10^{-5} N.

electronvolt (eV) A unit of energy measurement representing the energy acquired by an electron in passing through a potential difference of 1 volt. 1 eV = $(1.6 \pm 0.00007) \times 10^{-19}$ J.
erg A unit of energy measurement equal to the energy produced by a force of 1 dyne through a distance of 1 cm. Replaced by the joule, 1 erg = 10^{-7} J.
exa- In the US, a prefix meaning 1 quintillion (10^{18}); in the UK, meaning 1 trillion (10^{18}).

fathom (fm) Unit of length, especially used to measure marine depth. 1 fm = 6 ft. Originally based on the span of two outstretched arms.
feet per minute A unit of velocity representing the number of feet traveled in 1 min.
femto- In the US, a prefix meaning 1 quadrillionth (10^{-15}); in the UK, meaning 1 thousand billionth (10^{-15}).
firkin A unit of volume, used especially to measure beer or ale. In the US, 1 firkin = 9.8 US gal; in the UK, 1 firkin = 9 UK gal.
fluid Used to distinguish units of liquid (fluid) volume as opposed to dry (solid) volume.
fluid dram *see* Dram.

fluid ounce *see* Ounce.
foot (ft) A unit of length equal to 12 in.
furlong (fur) Unit of length equal to ⅛ mi (660 ft).

gallon (gal) A unit of liquid volume. In the US, 1 gal = 8 US pt; in the UK, 1 gal = 8 UK pt. The two should not be confused: 1.2 US gal = 1 UK gal.

Winchester wine gallon (WWG) A unit of volume used for wine, honey, or other liquids. Equal to 0.83 UK gal.

gauge A unit of length used to measure the diameter of a shotgun bore; e.g., 6-gauge equals 23.34 mm. Originally based on the number of balls, of certain size, contained in 1 lb of shot.
giga- In the US, a prefix meaning 1 billion (10^9); in the UK, meaning 1 thousand million (10^9). For example, in the US, 1 gigameter = 1 billion meters; in the UK, 1 gigameter = 1 thousand million meters.
gill A unit of liquid volume. In the US (gi), 1 gi = ¼ US fl pt; in UK, 1 gill = ¼ UK pt. The two should not be confused: ½ US gi = 1 UK gill.
grade (g) A measure of plane angle in geometry. $1^g = 0.9°$.
grain (gr) A unit of mass measurement, used especially in the apothecaries' system. 1 grain = $\frac{1}{7,000}$ lb (avoirdupois); 480 grains = 1 ounce troy; 24 grains = 1 pennyweight.
gram (g) A unit of mass or volume measurement. 1 g = 0.001 kg.
gross A counting measure equal to 144 (or 12 dozen).

hand A unit of length, used especially to measure horses' height. 1 hand = 4 in.
hectare (ha) A measure of area, usually of land, equal to 10,000 m^2.
hecto- Prefix meaning 100; e.g., a hectometer (hm) is a unit of length equal to 100 m.
hertz (Hz) A unit of frequency measurement equal to 1 cycle per second.
horsepower (hp) A unit of work representing the power needed to raise 550 lb by 1 ft in 1 s.
metric horsepower A unit of power representing that needed to raise a 75-kg mass 1 m in 1 s.
hour (hr) A unit of time measurement equal to 60 min (3,600 s).
hundredweight (cwt) A unit of mass.
1 hundredweight = 4 quarters; 1 hundredweight troy = 100 pounds troy
long (UK) hundredweight (cwt) 1 hundredweight =112 lb.
short (US) hundredweight (sh cwt)
1 short hundredweight = 100 lb.

inch (in) A unit of length equal to 1/12 ft.
inches per second A unit of velocity representing the number of inches traveled in 1 s.

joule (J) A unit of energy equal to the work done when a force of 1 newton is moved through a distance of 1 m. Used instead of calorie: 1 J = 0.239 cal. Named for J.P. Joule (1818–89).

keg A unit of volume, used especially for beer,

approximately equal to 30 gal. Also used as a measure of weight for nails, equal to 100 lb.
kelvin (K) A scale of temperature measurement in which each degree is equal to $\frac{1}{273.16}$ of the interval between 0 K (absolute zero) and the triple point of water. K = °C + 273.16. Named for William Thomson, Lord Kelvin (1824–1907).
kilo- Prefix meaning 1,000; e.g., a kilogram (kg) is a unit of volume measurement equal to 1,000 g.
kilocalorie (kcal or Cal) A unit of energy measurement representing the amount of heat required to raise 1 kg of water by 1 °C. Also called the "international calorie." 1 kcal = 1,000 cal. *See also* Calorie.
kilogram *see* Kilo-
kilometer (km) A unit of length equal to 1,000 m.
kiloparsec A unit of distance used to measure distance between galactic bodies. 1 kiloparsec = 3,260 light years (ly).
kilowatt (kW) A unit of power equal to 1,000 watts (W).
kilowatt-hour (kWh) A unit of energy equal to the energy expended when a power of 1 kW is used for 1 hr.
knot (kn) A nautical unit of speed measurement equal to the velocity at which 1 n mi is traveled in 1 hr. 1 kn = 6,076 ft per hour.

lakh An Indian counting unit equal to 100,000.
lambda (λ) A unit of volume measurement. 1 λ = 1 microliter (10^{-6} liter).
league A unit of length equal to 3 mi.
light year (ly) A unit of length (distance) representing the distance traveled by electromagnetic waves (light)

through space in 1 year. 1 light year = 9.4605×10^{12} km (or, in the US, 6 trillion miles; in the UK, 6 billion miles).

line A unit of length equal to 1/12 in; 4 lines = 1 barleycorn. It can also be used to measure button diameters, when 1 line = 1/40 in.

liter (l) A unit of volume measurement equal to the volume of 1 kg of water at its maximum density. 1 liter = 1,000 cm^3.

magnum A measure of volume, used especially for wine or champagne. In the US, 1 magnum = 2/5 US gal; in the UK, 1 magnum = 2/5 UK gal.

mega- Prefix meaning 1 million; e.g., a megaton is a unit of weight equal to 1 million tons.

megahertz (MHz) A unit of frequency (for radio) equal to 1 million cycles per second.

meter (m) A unit of length equal to 100 cm.

meters per minute (m/min) A unit of velocity measurement representing the number of meters traveled in 1 min.

metric system A system of measurement based on the meter.

micro- Prefix meaning 1 millionth; e.g., a microliter is a unit of volume equal to 1 millionth of a liter.

micron (μm) A unit of length equal to 1/1,000 (0.001) mm. Also called the micrometer.

mile (mi) A unit of length equal to 1,760 yd. Also called the statute mile in the UK.

nautical mile (n mi) A unit of length used in navigation. In the UK, 1 n mi = 6,080 ft; in the metric system, 1 n mi (international) = 1,852 m.

Also called the geographical mile.

sea mile A unit of length distinguished from the nautical mile. 1 sea mile = 1,000 fathoms (6,000 ft).

miles per hour (mph) A unit of velocity representing the number of miles traveled in 1 hr.

millennium A period of time equal to 1,000 years.

milli- Prefix meaning 1 thousandth or $\frac{1}{1,000}$; e.g., 1 millimeter (mm) is a unit of length equal to $\frac{1}{1,000}$ (0.001) m.

minim A unit of volume, usually for liquids. In the US, 1 minim = $\frac{1}{480}$ US fl oz; in the UK, 1 minim = $\frac{1}{480}$ UK fl oz. The two should not be confused: 0.961 US minim = 1 UK minim.

minute

geometric (′) A unit of measure for plane angles. $1' = \frac{1}{60}°$.

time (m or min) A unit of time measurement equal to 60 s. 60 min = 1 hr.

month

lunar A unit of time equal to 4 weeks (2,419,200 s).

sidereal *see* Year, sidereal.

tropical *see* Year, tropical.

nano- In the US, a prefix meaning 1 billionth (10^{-9}); in the UK, meaning 1 thousand millionth (10^{-9}). For example, in the US, 1 nanometer = 1 billionth of a meter; in the UK, 1 nanometer = 1 thousand millionth of a meter.

nautical mile *see* Mile.

newton (N) A unit of force equal to that creating an acceleration of 1 m per second when applied to a mass of 1 kg. This unit has replaced the dyne:

1 N = 10^5 dynes. Named for Isaac Newton (1642–1727).

ohm (Ω) A unit of electrical resistance. One ohm equals the resistance across which a potential difference of 1 volt produces a current flow of 1 ampere. Named for G.S. Ohm (1787–1854).

ounce (oz) A unit of mass equal to 1/16 lb.

fluid ounce A unit of liquid volume measurement. In the US, 1 fl oz = 1/16 US pt; in the UK, 1 fl oz = 1/20 UK pt.

metric ounce A unit of mass equal to 25 g. Also called a Mounce.

ounce troy A unit of mass in the troy system. Equal to 1/12 pound troy.

pace A unit of length/distance equal to 5 ft, used in ancient Rome.

palm A unit of length used in ancient Egypt, equal to the width of an average palm of the hand (4 digits).

parsec (pc) A unit of length used for measuring astronomical distances. 1 parsec = 3.26 light years (ly).

pascal (pa) A unit of pressure equal to the force of 1 N acting over an area of 1 m^2.

peck (pk) A unit of dry volume. In the US, 1 peck = 2 US gal; in the UK, 1 peck = 2 UK gal. The two should not be confused: 1.032 US peck ≈ 1 UK peck.

pennyweight (dwt) A unit of weight in the troy system equal to 1/20 ounce troy (25 grains).

perch A unit of length equal to 5½ yd. Also called a pole or a rod.

peta- In the US, a prefix meaning 1 quadrillion (10^{15});

in the UK, meaning 1 thousand billion (10^{15}).
pi (π) Symbol and name representing the ratio of a circle's circumference to its diameter. Its value is approximately 3.14.
pica A unit of length, used by printers, approximately equal to ⅙ in.
pico- In the US, a prefix meaning 1 trillionth (10^{-12}); in the UK, a prefix meaning 1 billionth (10^{-12}). For example, in the US, 1 picometre = 1 trillionth of a metre; in the UK, 1 picometre = 1 billionth of a metre.
pint (pt) A unit of volume. In the US, two kinds of pint are used: 1 fl pt = ¼ US gal. In the UK, a pint measures either dry or liquid volume: 1 pt = ⅛ UK gal; 1/64 US bu = 1 dry pt. These two should not be confused: 1.2 US fl pt ≈ 1.03 US dry pt ≈ 1 UK pt.
point A unit of length, used especially by printers, approximately equal to 1/72 in.
pole Unit of length equal to 5½ yd. *See also* Perch; Rod.
pound (lb) A unit of mass equal to 453.59 g.
force pound A unit of force equal to 32.174 poundals. Also called pound-force.
pound troy (lb tr) A unit of mass in the troy system. 1 pound troy = 12 ounces troy.
poundal A unit of force equal to that needed to give an acceleration of 1 ft per second to a mass of 1 lb.
PSI Pounds per square inch: a unit for measuring pressure. 1 PSI equals the pressure resulting from a force of 1 force pound acting over an area of 1 in^2. *See also* Pound.

quart (qt) A unit of volume, usually for liquids. In the US, 1 qt = 2 US fl pt; in the UK, 1 qt = 2 UK pt. The

two should not be confused: 1.2 US qt ≈ 1 UK qt.

dry quart (dry qt) A unit of measure for dry (solid) volume in US.

reputed quart A unit of volume, used especially for wine, equal to ⅙ of a Winchester wine gallon.

Winchester quart A unit of fluid volume equal to 2.5 liters.

quarter (qr)

mass quarter A unit of mass. In the US, 1 quarter = ¼ US ton (500 lb); in the UK, 1 quarter = ¼ UK hundredweight (28 lb).

quarter troy (qr tr) A unit of weight equal to 25 troy pounds.

volume quarter A unit of volume, in the US, equal to 8.24 US bu. In the UK, equal to 8 UK bu.

quintal (q) A unit of mass equal to 100 kg or 100 lb. Called the short hundredweight in the US.

rad A short form of radian, a unit of measure for plane angles. *See also* Centrad.

ream A unit of volume, used to measure paper in bulk. 1 ream equals about 500 sheets.

rod

area rod A unit of area equal to 30¼ yd^2. Also called a square perch or a square pole.

length rod A unit of length equal to 5½ yd. *See also* Perch; Pole.

rood A unit of area equal to ¼ acre (1210 yd^2).

score A counting unit equal to 20.

scruple A unit of mass in apothecaries' system equal to 20 grains.

second A unit of time equal to 1/60 minute.

geometric (′) A measure of plane angle equal to 1/360° and 1/60″

orbital A unit of time equal to 1/31,557 of the tropical year 1900. Also called Ephemeris second.

sidereal A unit of time equal to 1/86,400 of the interval needed for one complete rotation of the Earth on its axis.

square units (sq or ^{2}) These are arrived at by multiplying a number by itself once. To find the area of, e.g. a square or rectangle, length and width are multiplied together to give the area, which is measured in square units.

stere A unit of volume, especially used for measuring timber. 1 stere = 1 m^3.

stone (st) A unit of mass used in the UK. 1 st = 14 lb.

tablespoon (tbsp) A unit of volume used in cooking and equal to 1.5 centiliters (3 tsp). 16 tbsp = 1 cup.

teaspoon (tsp) A unit of volume used in cooking and equal to 0.5 centiliter. 3 tsp = 1 tbsp.

tera- In the US, a prefix meaning 1 trillion (10^{12}); in the UK, meaning 1 billion (10^{12}). For example, *in the US, 1 terameter = 1 trillion meters; in the UK, 1* terameter = 1 billion meters.

ton A unit of mass. In the US, 1 ton = 2,000 lb. Called a short ton in the UK. In the UK, 1 ton = 2,240 lb. Called a long ton in the US.

ton troy (ton tr) A unit of mass equal to 2,000 pounds troy.

tonne (t) A unit of mass equal to 1,000 kg. Also called a metric ton.

tonne of coal equivalent A measure of energy production/consumption based on the premise that 1 tonne of coal provides 8,000 kilowatt-hours (kWh) of energy.
trillion In US, equal to 10^{12}; in UK, equal to 10^{18}.
troy system A system of mass measurement based on the 20-ounce pound and the 20-pennyweight ounce.

volt (V) A unit of electromotive force and potential difference. Equal to the difference in potential between two points of a conducting wire carrying a constant current of 1 ampere (A), when the power released between the points is 1 watt (W). Named for Alessandro Volta (1745–1827).

watt (W) A unit of power equal to that available when 1 J of energy is expended in 1 s.
1 W = 1 volt-ampere; 746 W = 1 horsepower (hp).
Named for James Watt (1736–1819).

X-unit (x or XU) A unit of length used especially for measuring wavelength. 1 x-unit ≈ 10^{-3} ångström (10^{-13} m).

yard (yd) A unit of length equal to 3 ft (36 in).
yards per minute (ypm) A unit of velocity representing the number of yards traveled in 1 min.
year A unit of time measurement determined by the revolution of the Earth around the Sun.

- **anomalistic year** Equals the time interval between two consecutive passages of the Earth through its perihelion (365 days, 6 hr, 13 min, 53 s).

sidereal year Equals the time in which it takes the Earth to revolve around the Sun from one fixed point (usually a star) back to the same point (365 days, 6 hr, 9 min, 9 s).

tropical year Equals the time interval between two consecutive passages of the Sun, in one direction, through the Earth's equatorial plane (or from vernal equinox to vernal equinox; 365 days, 5 hr, 48 min, 46 s).

Unit sytems

International System of Units

The International System of Units (or Système International d'Unités – SI) is the current form of the metric system that has been in use since 1960. In the US, the SI system is increasingly used in education, science, and in everyday life.

The table opposite shows the common conversions from the metric to the US system of units.

Base units

There are seven base units in SI:

Unit	Symbol	Quantity
meter	m	length/distance
kilogram	kg	mass
ampere	A	electric current
kelvin	K	thermodynamic temperature
candela	cd	luminosity
second	s (or sec)	time
mole	mol	amount of substance

Prefixes to use with SI units

Prefixes are added to each of the base units to indicate multiples and submultiples of ten:

Submultiple/ multiple	Prefix	Symbol
10^{-6}	micro-	r
10^{-3}	milli-	m
10^{-2}	centi-	c
10^{-1}	deci-	d
10	deca-	da
10^{2}	hecto-	h
10^{3}	kilo-	k
10^{6}	mega-	M

Derived units

In addition, the SI system uses derived units. For example, velocity is given in meters per second (m/s, ms^{-1}). Other derived units in SI are referred to by special names: the watt (W) is a unit of power; the joule (J) is a unit of energy; and the newton (N) is a unit of force.

Common conversions

Metric	US
Length	
1 millimeter (mm)	0.039 in.
1 centimeter (cm)	0.394 in.
1 meter (m)	3.281 ft = 1.094 yd
1 kilometer (km)	1094 yd = 0.621 mi
Area	
1 square millimeter (mm^2)	0.015 $in.^2$
1 square centimeter (cm^2)	0.155 $in.^2$
1 square meter (m^2)	10.764 ft^2 = 1.196 yd^2
1 hectare (ha)	2.471 acres = 0.00386 mi^2
1 square kilometer (km^2)	0.386 mi^2
Volume	
1 cubic centimeter (cm^3)	0.061 $in.^3$
1 cubic meter (m^3)	35.315 ft^3 = 1.308 yd^3 = 227.020 dry gal = 264 fl gal
1 milliliter (ml)	0.034 fl oz
1 centiliter (cl)	0.338 fl oz
1 liter (l)	2.113 fl pt = 1.056 fl qt = 0.264 fl gal
Weight	
1 gram (g)	0.035 oz
1 kilogram (kg)	2.205 lb = 35.28 oz
1 tonne (t)	1.102 tons = 2204.623 lb

1: Numbers

Named numbers

Many numbers have names. Some of these names are in everyday use, others apply in more specialized areas such as music and multiple births and for sums of money. Some names for specialized numbers have the same first part (prefix). These prefixes indicate the number to which the name refers.

Everyday use

1/10	Tithe
2	Pair, couple, brace
6	Half a dozen
12	Dozen
13	Baker's dozen
20	Score
50	Half century
100	Century
144	Gross

Musicians

1	Soloist
2	Duet
3	Trio
4	Quartet
5	Quintet
6	Sextet
7	Septet
8	Octet

Multiple births

2	Twins
3	Triplets
4	Quadruplets (quads)
5	Quintuplets (quints)
6	Sextuplets

Slang for money

1¢	Penny
5¢	Nickel
10¢	Dime
25¢	Quarter, two bits
$1	Buck

Numerical prefixes

Prefixes in numerical order

$^1/_{10}$	Deci-	**7**	Hept-, hepta-, sept-, septi-, septem-
$^1/_2$	Semi-, hemi-, demi-	**8**	Oct-, octa-, octo-
1	Uni-	**9**	Non-, nona-, ennea-
2	Bi-, di-	**10**	Dec-, deca-, deka-
3	Tri-, ter-	**11**	Hendeca-, undec-, undeca-
4	Tetra-, tetr-, tessera-, quadri-, quadr-	**12**	Dodeca-
5	Pent-, penta-, quinqu-, quinque-, quint-	**15**	Quindeca-
6	Sex-, sexi-, hex-, hexa-	**20**	Icos-, icosa-, icosi-

Prefixes in alphabetical order

Bi-,	**2**	Pent-, penta-	**5**
Dec-, deca-, deka-	**10**	Quadr-, quadri-	**4**
Deci-	$^1/_{10}$	Quindeca-	**15**
Demi-	$^1/_2$	Quinqu-, quinque-	**5**
Di-	**2**	Quint-	**5**
Dodeca-	**12**	Semi-	$^1/_2$
Ennea-	**9**	Sept-, septem-, septi-	**7**
Hemi-	$^1/_2$	Sex-, sexi-	**6**
Hendeca-	**11**	Ter-	**3**
Hept-, Hepta-	**7**	Tessera-	**4**
Hex-, hexa-	**6**	Tetr-, tetra-	**4**
Icos-, icosa-, icosi-	**20**	Tri-	**3**
Non-, nona-	**9**	Undec-, undeca-	**11**
Oct-, octa-, octo-	**8**	Uni-	**1**

Prefixes and their values

Prefixes in order of value	Value
*Atto-	**0.000000000000000001**
*Femto-	**0.000000000000001**
*Pico-	**0.000000000001**
*Nano-	**0.000000001**
*Micro-	**0.000001**
*Milli-	**0.001**
*Centi-	**0.01**
*Deci-	**0.1**
Semi-, hemi-, demi-	**0.5**
Uni-	**1**
Bi-, di-	**2**
Tri-, ter-	**3**
Tetra-, tetr-, tessera-, quadri-, quadr-	**4**
Pent-, penta-, quinqu-, quinque-, quint-	**5**
Sex-, sexi-, hex-, hexa-	**6**
Hept-, hepta-, sept-, septi-, septem-	**7**

* approved for use with the SI system

Prefixes in order of value	Value
Oct-, octa-, octo-	**8**
Non-, nona-, ennea-	**9**
Dec-, deca-, deka-	**10**
Hendeca-, undec-, undeca-	**11**
Dodeca-	**12**
Quindeca-	**15**
Icos-, icosa-, icosi-	**20**
Hect-, hecto-	**100**
*Kilo-	**1,000**
Myria-	**10,000**
*Mega-	**1,000,000**
*Giga-	**1,000,000,000**
*Tera-	**1,000,000,000,000**
*Peta-	**1,000,000,000,000,000**
*Exa-	**1,000,000,000,000,000,000**

Historic number systems

Different civilizations have developed their own systems for writing numbers. Here we show numerals from eight such systems.

	Roman	Arabic	Chinese	Hindu
1	I	١	一	੧
2	II	٢	二	੨
3	III	٣	三	੩
4	IV	٤	四	੪
5	V	٥	五	੫
6	VI	٦	六	੬
7	VII	٧	七	੭
8	VIII	٨	八	੮
9	IX	٩	九	੯
10	X	١٠	十	੧੦
50	L	٥٠	五十	੫੦
100	C	١٠٠	百	੧੦੦
500	D	٥٠٠	五百	੫੦੦
1000	M	١٠٠٠	千	੧੦੦੦

Babylonian	Egyptian	Hebrew	Japanese
𒁹	𓏺	א	一
𒁹𒁹	𓏺𓏺	ב	二
𒁹𒁹𒁹	𓏺𓏺𓏺	ג	三
𒁹𒁹𒁹 𒁹	𓏺𓏺𓏺𓏺	ד	四
𒁹𒁹𒁹 𒁹𒁹	𓏺𓏺𓏺 𓏺𓏺	ה	五
𒁹𒁹𒁹 𒁹𒁹𒁹	𓏺𓏺𓏺 𓏺𓏺𓏺	ו	六
𒁹𒁹𒁹 𒁹𒁹𒁹 𒁹	𓏺𓏺𓏺𓏺 𓏺𓏺𓏺	ז	七
𒁹𒁹𒁹 𒁹𒁹𒁹 𒁹𒁹	𓏺𓏺𓏺𓏺 𓏺𓏺𓏺𓏺	ח	八
𒁹𒁹𒁹 𒁹𒁹𒁹 𒁹𒁹𒁹	𓏺𓏺𓏺 𓏺𓏺𓏺 𓏺𓏺𓏺	ט	九
𒌋	𓎆	י	十
𒌋𒌋𒌋𒌋𒌋	𓎆𓎆𓎆 𓎆𓎆	נ	五十
𒁹𒌋𒌋𒌋𒌋	𓍢	ק	百
𒁹𒁹𒁹𒁹𒌋	𓍢𓍢𓍢 𓍢𓍢	תק	五百
𒁹 𒌋𒁹	𓆼	אלף	千

Roman number system

The Roman numeral system is a method of notation in which the capitals are modeled on ancient Roman inscriptions. The numerals are represented by seven capital letters of the alphabet:

I one
V five
X ten
L fifty
C one hundred
D five hundred
M one thousand

These letters are the foundation of the system; they are combined in order to form all numbers. If a letter is preceded by another of lesser value (e.g., IX), the value of the combined form is the difference between the values of each letter (e.g., IX = X (10) - I (1) = 9).

To determine the value of a string of Roman numbers (letters), find the pairs in the string (those beginning with a lower value) and determine their values, then add these to the values of the other letters in the string:

MCMXCI = M+CM+XC+I = 1,000+900+90+1 = 1991

A dash over a letter multiplies the value by 1,000 (e.g. $\overline{V}$ = 5,000).

1 I	12 XII	35 XXXV	100 C
2 II	13 XIII	40 XL	200 CC
3 III	14 XIV	45 XLV	300 CCC
4 IV or IIII	15 XV	50 L	400 CD
5 V	16 XVI	55 LV	500 D
6 VI	17 XVII	60 LX	600 DC
7 VII	18 XVIII	65 LXV	700 DCC
8 VIII	19 XIX	70 LXX	800 DCCC
9 IX	20 XX	75 LXXV	900 CM
10 X	25 XXV	80 LXXX	1000 M
11 XI	30 XXX	90 XC	2000 MM

Mathematical symbols

+	plus or positive	≥	greater than or equal to
−	minus or negative	≤	less than or equal to
±	plus or minus, positive or negative	≫	much greater than
×	multiplied by	≪	much less than
÷	divided by	√	square root
=	equal to	∞	infinity
≡	identically equal to	∝	proportional to
≠	not equal to	Σ	sum of
≢	not identically equal to	Π	product of
≈	approximately equal to	Δ	difference
∼	of the order of or similar to	∴	therefore
>	greater than	∠	angle
<	less than	∥	parallel to
≯	not greater than	⊥	perpendicular to
≮	not less than	:	is to

Arithmetic operations

The four basic arithmetic operations are addition, subtraction, multiplication, and division. Each part of an arithmetic operation has a specific name.

Addition

29 Addend
+6 Addend
35 Sum

Subtraction

74 Minuend
-16 Subtrahend
58 Difference

Multiplication

46 Multiplicand
x9 Multiplier
414 Product

Division

Divisor
3 Quotient
13)44 Dividend
39
5 Remainder

Fraction

5/8 5 Numerator, 8 Denominator

Simple (or vulgar) fraction

9/7 9 Numerator, 7 Denominator

Binary numbers

The binary system is formulated on a base of 2, or on a sum of powers of 2. For example, the number 101011 is equal to $2^5 + 0 + 2^3 + 0 + 2^1 + 2^0$; in the decimal system, this number equals 43. The system is used frequently in computer applications.

In describing computer storage, 1 bit = 1 binary digit; 1 byte = 8 bits in most systems; 1 megabyte (MB) = 1,048,576 bytes. The table below shows other decimal/binary equivalents.

Decimal	Binary	Decimal	Binary
1	1	**21**	10101
2	10	**30**	11110
3	11	**40**	101000
4	100	**50**	110010
5	101	**60**	111100
6	110	**90**	1011010
7	111	**100**	1100100
8	1000	**200**	11001000
9	1001	**300**	100101100
10	1010	**400**	110010000
11	1011	**500**	111110100
12	1100	**600**	1001011000
13	1101	**900**	1110000100
14	1110	**1,000**	1111101000
15	1111	**2,000**	11111010000
16	10000	**4,000**	111110100000
17	10001	**5,000**	1001110001000
18	10010	**10,000**	10011100010000
19	10011	**20,000**	100111000100000
20	10100	**100,000**	11000011010100000

Computer coding systems

ASCII (American Standard Code for Information Interchange) is an international coding system of character representation. Its 256 codes represent computer commands and letters of the alphabet. Hexadecimal is a system of numbering based on 16 digits (as opposed to 10 in the decimal system): 1 to 9 and A to F.

Binary, ASCII, and hexadecimal systems are used in computer programming.

The table below shows character equivalents in decimal, hexadecimal, and ASCII systems.

Dec	Hex	ASCII
000	00	NUL
001	01	SOH
002	02	STX
003	03	ETX
004	04	EOT
005	05	ENQ
006	06	ACK
007	07	BEL
008	08	BS
009	09	HT
010	0A	LF
011	0B	VT
012	0C	FF
013	0D	CR
014	0E	SO
015	0F	SI

Dec	Hex	ASCII
016	10	DLE
017	11	DC1
018	12	DC2
019	13	DC3
020	14	DC4
021	15	NAK
022	16	SYN
023	17	ETB
024	18	CAN
025	19	EM
026	1A	SUB
027	1B	ESCAPE
028	1C	FS
029	1D	GS
030	1E	RS
031	1F	US

Dec	Hex	ASCII
032	20	SPACE
033	21	!
034	22	"
035	23	#
036	24	$
037	25	%
038	26	&
039	27	'
040	28	(
041	29	)
042	2A	*
043	2B	+
044	2C	,
045	2D	–
046	2E	.
047	2F	/
048	30	0
049	31	1
050	32	2
051	33	3
052	34	4
053	35	5
054	36	6
055	37	7
056	38	8

Dec	Hex	ASCII
057	39	9
058	3A	:
059	3B	;
060	3C	<
061	3D	=
062	3E	>
063	3F	?
064	40	@
065	41	A
066	42	B
067	43	C
068	44	D
069	45	E
070	46	F
071	47	G
072	48	H
073	49	I
074	4A	J
075	4B	K
076	4C	L
077	4D	M
078	4E	N
079	4F	O
080	50	P
081	51	Q

Dec	Hex	ASCII
082	52	R
083	53	S
084	54	T
085	55	U
086	56	V
087	57	W
088	58	X
089	59	Y
090	5A	Z
091	5B	[
092	5C	\
093	5D	]
094	5E	^
095	5F	_
096	60	`
097	61	a
098	62	b
099	63	c
100	64	d
101	65	e
102	66	f
103	67	g
104	68	h
105	69	i
106	6A	j

Dec	Hex	ASCII
107	6B	k
108	6C	l
109	6D	m
110	6E	n
111	6F	o
112	70	p
113	71	q
114	72	r
115	73	s
116	74	t
117	75	u
118	76	v
119	77	w
120	78	x
121	79	y
122	7A	z
123	7B	{
124	7C	|
125	7D	}
126	7E	~
127	7F	DEL

Fractions, decimals and percentages

Fraction					Decimal	Percentage
$^{1}/_{9}$					0.111111	11.11%
$^{1}/_{7}$					0.142857	14.29%
$^{1}/_{6}$					0.166667	16.67%
$^{1}/_{5}$					0.2	20.00%
$^{2}/_{9}$					0.222222	22.22%
$^{2}/_{7}$					0.285714	28.58%
$^{3}/_{9}$		$^{2}/_{6}$		$^{1}/_{3}$	0.333333	33.33%
$^{2}/_{5}$					0.4	40.00%
$^{3}/_{7}$					0.428571	42.86%
$^{4}/_{9}$					0.444444	44.44%
$^{3}/_{6}$					0.5	50.00%
$^{5}/_{9}$					0.555555	55.56%
$^{4}/_{7}$					0.571429	57.14%
$^{3}/_{5}$					0.6	60.00%
$^{6}/_{9}$		$^{4}/_{6}$		$^{2}/_{3}$	0.666666	66.67%
$^{5}/_{7}$					0.714286	71.43%
$^{7}/_{9}$					0.777778	77.78%
$^{4}/_{5}$					0.8	80.00%
$^{5}/_{6}$					0.833333	83.33%
$^{6}/_{7}$					0.857143	85.71%
$^{8}/_{9}$					0.888889	88.89%
$^{9}/_{9}$	$^{7}/_{7}$	$^{6}/_{6}$	$^{5}/_{5}$	$^{3}/_{3}$	1	100%

Fraction	Decimal	Percentage
$^{1}/_{64}$	0.015625	1.56%
$^{2}/_{64}$ $^{1}/_{32}$	0.03125	3.13%
$^{3}/_{64}$	0.046875	4.69%
$^{4}/_{64}$ $^{2}/_{32}$ $^{1}/_{16}$	0.0625	6.25%
$^{5}/_{64}$	0.078125	7.81%
$^{6}/_{64}$ $^{3}/_{32}$	0.09375	9.38%
$^{7}/_{64}$	0.109375	10.94%
$^{8}/_{64}$ $^{4}/_{32}$ $^{2}/_{16}$ $^{1}/_{8}$	0.125	12.50%
$^{9}/_{64}$	0.140625	14.06%
$^{10}/_{64}$ $^{5}/_{32}$	0.15625	15.63%
$^{11}/_{64}$	0.171875	17.19%
$^{12}/_{64}$ $^{6}/_{32}$ $^{3}/_{16}$	0.1875	18.75%
$^{13}/_{64}$	0.203125	20.31%
$^{14}/_{64}$ $^{7}/_{32}$	0.21875	21.88%
$^{15}/_{64}$	0.234375	23.44%
$^{16}/_{64}$ $^{8}/_{32}$ $^{4}/_{16}$ $^{2}/_{8}$ $^{1}/_{4}$	0.25	25.00%
$^{17}/_{64}$	0.265625	26.56%
$^{18}/_{64}$ $^{9}/_{32}$	0.28125	28.13%
$^{19}/_{64}$	0.296875	29.69%
$^{20}/_{64}$ $^{10}/_{32}$ $^{5}/_{16}$	0.3125	31.25%
$^{21}/_{64}$	0.328125	32.81%
$^{22}/_{64}$ $^{11}/_{32}$	0.34375	34.38%

Fractions, decimals and percentages (continued)

Fraction	Decimal	Percentage
$^{23}/_{64}$	0.359375	35.94%
$^{24}/_{64}$ $^{12}/_{32}$ $^{6}/_{16}$ $^{3}/_{8}$	0.375	37.50%
$^{25}/_{64}$	0.390625	39.06%
$^{26}/_{64}$ $^{12}/_{32}$	0.40625	40.63%
$^{27}/_{64}$	0.421875	42.19%
$^{28}/_{64}$ $^{14}/_{32}$ $^{7}/_{16}$	0.4375	43.75%
$^{29}/_{64}$	0.453125	45.31%
$^{30}/_{64}$ $^{15}/_{32}$	0.46875	46.88%
$^{31}/_{64}$	0.484375	48.44%
$^{32}/_{64}$ $^{16}/_{32}$ $^{8}/_{16}$ $^{4}/_{8}$ $^{2}/_{4}$ $^{1}/_{2}$	0.5	50.00%
$^{33}/_{64}$	0.515625	51.56%
$^{34}/_{64}$ $^{17}/_{32}$	0.53125	53.13%
$^{35}/_{64}$	0.546875	54.69%
$^{36}/_{64}$ $^{18}/_{32}$ $^{9}/_{16}$	0.5625	56.25%
$^{37}/_{64}$	0.578125	57.81%
$^{38}/_{64}$ $^{19}/_{32}$	0.59375	59.37%
$^{39}/_{64}$	0.609375	60.94%
$^{40}/_{64}$ $^{20}/_{32}$ $^{10}/_{16}$ $^{5}/_{8}$	0.625	62.50%
$^{41}/_{64}$	0.640625	64.06%
$^{42}/_{64}$ $^{21}/_{32}$	0.65625	65.63%
$^{43}/_{64}$	0.671875	67.19%
$^{44}/_{64}$ $^{22}/_{32}$ $^{11}/_{16}$	0.6875	68.75%

Fraction	Decimal	Percentage
$^{45}/_{64}$	0.703125	70.31%
$^{46}/_{64}$ $^{23}/_{32}$	0.71875	71.88%
$^{47}/_{64}$	0.734375	73.44%
$^{48}/_{64}$ $^{24}/_{32}$ $^{12}/_{16}$ $^{6}/_{8}$ $^{3}/_{4}$	0.75	75.00%
$^{49}/_{64}$	0.765625	76.56%
$^{50}/_{64}$ $^{25}/_{32}$	0.78125	78.13%
$^{51}/_{64}$	0.796875	79.69%
$^{52}/_{64}$ $^{26}/_{32}$ $^{13}/_{16}$	0.8125	81.25%
$^{53}/_{64}$	0.828125	82.81%
$^{54}/_{64}$ $^{27}/_{32}$	0.84375	84.38%
$^{55}/_{64}$	0.859375	85.94%
$^{56}/_{64}$ $^{28}/_{32}$ $^{14}/_{16}$ $^{7}/_{8}$	0.875	87.50%
$^{57}/_{64}$	0.890625	89.06%
$^{58}/_{64}$ $^{29}/_{32}$	0.90625	90.63%
$^{59}/_{64}$	0.921875	92.19%
$^{60}/_{64}$ $^{30}/_{32}$ $^{15}/_{16}$	0.9375	93.75%
$^{61}/_{64}$	0.953125	95.31%
$^{62}/_{64}$ $^{31}/_{32}$	0.96875	96.88%
$^{63}/_{64}$	0.984375	98.44%
$^{64}/_{64}$ $^{32}/_{32}$ $^{16}/_{16}$ $^{8}/_{8}$ $^{4}/_{4}$ $^{2}/_{2}$	1	100%

Prime numbers

These are whole numbers that have only two factors – the number itself and the number 1. The only even prime number is 2: all other prime numbers are odd.

There are an infinite number of prime numbers. The first 126 are given below. The number at the foot of the table is the largest prime known in 1952. The largest prime known in 1983 has 39,751 digits.

2	47	109	191	269	353	439	523	617
3	53	113	193	271	359	443	541	619
5	59	127	197	277	367	449	547	631
7	61	131	199	281	373	457	557	641
11	67	137	211	283	379	461	563	643
13	71	139	223	293	383	463	569	647
17	73	149	227	307	389	467	571	653
19	79	151	229	311	397	479	577	659
23	83	157	233	313	401	487	587	661
29	89	163	239	317	409	491	593	673
31	97	167	241	331	419	499	599	677
37	101	173	251	337	421	503	601	683
41	103	179	257	347	431	509	607	691
43	107	181	263	349	433	521	613	701

170141183460469231731687303715884105727

Fibonacci sequence

Each number in a Fibonacci sequence is the sum of the two numbers preceding it. The sequence can therefore be built up using simple addition. Below is an example of a Fibonacci sequence.

0+1 = **1**	987+610 = **1,597**
1+1 = **2**	1,597+987 = **2,584**
2+1 = **3**	2,584+1,597 = **4,181**
3+2 = **5**	4,181+2,584 = **6,765**
5+3 = **8**	6,765+4,181 = **10,946**
8+5 = **13**	10,946+6,765 = **17,711**
13+8 = **21**	17,711+10,946 = **28,657**
21+13 = **34**	28,657+17,711 = **46,368**
34+21 = **55**	46,368+28,657 = **75,025**
55+34 = **89**	75,025+46,368 = **121,393**
89+55 = **144**	121,393+75,025 = **196,418**
144+89 = **233**	196,418+121,393 = **317,811**
233+144 = **377**	317,811+196,418 = **514,229**
377+233 = **610**	514,229+317,811 = **832,040**
610+377 = **987**	832,040+514,229 = **1,346,269**

Square and cube roots

*Accurate to 3 decimal places – they have not been rounded up or down.

Square and cube* roots of 1 to 25		
	$\sqrt{}$	$\sqrt[3]{}$
1	1.000	1.000
2	1.414	1.259
3	1.732	1.442
4	2.000	1.587
5	2.236	1.709
6	2.449	1.817
7	2.645	1.912
8	2.828	2.000
9	3.000	2.080
10	3.162	2.154
11	3.316	2.223
12	3.464	2.289
13	3.605	2.351
14	3.741	2.410
15	3.873	2.466
16	4.000	2.519
17	4.123	2.571
18	4.242	2.620
19	4.358	2.668
20	4.472	2.714
21	4.582	2.758
22	4.690	2.802
23	4.795	2.843
24	4.899	2.884
25	5.000	2.924

Square and cube* roots of 26 to 50		
	$\sqrt{}$	$\sqrt[3]{}$
26	5.099	2.962
27	5.196	3.000
28	5.291	3.036
29	5.385	3.072
30	5.477	3.107
31	5.567	3.141
32	5.656	3.174
33	5.744	3.207
34	5.831	3.239
35	5.916	3.271
36	6.000	3.301
37	6.082	3.332
38	6.164	3.361
39	6.245	3.391
40	6.324	3.419
41	6.403	3.448
42	6.480	3.476
43	6.557	3.503
44	6.633	3.530
45	6.708	3.556
46	6.782	3.583
47	6.855	3.608
48	6.928	3.634
49	7.000	3.659
50	7.071	3.684

Square and cube* roots of 51 to 75

	$\sqrt{}$	$\sqrt[3]{}$
51	7.141	3.708
52	7.211	3.732
53	7.280	3.756
54	7.348	3.779
55	7.416	3.802
56	7.483	3.825
57	7.549	3.848
58	7.615	3.870
59	7.681	3.893
60	7.746	3.913
61	7.810	3.936
62	7.874	3.957
63	7.937	3.979
64	8.000	4.000
65	8.062	4.020
66	8.124	4.041
67	8.185	4.061
68	8.246	4.081
69	8.306	4.101
70	8.366	4.121
71	8.426	4.140
72	8.485	4.160
73	8.544	4.179
74	8.602	4.198
75	8.660	4.217

Square and cube* roots of 76 to 100

	$\sqrt{}$	$\sqrt[3]{}$
76	8.717	4.235
77	8.775	4.254
78	8.831	4.272
79	8.888	4.290
80	8.944	4.308
81	9.000	4.326
82	9.055	4.344
83	9.110	4.362
84	9.165	4.379
85	9.219	4.396
86	9.273	4.414
87	9.327	4.431
88	9.380	4.447
89	9.434	4.464
90	9.486	4.481
91	9.539	4.497
92	9.591	4.514
93	9.643	4.530
94	9.695	4.546
95	9.746	4.562
96	9.798	4.578
97	9.848	4.594
98	9.899	4.610
99	9.949	4.626
100	10.000	4.641

Multiplication tables

	×2
1	2
2	4
3	6
4	8
5	10
6	12
7	14
8	16
9	18
10	20
11	22
12	24
13	26
14	28
15	30
16	32
17	34
18	36
19	38
25	50
35	70
45	90
55	110
65	130
75	150
85	170
95	190

	×3
1	3
2	6
3	9
4	12
5	15
6	18
7	21
8	24
9	27
10	30
11	33
12	36
13	39
14	42
15	45
16	48
17	51
18	54
19	57
25	75
35	105
45	135
55	165
65	195
75	225
85	255
95	285

	×4
1	4
2	8
3	12
4	16
5	20
6	24
7	28
8	32
9	36
10	40
11	44
12	48
13	52
14	56
15	60
16	64
17	68
18	72
19	76
25	100
35	140
45	180
55	220
65	260
75	300
85	340
95	380

	×5
1	5
2	10
3	15
4	20
5	25
6	30
7	35
8	40
9	45
10	50
11	55
12	60
13	65
14	70
15	75
16	80
17	85
18	90
19	95
25	125
35	175
45	225
55	275
65	325
75	375
85	425
95	475

	×6
1	6
2	12
3	18
4	24
5	30
6	36
7	42
8	48
9	54
10	60
11	66
12	72
13	78
14	84
15	90
16	96
17	102
18	108
19	114
25	150
35	210
45	270
55	330
65	390
75	450
85	510
95	570

	×7
1	7
2	14
3	21
4	28
5	35
6	42
7	49
8	56
9	63
10	70
11	77
12	84
13	91
14	98
15	105
16	112
17	119
18	126
19	133
25	175
35	245
45	315
55	385
65	455
75	525
85	595
95	665

	×8
1	8
2	16
3	24
4	32
5	40
6	48
7	56
8	64
9	72
10	80
11	88
12	96
13	104
14	112
15	120
16	128
17	136
18	144
19	152
25	200
35	280
45	360
55	440
65	520
75	600
85	680
95	760

	×9
1	9
2	18
3	27
4	36
5	45
6	54
7	63
8	72
9	81
10	90
11	99
12	108
13	117
14	126
15	135
16	144
17	153
18	162
19	171
25	225
35	315
45	405
55	495
65	585
75	675
85	765
95	855

	×10
1	10
2	20
3	30
4	40
5	50
6	60
7	70
8	80
9	90
10	100
11	110
12	120
13	130
14	140
15	150
16	160
17	170
18	180
19	190
25	250
35	350
45	450
55	550
65	650
75	750
85	850
95	950

	×11
1	11
2	22
3	33
4	44
5	55
6	66
7	77
8	88
9	99
10	110
11	121
12	132
13	143
14	154
15	165
16	176
17	187
18	198
19	209
25	275
35	385
45	495
55	605
65	715
75	825
85	935
95	1,045

Multiplication tables (continued)

×12	
1	12
2	24
3	36
4	48
5	60
6	72
7	84
8	96
9	108
10	120
11	132
12	144
13	156
14	168
15	180
16	192
17	204
18	216
19	228
25	300
35	420
45	540
55	660
65	780
75	900
85	1,020
95	1,140

×13	
1	13
2	26
3	39
4	52
5	65
6	78
7	91
8	104
9	117
10	130
11	143
12	156
13	169
14	182
15	195
16	208
17	221
18	234
19	247
25	325
35	455
45	585
55	715
65	845
75	975
85	1,105
95	1,235

×14	
1	14
2	28
3	42
4	56
5	70
6	84
7	98
8	112
9	126
10	140
11	154
12	168
13	182
14	196
15	210
16	224
17	238
18	252
19	266
25	350
35	490
45	630
55	770
65	910
75	1,050
85	1,190
95	1,330

×15	
1	15
2	30
3	45
4	60
5	75
6	90
7	105
8	120
9	135
10	150
11	165
12	180
13	195
14	210
15	225
16	240
17	255
18	270
19	285
25	375
35	525
45	675
55	825
65	975
75	1,125
85	1,275
95	1,425

×16	
1	16
2	32
3	48
4	64
5	80
6	96
7	112
8	128
9	144
10	160
11	176
12	192
13	208
14	224
15	240
16	256
17	272
18	288
19	304
25	400
35	560
45	720
55	880
65	1,040
75	1,200
85	1,360
95	1,520

×17	
1	17
2	34
3	51
4	68
5	85
6	102
7	119
8	136
9	153
10	170
11	187
12	204
13	221
14	238
15	255
16	272
17	289
18	306
19	323
25	425
35	595
45	765
55	935
65	1,105
75	1,275
85	1,445
95	1,615

×18	
1	18
2	36
3	54
4	72
5	90
6	108
7	126
8	144
9	162
10	180
11	198
12	216
13	234
14	252
15	270
16	288
17	306
18	324
19	342
25	450
35	630
45	810
55	990
65	1,170
75	1,350
85	1,530
95	1,710

×19	
1	19
2	38
3	57
4	76
5	95
6	114
7	133
8	152
9	171
10	190
11	209
12	228
13	247
14	266
15	285
16	304
17	323
18	342
19	361
25	475
35	665
45	855
55	1,045
65	1,235
75	1,425
85	1,615
95	1,805

×20	
1	20
2	40
3	60
4	80
5	100
6	120
7	140
8	160
9	180
10	200
11	220
12	240
13	260
14	280
15	300
16	320
17	340
18	360
19	380
25	500
35	700
45	900
55	1,100
65	1,300
75	1,500
85	1,700
95	1,900

×21	
1	21
2	42
3	63
4	84
5	105
6	126
7	147
8	168
9	189
10	210
11	231
12	252
13	273
14	294
15	315
16	336
17	357
18	378
19	399
25	525
35	735
45	945
55	1,155
65	1,365
75	1,575
85	1,785
95	1,995

Multiplication grid

Below is a quick-reference grid giving products and quotients. It can be used for either multiplication or division.

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

Multiplication

To multiply 6 by 9, for example, scan down column six until you reach row nine. The number in the square where column six intersects row nine is the product, 54.

Division

To divide 56 by 8, scan down column eight to find 56 (the dividend) then scan across to find the row number. This is the quotient, 7.

Interest

Interest refers to the charge made for borrowing money or to payment given for investing money. It is usually expressed in terms of percentage rates. There are two types of interest: simple interest and compound interest.

Simple interest

This type of interest is calculated on the amount of money originally loaned (the principal). The formula used to calculate simple interest is:

$$I = \frac{P \times R \times T}{100}$$

I is interest, P is principal, R is the percentage rate per unit time, and T is the length of time (measured in units) over which the money is invested or loaned.

The final sum – or amount of money to which the principal will grow – is figured using the formula:

$$S\ (\text{sum}) = P\left(1 + \frac{R \times T}{100}\right)$$

Compound interest

Unlike simple interest, which is paid only on the principal, compound interest is paid also on the previous interest earned. Thus the sum – or amount to which the principal will grow – increases at a much faster rate than with simple interest.

Compound interest is figured using the formula:

$$S = P(1 + i)^n$$

The "i" represents the periodic interest; "n" is the number of periods.

Simple interest

Simple interest rates (in dollars) to add to $1000

	percent per annum			
Period	**2.5%**	**3%**	**3.5%**	**4%**
1 day	0.068	0.082	0.096	0.110
2 days	0.137	0.164	0.192	0.219
3 days	0.205	0.247	0.288	0.329
4 days	0.274	0.329	0.384	0.438
5 days	0.342	0.411	0.479	0.548
6 days	0.411	0.493	0.575	0.658
30 days	2.055	2.466	2.877	3.288
60 days	4.110	4.932	5.753	6.575
90 days	6.164	7.397	8.630	9.863
180 days	12.329	14.795	17.260	19.726
360 days	24.658	29.589	34.521	39.452
1 year	25.000	30.000	35.000	40.000

Simple interest (in dollars) added on to a principal of $100 percent per annum

Period	**7%**	**8%**	**9%**	**10%**
1 year	107.00	108.00	109.00	110.00
5 years	135.00	140.00	145.00	150.00
10 years	170.00	180.00	190.00	200.00
20 years	240.00	260.00	280.00	300.00
30 years	310.00	340.00	370.00	400.00
40 years	380.00	420.00	460.00	500.00
50 years	450.00	500.00	550.00	600.00

percent per annum

4.5%	5%	5.5%	6%	6.5%	7%
0.123	0.137	0.151	0.164	0.178	0.192
0.247	0.274	0.301	0.389	0.356	0.384
0.370	0.411	0.452	0.493	0.534	0.575
0.493	0.548	0.603	0.658	0.712	0.767
0.616	0.685	0.753	0.822	0.890	0.959
0.740	0.822	0.904	0.986	1.068	1.151
3.699	4.110	4.521	4.932	5.342	5.753
7.397	8.219	9.041	9.863	10.685	11.507
11.096	12.329	13.562	14.795	16.027	17.260
22.192	24.658	27.123	29.589	32.055	34.521
44.384	49.315	54.247	59.178	64.110	69.041
45.000	50.000	55.000	60.000	65.000	70.000

percent per annum

11%	12%	13%	14%	15%
111.00	112.00	113.00	114.00	115.00
155.00	160.00	165.00	170.00	175.00
210.00	220.00	230.00	240.00	250.00
320.00	340.00	360.00	380.00	400.00
430.00	460.00	490.00	520.00	550.00
540.00	580.00	620.00	660.00	700.00
650.00	700.00	750.00	800.00	850.00

Compound interest

The table below shows the compound interest paid (in dollars) on a principal of $100. The interest rate is in percent per annum.

Period	4%	5%	6%	7%
1 day	0.011	0.014	0.016	0.019
1 week	0.077	0.096	0.115	0.135
6 months	2.00	2.50	3.00	3.50
1 year	4.00	5.00	6.00	7.00
2 years	8.16	10.25	12.36	14.49
3 years	12.49	15.76	19.10	22.50
4 years	16.99	21.55	26.25	31.08
5 years	21.67	27.63	33.82	40.26
6 years	26.53	34.01	41.85	50.07
7 years	31.59	40.71	50.36	60.58
8 years	36.86	47.75	59.38	71.82
9 years	42.33	55.13	68.95	83.85
10 years	48.02	62.89	79.08	96.72

Comparing the two

Money grows much more quickly with compound interest than with simple interest. Compare, for example, the amount of time required for an amount of money to double itself with simple interest and with compound interest:

8%	9%	10%	12%	14%	16%
0.022	0.025	0.027	0.033	0.038	0.044
0.154	0.173	0.192	0.231	0.269	0.308
4.00	4.50	5.00	6.00	7.00	8.00
8.00	9.00	10.00	12.00	14.00	16.00
16.64	18.81	21.00	25.44	29.96	34.56
25.97	29.50	33.10	40.49	48.15	56.09
36.05	41.16	46.41	57.35	68.90	81.06
46.93	53.86	61.05	76.23	92.54	110.03
58.69	67.71	77.16	97.38	119.50	143.64
71.38	82.80	94.87	121.07	150.23	182.62
85.09	99.26	114.36	147.60	185.26	227.84
99.90	117.19	135.79	177.31	225.19	280.30
115.89	136.74	159.37	210.58	270.72	341.14

Rate	Simple	Compound
7%	14 yrs, 104 days	10 yrs, 89 days
10%	10 yrs	7 yrs, 100 days

2: Length and area

Formulas: length

Below are listed the multiplication/division factors for converting units of length from US units/UK imperial units to metric, and vice versa. Note that two kinds of factors are given: quick, for an approximate conversion that can be made without a calculator; and accurate, for an exact conversion.

Milli-inches (mils) Micrometers (μm)		**Quick**	**Accurate**
mils → μm		× 25	× 25.4
μm → mils		÷ 25	× 0.0394
Inches (in) Millimeters (mm)			
in → mm		× 25	× 25.4
mm → in		÷ 25	× 0.0394
Inches (in) Centimeters (cm)			
in → cm		× 2.5	× 2.54
cm → in		÷ 2.5	× 0.394
Feet (ft) Meters (m)			
ft → m		÷ 3.3	× 0.305
m → ft		× 3.3	× 3.281
Yards (yd) Meters (m)			
yd → m		÷ 1	× 0.914
m → *yd*		× 1	× 1.094

Fathoms (fm) Meters (m)		Quick	Accurate
fm → m		× 2	× 1.83
m → fm		÷ 2	× 0.547

Chains (ch) Meters (m)			
ch → m		× 20	× 20.108
m → ch		÷ 20	× 0.0497

Furlongs (fur) Meters (m)			
fur → m		× 200	× 201.17
m → fur		÷ 200	× 0.005

Yards (yd) Kilometers (km)			
yd → km		÷ 1000	× 0.00091
km → yd		× 1000	× 1093.6

Miles (mi) Kilometers (km)			
mi → km		× 1.5	× 1.609
km → mi		÷ 1.5	× 0.621

Nautical miles (n mi) Miles (mi)			
n mi → mi		× 1.2	× 1.151
mi → n mi		÷ 1.2	× 0.869

Nautical miles (n mi) Kilometers (km)			
n mi → km		× 2	× 1.852
km → n mi		÷ 2	× 0.54

Conversion tables: length

The tables below can be used to convert units of length from one measuring system to another. The first group of tables converts US units/UK imperial units to

Milli-inches to Micrometers

mils	µm
1	25.4
2	50.8
3	76.2
4	101.6
5	127.0
6	152.4
7	177.8
8	203.2
9	228.6
10	254.0
20	508.0
30	762.0
40	1,016.0
50	1,270.0
60	1,524.0
70	1,778.0
80	2,032.0
90	2,286.0
100	2,540.0

Inches to Millimeters

in	mm
1	25.4
2	50.8
3	76.2
4	101.6
5	127.0
6	152.4
7	177.8
8	203.2
9	228.6
10	254.0
20	508.0
30	762.0
40	1,016.0
50	1,270.0
60	1,524.0
70	1,778.0
80	2,032.0
90	2,286.0
100	2,540.0

Inches to Centimeters

in	cm
1	2.54
2	5.08
3	7.62
4	10.16
5	12.70
6	15.24
7	17.78
8	20.32
9	22.86
10	25.40
20	50.80
30	76.20
40	101.60
50	127.00
60	152.40
70	177.80
80	203.20
90	228.60
100	254.00

metric; the second, beginning on page 66, converts metric to US units/UK imperial.

Feet to Meters

ft	m
1	0.305
2	0.610
3	0.914
4	1.219
5	1.524
6	1.829
7	2.134
8	2.438
9	2.743
10	3.048
20	6.096
30	9.144
40	12.192
50	15.240
60	18.288
70	21.336
80	24.384
90	27.432
100	30.480

Yards to Meters

yd	m
1	0.914
2	1.829
3	2.743
4	3.658
5	4.572
6	5.486
7	6.401
8	7.315
9	8.230
10	9.144
20	18.288
30	27.432
40	36.576
50	45.720
60	54.864
70	64.008
80	73.152
90	82.296
100	91.440

Fathoms to Meters

fm	m
1	1.83
2	3.66
3	5.49
4	7.32
5	9.14
6	10.97
7	12.80
8	14.63
9	16.46
10	18.29
20	36.58
30	54.87
40	73.16
50	91.45
60	109.74
70	128.03
80	146.32
90	164.61
100	182.90

US units/UK imperial and metric units of length (continued)

Chains to Meters

ch	m
1	20.108
2	40.216
3	60.324
4	80.432
5	100.540
6	120.648
7	140.756
8	160.864
9	180.972
10	201.080
20	402.160
30	603.240
40	804.320
50	1,005.400
60	1,206.480
70	1,407.560
80	1,608.640
90	1,809.720
100	2,010.800

Furlongs to Meters

fur	m
1	201.17
2	402.34
3	603.50
4	804.67
5	1,005.84
6	1,207.01
7	1,408.18
8	1,609.34
9	1,810.51
10	2,011.68
20	4,023.36
30	6,035.04
40	8,046.72
50	10,058.40
60	12,070.08
70	14,081.76
80	16,093.44
90	18,105.12
100	20,116.80

Yards to Kilometers

yd	km
100	0.091
200	0.183
300	0.274
400	0.366
500	0.457
600	0.549
700	0.640
800	0.731
900	0.823
1,000	0.914
2,000	1.829
3,000	2.743
4,000	3.658
5,000	4.572
6,000	5.486
7,000	6.401
8,000	7.315
9,000	8.230
10,000	9.144

Miles to Kilometers

mi	km
1	1.609
2	3.219
3	4.828
4	6.437
5	8.047
6	9.656
7	11.265
8	12.875
9	14.484
10	16.093
20	32.187
30	48.280
40	64.374
50	80.467
60	96.561
70	112.654
80	128.748
90	144.841
100	160.934

Nautical miles to Miles

n mi	mi
1	1.151
2	2.302
3	3.452
4	4.603
5	5.754
6	6.905
7	8.055
8	9.206
9	10.357
10	11.508
20	23.016
30	34.523
40	46.031
50	57.539
60	69.047
70	80.554
80	92.062
90	103.570
100	115.078

Nautical miles to Kilometers

n mi	km
1	1.852
2	3.704
3	5.556
4	7.408
5	9.260
6	11.112
7	12.964
8	14.816
9	16.668
10	18.520
20	37.040
30	55.560
40	74.080
50	92.600
60	111.120
70	129.640
80	148.160
90	166.680
100	185.200

US units/UK imperial and metric units of length (continued)

Micrometers to Milli-inches

µm	mils
1	0.039
2	0.079
3	0.118
4	0.157
5	0.197
6	0.236
7	0.276
8	0.315
9	0.354
10	0.394
20	0.787
30	1.181
40	1.575
50	1.969
60	2.362
70	2.756
80	3.150
90	3.543
100	3.937

Millimeters to Inches

mm	in
1	0.039
2	0.079
3	0.118
4	0.157
5	0.197
6	0.236
7	0.276
8	0.315
9	0.354
10	0.394
20	0.787
30	1.181
40	1.575
50	1.969
60	2.362
70	2.756
80	3.150
90	3.543
100	3.937

Centimeters to Inches

cm	in
1	0.394
2	0.787
3	1.181
4	1.575
5	1.969
6	2.362
7	2.756
8	3.150
9	3.543
10	3.937
20	7.874
30	11.811
40	15.748
50	19.685
60	23.622
70	27.559
80	31.496
90	35.433
100	39.370

Meters to Feet

m	ft
1	3.281
2	6.562
3	9.843
4	13.123
5	16.404
6	19.685
7	22.966
8	26.247
9	29.528
10	32.808
20	65.617
30	98.425
40	131.234
50	164.042
60	196.850
70	229.659
80	262.467
90	295.276
100	328.084

Meters to Yards

m	yd
1	1.094
2	2.187
3	3 281
4	4.374
5	5.468
6	6.562
7	7.655
8	8.749
9	9.843
10	10.936
20	21.872
30	32.808
40	43.745
50	54.681
60	65.617
70	76.553
80	87.489
90	98.425
100	109.361

Meters to Fathoms

m	fm
1	0.547
2	1.093
3	1.640
4	2.187
5	2.734
6	3.280
7	3.827
8	4.374
9	4.921
10	5.467
20	10.935
30	16.402
40	21.870
50	27.337
60	32.805
70	38.272
80	43.740
90	49.207
100	54.674

US units/UK imperial and metric units of length (continued)

Meters to Chains

m	ch
1	0.0497
2	0.0994
3	0.1491
4	0.1989
5	0.2487
6	0.2983
7	0.3481
8	0.3979
9	0.4476
10	0.4973
20	0.9946
30	1.4919
40	1.9893
50	2.4866
60	2.9839
70	3.4812
80	3.9785
90	4.4758
100	4.9731

Meters to Furlongs

m	fur
1	0.005
2	0.010
3	0.015
4	0.020
5	0.025
6	0.030
7	0.035
8	0.040
9	0.045
10	0.050
20	0.099
30	0.149
40	0.199
50	0.249
60	0.298
70	0.348
80	0.398
90	0.447
100	0.497

Kilometers to Yards

km	yd
1	1,093.6
2	2,187.2
3	3,280.8
4	4,374.4
5	5,468.0
6	6,561.6
7	7,655.2
8	8,748.8
9	9,842.4
10	10,936.0
20	21,872.0
30	32,808.0
40	43,744.0
50	54,680.0
60	65,616.0
70	76,552.0
80	87,488.0
90	98,424.0
100	109,360.0

Kilometers to Miles

km	mi
1	0.621
2	1.243
3	1.864
4	2.485
5	3.107
6	3.728
7	4.350
8	4.971
9	5.592
10	6.214
20	12.427
30	18.641
40	24.855
50	31.069
60	37.282
70	43.496
80	49.710
90	55.923
100	62.137

Miles to Nautical miles

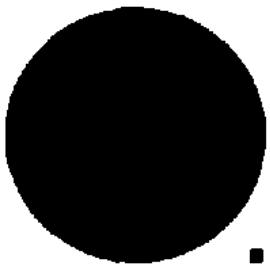
mi	n mi
1	0.869
2	1.738
3	2.607
4	3.476
5	4.349
6	5.214
7	6.083
8	6.952
9	7.821
10	8.690
20	17.380
30	26.069
40	34.759
50	43.449
60	52.139
70	60.828
80	69.518
90	78.208
100	86.900

Kilometers to Nautical miles

km	n mi
1	0.54
2	1.08
3	1.62
4	2.16
5	2.70
6	3.24
7	3.78
8	4.32
9	4.86
10	5.40
20	10.80
30	16.20
40	21.60
50	27.00
60	32.40
70	37.80
80	43.20
90	48.60
100	54.00

Formulas: area

Below are listed the multiplication/division factors for converting units of area from US units/UK imperial units to metric, and vice versa. Note that two kinds of factors are given: quick, for an approximate conversion that can be made without a calculator; and accurate, for an exact conversion.



Circular mils (cmil) Square micrometers (μm^2)		**Quick**	**Accurate**
cmil → μm^2		×500	×506.7
μm^2 → cmil		÷500	×0.002

Square inches (in^2) Square millimeters (mm^2)			
in^2 → mm^2		× 650	× 645.2
mm^2 → in^2		÷ 650	× 0.0015

Square inches (in^2) Square centimeters (cm^2)			
in^2 → cm^2		× 6.5	× 6.452
cm^2 → in^2		÷ 6.5	× 0.15

Square chains (ch^2) Square meters (m^2)			
ch^2 → m^2		× 400	× 404.686
m^2 → ch^2		÷ 400	× 0.0025

Square miles (mi^2)
Square kilometers (km^2)

		Quick	Accurate
mi^2 → km^2		× 2.5	× 2.590
km^2 → mi^2		÷ 2.5	× 0.386

Square miles (mi^2)
Hectares (ha)

		Quick	Accurate
mi^2 → ha		× 250	× 258.999
ha → mi^2		÷ 250	× 0.0039

Hectares (ha)
Acres

		Quick	Accurate
ha → acre		× 2.5	× 2.471
acre → ha		÷ 2.5	× 0.405

Square meters (m^2)
Square yards (yd^2)

		Quick	Accurate
m^2 → yd^2		× 1	× 1.196
yd^2 → m^2		÷ 1	× 0.836

Square meters (m^2)
Square feet (ft^2)

		Quick	Accurate
m^2 → ft^2		× 11	× 10.764
ft^2 → m^2		÷ 11	× 0.093

Conversion tables: area

The tables below can be used to convert units of area from one measuring system to another. The first group of tables converts US units/UK imperial units to

Circular mils to Square micrometers

cmil	μm²
1	506.7
2	1,013.4
3	1,520.1
4	2,026.8
5	2,533.5
6	3,040.2
7	3,546.9
8	4,053.6
9	4,560.3
10	5,067.0
20	10,134.0
30	15,201.0
40	20,268.0
50	25,335.0
60	30,402.0
70	35,469.0
80	40,536.0
90	45,603.0
100	50,670.0

Square inches to Square millimeters

in²	mm²
1	645.2
2	1,290.4
3	1,935.6
4	2,580.8
5	3,226.0
6	3,871.2
7	4,516.4
8	5,161.6
9	5,806.8
10	6,452.0
20	12,904.0
30	19,356.0
40	25,808.0
50	32,260.0
60	38,712.0
70	45,164.0
80	51,616.0
90	58,068.0
100	64,520.0

Square inches to Square centimeters

in²	cm²
1	6.452
2	12.903
3	19.355
4	25.806
5	32.258
6	38.710
7	45.161
8	51.613
9	58.064
10	64.516
20	129.032
30	193.548
40	258.064
50	322.580
60	387.096
70	451.612
80	516.128
90	580.644
100	645.160

metric; the second, beginning on page 75, converts metric to US units/UK imperial.

Square feet to Square meters

ft^2	m^2
1	0.093
2	0.186
3	0.279
4	0.372
5	0.465
6	0.557
7	0.650
8	0.743
9	0.836
10	0.929
20	1.858
30	2.787
40	3.716
50	4.645
60	5.574
70	6.503
80	7.432
90	8.361
100	9.290

Square yards to Square meters

yd^2	m^2
1	0 836
2	1.672
3	2.508
4	3.345
5	4.181
6	5.017
7	5.853
8	6.689
9	7.525
10	8.361
20	16.723
30	25.084
40	33.445
50	41.806
60	50.168
70	58.529
80	66.890
90	75.251
100	83.613

Square chains to Square meters

ch^2	m^2
1	404.686
2	809.372
3	1,214.058
4	1,618.744
5	2,023.430
6	2,428.116
7	2,832.802
8	3,237.488
9	3,642.174
10	4,046.860
20	8,093.720
30	12,140.580
40	16,187.440
50	20,234.300
60	24,281.160
70	28,328.020
80	32,374.880
90	36,421.740
100	40,468.600

US units/UK imperial and metric units of length (continued)

Acres to Hectares

acre	ha
1	0.405
2	0.809
3	1.214
4	1.619
5	2.023
6	2.428
7	2.833
8	3.237
9	3.642
10	4.047
20	8.094
30	12.141
40	16.187
50	20.234
60	24.281
70	28.328
80	32.375
90	36.422
100	40 469

Square miles to Hectares

mi^2	ha
1	258.999
2	517.998
3	776.997
4	1,035.996
5	1,294.995
6	1,553.994
7	1,812.993
8	2,071.992
9	2,330.991
10	2,589.990
20	5,179.980
30	7,769.970
40	10,359.960
50	12,949.950
60	15,539.940
70	18,129.930
80	20,719.920
90	23,309.910
100	25,899.900

Square miles to Square kilometers

mi^2	km^2
1	2.590
2	5.180
3	7.770
4	10.360
5	12.950
6	15.540
7	18.130
8	20.720
9	23.310
10	25.900
20	51.800
30	77.700
40	103.600
50	129.499
60	155.399
70	181.299
80	207.199
90	233.099
100	258.999

Square micrometers to Circular mils

μm^2	cmil
1	0.002
2	0.004
3	0.006
4	0.008
5	0.010
6	0.012
7	0.014
8	0.016
9	0.018
10	0.020
20	0.040
30	0.060
40	0.080
50	0.100
60	0.120
70	0.140
80	0.160
90	0.180
100	0.200

Square millimeters to Square inches

mm^2	in^2
1	0.0015
2	0.0031
3	0.0047
4	0.0062
5	0.0078
6	0.0093
7	0.0109
8	0.0124
9	0.0140
10	0.0155
20	0.0310
30	0.0465
40	0.0620
50	0.0775
60	0.0930
70	0.1085
80	0.1240
90	0.1395
100	0.1550

Square centimeters to Square inches

cm^2	in^2
1	0.155
2	0.310
3	0.465
4	0.620
5	0.775
6	0.930
7	1.085
8	1.240
9	1.395
10	1.550
20	3.100
30	4.650
40	6.200
50	7.750
60	9.300
70	10.850
80	12.400
90	13.950
100	15.500

US units/UK imperial and metric units of length (continued)

Square meters to Square feet

m^2	ft^2
1	10.764
2	21.528
3	32.292
4	43.056
5	53.820
6	64.583
7	75.347
8	86.111
9	96.875
10	107.639
20	215.278
30	322.917
40	430.556
50	538.196
60	645.835
70	753.474
80	861.113
90	968.752
100	1,076.391

Square meters to Square yards

m^2	yd^2
1	1.196
2	2.392
3	3.588
4	4.784
5	5.980
6	7.176
7	8.372
8	9.568
9	10.764
10	11.960
20	23.920
30	35.880
40	47.840
50	59.800
60	71.759
70	83.719
80	95.679
90	107.639
100	119.599

Square meters to Square chains

m^2	ch^2
1	0.002
2	0.004
3	0.006
4	0.008
5	0.010
6	0.012
7	0.014
8	0.016
9	0.018
10	0.020
20	0.040
30	0.060
40	0.080
50	0.100
60	0.120
70	0.140
80	0.160
90	0.180
100	0.200

Hectares to Acres

ha	acre
1	2.471
2	4.942
3	7.413
4	9.884
5	12.355
6	14.826
7	17.297
8	19.768
9	22.239
10	24.711
20	49.421
30	74.132
40	98.842
50	123.553
60	148.263
70	172.974
80	197.684
90	222.395
100	247.105

Hectares to Square miles

ha	mi^2
1	0.00386
2	0.00772
3	0.01158
4	0.01544
5	0.01931
6	0.02317
7	0.02703
8	0.03089
9	0.03475
10	0.03861
20	0.07722
30	0.11583
40	0.15444
50	0.19305
60	0.23166
70	0.27027
80	0.30888
90	0.34749
100	0.38610

Square kilometers to Square miles

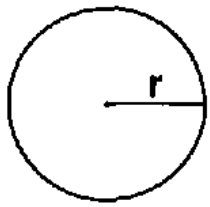
km^2	mi^2
1	0.386
2	0.772
3	1.158
4	1.544
5	1.931
6	2.317
7	2.703
8	3.089
9	3.475
10	3.861
20	7.722
30	11.583
40	15.444
50	19.305
60	23.166
70	27.027
80	30.888
90	34.749
100	38.610

Geometry of area

ABBREVIATIONS
a = length of top
b = length of base
h = perpendicular height
r = length of radius

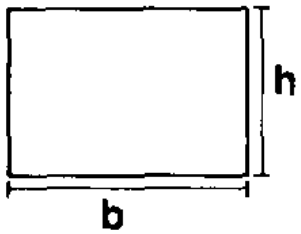
$$\pi = 3.1416$$

Circle



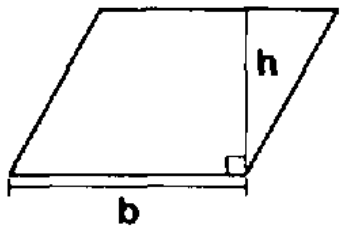
$$\pi \times r^2$$

Rectangle



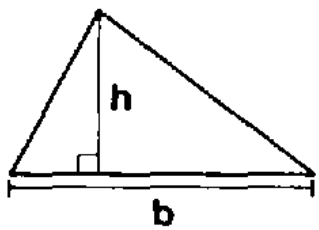
$$b \times h$$

Parallelogram



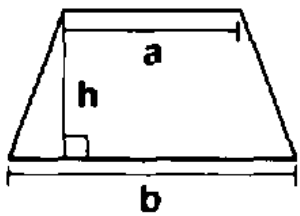
$$b \times h$$

Triangle



$$\frac{1}{2} \times b \times h$$

Trapezoid



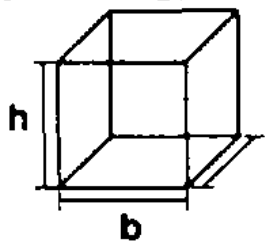
$$\frac{(a + b)\,h}{2}$$

Geometry of surface area

ABBREVIATIONS

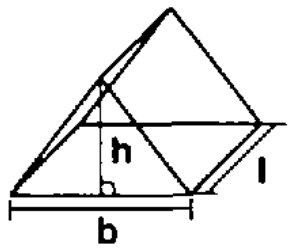
b = breadth of base
h = perpendicular height
l = length of base
r = length of radius

$$\pi = 3.1416$$



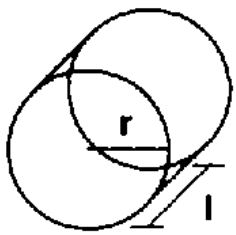
Cube

$$h \times b \times 6$$



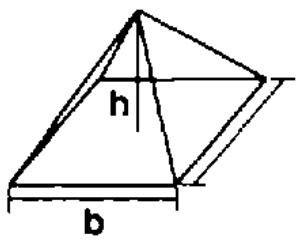
Prism

$$(b \times h) + (3 \times l \times b)$$



Cylinder

$$(2 \times \pi \times r \times l) + (2 \times \pi \times r^2)$$



Pyramid

$$(2 \times b \times h) + (b^2)$$

Sphere

$$4 \times \pi \times r^2$$

3: Volume

Formulas

Below are listed the multiplication/division factors for converting units of volume from one measuring system to another. Note that two kinds of factors are given: quick, for an approximate conversion that can be made without a calculator; and accurate, for an exact conversion.

			Quick	Accurate
1	1	US fluid gallons (fl gal) UK gallons (gal)		
		US fl gal → UK gal	÷ 1	× 0.833
		UK gal → US fl gal	× 1	× 1.201
1	1	US fluid quarts (fl qt) UK quarts (qt)		
		US fl qt → UK qt	÷ 1	× 0.833
		UK qt → US fl qt	× 1	× 1.201
1	1	US fluid pints (fl pt) UK pints (pt)		
		US fl pt → UK pt	÷ 1	× 0.833
		UK pt → US fl pt	× 1	× 1.201
1	1	US fluid ounces (fl oz) UK fluid ounces (fl oz)		
		US fl oz → UK fl oz	÷ 1	× 1.041
		UK fl oz → US fl oz	× 1	× 0.961
1	16	Cubic inches (in^3) Cubic centimeters (cm^3)		
		in^3 → cm^3	× 16	× 16.387
		cm^3 → in^3	÷ 16	× 0.061

1 35	Cubic meters (m^3) Cubic feet (ft^3)			
	m^3 ⟶ ft^3	× 35	× 35.315
	ft^3 ⟶ m^3	÷ 35	× 0.028
1 1	Cubic meters (m^3) Cubic yards (yd^3)			
	m^3 ⟶ yd^3	× 1	× 1.308
	yd^3 ⟶ m^3	÷ 1	× 0.765
1 30	US fluid ounces (fl oz) Milliliters (ml)			
	US fl oz ⟶ ml	× 30	× 29.572
	ml ⟶ US fl oz	÷ 30	× 0.034
1 4	US fluid gallons (fl gal) Liters (l)			
	US fl gal ⟶ l	× 4	× 3.785
	l ⟶ US fl gal	÷ 4	× 0.264
1 2	Liters (l) US fluid pints (fl pt)			
	l ⟶ US fl pt	× 2	× 2.113
	US fl pt ⟶ l	÷ 2	× 0.473
1 1	Liters (l) US fluid quarts (fl qt)			
	l ⟶ US fl qt	× 1	× 1.056
	US fl qt ⟶ l	÷ 1	× 0.947
1 264	Cubic meters (m^3) US fluid gallons (fl gal)			
	m^3 ⟶ US fl gal	× 264	× 264.173
	US fl gal ⟶ m^3	÷ 264	× 0.004

1 227	Cubic meters (m^3) US dry gallons (dry gal)	**Quick**	**Accurate**
	m^3 → dry gal	× 227	× 227.020
	dry gal → m^3	÷ 227	× 0.004
1 2	UK fluid ounces (fl oz) Cubic inches (in^3)		
	UK fl oz → in^3	× 2	× 1.734
	in^3 → UK fl oz	÷ 2	× 0.577
1 28	UK fluid ounces (fl oz) Milliliters (ml)		
	UK fl oz → ml	× 28	× 28.413
	ml → UK fl oz	÷ 28	× 0.035
1 1	UK quarts (qt) Liters (l)		
	UK qt → l	× 1	× 1.137
	l → UK qt	÷ 1	× 0.880
1 4.5	UK gallons (gal) Liters (l)		
	UK gal → l	× 4.5	× 4.546
	l → UK gal	÷ 4.5	× 0.220
1 2	Liters (l) UK pints (pt)		
	l → UK pt	× 2	× 1.760
	UK pt → l	÷ 2	× 0.568
1 220	Cubic meters (m^3) UK gallons (gal)		
	m^3 → UK gal	× 220	× 219.970
	UK gal → m^3	÷ 220	× 0.005

Conversion tables

The tables below can be used to convert units of volume from one measuring system to another. The first group of tables, beginning below, converts US units to UK imperial units; the second, beginning on page 85, converts UK imperial units to US units.

US fluid gallons to UK gallons

US fl gal	UK gal
1	0.833
2	1.665
3	2.498
4	3.331
5	4.164
6	4.998
7	5.829
8	6.662
9	7.494
10	8.327
20	16.654
30	24.981
40	33.308
50	41.635
60	49.962
70	58.289
80	66.616
90	74.943
100	83.270

US fluid quarts to UK quarts

US fl qt	UK qt
1	0.833
2	1.665
3	2.498
4	3.331
5	4.164
6	4.996
7	5.829
8	6.662
9	7.494
10	8.327
20	16.654
30	24.981
40	33.308
50	41.635
60	49.962
70	58.289
80	66.616
90	74.943
100	83.270

US units to UK imperial units conversions (continued)

US fluid pints to UK pints

US fl pt	UK pt
1	0.833
2	1.665
3	2.498
4	3.331
5	4.164
6	4.996
7	5.829
8	6.662
9	7.494
10	8.327
20	16.654
30	24.981
40	33.308
50	41.635
60	49.962
70	58.289
80	66.616
90	74.943
100	83.270

US fluid ounces to UK fluid ounces

US fl oz	UK fl oz
1	1.041
2	2.082
3	3.122
4	4.163
5	5.204
6	6.245
7	7.286
8	8.327
9	9.367
10	10.408
20	20.816
30	31.224
40	41.632
50	52.040
60	62.448
70	72.856
80	83.264
90	93.672
100	104.080

UK imperial units to US units conversions

The conversion tables below are used to convert UK imperial units of volume to US units; tables beginning on page 87 convert US units to metric units.

UK gallons to US fluid gallons

UK gal	US fl gal
1	1.201
2	2.402
3	3.603
4	4.804
5	6.005
6	7.206
7	8.407
8	9.608
9	10.809
10	12.010
20	24.020
30	36.030
40	48.040
50	60.050
60	72.060
70	84.070
80	96.080
90	108.090
100	120.100

UK quarts to US fluid quarts

UK qt	US fl qt
1	1.201
2	2.402
3	3.603
4	4.804
5	6.005
6	7.206
7	8.407
8	9.608
9	10.809
10	12.010
20	24.020
30	36.030
40	48.040
50	60.050
60	72.060
70	84.070
80	96.080
90	108.090
100	120.100

UK imperial to US units conversions (continued)

UK pints to US fluid pints

UK pt	US fl pt
1	1.201
2	2.402
3	3.603
4	4.804
5	6.005
6	7.206
7	8.407
8	9.608
9	10.809
10	12.010
20	24.020
30	36.030
40	48.040
50	60.050
60	72.060
70	84.070
80	96.080
90	108.090
100	120.100

UK fluid ounces to US fluid ounces

UK fl oz	US fl oz
1	0.961
2	1.922
3	2.882
4	3.843
5	4.804
6	5.765
7	6.726
8	7.686
9	8.647
10	9.608
20	19.216
30	28.824
40	38.432
50	48.040
60	57.648
70	67.256
80	76.864
90	86.472
100	96.080

US units to metric conversions

The conversion tables below are used to convert US units of volume to metric units; tables beginning on page 95 convert metric units to US units.

US fluid ounces to Milliliters

US fl oz	ml
1	29.572
2	59.145
3	88.717
4	118.289
5	147.862
6	177.434
7	207.006
8	236.579
9	266.152
10	295.724
20	591.447
30	887.171
40	1,182.894
50	1,478.618
60	1,774.341
70	2,070.065
80	2,365.788
90	2,661.512
100	2,957.235

US fluid pints to Liters

US fl pt	l
1	0.473
2	0.946
3	1.420
4	1.893
5	2.366
6	2.839
7	3.312
8	3.785
9	4.259
10	4.732
20	9.464
30	14.195
40	18.927
50	23.659
60	28.391
70	33.123
80	37.854
90	42.586
100	47.318

US fluid quarts to Liters

US fl qt	l
1	0.947
2	1.894
3	2.840
4	3.787
5	4.734
6	5.681
7	6.628
8	7.575
9	8.521
10	9.468
20	18.937
30	28.405
40	37.873
50	47.341
60	56.810
70	66.278
80	75.746
90	85.215
100	94.683

US units to metric conversions (continued)

US fluid gallons to Liters	
US fl gal	l
1	3.785
2	7.571
3	11.356
4	15.141
5	18.927
6	22.712
7	26.497
8	30.282
9	34.068
10	37.853
20	75.706
30	113.559
40	151.412
50	189.265
60	227.118
70	264.971
80	302.824
90	340.677
100	378.530

US fluid gallons to Cubic meters	
US fl gal	m^3
1	0.004
2	0.008
3	0.011
4	0.015
5	0.019
6	0.023
7	0.026
8	0.030
9	0.034
10	0.038
20	0.076
30	0.114
40	0.151
50	0.189
60	0.227
70	0.265
80	0.303
90	0.341
100	0.379

US dry gallons to Cubic meters	
US dry gal	m^3
1	0.004
2	0.009
3	0.013
4	0.018
5	0.022
6	0.026
7	0.031
8	0.035
9	0.040
10	0.044
20	0.088
30	0.132
40	0.176
50	0.220
60	0.264
70	0.308
80	0.352
90	0.396
100	0.440

Metric to US units conversions

The tables below convert metric units to US units.

Milliliters to US fluid ounces

ml	US fl oz
1	0.034
2	0.068
3	0.101
4	0.135
5	0.169
6	0.203
7	0.237
8	0.271
9	0.304
10	0.338
20	0.676
30	1.014
40	1.353
50	1.691
60	2.029
70	2.367
80	2.705
90	3.043
100	3.382

Liters to US fluid pints

l	US fl pt
1	2.113
2	4.227
3	6.340
4	8.454
5	10.567
6	12.680
7	14.794
8	16.907
9	19.020
10	21.134
20	42.268
30	63.401
40	84.535
50	105.669
60	126.803
70	147.937
80	169.070
90	190.204
100	211.338

Liters to US fluid quarts

l	US fl qt
1	1.056
2	2.112
3	3.168
4	4.225
5	5.281
6	6.337
7	7.393
8	8.449
9	9.505
10	10.562
20	21.123
30	31.685
40	42.246
50	52.808
60	63.369
70	73.931
80	84.493
90	95.054
100	105.616

Metric to US units conversions (continued)

Liters to US fluid gallons

l	US fl gal
1	0.264
2	0.528
3	0.793
4	1.057
5	1.321
6	1.585
7	1.849
8	2.113
9	2.378
10	2.642
20	5.283
30	7.925
40	10.567
50	13.209
60	15.850
70	18.492
80	21.134
90	23.775
100	26.417

Cubic meters to US fluid gallons

m^3	US fl gal
1	264.173
2	528.346
3	792.519
4	1,056.692
5	1,320.865
6	1,585.038
7	1,849.211
8	2,113.385
9	2,377.558
10	2,641.731
20	5,283.462
30	7,925.192
40	10,566.923
50	13,208.653
60	15,850.383
70	18,492.115
80	21,133.846
90	23,775.578
100	26,417.308

Cubic meters to US dry gallons

m^3	US dry gal
1	227.020
2	454.041
3	681.061
4	908.081
5	1,135.102
6	1,362.122
7	1,589.143
8	1,816.163
9	2,043.183
10	2,270.204
20	4,540.407
30	6,810.611
40	9,080.814
50	11,351.018
60	13,621.221
70	15,891.425
80	18,161.628
90	20,431.832
100	22,702.036

UK imperial to metric conversions

The conversion tables below are used to convert UK imperial units of volume to cubic units and metric units; tables beginning on page 94 convert metric units to UK imperial units.

UK fluid ounces to Cubic inches

UK fl oz	in^3
1	1.734
2	3.468
3	5.202
4	6.935
5	8 669
6	10.403
7	12.137
8	13.871
9	15.605
10	17.339
20	34.677
30	52.016
40	69.355
50	86.694
60	104.032
70	121.371
80	138.710
90	156.048
100	173.387

Cubic inches to Cubic centimeters

in^3	cm^3
1	16.387
2	32.774
3	49.161
4	65.548
5	81.935
6	98.322
7	114.709
8	131.096
9	147.484
10	163.871
20	327.741
30	491.612
40	655.482
50	819.353
60	983.224
70	1,147.094
80	1,310.965
90	1,474.835
100	1,638.706

Cubic feet to Cubic meters

ft^3	m^3
1	0.028
2	0.057
3	0.085
4	0.113
5	0.142
6	0.170
7	0.198
8	0.227
9	0.255
10	0.283
20	0.566
30	0.850
40	1.133
50	1.416
60	1.699
70	1.982
80	2.266
90	2.549
100	2.832

UK imperial to metric conversions (continued)

Cubic yards to Cubic meters

yd^3	m^3
1	0.765
2	1.529
3	2.294
4	3.058
5	3.823
6	4.587
7	5.352
8	6.116
9	6.881
10	7.646
20	15.291
30	22.937
40	30.582
50	38.228
60	45.873
70	53.519
80	61.164
90	68.810
100	76.455

UK gallons to Cubic meters

UK gal	m^3
1	0.005
2	0.009
3	0.014
4	0.018
5	0.023
6	0.027
7	0.032
8	0.036
9	0.041
10	0.045
20	0.091
30	0.136
40	0.182
50	0.227
60	0.273
70	0.318
80	0.364
90	0.409
100	0.455

UK gallons to Liters

UK gal	l
1	4.546
2	9.092
3	13.638
4	18.184
5	22.730
6	27.277
7	31.823
8	36.369
9	40.915
10	45.461
20	90.922
30	136.383
40	181.844
50	227.305
60	272.765
70	318.226
80	363.687
90	409.148
100	454.609

UK quarts to Liters

UK qt	l
1	1.137
2	2.273
3	3.410
4	4.546
5	5.683
6	6.819
7	7.956
8	9.092
9	10.229
10	11.365
20	22.730
30	34.096
40	45.461
50	56.826
60	68.191
70	79.556
80	90.922
90	102.287
100	113.652

UK pints to Liters

UK pt	l
1	0.568
2	1.137
3	1.705
4	2.273
5	2.841
6	3.410
7	3.978
8	4.546
9	5.114
10	5.683
20	11.365
30	17.048
40	22.730
50	28.413
60	34.096
70	39.778
80	45.461
90	51.143
100	56.826

UK fluid ounces to Milliliters

UK fl oz	ml
1	28.413
2	56.826
3	85.239
4	113.652
5	142.065
6	170.478
7	198.891
8	227.305
9	255.718
10	284.131
20	568.261
30	852.392
40	1,136.523
50	1,420.654
60	1,704.784
70	1,988.915
80	2,273.046
90	2,557.177
100	2,841.307

Metric to UK imperial conversions

The tables below convert metric units to UK imperial units.

Milliliters to UK fluid ounces

ml	UK fl oz
1	0.035
2	0.070
3	0.106
4	0.141
5	0.176
6	0.211
7	0.246
8	0.282
9	0.317
10	0.352
20	0.704
30	1.056
40	1.408
50	1.760
60	2.112
70	2.464
80	2.816
90	3.168
100	3.520

Liters to UK pints

l	UK pt
1	1.760
2	3.520
3	5.279
4	7.039
5	8.799
6	10.559
7	12.318
8	14.078
9	15.838
10	17.598
20	35.195
30	52.793
40	70.390
50	87.988
60	105.585
70	123.183
80	140.780
90	158.378
100	175.975

Liters to UK quarts

l	UK qt
1	0.880
2	1.760
3	2.640
4	3.520
5	4.399
6	5.279
7	6.159
8	7.039
9	7.919
10	8.799
20	17.598
30	26.396
40	35.195
50	43.994
60	52.793
70	61.591
80	70.390
90	79.189
100	87.988

Liters to UK gallons

l	UK gal
1	0.220
2	0.440
3	0.660
4	0.880
5	1.100
6	1.320
7	1.540
8	1.760
9	1.980
10	2.200
20	4.399
30	6.599
40	8.799
50	10.999
60	13.198
70	15.398
80	17.598
90	19.797
100	21.997

Cubic meters to UK gallons

m^3	UK gal
1	219.970
2	439.940
3	659.909
4	879.879
5	1,099.849
6	1,319.818
7	1,539.788
8	1,759.757
9	1,979.727
10	2,199.697
20	4,399.396
30	6,599 093
40	8,798.789
50	10,998.485
60	13,198.181
70	15,397.877
80	17,597.573
90	19,797.269
100	21,996.965

Cubic meters to Cubic feet

m^3	ft^3
1	35.315
2	70.629
3	105.944
4	141.259
5	176.573
6	211.888
7	247.203
8	282.517
9	317.832
10	353.147
20	706.293
30	1,059.440
40	1,412.587
50	1,765.734
60	2,118.880
70	2,472.027
80	2,825.174
90	3,178.320
100	3,531.467

Metric to UK imperial conversions (continued)

Cubic meters to Cubic yards

m^3	yd^3
1	1.308
2	2.616
3	3.924
4	5.232
5	6.540
6	7.848
7	9.156
8	10.464
9	11.772
10	13.080
20	26.159
30	39.239
40	52.318
50	65.398
60	78.477
70	91.557
80	104.636
90	117.716
100	130.795

Cubic centimeters to Cubic inches

cm^3	in^3
1	0.061
2	0.122
3	0.183
4	0.244
5	0.305
6	0.366
7	0.427
8	0.488
9	0.549
10	0.610
20	1.220
30	1.831
40	2.441
50	3.051
60	3.661
70	4.271
80	4.882
90	5.492
100	6.102

Cubic inches to UK fluid ounces

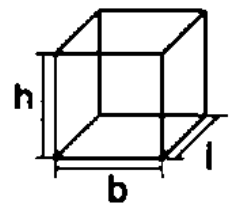
in^3	UK fl oz
1	0.577
2	1.153
3	1.730
4	2.307
5	2.884
6	3.460
7	4.037
8	4.614
9	5.191
10	5.767
20	11.535
30	17.302
40	23.069
50	28.837
60	34.604
70	40.371
80	46.138
90	51.906
100	57.673

Geometry of volume

ABBREVIATIONS

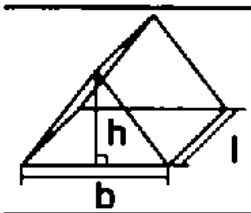
b = width of base
h = perpendicular height
l = length of base
r = length of radius

$$\pi = 3.1416$$



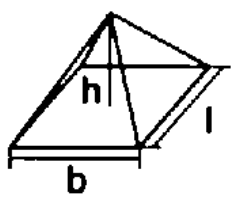
Cube or cuboid

$$b \times h \times l$$



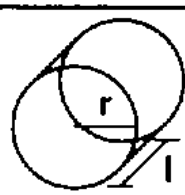
Prism

$$\frac{b \times h \times l}{2}$$



Pyramid

$$\frac{b \times h \times l}{3}$$

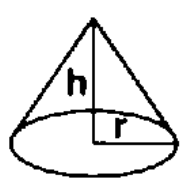


Cylinder

$$\pi \times r^2 \times l$$

Sphere

$$\frac{4 \times \pi \times r^3}{3}$$



Cone

$$\frac{\pi \times r^2 \times h}{3}$$

Cooking measures

Although the names of the units are often the same, US measures are slightly different from UK imperial measures – for example, the US pint is 16 ounces, and the UK imperial pint is 20 ounces. US cooks use different measures for liquids and solids; in the imperial system used in the UK, a fluid ounce is equal to a dry ounce. On average, US units are roughly 4/5 the size of UK units. Metric measures are rarely used for cooking in the US or UK, except milliliters for small liquid amounts.

US liquid measures

60 minims = 1 fl dram
8 fl drams = 1 fl oz
4 fl oz = 1 gill
4 gills = 1 pint
2 pints = 1 quart
4 quarts = 1 gallon

US dry measures

1 dry pint = ½ dry quart
2 dry pints = 1 dry quart
8 dry quarts = 1 peck
4 pecks = 1 bushel
36 bushels = 1 chaldron

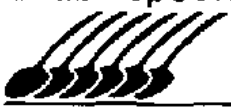
UK liquid and dry measures

60 minims = 1 dram
8 drams = 1 fl oz
5 fl oz = 1 gill
1 gill = ¼ pint
1 pint = 20 fl oz
2 pints = 1 quart
4 quarts = 1 gallon
1 gallon = 10 lb (weight in water)
2 gallons = 1 peck
4 pecks = 1 bushel
36 bushels = 1 chaldron

Water weights

1 fl oz water = 1 oz
1 pint water = 1 lb
1 quart water = 2 lb
1 gallon water = 8 lb

Handy measures

Object	US units	Metric
1 thimbleful 	30 drops	2.5 ml
60 drops 	1 teaspoon	5 ml
1 teaspoon 	1 fl dram	5 ml
1 dessertspoon 	2 fl drams	10 ml
1 tablespoon 	4 fl drams	15 ml
2 tablespoons 	1 fl oz	30 ml
4 tablespoons 	2 fl oz	60 ml
1 wine glass 	4 fl oz (1 gill)	120 ml
1 cup 	8 fl oz (½ pint)	240 ml

Beverage measures

Beer measures

1 nip = 1/4 pint
1 small = 1/2 pint
1 large = 1 pint
1 flagon = 1 quart
1 anker = 10 gallons
1 firkin = 9.8 gallons
1 barrel = 31 1/2 gallons
1 hogshead = 2 barrels
1 butt = 2 hogsheads
1 tun = 2 butts
252 gallons

Handy measures

small jigger = 1 fl oz
small wine glass = 2 fl oz
sherry glass = 2 fl oz
cocktail glass = 1/4 pint
large wine glass = 1/4 pint
tumbler = 1/2 pint

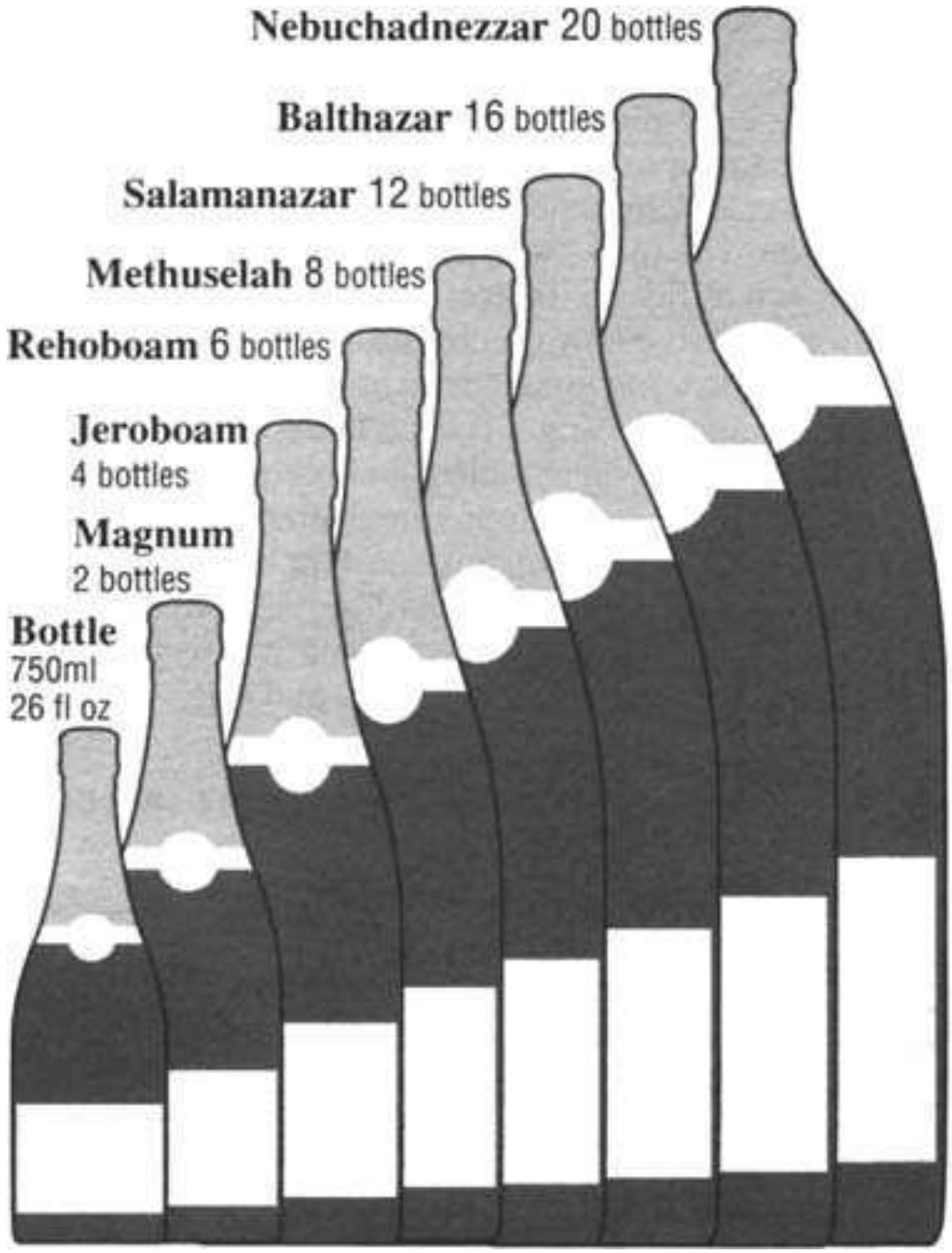
Wine measures

10 gallons = 1 anker
1 hogshead = 63 gallons
2 hogsheads = 1 pipe
2 pipes = 1 tun
1 puncheon = 84 gallons
1 butt = 126 gallons

US spirits measures

1 shot = 1 fl oz
1 pony = 1 shot
1 jigger = 1 1/2 shots
1 pint = 16 shots
1 fifth = 25.6 shots
1.6 pints
0.8 quart
0.758 liter
1 quart = 32 shots
1 1/4 fifths
1 magnum of wine = 2 fifths
2 bottles

Champagne bottle sizes

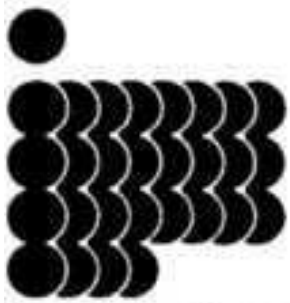


4: Weight

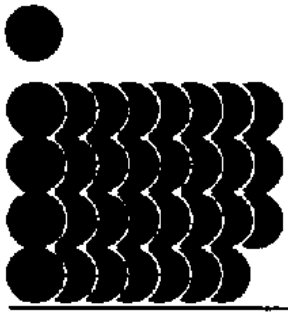
Formulas

Below are listed the multiplication/division factors for converting units of weight from one measuring system to another. Note that two kinds of factors are given: quick, for an approximate conversion that can be made without a calculator; and accurate, for an exact conversion. The term "weight" differs in everyday use from its scientific use. In everyday terms, we use weight to describe how much substance an object has. In science, the term "mass" is used to describe this quantity of matter. Weight is used to describe the gravitational force on an object and is equal to its mass multiplied by the gravitational field strength. In scientific terms, mass remains constant but weight varies according to the strength of gravity. All units that follow are strictly units of mass rather than weight, apart from the pressure units kg/cm^2 and PSI.

Grams (g) Grains (gr)	Quick	Accurate
g ⟶ gr	× 15	× 15.432
gr ⟶ g	÷ 15	× 0.065



Ounces (oz) Grams (g)		
oz ⟶ g	× 28	× 28.349
g ⟶ oz	÷ 28	× 0.035

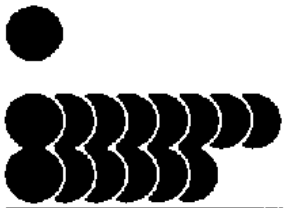


Ounces troy (oz tr) Grams (g)	Quick	Accurate
oz tr → g	× 31	× 31.103
g → oz tr	÷ 31	× 0.032

Stones (st) Kilograms (kg)		
st → kg	× 6	× 6.350
kg → st	÷ 6	× 0.157

Long (UK) tons (l t) Tonnes (t)		
l t → t	× 1	× 1.016
t → l t	÷ 1	× 0.984

Kilograms (kg) Pounds (lb)		
kg → lb	× 2	× 2.205
lb → kg	÷ 2	× 0.454



Kilograms per square centimeter (kg/cm^2) Pounds per square inch (PSI)		
kg/cm^2 → PSI	× 14	× 14.223
PSI → kg/cm^2	÷ 14	× 0.070

Tonnes (t) Short (US) tons (sh t)		
t → sh t	× 1	× 1.102
sh t → t	÷ 1	× 0.907

Ounces troy (oz tr) Ounces (oz)		
oz tr → oz	× 1	× 1.097
oz → oz tr	÷ 1	× 0.911

Conversion tables

The tables below can be used to convert units of weight from one measuring system to another. The units included in the tables are troy, US units/UK imperial, and metric.

Grains to Grams

gr	g
1	0.065
2	0.130
3	0.194
4	0.259
5	0.324
6	0.389
7	0.454
8	0.518
9	0.583
10	0.648
20	1.296
30	1.944
40	2.592
50	3.240
60	3.888
70	4.536
80	5.184
90	5.832
100	6.480

Ounces troy to Grams

oz tr	g
1	31.103
2	62.207
3	93.310
4	124.414
5	155.517
6	186.621
7	217.724
8	248.829
9	279.931
10	311.035
20	622.070
30	933.104
40	1,244.139
50	1,555.174
60	1,866.209
70	2,177.243
80	2,488.278
90	2,799.313
100	3,110.348

Ounces to Grams

oz	g
1	28.349
2	56.699
3	85.048
4	113.398
5	141.747
6	170.097
7	198.446
8	226.796
9	255.145
10	283.495
20	566.990
30	850.485
40	1,133.980
50	1,417.475
60	1,700.970
70	1,984.465
80	2,267.960
90	2,551.455
100	2,834.900

Pounds to Kilograms

lb	kg
1	0.454
2	0.907
3	1.361
4	1.814
5	2.268
6	2.722
7	3.175
8	3.629
9	4.082
10	4.536
20	9.072
30	13.608
40	18.144
50	22.680
60	27.216
70	31.751
80	36.287
90	40.823
100	45.359

Pounds per square inch to Kilograms per square centimeter

PSI	kg/cm²
10	0.703
15	1.055
20	1.406
22	1.547
24	1.687
26	1.828
28	1.986
30	2.109
32	2.250
34	2.390
36	2.531
38	2.671
40	2.812
45	3.164
50	3.515

Stones to Kilograms

st	kg
1	6.350
2	12.700
3	19.050
4	25.401
5	31.751
6	38.101
7	44.452
8	50.802
9	57.152
10	63.502
20	127.006
30	190.509
40	254.012
50	317.515
60	381.018
70	444.521
80	508.023
90	571.526
100	635.029

US units/UK imperial and metric units of weight (continued)

Short (US) tons to Tonnes	
sh t	t
1	0.907
2	1.814
3	2.721
4	3.628
5	4.535
6	5.443
7	6.350
8	7.257
9	8.164
10	9.071
20	18.143
30	27.215
40	36.287
50	45.359
60	54.431
70	63.502
80	72.574
90	81.646
100	90.718

Long (UK) tons to Tonnes	
l t	t
1	1.016
2	2.032
3	3.048
4	4.064
5	5.080
6	6.096
7	7.112
8	8.128
9	9.144
10	10.160
20	20.320
30	30.481
40	40.641
50	50.802
60	60.962
70	71.123
80	81.283
90	91.444
100	101.604

Grams to Grains	
g	gr
1	15.432
2	30.865
3	46.297
4	61.729
5	77.162
6	92.594
7	108.027
8	123.459
9	138.891
10	154.324
20	308.647
30	462.971
40	617.294
50	771.618
60	925.942
70	1,080.265
80	1,234.589
90	1,388.912
100	1,543.236

Grams to Ounces troy

g	oz tr
1	0.032
2	0.064
3	0.096
4	0.129
5	0.161
6	0.193
7	0.225
8	0.257
9	0.289
10	0.322
20	0.643
30	0.965
40	1.286
50	1.608
60	1.929
70	2.251
80	2.572
90	2.894
100	3.215

Grams to Ounces

g	oz
1	0.035
2	0.071
3	0.106
4	0.141
5	0.176
6	0.212
7	0.247
8	0.282
9	0.317
10	0.353
20	0.705
30	1.058
40	1.411
50	1.764
60	2.116
70	2.469
80	2.822
90	3.175
100	3.527

Kilograms to Pounds

kg	lb
1	2.205
2	4.409
3	6.614
4	8.818
5	11.023
6	13.228
7	15.432
8	17.637
9	19.842
10	22.046
20	44.092
30	66.139
40	88.185
50	110.231
60	132.277
70	154.324
80	176.370
90	198.416
100	220.462

US units/UK imperial and metric units of weight (continued)

Kilograms per square centimeter to Pounds per square inch

kg/cm²	PSI
0.6	8.534
0.8	11.378
1.0	14.223
1.2	17.068
1.4	19.912
1.6	22.757
1.8	25.601
2.0	28.446
2.2	31.291
2.4	34.135
2.6	36.980
2.8	39.824
3.0	42.669
3.2	45.514
3.5	49.781

Tonnes to Short (US) tons

t	sh t
1	1.102
2	2.205
3	3.307
4	4.409
5	5.512
6	6.614
7	7.716
8	8.818
9	9.921
10	11.023
20	22.046
30	33.069
40	44.092
50	55.116
60	66.139
70	77.162
80	88.185
90	99.208
100	110.231

Kilograms to Stones

kg	st
1	0.157
2	0.315
3	0.472
4	0.630
5	0.787
6	0.945
7	1.102
8	1.260
9	1.417
10	1.574
20	3.149
30	4.724
40	6.299
50	7.874
60	9.448
70	11.023
80	12.598
90	14.173
100	15.747

Tonnes to Long (UK) tons

t	l t
1	0.984
2	1.968
3	2.953
4	3.937
5	4.921
6	5.905
7	6.889
8	7.874
9	8.858
10	9.842
20	19.684
30	29.526
40	39.368
50	49.211
60	59.052
70	68.894
80	78.737
90	88.579
100	98.421

Ounces troy to Ounces

oz tr	oz
1	1.097
2	2.194
3	3.291
4	4.389
5	5.486
6	6.583
7	7.680
8	8.777
9	9.874
10	10.971
20	21.943
30	32.914
40	43.886
50	54.857
60	65.828
70	76.800
80	87.771
90	98.743
100	109.714

Ounces to Ounces troy

oz	oz tr
1	0.911
2	1.823
3	2.734
4	3.646
5	4.557
6	5.468
7	6.380
8	7.291
9	8.203
10	9.114
20	18.229
30	27.344
40	36.458
50	45.573
60	54.687
70	63.802
80	72.917
90	82.031
100	91.146

Periodic table

The periodic table is a means of classifying and comparing chemical elements. Substances as different as hydrogen, calcium, and gold are all elements; each has distinctive properties and cannot be split chemically into a simpler form.

The table groups elements into seven rows or periods. Elements in the vertical columns, or groups, have similar properties. For example, the first element in any period (called an alkali metal) is reactive; while the last element (a noble, or inert, gas) is almost totally nonreactive.

1 H								
3 Li	4 Be							
11 Na	12 Mg							
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh
55 Cs	56 Ba	57-71 -	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir
87 Fr	88 Ra	89-103 -	104 Unq	105 Unp	106 Unh	107 Uns	108 Uno	109 Une

57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu
89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am

The elements are listed in the table in order of their atomic numbers, from 1 to 109 (appearing in the upper left-hand corner of each box). The atomic number represents the number of protons the element has in its nucleus.

The two bottom rows are the lanthanides (57–71) and the actinides (89–103). These are separate because they have such similar properties that they fit the space of only two elements in the main table.

							2 He
			5 B	6 C	7 N	8 O	9 F	10 Ne
			13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn

64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

Chemical elements

On the following pages, the elements are listed in three separate ways: **1** by atomic number; **2** by element name; and **3** by letter symbol. Each listing includes the atomic number, element name, symbol, and atomic weight (or relative atomic mass) of each element.

* Indicates atomic weight of the isotope with the longest known half-life.

1 BY ATOMIC NUMBER

Atomic No.	Name	Symbol	Atomic weight
1	Hydrogen	H	1.0079
2	Helium	He	4.0026
3	Lithium	Li	6.941
4	Beryllium	Be	9.01218
5	Boron	B	10.81
6	Carbon	C	12.011
7	Nitrogen	N	14.0067
8	Oxygen	O	15.9994
9	Fluorine	F	18.9984
10	Neon	Ne	20.179
11	Sodium	Na	22.98977
12	Magnesium	Mg	24.305
13	Aluminum	Al	26.98154
14	Silicon	Si	28.0855
15	Phosphorus	P	30.97376
16	Sulfur	S	32.064
17	Chlorine	Cl	35.453
18	Argon	Ar	39.948
19	Potassium	K	39.0983
20	Calcium	Ca	40.08

Atomic No.	Name	Symbol	Atomic weight
21	Scandium	Sc	44.9559
22	Titanium	Ti	47.9
23	Vanadium	V	50.9414
24	Chromium	Cr	51.996
25	Manganese	Mn	54.938
26	Iron	Fe	55.847
27	Cobalt	Co	58.9332
28	Nickel	Ni	58.71
29	Copper	Cu	63.546
30	Zinc	Zn	65.381
31	Gallium	Ga	69.72
32	Germanium	Ge	72.59
33	Arsenic	As	74.9216
34	Selenium	Se	78.96
35	Bromine	Br	79.904
36	Krypton	Kr	83.8
37	Rubidium	Rb	85.4678
38	Strontium	Sr	87.62
39	Yttrium	Y	88.9059
40	Zirconium	Zr	91.22
41	Niobium	Nb	92.9064
42	Molybdenum	Mo	95.94
43	Technetium	Tc	96.9064*
44	Ruthenium	Ru	101.07
45	Rhodium	Rh	102.9055
46	Palladium	Pd	106.4
47	Silver	Ag	107.868
48	Cadmium	Cd	112.41
49	Indium	In	114.82

Atomic No.	Name	Symbol	Atomic weight
50	Tin	Sn	118.69
51	Antimony	Sb	121.75
52	Tellurium	Te	127.6
53	Iodine	I	126.905
54	Xenon	Xe	131.3
55	Cesium	Cs	132.9054
56	Barium	Ba	137.33
57	Lanthanum	La	138.9055
58	Caerium	Ce	140.12
59	Praseodymium	Pr	140.9077
60	Neodymium	Nd	144.24
61	Promethium	Pm	144.9128*
62	Samarium	Sm	150.35
63	Europium	Eu	151.96
64	Gadolinium	Gd	157.25
65	Terbium	Tb	158.9254
66	Dysprosium	Dy	162.5
67	Holmium	Ho	164.9304
68	Erbium	Er	167.26
69	Thulium	Tm	168.9342
70	Ytterbium	Yb	173.04
71	Lutetium	Lu	174.97
72	Hafnium	Hf	178.49
73	Tantalum	Ta	180.9479
74	Tungsten	W	183.85
75	Rhenium	Re	186.207
76	Osmium	Os	190.2
77	Iridium	Ir	192.22
78	Platinum	Pt	195.09

Atomic No.	Name	Symbol	Atomic weight
79	Gold	Au	196.9665
80	Mercury	Hg	200.59
81	Thallium	Tl	204.37
82	Lead	Pb	207.19
83	Bismuth	Bi	208.9804
84	Polonium	Po	208.9824*
85	Astatine	At	209.9870*
86	Radon	Rn	222.017 6*
87	Francium	Fr	223.0197*
88	Radium	Ra	226.0254*
89	Actinium	Ac	227.0278*
90	Thorium	Th	232.0381
91	Protoactinium	Pa	231.0359
92	Uranium	U	238.029*
93	Neptunium	Np	237.0482*
94	Plutonium	Pu	244.0642*
95	Americium	Am	243.0614*
96	Curium	Cm	247.0703*
97	Berkelium	Bk	247.0703*
98	Californium	Cf	251.0796*
99	Einsteinium	Es	254.0880*
100	Fermium	Fm	257.0951*
101	Mendelevium	Md	258.099*
102	Nobelium	No	259.101*
103	Lawrencium	Lr	260.105*
104	Unnilquadium	Unq	261.109*
105	Unnilpentium	Unp	262.114*
106	Unnilhexium	Unh	263.120*
107	Unnilseptium	Uns	262*

Atomic No.	Name	Symbol	Atomic weight
108	Unniloctium	Uno	265
109	Unnilennium	Une	266*

2 BY ELEMENT NAME

Name	Atomic No.	Symbol	Atomic weight
Actinium	89	Ac	227.0278*
Aluminum	13	Al	26.98154
Americium	95	Am	243.0614*
Antimony	51	Sb	121.75
Argon	18	Ar	39.948
Arsenic	33	As	74.9216
Astatine	85	At	209.9870*
Barium	56	Ba	137.33
Berkelium	97	Bk	247.0703*
Beryllium	4	Be	9.01218
Bismuth	83	Bi	208.9804
Boron	5	B	10.81
Bromine	35	Br	79.904
Cadmium	48	Cd	112.41
Calcium	20	Ca	40.08
Californium	98	Cf	251.0796*
Carbon	6	C	12.011
Cerium	58	Ce	140.12
Cesium	55	Cs	132.9054
Chlorine	17	Cl	35.453
Chromium	24	Cr	51.996
Cobalt	27	Co	58.9332

Name	Atomic No.	Symbol	Atomic weight
Copper	29	Cu	63.546
Curium	96	Cm	247.703*
Dysprosium	66	Dy	162.5
Einsteinium	99	Es	254.0880*
Erbium	68	Er	167.26
Europium	63	Eu	151.96
Fermium	100	Fm	257.0951*
Fluorine	9	F	18.9984
Francium	87	Fr	223.0197*
Gadolinium	64	Gd	157.25
Gallium	31	Ga	69.72
Germanium	32	Ge	72.59
Gold	79	Au	196.9665
Hafnium	72	Hf	178.49
Helium	2	He	4.0026
Holmium	67	Ho	164.9304
Hydrogen	1	H	1.0079
Indium	49	In	114.82
Iodine	53	I	126.9045
Iridium	77	Ir	192.22
Iron	26	Fe	55.847
Krypton	36	Kr	83.8
Lanthanum	57	La	138.9055
Lawrencium	103	Lr	260.105*
Lead	82	Pb	207.19
Lithium	3	Li	6.941
Lutetium	71	Lu	174.97
Magnesium	12	Mg	24.305

Name	Atomic No.	Symbol	Atomic weight
Manganese	25	Mn	54.938
Mendelevium	101	Md	258.099*
Mercury	80	Hg	200.59
Molybdenum	42	Mo	95.94
Neodymium	60	Nd	144.24
Neon	10	Ne	20.179
Neptunium	93	Np	237.0482*
Nickel	28	Ni	58.71
Niobium	41	Nb	92.9064
Nitrogen	7	N	14.0067
Nobelium	102	No	259.101*
Osmium	76	Os	190.2
Oxygen	8	O	15.9994
Palladium	46	Pd	106.4
Phosphorus	15	P	30.97376
Platinum	78	Pt	195.09
Plutonium	94	Pu	244.0642*
Polonium	84	Po	208.9824*
Potassium	19	K	39.0983
Praseodymium	59	Pr	140.9077
Promethium	61	Pm	144.9128*
Protoactinium	91	Pa	231.0359
Radium	88	Ra	226.0254*
Radon	86	Rn	222.0176*
Rhenium	75	Re	186.207
Rhodium	45	Rh	102.9055
Rubidium	37	Rb	85.4678
Ruthenium	44	Ru	101.07
Samarium	62	Sm	150.35

Name	Atomic No.	Symbol	Atomic weight
Scandium	21	Sc	44.9559
Selenium	34	Se	78.96
Silicon	14	Si	28.0855
Silver	47	Ag	107.868
Sodium	11	Na	22.98977
Strontium	38	Sr	87.62
Sulfur	16	S	32.064
Tantalum	73	Ta	180.9479
Technetium	43	Tc	96.9064*
Tellurium	52	Te	127.6
Terbium	65	Tb	158.9254
Thallium	81	Tl	204.37
Thorium	90	Th	232.0381
Thulium	69	Tm	168.9342
Tin	50	Sn	118.69
Titanium	22	Ti	47.9
Tungsten	74	W	183.85
Unnilennium	109	Une	266*
Unnilhexium	106	Unh	263.120*
Unniloctium	108	Uno	265
Unnilpentium	105	Unp	262.114*
Unnilquadium	104	Unq	261.109*
Unnilseptium	107	Uns	262*
Uranium	92	U	238.029*
Vanadium	23	V	50.9414
Xenon	54	Xe	131.3
Ytterbium	70	Yb	173.04
Yttrium	39	Y	88.9059

Name	Atomic No.	Symbol	Atomic weight
Zinc	30	Zn	65.381
Zirconium	40	Zr	91.22

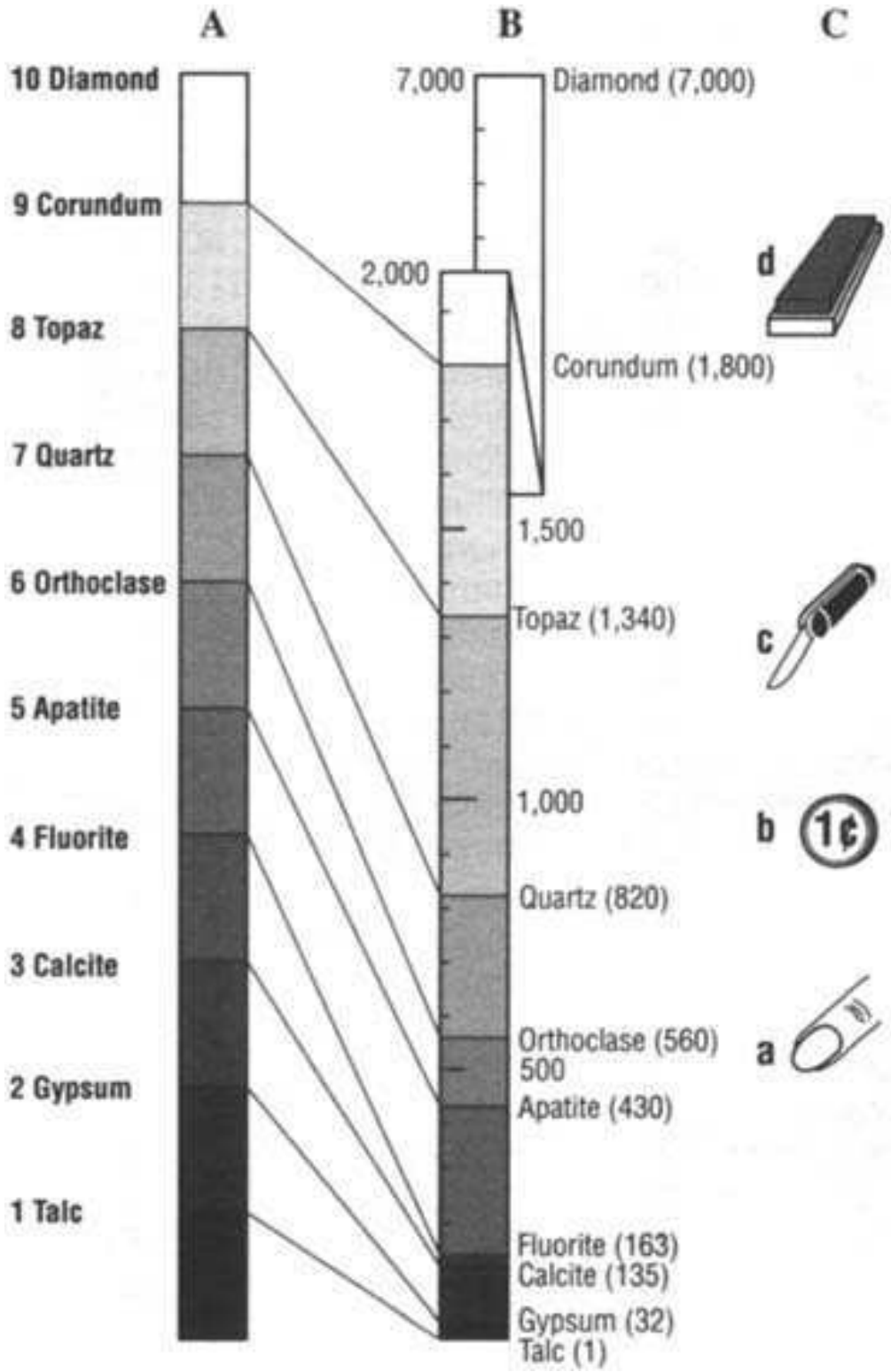
3 BY LETTER SYMBOL

Symbol	Atomic No.	Name	Atomic weight
Ac	89	Actinium	227.0278*
Ag	47	Silver	107.868
Al	13	Aluminum	26.98154
Am	95	Americium	243.0614*
Ar	18	Argon	39.948
As	33	Arsenic	74.9216
At	85	Astatine	209.9870*
Au	79	Gold	196.9665
B	5	Boron	10.81
Ba	56	Barium	137.33
Be	4	Beryllium	9.01218
Bk	97	Berkelium	247.0703*
Bi	83	Bismuth	208.9804
Br	35	Bromine	79.904
C	6	Carbon	12.011
Ca	20	Calcium	40.08
Cd	48	Cadmium	112.41
Ce	58	Cerium	140.12
Cf	98	Californium	251.0796*
Cl	17	Chlorine	35.453
Cm	96	Curium	247.0703*
Co	27	Cobalt	58.9332
Cr	24	Chromium	51.996

Symbol	Atomic No.	Name	Atomic weight
Cs	55	Cesium	132.9054
Cu	29	Copper	63.546
Dy	66	Dysprosium	162.5
Er	68	Erbium	167.26
Es	99	Einsteinium	254.088*
Eu	63	Europium	151.96
F	9	Fluorine	18.9984
Fe	26	Iron	55.847
Fm	100	Fermium	257.0951*
Fr	87	Francium	223.0197*
Ga	31	Gallium	69.72
Gd	64	Gadolinium	157.25
Ge	32	Germanium	72.59
H	1	Hydrogen	1.0079
He	2	Helium	4.0026
Hf	72	Hafnium	178.49
Hg	80	Mercury	200.59
Ho	67	Holmium	164.9304
I	53	Iodine	126.9045
In	49	Indium	114.82
Ir	77	Iridium	192.22
K	19	Potassium	39.0983
Kr	36	Krypton	83.8
La	57	Lanthanum	138.9055
Li	3	Lithium	6.941
Lr	103	Lawrencium	260.105*
Lu	71	Lutetium	174.97
Md	101	Mendelevium	258.099*
Mg	12	Magnesium	24.305

Symbol	Atomic No.	Name	Atomic weight
Mn	25	Manganese	54.938
Mo	42	Molybdenum	95.94
N	7	Nitrogen	14.0067
Na	11	Sodium	22.98977
Nb	41	Niobium	92.9064
Nd	60	Neodymium	144.24
Ne	10	Neon	20.179
Ni	28	Nickel	58.71
No	102	Nobelium	259.101•
Np	93	Neptunium	237.0482*
O	8	Oxygen	15.9994
Os	76	Osmium	190.2
P	15	Phosphorus	30.97376
Pa	91	Protoactinium	231.0359
Pb	82	Lead	207.19
Pd	46	Palladium	106.4
Pm	61	Promethium	144.9128*
Po	84	Polonium	208.9824*
Pr	59	Praseodymium	140.9077
Pt	78	Platinum	195.09
Pu	94	Plutonium	244.0642*
Ra	88	Radium	226.0254*
Rb	37	Rubidium	85.4678
Re	75	Rhenium	186.207
Rh	45	Rhodium	102.9055
Rn	86	Radon	222.0176*
Ru	44	Ruthenium	101.07
S	16	Sulfur	32.064
Sb	51	Antimony	121.75

Symbol	Atomic No.	Name	Atomic weight
Sc	21	Scandium	44.9559
Se	34	Selenium	78.96
Si	14	Silicon	28.0855
Sm	62	Samarium	150.35
Sn	50	Tin	118.69
Sr	38	Strontium	87.62
Ta	73	Tantalum	180.9479
Tb	65	Terbium	158.9254
Tc	43	Technetium	96.9064*
Te	52	Tellurium	127.6
Th	90	Thorium	232.0381
Ti	22	Titanium	47.9
Tl	81	Thallium	204.37
Tm	69	Thulium	168.9342
U	92	Uranium	238.029*
Une	109	Unnilennium	266*
Unh	106	Unnilhexium	263.120*
Uno	108	Unniloctium	265
Unp	105	Unnilpentium	262.114*
Unq	104	Unnilquadium	261.109*
Uns	107	Unnilseptium	262*
V	23	Vanadium	50.9414
W	74	Tungsten	183.85
Xe	54	Xenon	131.3
Y	39	Yttrium	88.9059
Yb	70	Ytterbium	173.04
Zn	30	Zinc	65.381
Zr	40	Zirconium	91.22


A
B
C
10 Diamond
9 Corundum
8 Topaz
7 Quartz
6 Orthoclase
5 Apatite
4 Fluorite
3 Calcite
2 Gypsum
1 Talc
7,000
Diamond (7,000)
2,000
Corundum (1,800)
1,500
Topaz (1,340)
1,000
Quartz (820)
Orthoclase (560)
500
Apatite (430)
Fluorite (163)
Calcite (135)
Gypsum (32)
Talc (1)
d
c
b
1¢
a

Scales of hardness

Solids vary in their degree of hardness, which indicates their resistance to being scratched or cut.

A Mohs' scale

Mohs' scale is used to measure the relative hardness of minerals. The framework uses the 10 minerals – talc to diamond – shown in the scale. Each of these minerals is assigned a numerical value from 1 to 10: the higher the number, the harder the mineral.

Order is determined by the ability of a mineral to scratch all those that have a lower number and to be scratched by those with a higher number. Once this is established, it is possible to place all other minerals on the scale by means of the same scratching procedure.

B Knoop scale

Another system of measuring the hardness of minerals is the Knoop scale. The Knoop scale gives absolute rather than relative measurements. Readings on this scale are made by measuring the size of the indentation made by a diamond-shaped device dropped on the material.

Again, the higher the number the harder the substance, but the intervals between minerals and levels of hardness differ greatly from scale to scale. Minerals with values between 1 and 7 on Mohs' scale fall below 1,000 on the Knoop scale, and between 8 and 9 fall below 2,000, but diamond falls at 7,000.

C Common-object scale

A simple way of measuring hardness uses common objects, whose hardness on the Mohs' scale is known:

a) fingernail (2–2.5 Mohs')
b) coin (4)
c) knife blade (5–6)
d) knife sharpener (8–9)

5: Energy

Formulas

Below are listed the multiplication/division factors for converting units of energy from one measuring system to another. Note that two kinds of factors are given: quick, for an approximate conversion that can be made without a calculator; and accurate, for an exact conversion.

	Quick	Accurate
Kilowatts (kW) Horsepower (hp)		
kW → hp	× 1.5	× 1.341
hp → kW	÷ 1.5	× 0.746
Calories (cal) Joules (J)		
cal → J	× 4	× 4.187
J → cal	÷ 4	× 0.239
Kilocalories (kcal) Kilojoules (kJ)		
kcal → kJ	× 4	× 4.187
kJ → kcal	÷ 4	× 0.239

Conversion tables

The tables below can be used to convert units of energy from one measuring system to another.

Horsepower to Kilowatts

hp	kW
1	0.746
2	1.491
3	2.237
4	2.983
5	3.729
6	4.474
7	5.220
8	5.966
9	6.711
10	7.457
20	14.914
30	22.371
40	29.828
50	37.285
60	44.742
70	52.199
80	59.656
90	67.113
100	74.570

Kilowatts to Horsepower

kW	hp
1	1.341
2	2.682
3	4.023
4	5.364
5	6.705
6	8.046
7	9.387
8	10.728
9	12.069
10	13.410
20	26.820
30	40.231
40	53.641
50	67.051
60	80.461
70	93.871
80	107.280
90	120.690
100	134.100

Metric units of energy

Joules to Calories international

J	cal
1	0.239
2	0.478
3	0.716
4	0.955
5	1.194
6	1.433
7	1.672
8	1.911
9	2.150
10	2.388
20	4.777
30	7.165
40	9.554
50	11.942
60	14.330
70	16.719
80	19.108
90	21.496
100	23.885

Kilojoules to Kilocalories international

kJ	kcal
1	0.239
2	0.478
3	0.716
4	0.955
5	1.194
6	1.433
7	1.672
8	1.911
9	2.150
10	2.388
20	4.777
30	7.165
40	9.554
50	11.942
60	14.330
70	16.719
80	19.108
90	21.496
100	23.885

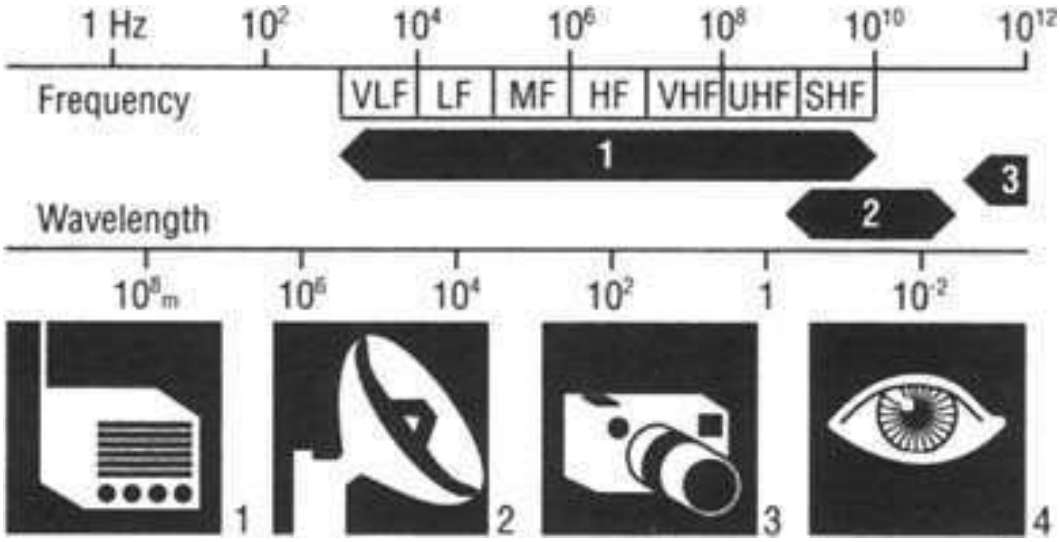
Calories international to Joules

cal	J
1	4.187
2	8.374
3	12.560
4	16.747
5	20.934
6	25.121
7	29.308
8	33.494
9	37.681
10	41.868
20	83.736
30	125.604
40	167.472
50	209.340
60	251.208
70	293.076
80	334.944
90	376.812
100	418.680

Kilocalories international to Kilojoules

kcal	kJ
1	4.187
2	8.374
3	12.560
4	16.747
5	20.934
6	25.121
7	29.308
8	33.494
9	37.681
10	41.868
20	83.736
30	125.604
40	167.472
50	209.340
60	251.208
70	293.076
80	334.944
90	376.812
100	418.680

Electromagnetic spectrum



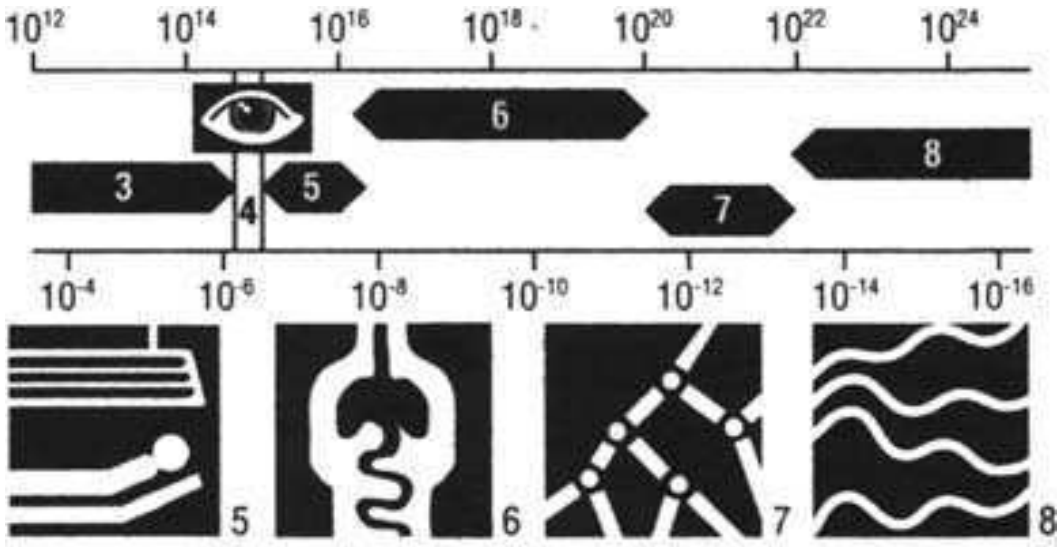
Measuring energy

Light and radio waves, X-rays, and other forms of energy are transmitted through space as electromagnetic waves. These waves have alternating high and low points – crests and troughs – like actual waves. The distance between wave crests is called the wavelength; this is measured in meters. Frequency refers to the number of waves per second passing a certain point; this is measured in hertz (Hz).

Above is an electromagnetic spectrum, showing the different forms of energy in order of frequency and wavelength. The top part of the diagram shows the frequency in hertz; the lower part measures the wavelength in meters.

1 Radio waves

These waves transmit television and radio signals. This section of the spectrum is divided into bands, from VLF (very low frequency) – used for time signals – to SHF (super-high frequency) – used for space and satellite communication.



2 Radar and microwaves
Radar bounces waves off objects, allowing unseen objects to be seen; microwaves can cook food quickly.

3 Infrared waves
These waves are emitted by all hot objects.

4 Visible light
The band of visible light from red to violet.

5 Ultraviolet light
In small amounts, these waves produce vitamin D and cause skin to tan; in larger amounts they can damage living cells.

6 X-rays
Used to photograph the internal structures of the body.

7 Gamma rays
Emitted during the decay of some radioisotopes, these waves can be very damaging to the body.

8 Cosmic rays
Caused by nuclear explosions and reactions in space, nearly all of these waves are absorbed by the Earth's atmosphere.

Earthquakes

Earthquake magnitude is measured in units on the Richter scale, which measures the amount of energy released. Each year there are more than 300,000 earth tremors with Richter magnitudes of 2 to 2.9. An earthquake of 8.5 or higher occurs about every 5 to 10 years.

Intensity

The intensity of an earthquake is measured on the Mercalli scale; the numbers refer to an earthquake's effect at a specific place on the Earth's surface.

Below are listed numbers on the Mercalli scale and the characteristics of each.

No.	Characteristic
I	instrumental (detected only by seismograph)
II	feeble (noticed only by people at rest)
III	slight (similar to vibrations from a passing truck)
IV	moderate (felt indoors, parked cars rock)
V	rather strong (felt generally, waking sleepers)
VI	strong (trees sway, some damage)
VII	very strong (general alarm, walls crack)
VIII	destructive (walls collapse)
IX	ruinous (some houses collapse, ground cracks)
X	disastrous (buildings destroyed, rails bend)
XI	very disastrous (landslides, few buildings survive)
XII	catastrophic (total destruction)

Listed below are the Mercalli and Richter scales, with equivalents in joules, and a table comparing the Richter scale *with joules*.

Mercalli	Richter	Joules
I	<3.5	$<1.6 \times 10^{7}$ J
II	3.5	1.6×10^{7} J
III	4.2	7.5×10^{8} J
IV	4.5	4.0×10^{9} J
V	4.8	2.1×10^{10} J
VI	5.4	5.7×10^{11} J
VII	6.1	2.8×10^{13} J
VIII	6.5	2.5×10^{14} J
IX	6.9	2.3×10^{15} J
X	7.3	2.1×10^{16} J
XI	8.1	1.7×10^{18} J
XII	>8.1	$>1.7 \times 10^{18}$ J

Richter	Joules
0	6.3×10^{-2} J
1	1.6×10 J
2	4.0×10^{3} J
3	1.0×10^{6} J
4	2.5×10^{8} J
5	6.3×10^{10} J
6	1.6×10^{13} J
7	4.0×10^{15} J
8	1.0×10^{18} J
9	2.5×10^{20} J
10	6.3×10^{22} J

Actual earthquakes

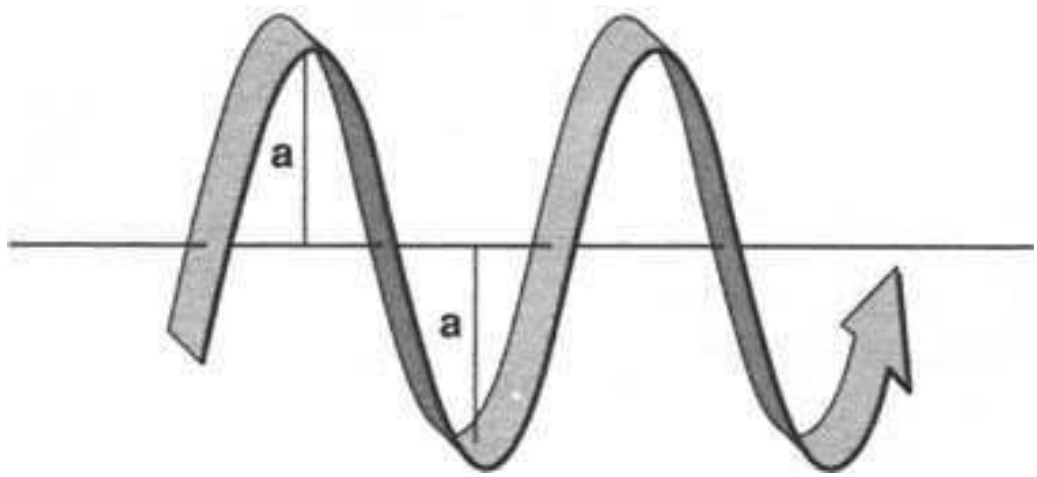
The table below lists the year of selected earthquakes in different parts of the world and where they occurred, as well as the Richter magnitude of each.

Earthquakes	Richter
Assam, India (1897)	8.7
Alaska, USA (1964)	8.6
Concepción, Chile (1960)	8.5
San Francisco, USA (1906)	8.25
Mexico City, Mexico (1985)	8.1
Guatemala (1976)	7.9
Tangshan, China (1976)	7.6
Messina, Italy (1908)	7.5
Vrancea, Romania (1977)	7.2
San Francisco, USA (1989)	6.9

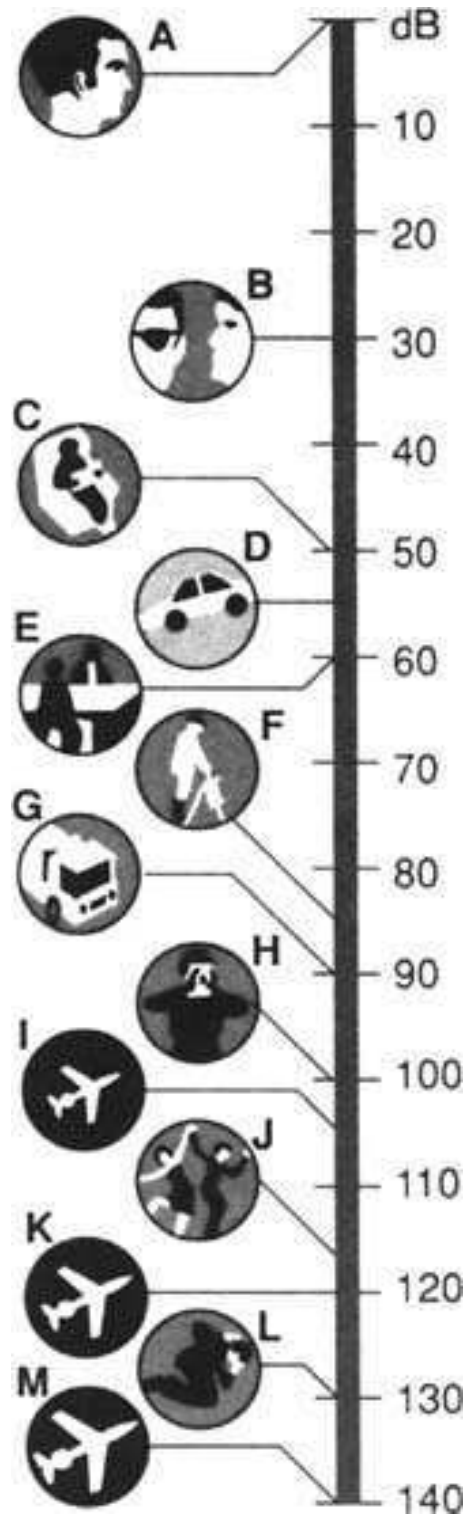
Decibels
The loudness of a sound is measured by the size of its vibrations; this is measured in decibels (dB).

Decibel scale
The dB scale is relative and increases exponentially, beginning with the smallest sound change that can be heard by humans (0–1 dB). A 20 dB sound is 10 times louder than a 10 dB sound; a 30 dB sound is 100 times as loud as that. Noises at the level of 120–130 dB can cause pain in humans; higher levels can cause permanent ear damage. The dB ratings (at certain distances) of some common noises are listed on page 135.

Wave amplitude
Amplitude (**a**) is the distance between a wave peak or trough and an intermediate line of equilibrium. The greater the amount of energy transmitted in a sound wave, the greater is the wave's amplitude and the louder the sound heard.

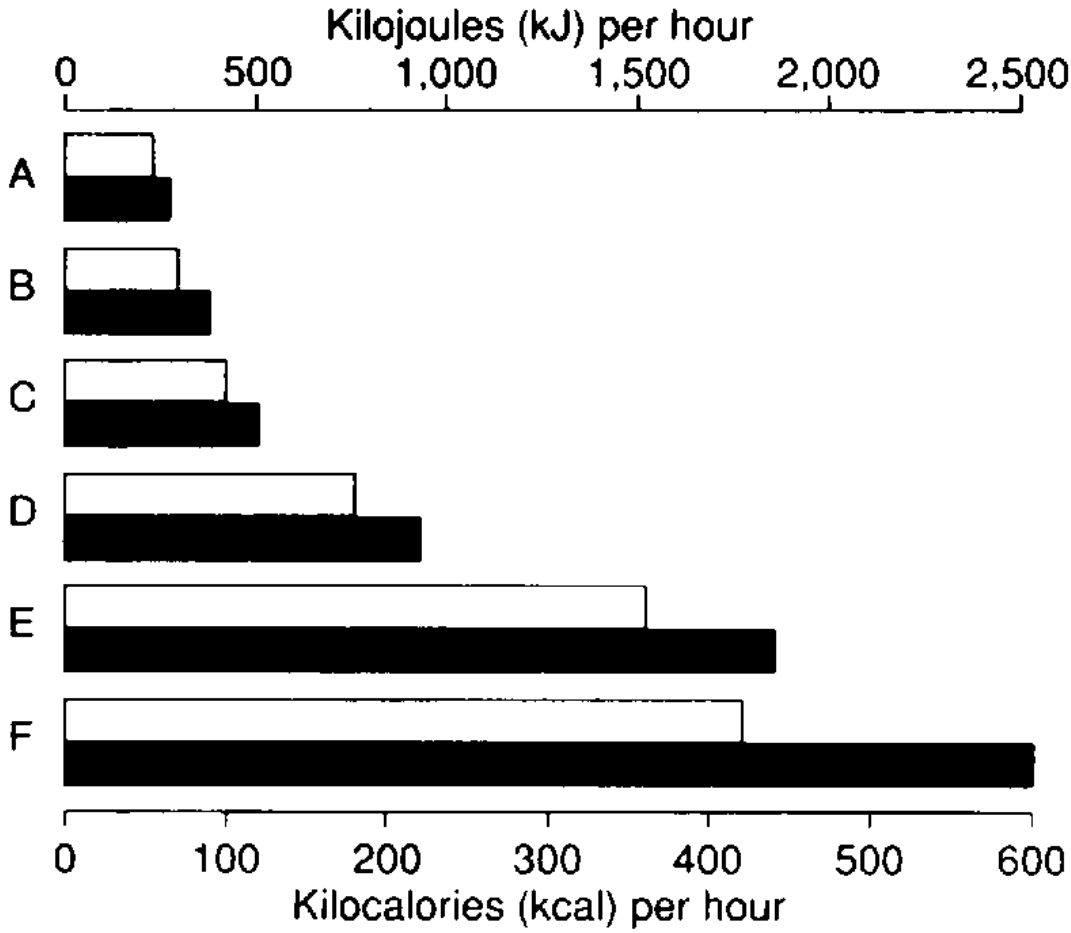


A 0 dB human minimum audibility
B 30 dB soft whisper at 15 ft
C 50 dB inside urban home
D 55 dB light traffic at 50 ft
E 60 dB conversation at 3 ft
F 85 dB pneumatic drill at 50 ft
G 90 dB heavy traffic at 50 ft
H 100 dB loud shout at 50 ft
I 105 dB airplane take-off at 2,000 ft
J 117 dB inside full-volume disco
K 120 dB airplane take-off at 200 ft
L 130 dB pain threshold for humans
M 140 dB airplane take-off at 100 ft



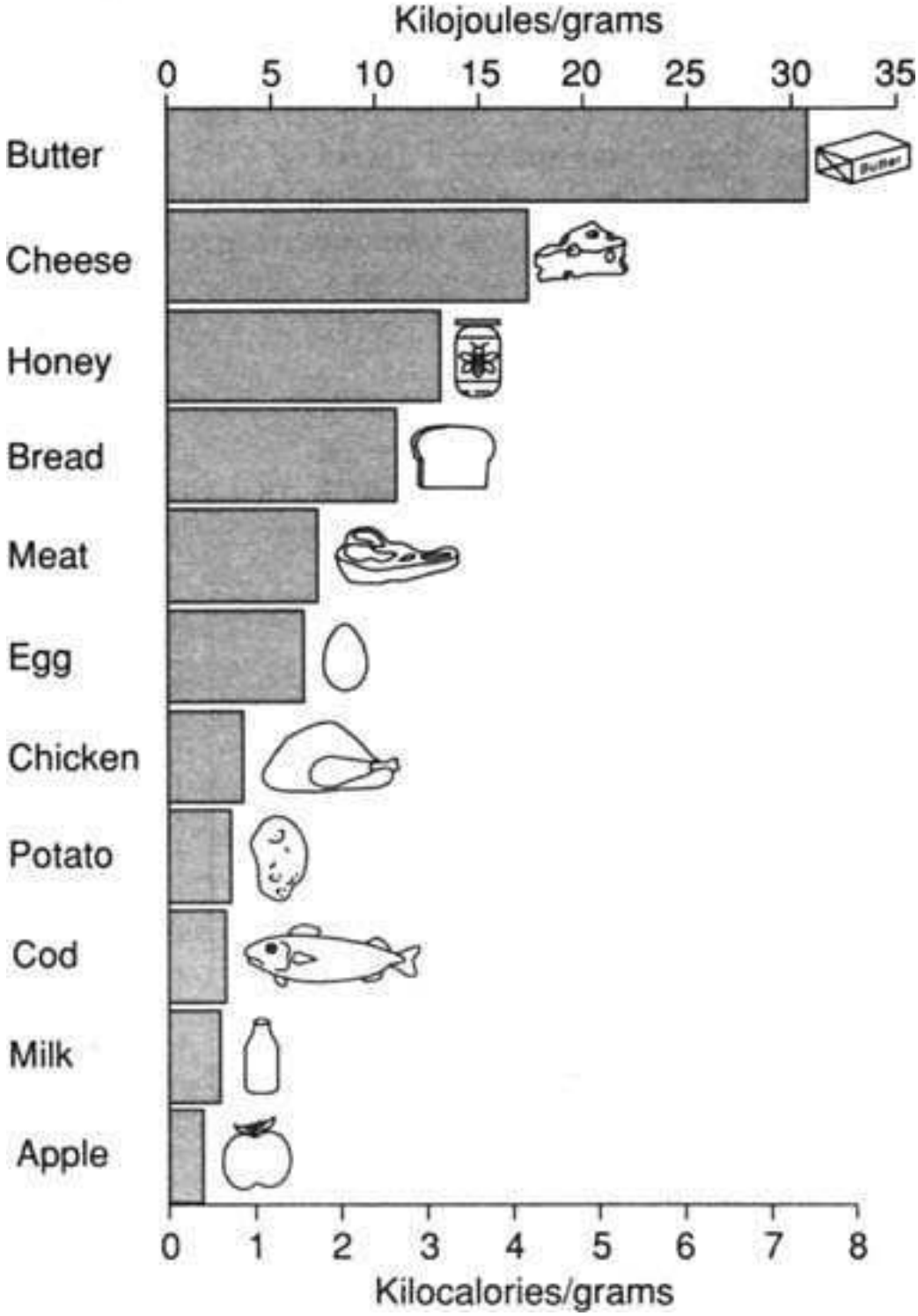
Energy needs by activity

	Activity	Women	Men
A	Sleeping	230 kJ; 55 kcal	272 kJ; 65 kcal
B	Sitting	293 kJ; 70 kcal	377 kJ; 90 kcal
C	Standing	419 kJ; 100 kcal	502 kJ; 120 kcal
D	Walking	754 kJ; 180 kcal	921 kJ; 220 kcal
E	Walking (uphill)	1,507 kJ; 360 kcal	1,842 kJ; 440 kcal
F	Running	1,759 kJ; 420 kcal	2,512 kJ; 600 kcal



Men use more kilocalories than women for all activities because men have more weight to carry around, and because women usually have more body fat and so need less energy to retain body heat.

Energy values of selected foods



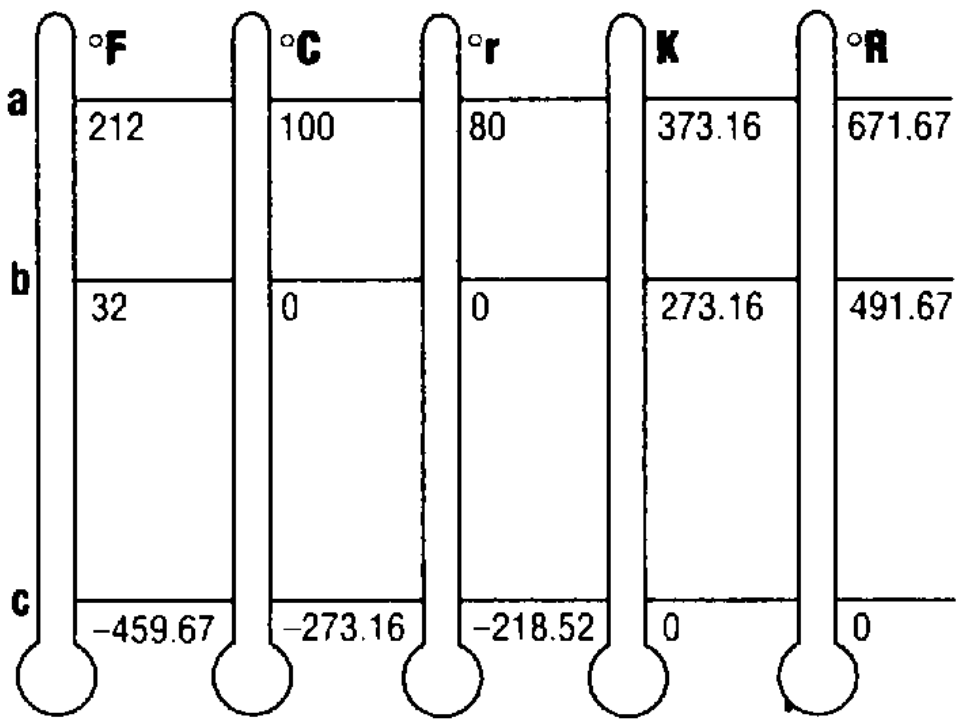
6: Temperature

Systems of measurement

Below, the different systems of temperature measurement are compared: Fahrenheit (°F), Celsius (°C), Réaumur (°r), Rankine (°R), and Kelvin (K). Also listed are the formulas for converting temperature measurements from one system to another.

Formulas

°F ➡ °C	(°F−32)÷1.8	**°r ➡ K**	(°r×1.25)+273.16
°C ➡ °F	(°C×1.8)+32	**°R ➡ K**	°R÷1.8
°F ➡ K	(°F+459.67)÷1.8	**K ➡ °F**	(K×1.8)−459.67
°C ➡ K	°C+273.16	**K ➡ °C**	K−273.16



a boiling point of water **b** freezing point of water
c absolute zero

Conversion tables

The tables below list the equivalent units of temperature in the Fahrenheit, Celsius, and Kelvin systems.

Fahrenheit to Celsius to Kelvin

°F	°C	K
−40.0	−40	233
−38.2	−39	234
−36.4	−38	235
−34.6	−37	236
−32.8	−36	237
−31.0	−35	238
−29.2	−34	239
−27.4	−33	240
−25.6	−32	241
−23.8	−31	242
−22.0	−30	243
−20.2	−29	244
−18.4	−28	245
−16.6	−27	246
−14.8	−26	247
−13.0	−25	248
−11.2	−24	249
−9.4	−23	250
−7.6	−22	251
−5.8	−21	252

Fahrenheit to Celsius to Kelvin

°F	°C	K
−4.0	−20	253
−2.2	−19	254
−0.4	−18	255
1.4	−17	256
3.2	−16	257
5.0	−15	258
6.8	−14	259
8.6	−13	260
10.4	−12	261
12.2	−11	262
14.0	−10	263
15.8	−9	264
17.6	−8	265
19.4	−7	266
21.2	−6	267
23.0	−5	268
24.8	−4	269
26.6	−3	270
28.4	−2	271
30.2	−1	272

Fahrenheit, Celsius, and Kelvin unit equivalents (continued)

Fahrenheit to Celsius to Kelvin

°F	°C	K
32.0	0	273
33.8	1	274
35.6	2	275
37.4	3	276
39.2	4	277
41.0	5	278
42.8	6	279
44.6	7	280
46.4	8	281
48.2	9	282
50.0	10	283
51.8	11	284
53.6	12	285
55.4	13	286
57.2	14	287
59.0	15	288
60.8	16	289
62.6	17	290
64.4	18	291
66.2	19	292

Fahrenheit to Celsius to Kelvin

°F	°C	K
68.0	20	293
69.8	21	294
71.6	22	295
73.4	23	296
75.2	24	297
77.0	25	298
78.8	26	299
80.6	27	300
82.4	28	301
84.2	29	302
86.0	30	303
87.8	31	304
89.6	32	305
91.4	33	306
93.2	34	307
95.0	35	308
96.8	36	309
98.6	37	310
100.4	38	311
102.2	39	312

Fahrenheit to Celsius to Kelvin

°F	°C	K
104.0	40	313
105.8	41	314
107.6	42	315
109.4	43	316
111.2	44	317
113.0	45	318
114.8	46	319
116.6	47	320
118.4	48	321
120.2	49	322
122.0	50	323
123.8	51	324
125.6	52	325
127.4	53	326
129.2	54	327
131.0	55	328
132.8	56	329
134.6	57	330
136.4	58	331
138.2	59	332

Fahrenheit to Celsius to Kelvin

°F	°C	K
140.0	60	333
141.8	61	334
143.6	62	335
145.4	63	336
147.2	64	337
149.0	65	338
150.8	66	339
152.6	67	340
154.4	68	341
156.2	69	342
158.0	70	343
159.8	71	344
161.6	72	345
163.4	73	346
165.2	74	347
167.0	75	348
168.8	76	349
170.6	77	350
172.4	78	351
174.2	79	352

Fahrenheit, Celsius, and Kelvin unit equivalents (continued)

Fahrenheit to Celsius to Kelvin

°F	°C	K
176.0	80	353
177.8	81	354
179.6	82	355
181.4	83	356
183.2	84	357
185.0	85	358
186.8	86	359
188.6	87	360
190.4	88	361
192.2	89	362
194.0	90	363
195.8	91	364
197.6	92	365
199.4	93	366
201.2	94	367
203.0	95	368
204.8	96	369
206.6	97	370
208.4	98	371
210.2	99	372

Fahrenheit to Celsius to Kelvin

°F	°C	K
212.0	100	373
213.8	101	374
215.6	102	375
217.4	103	376
219.2	104	377
221.0	105	378
222.8	106	379
224.6	107	380
226.4	108	381
228.2	109	382
230.0	110	383
231.8	111	384
233.6	112	385
235.4	113	386
237.2	114	387
239.0	115	388
240.8	116	389
242.6	117	390
244.4	118	391
246.2	119	392

Useful temperatures

Quick temperature reference

Condition	°F	°C
Water freezes	32	0
Mild winter day	50	10
Warm spring day	68	20
Hot summer day	86	30
Body temperature	98.6	37
Heat wave	104	40
Water boils	212	100

Oven temperatures

Below is a table of Fahrenheit/Celsius conversions for common oven temperatures.

°F	°C	Oven
225	110	very cool
250	130	
275	140	cool
300	150	
325	170	moderate
350	180	
375	190	moderately hot
400	200	
425	220	hot
450	230	
475	240	very hot

For other conversions, use the following formulas:
°F to **°C** Subtract 32, then divide by 1.8.
°C to **°F** Multiply by 1.8, then add 32.

7: Time

Units of time

Listed below are the names of time periods that are artificially derived, as opposed to astronomical periods.

Time periods

Below are some widely used names for periods of time.

Name	Period	Name	Period
millennium	1,000 years	leap year	366 days
half-millennium	500 years	year	365 days
century	100 years	year	12 months
half-century	50 years	year	52 weeks
decade	10 years	month	28–31 days
half-decade	5 years	week	7 days

Days, hours, minutes

Below are listed the basic subdivisions of a day and their equivalents.

1 day = 24 hours = 1,440 minutes = 86,400 seconds
1 hour = $^1/_{24}$ day = 60 minutes = 3,600 seconds
1 minute = $^1/_{1,440}$ day = $^1/_{60}$ hour = 60 seconds
1 second = $^1/_{86,400}$ day = $^1/_{3,600}$ hour = $^1/_{60}$ minute

Seconds

Greater precision in measuring time has required seconds (s) to be broken down into smaller units, using standard metric prefixes.

1 terasecond (Ts)	10^{12} s	31,689 years
1 gigasecond (Gs)	10^9 s	31.7 years
1 megasecond (Ms)	10^6 s	11.6 days
1 kilosecond (ks)	10^3 s	16.67 minutes
1 millisecond (ms)	10^{-3} s	0.001 seconds

1 microsecond (μs)	10^{-6} s	0.000001
1 nanosecond (ns)	10^{-9} s	0.000000001
1 picosecond (ps)	10^{-12} s	0.000000000001
1 femtosecond (fs)	10^{-15} s	0.000000000000001
1 attosecond (as)	10^{-18} s	0.000000000000000001

Astronomical time

Time can be measured by motion; in fact, the motion of the Earth, Sun, Moon, and stars provided humans with the first means of measuring time.

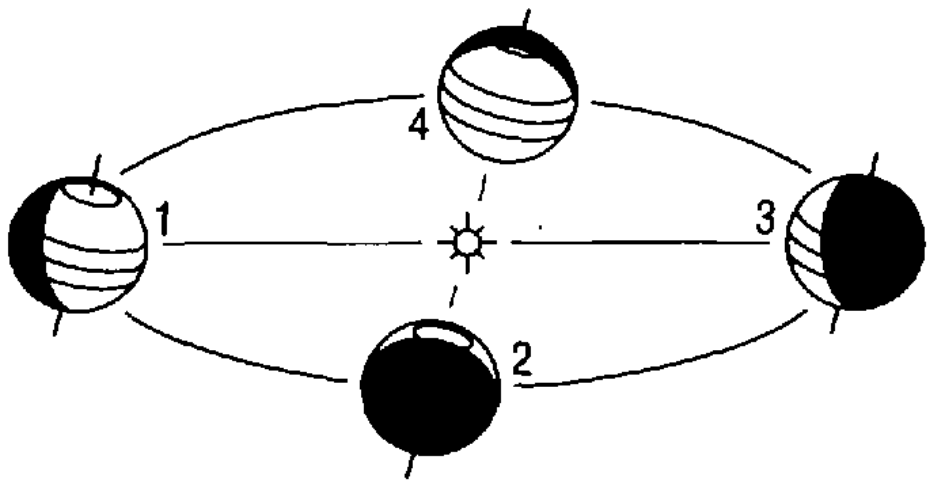
Years, months, days

Sidereal times are calculated by the Earth's position according to fixed stars. The anomalistic year is measured according to the Earth's orbit in relation to the perihelion (Earth's minimum distance to the Sun). Tropical times refer to the apparent passage of the Sun and the actual passage of the Moon across the Earth's equatorial plane. The synodic month is based on the phases of the Moon. Solar time (as in a mean solar day) refers to periods of darkness and light averaged over a year.

Time	Days	Hours	Minutes	Seconds
sidereal year	365	6	9	10
anomalistic year	365	6	13	53
tropical year	365	5	48	45
sidereal month	27	7	43	11
tropical month	27	7	43	5
synodic month	29	12	44	3
mean solar day	0	24	0	0
sidereal day	0	23	56	4

Equinox and solstice

The inclination of the Earth to its plane of rotation around the Sun produces variations in the lengths of day and night at different times of the year. Solstices are when the Sun appears to be overhead at midday at the maximum distances north and south of the Equator. At the summer solstice, days are longest and nights are shortest; this is reversed at the winter solstice. Equinoxes are when day and night are equal everywhere; at these times, the Sun appears overhead at midday at the Equator.



The table lists the dates of the solstices and equinox in each hemisphere, keyed by number to the diagram above, which shows the Earth at four points in its orbit.

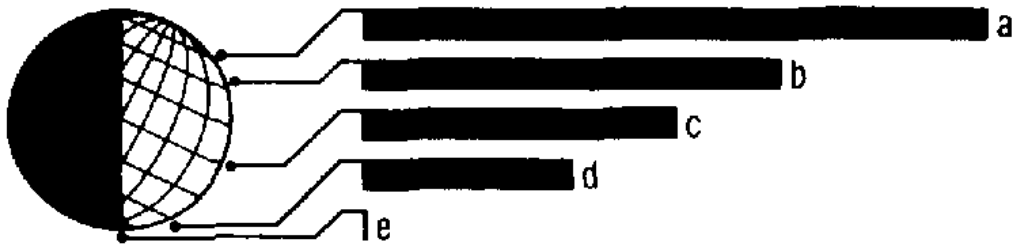
Date	Northern	Southern
1 June 21	summer solstice	winter solstice
2 Sept. 23	autumnal equinox	vernal equinox
3 Dec. 22	winter solstice	summer solstice
4 March 21	vernal equinox	autumnal equinox

Years and seasons

Seasonal variations are another result of the inclination of the Earth's axis to its plane of rotation around the Sun. Parts of the globe tilted away from the Sun receive less radiant energy per unit area than those receiving rays more directly. The table below lists the seasonal equivalents in the two hemispheres, keyed by number to the diagram on the previous page.

Northern	**Southern**
1 summer	winter
2 fall	spring
3 winter	summer
4 spring	fall

Length of days



a Arctic Circle: 66° 33′N – 24 hours daylight
b 49° 3′N – 16 hours daylight
c The Equator: 0° – 12 hours daylight
d 49° 3′S – 8 hours daylight
e Antarctic Circle: 66° 33′S – 0 hours daylight

The diagram above illustrates the variety in the length of the day (21 June) at different latitudes (° = degrees; ′ = minutes). On this day, the northern hemisphere receives the maximum hours of daylight; the southern hemisphere, the minimum.

Geological timescale

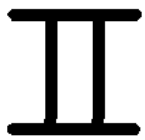
Era millions of years ago	**Period**	**Epoch**
Cenozoic 65–present	Quaternary 2–present	Holocene 0.01–*present*
		Pleistocene 2–0.01
	Tertiary 65–2	Pliocene 7–2
		Miocene 26–7
		Oligocene 38–26
		Eocene 54–38
		Paleocene 65–54
Mesozoic 248–65	Cretaceous 136–65	
	Jurassic 193–136	
	Triassic 225–193	
Paleozoic 590–248	Permian 280–225	
	*Carboniferous 345–280	
	Devonian 395–345	
	Silurian 440–395	
	Ordovician 500–440	
	Cambrian 590–500	
Precambrian before 590		

* Mississippian and Pennsylvanian periods in N. America

The zodiac year

Aries
Ram
(March 21-April 20)

Taurus
Bull
(April 21-May 20)



Gemini
Twins
(May 21-June 20)

Cancer
Crab
(June 21-July 21)

Leo
Lion
(July 22-August 21)

Virgo
Virgin
(August 22-September 21)

Libra
Scales
(Sepember 22-October 22)

Scorpio
Scorpion
(October 23-November 21)

Sagittarius
Archer
(November 22-December 20)

Capricorn
Goat
(December 21-January 19)

Aquarius
Water-bearer
(January 20-February 18)

Pisces
Fish
(February 19-March 20)

Types of calendar

The number of days in a year varies among cultures and from year to year.

Gregorian

The Gregorian calendar is a 16th-century adaptation of the Julian calendar devised in the 1st century BC. The year in this calendar is based on the solar year, which lasts about 365 1/4 days. In this system, years whose number is not divisible by 4 have 365 days, as do centennial years unless the figures before the zeros are divisible by 4. All other years have 366 days; these are leap years.

Below are the names of the months and number of days for a non-leap year.

January	31	July	31
February	28*	August	31
March	31	September	30
April	30	October	31
May	31	November	30
June	30	December	31

* 29 in leap years.

Jewish

A year in the Jewish calendar has 13 months if its number, when divided by 9, leaves 0, 3, 6, 8, 11, 14, or 17; otherwise, it has 12 months. The year is based on the lunar year, but its number of months varies to keep broadly in line with the solar cycle. Its precise number of days is fixed with reference to particular festivals that must not fall on certain days of the week.

Below are the names of the months and number of days in each for the year 5471, a 12-month year (1980 AD in Gregorian).

Tishri	30	Nisan	30
Cheshvan	29*	Iyar	29
Kislev	29*	Sivan	30
Tevet	29	Tammuz	29
Shevat	30	Av	30
Adar	29†	Elul	29

* 30 in some years.
† In 13-month years, the month Veadar, with 29 days, falls between Adar and Nisan.

Muslim

A year in the Muslim calendar has 355 days if its number, when divided by 30, leaves 2, 5, 7, 10, 13, 16, 18, 21, 24, 26, or 29; otherwise it has 354 days. As in the Jewish calendar, years are based on the lunar cycle.

Below are the names of the months and number of days in each for the Muslim year 1401 (1980 AD in Gregorian).

Muharram	30	Rajab	30
Safar	29	Sha'ban	29
Rabi'I	30	Ramadan	30
Rabi'II	29	Shawwal	29
Jumada I	30	Dhu l-Qa'dah	30
Jumada II	29	Dhu l-Hijja	30*

* 29 in some years.

Wedding anniversaries

Year	**Traditional** (alternative)	**Modern**
1st	Paper (plastics)	Clocks
2nd	Cotton (calico)	China
3rd	Leather	Crystal, glass
4th	Linen (silk, synthetics)	Electrical appliances
5th	Wood	Silverware
6th	Iron	Wood
7th	Wool (copper, brass)	Desk sets
8th	Bronze (electrical appliances)	Linen, lace
9th	Pottery (china)	Leather
10th	Tin (aluminum)	Diamond jewelry
11th	Steel	Fashion jewelry, accessories
12th	Silk (linen)	Pearls or colored gems
13th	Lace	Textile, furs
14th	Ivory	Gold jewelry
15th	Crystal (glass)	Watches
20th	China	Platinum
25th	Silver	Sterling silver jubilee
30th	Pearl	Diamond
35th	Coral (jade)	Jade
40th	Ruby (garnets)	Ruby
45th	Sapphire (tourmalines)	Sapphire
50th	Gold	Gold
55th	Emerald (turquoise)	Emerald
60th	Diamond (gold)	Diamond

Perpetual calendar

How to use the calendar To discover on which day of the week any date between the years 1780 and 2046 falls, look up the year in the key and the letter shown to the right will indicate which of the calendars A–N you should consult.

Key:

1780	N	1805	C	1830	F
1781	B	1806	D	1831	G
1782	C	1807	E	1832	H
1783	D	1808	M	1833	C
1784	L	1809	A	1834	D
1785	G	1810	B	1835	E
1786	A	1811	C	1836	M
1787	B	1812	K	1837	A
1788	J	1813	F	1838	B
1789	E	1814	G	1839	C
1790	F	1815	A	1840	K
1791	G	1816	I	1841	F
1792	H	1817	D	1842	G
1793	C	1818	E	1843	A
1794	D	1819	F	1844	I
1795	E	1820	N	1845	D
1796	M	1821	B	1846	E
1797	A	1822	C	1847	F
1798	B	1823	D	1848	N
1799	C	1824	L	1849	B
1800	D	1825	G	1850	C
1801	E	1826	A	1851	D
1802	F	1827	B	1852	L
1803	G	1828	J	1853	G
1804	H	1829	E	1854	A

1855	B	1887	G	1919	D
1856	J	1888	H	1920	L
1857	E	1889	C	1921	G
1858	F	1890	D	1922	A
1859	G	1891	E	1923	B
1860	H	1892	M	1924	J
1861	C	1893	A	1925	E
1862	D	1894	B	1926	F
1863	E	1895	C	1927	G
1864	M	1896	K	1928	H
1865	A	1897	F	1929	C
1866	B	1898	G	1930	D
1867	C	1899	A	1931	E
1868	K	1900	B	1932	M
1869	F	1901	C	1933	A
1870	G	1902	D	1934	B
1871	A	1903	E	1935	C
1872	I	1904	M	1936	K
1873	D	1905	A	1937	F
1874	E	1906	B	1938	G
1875	F	1907	C	1939	A
1876	N	1908	K	1940	I
1877	B	1909	F	1941	D
1878	C	1910	G	1942	E
1879	D	1911	A	1943	F
1880	L	1912	I	1944	N
1881	G	1913	D	1945	B
1882	A	1914	E	1946	C
1883	B	1915	F	1947	D
1884	J	1916	N	1948	L
1885	E	1917	B	1949	G
1886	F	1918	C	1950	A

1951	**B**	1983	**G**	2015	**E**
1952	**J**	1984	**H**	2016	**M**
1953	**E**	1985	**C**	2017	**A**
1954	**F**	1986	**D**	2018	**B**
1955	**G**	1987	**E**	2019	**C**
1956	**H**	1988	**M**	2020	**K**
1957	**C**	1989	**A**	2021	**F**
1958	**D**	1990	**B**	2022	**G**
1959	**E**	1991	**C**	2023	**A**
1960	**M**	1992	**K**	2024	**I**
1961	**A**	1993	**F**	2025	**D**
1962	**B**	1994	**G**	2026	**E**
1963	**C**	1995	**A**	2027	**F**
1964	**K**	1996	**I**	2028	**N**
1965	**F**	1997	**D**	2029	**B**
1966	**G**	1998	**E**	2030	**C**
1967	**A**	1999	**F**	2031	**D**
1968	**I**	2000	**N**	2032	**L**
1969	**D**	2001	**B**	2033	**G**
1970	**E**	2002	**C**	2034	**A**
1971	**F**	2003	**D**	2035	**B**
1972	**N**	2004	**L**	2036	**J**
1973	**B**	2005	**G**	2037	**E**
1974	**C**	2006	**A**	2038	**F**
1975	**D**	2007	**B**	2039	**G**
1976	**L**	2008	**J**	2040	**H**
1977	**G**	2009	**E**	2041	**C**
1978	**A**	2010	**F**	2042	**D**
1979	**B**	2011	**G**	2043	**E**
1980	**J**	2012	**H**	2044	**M**
1981	**E**	2013	**C**	2045	**A**
1982	**F**	2014	**D**	2046	**B**

A **1786 1797 1809 1815 1826 1837 1843**
1854 1865 1871 1882 1893 1899 1905

JANUARY

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FEBRUARY

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B **1781 1787 1798 1810 1821 1827 1838**
1849 1855 1866 1877 1883 1894 1900

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1973 1979 1990 2001 2007 2018 2029
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B

JULY

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C **1782 1793 1799 1805 1811 1822 1833**
1839 1850 1861 1867 1878 1889 1895

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APRIL

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1963 1974 1985 1991 2002 2013 2019
2030 2041

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OCTOBER

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NOVEMBER

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DECEMBER

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D **1783 1794 1800 1806 1817 1823 1834**
1845 1851 1862 1873 1879 1890 1902

JANUARY

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FEBRUARY

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MARCH

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APRIL

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MAY

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JUNE

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1913 1919 1930 1941 1947 1958 1969 1975 1986 1997 2003 2014 2025 2031 2042

D

JULY

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13	14	15	16	17	18	19
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27	28	29	30	31		

AUGUST

S	M	T	W	T	F	S
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10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

SEPTEMBER

S	M	T	W	T	F	S
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14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

OCTOBER

S	M	T	W	T	F	S
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12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

NOVEMBER

S	M	T	W	T	F	S
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16	17	18	19	20	21	22
23	24	25	26	27	28	29
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DECEMBER

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21	22	23	24	25	26	27
28	29	30	31			

E **1789 1795 1801 1807 1818 1829 1835**
1846 1857 1863 1874 1885 1891 1903

JANUARY

S	M	T	W	T	F	S
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11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

FEBRUARY

S	M	T	W	T	F	S
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8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

MARCH

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15	16	17	18	19	20	21
22	23	24	25	26	27	28
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APRIL

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MAY

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JUNE

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E

JULY

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AUGUST

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SEPTEMBER

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OCTOBER

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NOVEMBER

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DECEMBER

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F **1790 1802 1813 1819 1830 1841 1847**
1858 1869 1875 1886 1897 1909 1915

JANUARY

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FEBRUARY

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MARCH

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APRIL

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MAY

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JUNE

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1993 1999 2010 2021 2027 2038

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JULY

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AUGUST

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SEPTEMBER

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OCTOBER

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NOVEMBER

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DECEMBER

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G **1785 1791 1803 1814 1825 1831 1842**
1853 1859 1870 1881 1887 1898 1910

JANUARY

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FEBRUARY

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APRIL

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MAY

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1983 1994 2005 2011 2022 2033 2039

JULY

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AUGUST

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OCTOBER

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NOVEMBER

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DECEMBER

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H 1792 1804 1832 1860 1888
1928 1956 1984 2012 2040

JANUARY

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FEBRUARY

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MARCH

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APRIL

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MAY

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JUNE

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JULY

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AUGUST

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SEPTEMBER

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OCTOBER

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NOVEMBER

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DECEMBER

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I **1816 1844 1872 1912**
1940 1968 1996 2024

JANUARY

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FEBRUARY

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MARCH

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APRIL

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MAY

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JUNE

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JULY

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AUGUST

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SEPTEMBER

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OCTOBER

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NOVEMBER

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DECEMBER

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J **1788 1828 1856 1884 1924**
1952 1980 2008 2036

JANUARY

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FEBRUARY

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MARCH

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APRIL

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MAY

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JUNE

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JULY

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AUGUST

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SEPTEMBER

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OCTOBER

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DECEMBER

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K **1812 1840 1868 1896 1908**
1936 1964 1992 2020

JANUARY

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MARCH

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APRIL

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SEPTEMBER

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OCTOBER

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NOVEMBER

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DECEMBER

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13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

L **1784 1824 1852 1880 1920**
1948 1976 2004 2032

JANUARY

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

FEBRUARY

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29						

MARCH

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

APRIL

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

MAY

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2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

JUNE

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

L

JULY

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

AUGUST

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

SEPTEMBER

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
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19	20	21	22	23	24	25
26	27	28	29	30		

OCTOBER

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					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

NOVEMBER

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

DECEMBER

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

M 1796 1808 1836 1864 1892 1904
1932 1960 1988 2016 2044

JANUARY

S	M	T	W	T	F	S
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10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

FEBRUARY

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7	8	9	10	11	12	13
14	15	16	17	18	19	20
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28	29					

MARCH

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
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APRIL

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17	18	19	20	21	22	23
24	25	26	27	28	29	30

MAY

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1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

JUNE

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

M

JULY

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

AUGUST

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

SEPTEMBER

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

OCTOBER

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

NOVEMBER

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

DECEMBER

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

1780 1820 1848 1876 1916
1944 1972 2000 2028

JANUARY

S	M	T	W	T	F	S
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2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

FEBRUARY

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29				

MARCH

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

APRIL

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

MAY

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

JUNE

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

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JULY

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

AUGUST

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

SEPTEMBER

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

OCTOBER

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

NOVEMBER

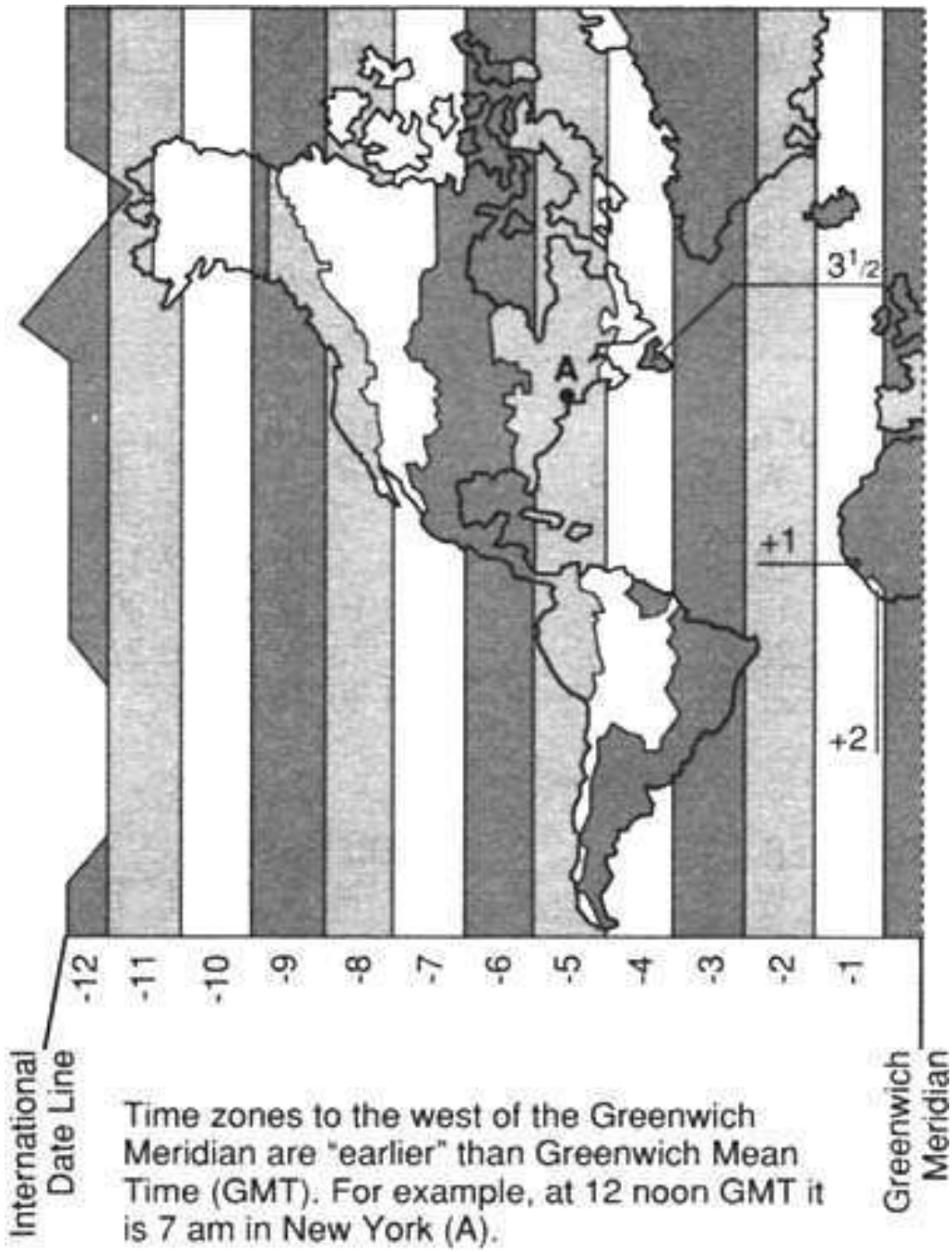
S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

DECEMBER

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

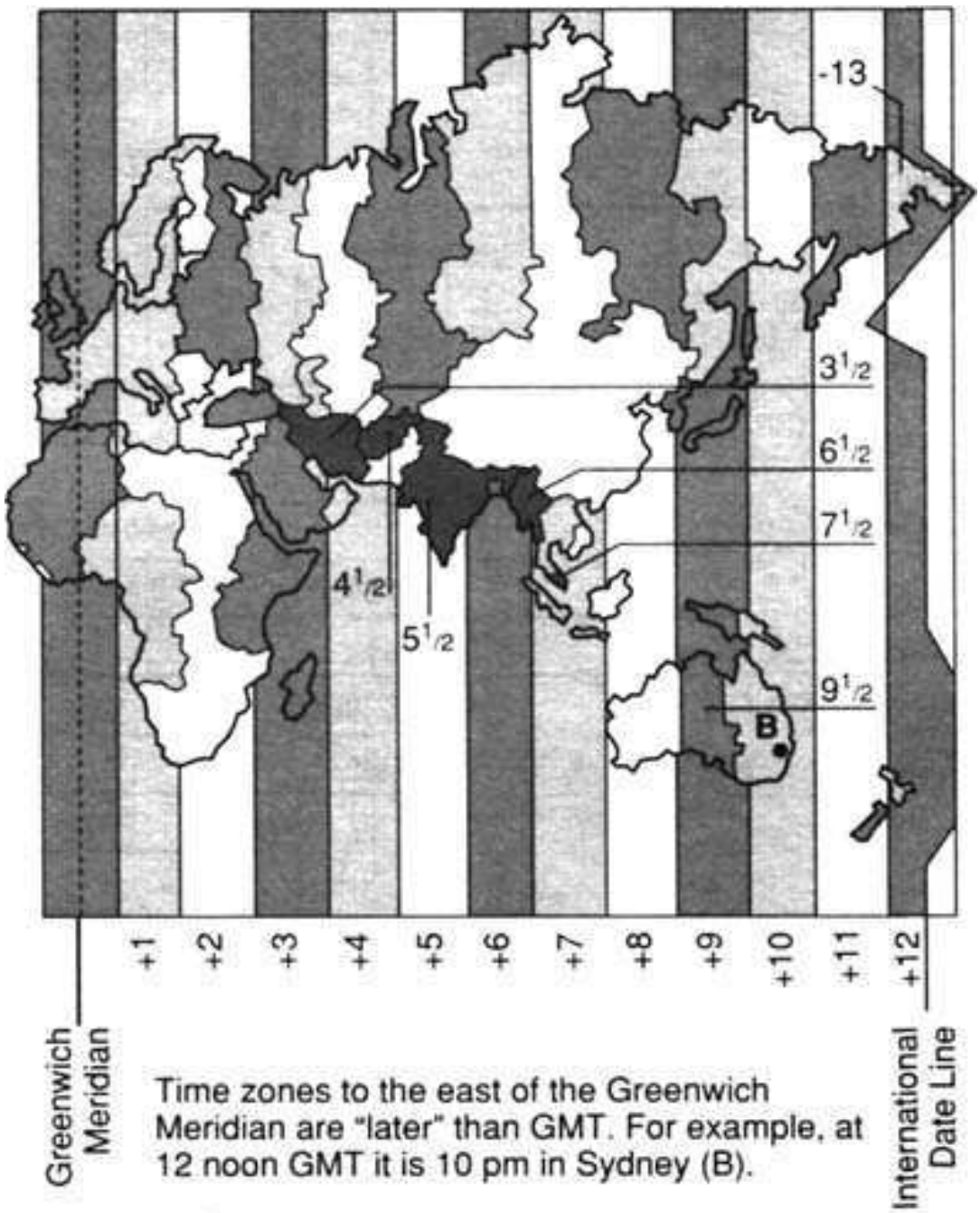
Time zones of the world

Some countries, including the US, adopt Daylight Saving Time (DST) in order to receive more daylight



Time zones to the west of the Greenwich Meridian are "earlier" than Greenwich Mean Time (GMT). For example, at 12 noon GMT it is 7 am in New York (A).

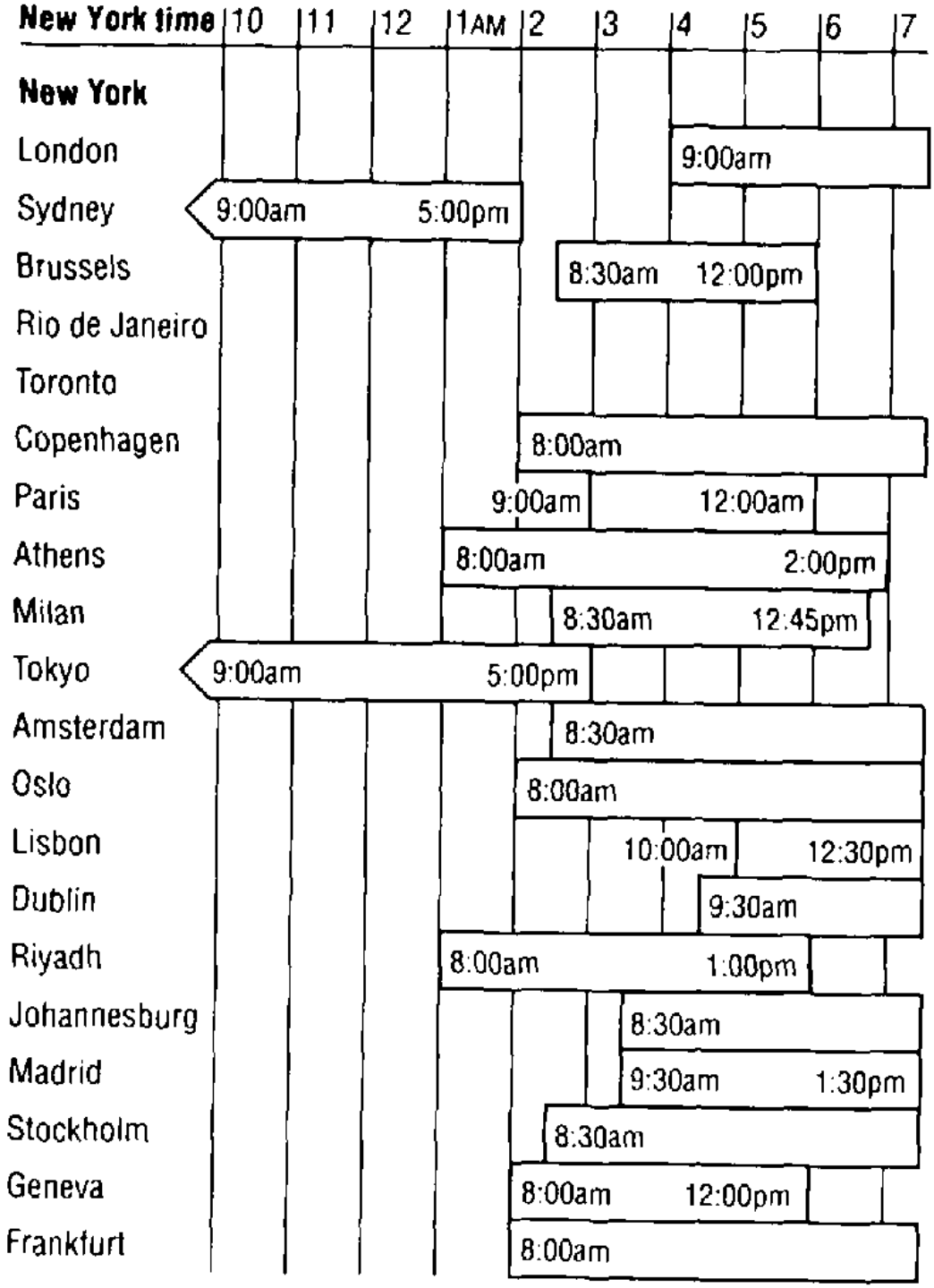
in summer. Clocks are put forward 1 hour in spring and back 1 hour in fall. The maps below do not reflect DST adjustments.



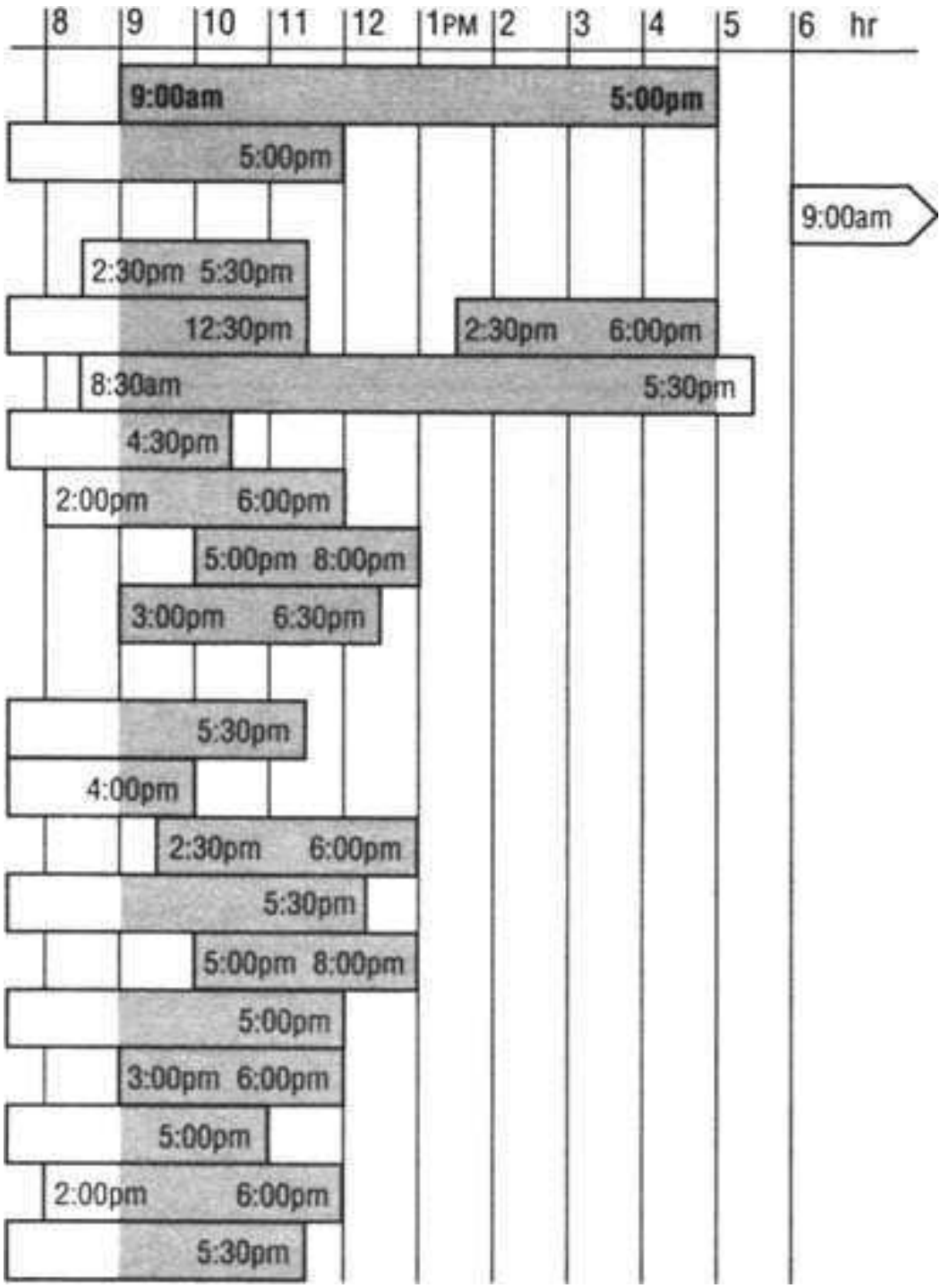
Time zones to the east of the Greenwich Meridian are "later" than GMT. For example, at 12 noon GMT it is 10 pm in Sydney (B).

Office times

The table shows the usual office hours (local time) in various cities around the world compared to New York



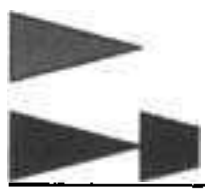
(east coast time). Los Angeles (west coast time) is three hours behind.



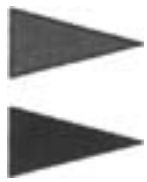
8: Speed

Formulas

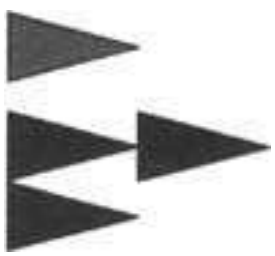
Below are listed the multiplication/division factors for converting units of speed from one measuring system to another. Note that two kinds of factors are given: quick, for an approximate conversion that can be made without a calculator; and accurate, for an exact conversion.



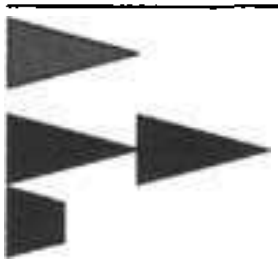
		Quick	Accurate
Miles per hour (mph) Kilometers per hour (km/h)			
mph ⟶ km/h		× 1.5	× 1.609
km/h ⟶ mph		÷ 1.5	× 0.621



Yards per minute (ypm) Meters per minute (m/min)			
ypm ⟶ m/min		÷ 1	× 0.914
m/min ⟶ ypm		× 1	× 1.094



Feet per minute (ft/min) Meters per minute (m/min)			
ft/min ⟶ m/min		÷ 3	× 0.305
m/min ⟶ ft/min		× 3	× 3.281

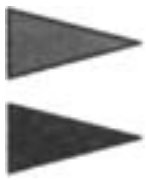


Inches per second (in/s) Centimeters per second (cm/s)			
in/s ⟶ cm/s		× 2.5	× 2.54
cm/s ⟶ in/s		÷ 2.5	× 0.394

International knots (kn)
Miles per hour (mph)

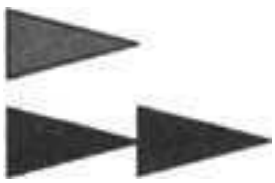
		Quick	Accurate
kn →	mph	× 1	× 1.151
mph →	kn	÷ 1	× 0.869

British knots (UK kn)
International knots (kn)



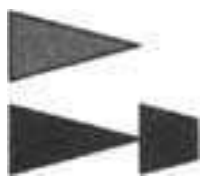
		Quick	Accurate
UK kn →	kn	× 1	× 1.001
kn →	UK kn	÷ 1	× 0.999

International knots (kn)
Kilometers per hour (km/h)



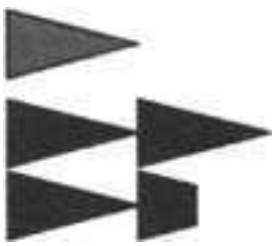
		Quick	Accurate
kn →	km/h	× 2	× 1.852
km/h →	kn	÷ 2	× 0.540

Miles per hour (mph)
Feet per second (ft/s)



		Quick	Accurate
mph →	ft/s	× 1.5	× 1.467
ft/s →	mph	÷ 1.5	× 0.682

Kilometers per hour (km/h)
Meters per second (m/s)



		Quick	Accurate
km/h →	m/s	÷ 3.5	× 0.278
m/s →	km/h	× 3.5	× 3.599

Conversion tables

The tables below can be used to convert units of speed from one measuring system to another. The first group

Miles per hour to Kilometers per hour

mph	km/h
1	1.609
2	3.219
3	4.828
4	6.437
5	8.047
6	9.656
7	11.265
8	12.875
9	14.484
10	16.093
20	32.187
30	48.280
40	64.374
50	80.467
60	96.561
70	112.654
80	128.748
90	144.841
100	160.934

Kilometers per hour to Miles per hour

km/h	mph
1	0.621
2	1.242
3	1.864
4	2.485
5	3.106
6	3.728
7	4.349
8	4.970
9	5.592
10	6.213
20	12.427
30	18.641
40	24.854
50	31.068
60	37.282
70	43.495
80	49.709
90	55.923
100	62.137

Yards per minute to Meters per minute

ypm	m/min
1	0.914
2	1.829
3	2.743
4	3.658
5	4.572
6	5.486
7	6.401
8	7.315
9	8.230
10	9.144
20	18.288
30	27.432
40	36.576
50	45.720
60	54.864
70	64.008
80	73.152
90	82.296
100	91.440

of tables converts US units/UK imperial units to metric, and vice versa. The tables beginning on page 192 convert knots, imperial, and metric units.

Meters per minute to Yards per minute

m/min	ypm
1	1.094
2	2.187
3	3.281
4	4.374
5	5.468
6	6.562
7	7.655
8	8.749
9	9.842
10	10.936
20	21.872
30	32.808
40	43.744
50	54.680
60	65.616
70	76.552
80	87.488
90	98.424
100	109.360

Feet per minute to Meters per minute

ft/min	m/min
1	0.305
2	0.610
3	0.914
4	1.219
5	1.524
6	1.829
7	2.134
8	2.438
9	2.743
10	3.048
20	6.096
30	9.144
40	12.192
50	15.240
60	18.288
70	21.336
80	24.384
90	27.432
100	30.480

Meters per minute to Feet per minute

m/min	ft/min
1	3.281
2	6.562
3	9.842
4	13.123
5	16.404
6	19.685
7	22.966
8	26.246
9	29.527
10	32.808
20	65.616
30	98.424
40	131.232
50	164.040
60	196.848
70	229.656
80	262.464
90	295.272
100	328.080

US units/UK imperial and metric units of speed (continued)

Inches per second to Centimeters per second

in/s	cm/s
1	2.54
2	5.08
3	7.62
4	10.16
5	12.70
6	15.24
7	17.78
8	20.32
9	22.86
10	25.40
20	50.80
30	76.20
40	101.60
50	127.00
60	152.40
70	177.80
80	203.20
90	228.60
100	254.00

Centimeters per second to Inches per second

cm/s	in/s
1	0.394
2	0.787
3	1.181
4	1.579
5	1.969
6	2.362
7	2.760
8	3.150
9	3.543
10	3.937
20	7.874
30	11.811
40	15.748
50	19.685
60	23.622
70	27.559
80	31.496
90	35.433
100	39.370

International knots to Miles per hour

kn	mph
1	1.151
2	2.302
3	3.452
4	4.603
5	5.753
6	6.905
7	8.055
8	9.206
9	10.357
10	11.508
20	23.016
30	34.523
40	46.031
50	57.540
60	69.047
70	80.555
80	92.062
90	103.570
100	115.078

Miles per hour to International knots

mph	kn
1	0.869
2	1.738
3	2.607
4	3.476
5	4.345
6	5.214
7	6.083
8	6.952
9	7.821
10	8.690
20	17.380
30	26.069
40	34.759
50	43.449
60	52.139
70	60.828
80	69.518
90	78.208
100	86.898

UK knots to International knots

UK kn	kn
1	1.001
2	2.001
3	3.002
4	4.003
5	5.003
6	6.004
7	7.004
8	8.005
9	9.006
10	10.006
20	20.013
30	30.019
40	40.026
50	50.032
60	60.038
70	70.045
80	80.051
90	90.058
100	100.064

International knots to UK knots

kn	UK kn
1	0.999
2	1.999
3	2.998
4	3.997
5	4.997
6	5.996
7	6.996
8	7.995
9	8.994
10	9.994
20	19.987
30	29.981
40	39.974
50	49.968
60	59.962
70	69.955
80	79.949
90	89.942
100	99.936

US units/UK imperial and metric units of speed (continued)

International knots to Kilometers per hour

kn	km/h
1	1.852
2	3.704
3	5.556
4	7.408
5	9.260
6	11.112
7	12.964
8	14.816
9	16.668
10	18.520
20	37.040
30	55.560
40	74.080
50	92.600
60	111.120
70	129.640
80	148.160
90	166.680
100	185.200

Kilometers per hour to International knots

km/h	kn
1	0.540
2	1.08
3	1.62
4	2.16
5	2.70
6	3.23
7	3.77
8	4.31
9	4.85
10	5.30
20	10.78
30	16.17
40	21.56
50	26.95
60	32.34
70	37.73
80	43.12
90	48.51
100	53.90

Miles per hour to Feet per second

mph	ft/s
1	1.467
2	2.933
3	4.400
4	5.867
5	7.334
6	8.800
7	10.267
8	11.734
9	13.203
10	14.667
20	29.334
30	44.001
40	58.668
50	73.335
60	88.002
70	102.669
80	117.336
90	132.003
100	146.670

Feet per second to Miles per hour

ft/s	mph
1	0.682
2	1.364
3	2.046
4	2.728
5	3.410
6	4.092
7	4.774
8	5.456
9	6.138
10	6.820
20	13.640
30	20.460
40	27.280
50	34.100
60	40.920
70	47.740
80	54.560
90	61.380
100	68.200

Kilometers per hour to Meters per second

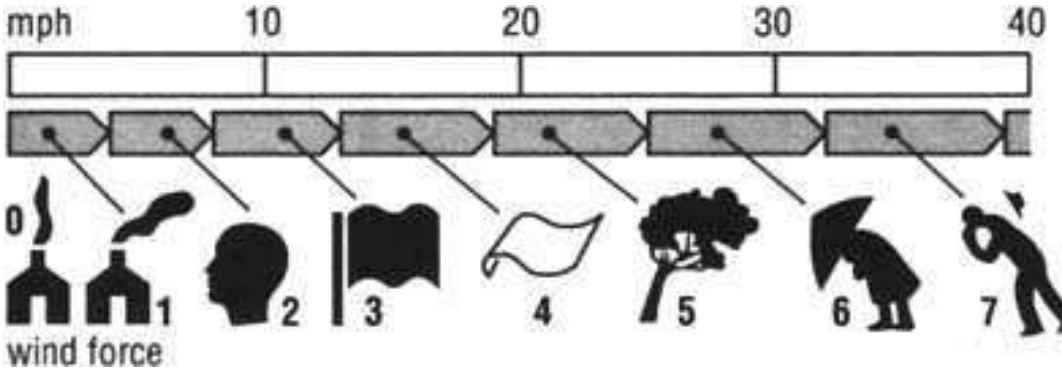
km/h	m/s
1	0.278
2	0.556
3	0.834
4	1.111
5	1.389
6	1.669
7	1.945
8	2.222
9	2.500
10	2.778
20	5.556
30	8.334
40	11.112
50	13.890
60	16.668
70	19.446
80	22.224
90	25.002
100	27.780

Meters per second to Kilometers per hour

m/s	km/h
1	3.599
2	7.198
3	10.797
4	14.396
5	17.995
6	21.594
7	25.193
8	28.792
9	32.391
10	35.990
20	71.980
30	107.970
40	143.960
50	179.950
60	215.940
70	251.930
80	287.920
90	323.910
100	359.900

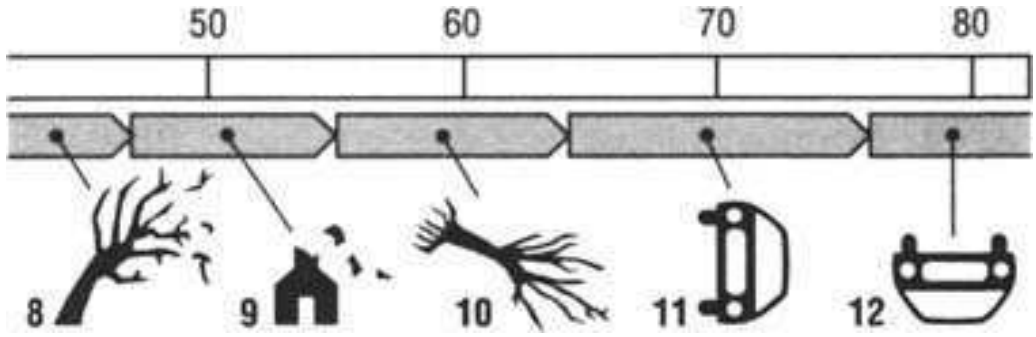
The Beaufort scale

The speed of wind is measured by using the Beaufort Scale, based on easily observable factors such as tree movement, smoke behavior, and damage incurred. It was devised by a 19th-century British admiral, Sir Francis Beaufort.



Number	Description	Speed range mph
Force 0	Calm	Below 1
Force 1	Light air	1–3
Force 2	Light breeze	4–7
Force 3	Gentle breeze	8–12
Force 4	Moderate breeze	13–18
Force 5	Fresh breeze	19–24
Force 6	Strong breeze	25–31
Force 7	Moderate gale	32–38
Force 8	Fresh gale	39–46
Force 9	Strong gale	47–54
Force 10	Whole gale	55–63
Force 11	Storm	64–75
Force 12	Hurricane	Over 75

As air moves across the surface of the Earth, its direction is determined by such factors as the Earth's rotation, variations in temperature, air pressure, and land features such as mountains. Listed below are examples showing the effects of wind as measured on the Beaufort Scale, the variety of winds that are measured, and the range of speeds to which they apply.

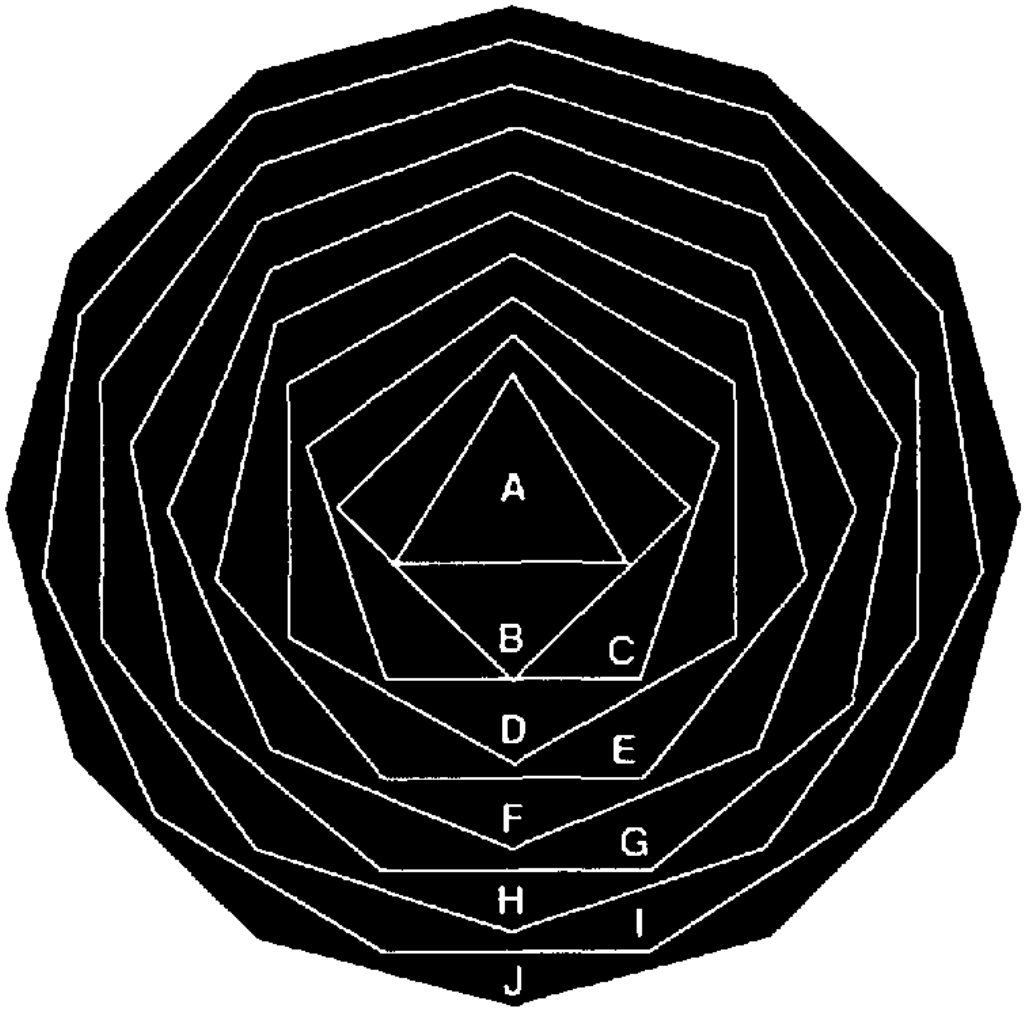


Number	Characteristics
Force 0	Smoke rises straight up
Force 1	Smoke shows wind direction
Force 2	Wind felt on face
Force 3	Flag extends
Force 4	Dust and paper blow in wind
Force 5	Small trees sway in wind
Force 6	Umbrellas are difficult to use
Force 7	Difficult to stand up in wind
Force 8	Twigs break off trees
Force 9	Chimney tops and tiles are dislodged
Force 10	Trees are uprooted
Force 11	Extensive damage
Force 12	Extremely violent

9: Geometry

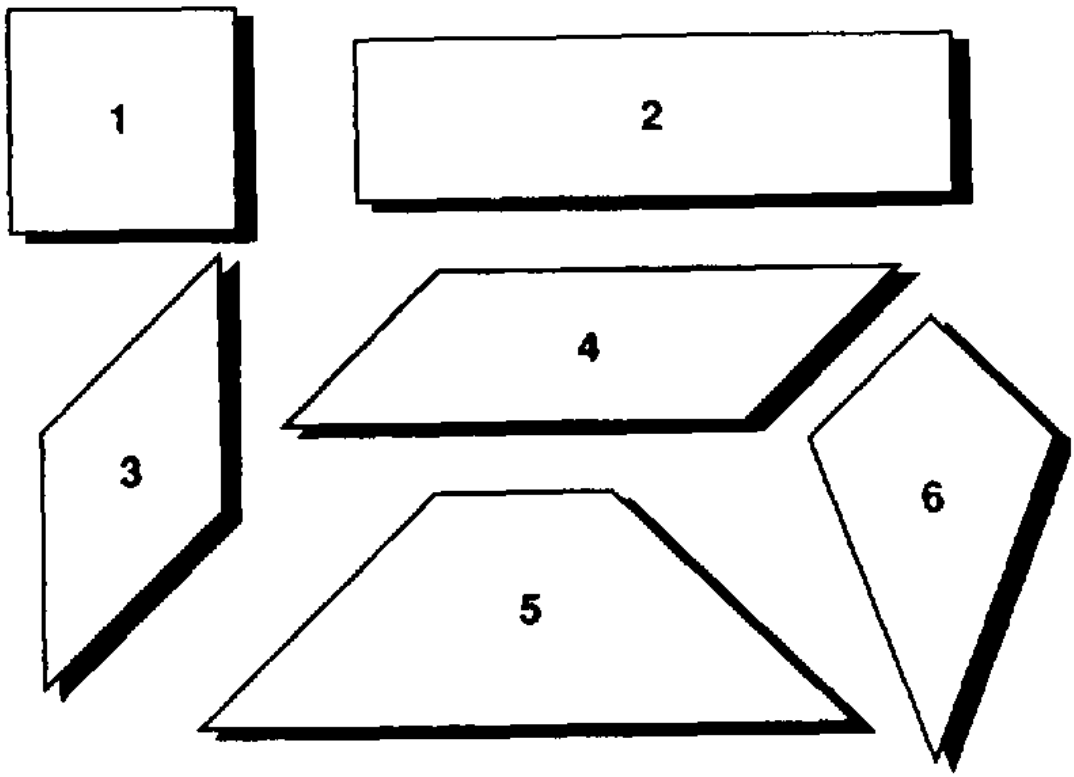
Polygons

	Name of polygon	Number of sides	Each internal angle	Sum of internal angles
	Triangle	3	60°	180°
	Square	4	90°	360°
	Pentagon	5	108°	540°
	Hexagon	6	120°	720°
	Heptagon	7	128.6°	900°
	Octagon	8	135°	1,080°
	Nonagon	9	140°	1,260°
	Decagon	10	144°	1,440°
	Undecagon	11	147.3°	1,620°
	Dodecagon	12	150°	1,800°



A Triangle
B Square
C Pentagon
D Hexagon
E Heptagon
F Octagon
G Nonagon
H Decagon
I Undecagon
J Dodecagon

Quadrilaterals

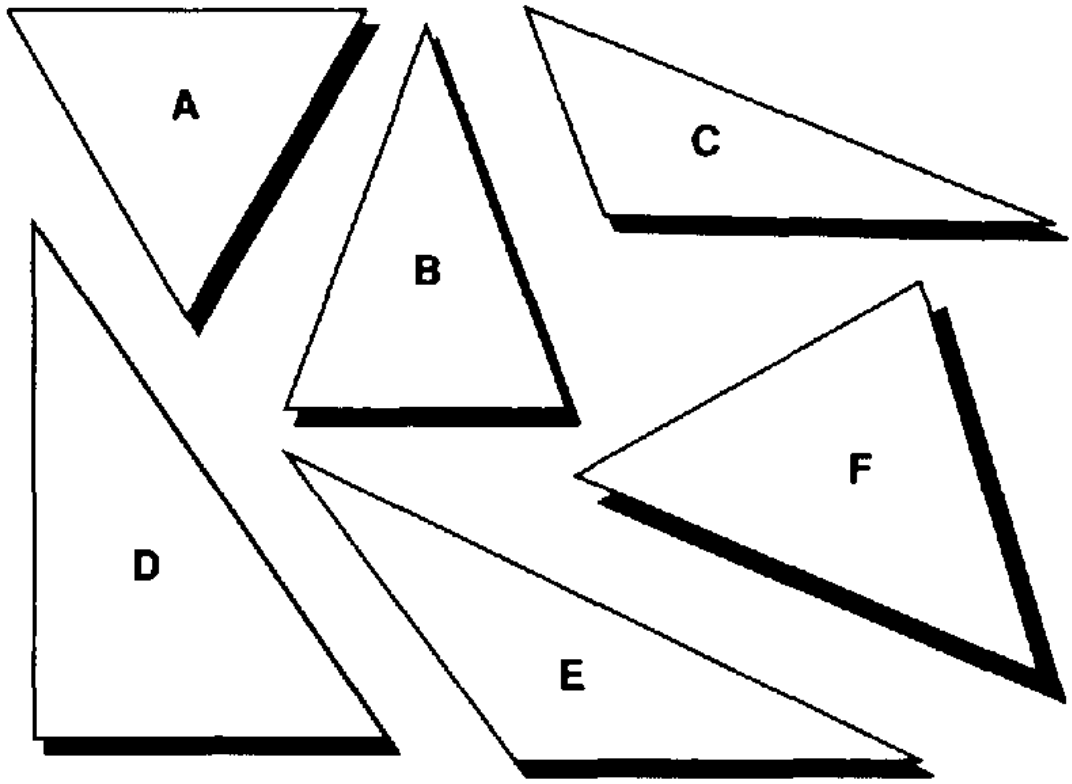


Quadrilaterals

A quadrilateral is a four-sided polygon.

1 Square	All the sides are the same length and all the angles are right angles.
2 Rectangle	Opposite sides are the same length and all the angles are right angles.
3 Rhombus	All the sides are the same length but none of the angles are right angles.
4 Parallelogram	Opposite sides are parallel to each other and of the same length.
5 Trapezoid	One pair of the opposite sides is parallel.
6 Kite	Adjacent sides are the same length and the diagonals intersect at right angles.

Triangles

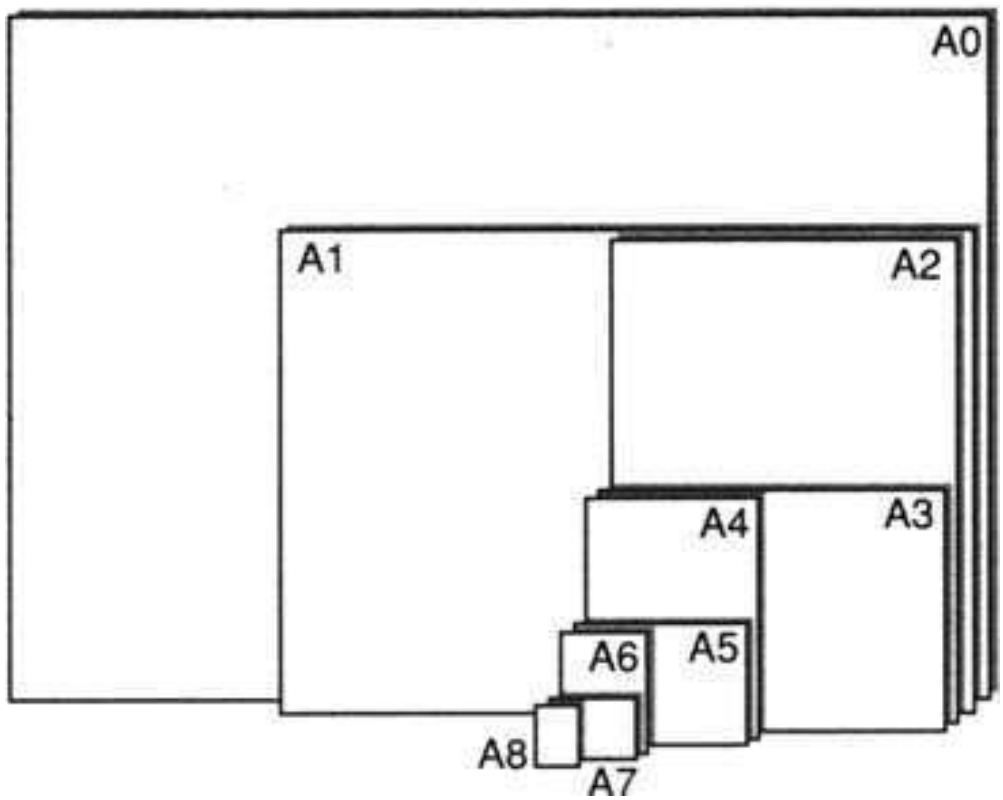


Triangles

A Equilateral	All the sides are the same length and all the angles are equal.
B Isosceles	Two sides are of the same length and two angles are of equal size.
C Scalene	All the sides are of different length and all the angles are of different sizes.
D Right angle	A triangle that contains one right angle.
E Obtuse angle	A triangle that contains one obtuse angle.
F Acute angle	A triangle with three acute angles.

10: Everyday measures

Standard international paper sizes



A0	33 1/2 × 46 3/4 in	841 × 1,189 mm
A1	23 3/8 × 33 1/8 in	594 × 841 mm
A2	16 1/2 × 23 3/8 in	594 × 420 mm
A3	11 3/4 × 16 1/2 in	297 × 420 mm
A4	8 1/4 × 11 3/4 in	297 × 210 mm
A5	5 7/8 × 8 1/4 in	148 × 210mm
A6	4 1/8 × 6 in	148 × 105 mm
A7	3 × 4 1/8 in	74 × 105 mm
A8	2 × 3 in	74 × 52 mm

Stock paper sizes

Although special paper sizes may be ordered from paper merchants, the grades of paper that are most popular in the US are provided in standard sizes. These standard sizes are measured in the metric system used in Europe, as is the "A series" given on the previous page.

Stock sizes for book paper

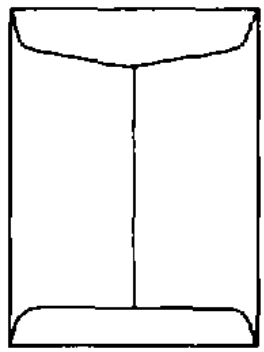
In the US, the sizes of the presses used for book printing and the most popular book trim sizes dictate the stock sizes for book paper. The figures for some of these sizes are given below.

Sheet size	No. of pages per sheet	Folded size before trimming	Trim size
35 × 45 in	64	5⅝ × 8¾	5½ × 8½
38 × 50 in	64	6¼ × 9½	6⅛ × 9¼
41 × 61 in	128	5⅛ × 7⅝	5 × 7⅜
44 × 66 in	128	5½ × 8¾	5⅜ × 8
45 × 68 in	128	5⅝ × 8½	5½ × 8¼
45 × 69 in	128	5¾ × 8⅝	5⅛ × 8⅜

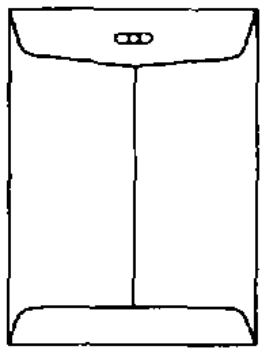
Envelope sizes and styles

There are two basic styles of envelope: open-end and open-side. Within these two categories, there are as many variations of style and size as there are uses. Here, a selection of styles is given, together with the smallest and largest sizes in which they are available.

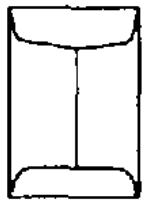
Open-end envelopes



Catalog A strong envelope used for magazines, booklets, reports, and catalogs.
Smallest (glove): $3\frac{7}{8} \times 7\frac{1}{2}$ in
Largest (catalog): $12 \times 15\frac{1}{2}$ in

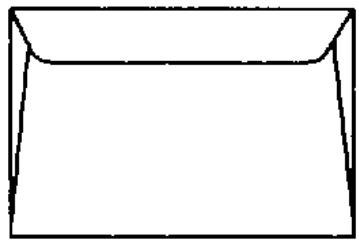


Clasp/string and button A strong, reusable catalog envelope, with a metal clasp or string and button, used for mailing bulky material.
Smallest: $2\frac{1}{2} \times 4\frac{1}{4}$ in
Largest: $12 \times 15\frac{1}{2}$ in

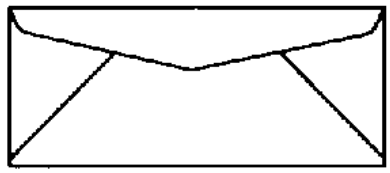


Coin Used for coins, currency, pay, etc.
Smallest: $1\frac{11}{16} \times 2\frac{3}{4}$ in
Largest: $3\frac{1}{2} \times 6\frac{1}{2}$ in

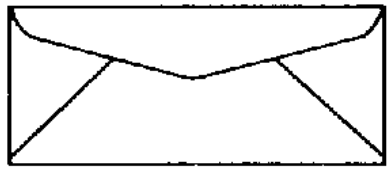
Open-side envelopes



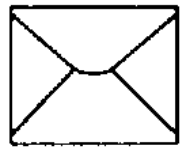
Booklet Used for direct mailing, brochures, annual reports, sales literature, etc.
Smallest: 3 1/4 × 6 3/4 in
Largest: 9 1/2 × 12 5/8 in



Commercial/official Used for all types of correspondence, both personal and official.
Smallest (commercial): 3 1/16 × 5 1/2 in
Largest (official): 5 × 11 1/2 in

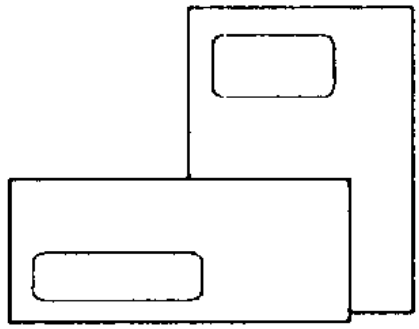


Banker's flap Stronger than a commercial envelope.
Smallest: 3 7/8 × 7 1/2 in
Largest: 6 × 12 in



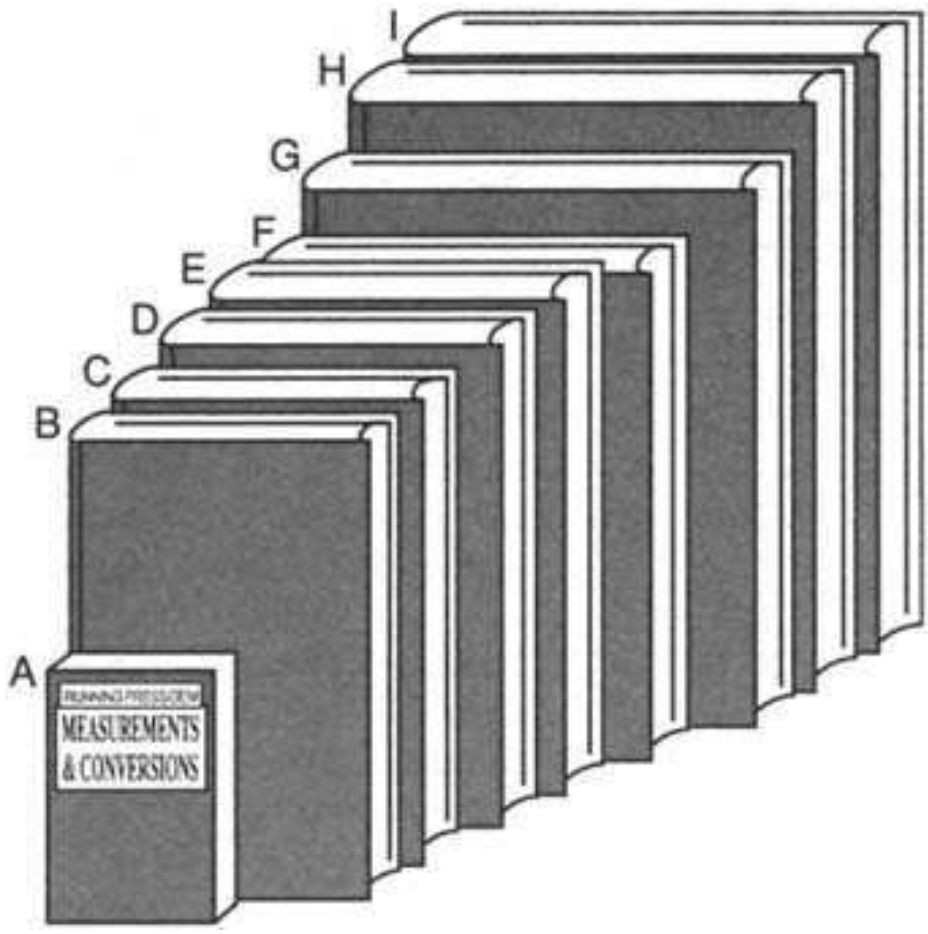
Baronial Used for invitations and greetings cards.
Smallest: 3 5/8 × 5 1/8 in
Largest (card): 4 5/8 × 6 1/4 in

Window envelopes



These are available in many different sizes and styles.

Book sizes



A	Running Press Gem $3\frac{1}{8} \times 4\frac{5}{8}$ in	117 × 79 mm
Octavo formats		
B	$5\frac{1}{4} \times 8\frac{1}{2}$ in	133 × 216 mm
C	$5\frac{1}{2} \times 8\frac{1}{2}$ in	140 × 216 mm
D	6 × 9 in	152 × 229 mm
E	$6\frac{1}{8} \times 9\frac{1}{4}$ in	156 × 235 mm
Quarto formats		
F	7 × 9 in	178 × 229 mm
G	8 × 10 in	203 × 254 mm
H	$8\frac{1}{4} \times 10\frac{7}{8}$ in	210 × 276 mm
I	$8\frac{1}{2} \times 11$ in	216 × 279 mm

Wine bottle shapes

Bordeaux

Burgundy;
Moselle

Côtes de
Provence

Alsace

Chianti

Hock

Clothing sizes

US clothing sizes are equal to UK sizes for some items, such as children's shoes; for others, the two vary slightly. Below are listed the European equivalents of US and UK clothing and shoe sizes. Remember also that sizes vary depending on the manufacturer.

Men's shoes

USA	UK	Europe
7	6 1/2	39
7 1/2	7	40
8	7 1/2	41
8 1/2	8	42
9	8 1/2	43
9 1/2	9	43
10	9 1/2	44
10 1/2	10	44
11	10 1/2	45

Women's shoes

USA	UK	Europe
5	3 1/2	36
6	4 1/2	37
7	5 1/2	38
8	6 1/2	39
9	7 1/2	40

Children's shoes

USA/UK	Europe
0	15
1	17
2	18
3	19
4	20
4 1/2	21
5	22
6	23
7	24
8	25
8 1/2	26
9	27
10	28
11	29
12	30
12 1/2	31
13	32

Men's suits/overcoats

USA/UK	Europe
36	46
38	48
40	50
42	52
44	54
46	56

Men's shirts

USA/UK	Europe
12	30–31
12½	32
13	33
13½	34–35
14	36
14½	37
15	38
15½	39–40
16	41
16½	42
17	43
17½	44–45

Men's socks

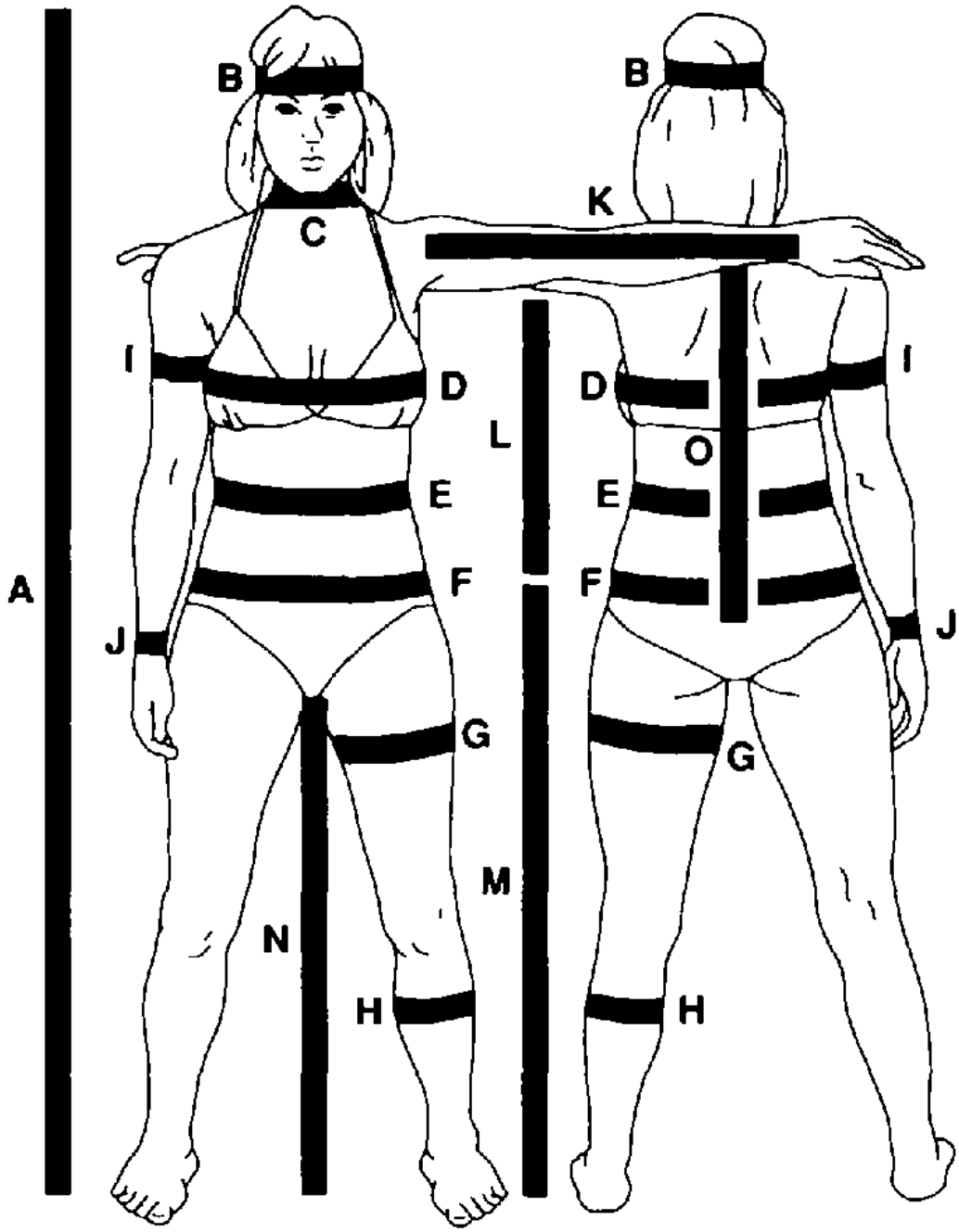
USA/UK	Europe
9	38–39
10	39–40
10½	40–41
11	41–42
11½	42–43

Women's clothing

USA	UK	Europe
6	8	36
8	10	38
10	12	40
12	14	42
14	16	44
16	18	46
18	20	48
20	22	50
22	24	52

Children's clothing

USA	UK	Europe
2	16–18	40–45
4	20–22	50–55
6	24–26	60–65
7	28–30	70–75
8	32–34	80–85
9	36–38	90–95



A height
B head
C neck
D chest/bust
E waist

F hips
G thigh
H calf
I arm
J wrist

K arm length
L armpit to hip
M outside leg
N inside leg
O back

Body measurements

The standard body measurements shown on the diagram on the opposite page are those needed for garment fitting.

Below are a few tips on taking some of these measurements.

Neck

Measure at the fullest part.

Chest/bust

Measure at the fullest part of the bust or chest and straight across the back.

Waist

Tie a string around the thinnest part of your body (the waist) and leave it there as a point of reference for other measurements.

Hips

There are two places to measure hips, depending on the garment: one is 2–4 in below the waist, at the top of the hipbones; the other is at the fullest part, usually 7–9 in below.

Arm

Measure at the fullest part, usually about 1 in below the armpit.

Arm length

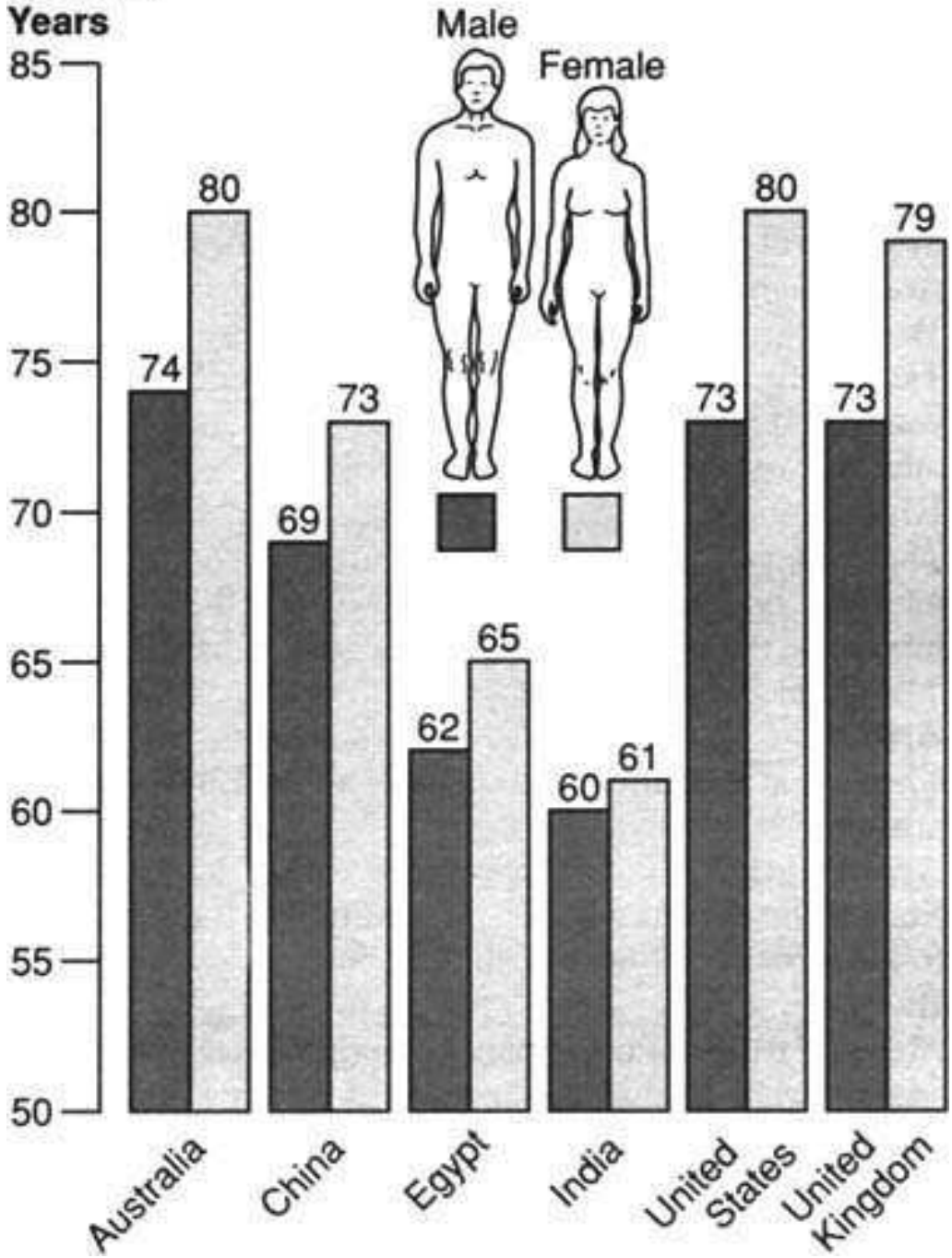
Start at the shoulder bone and continue past the elbow to the wrist, with the arm slightly bent.

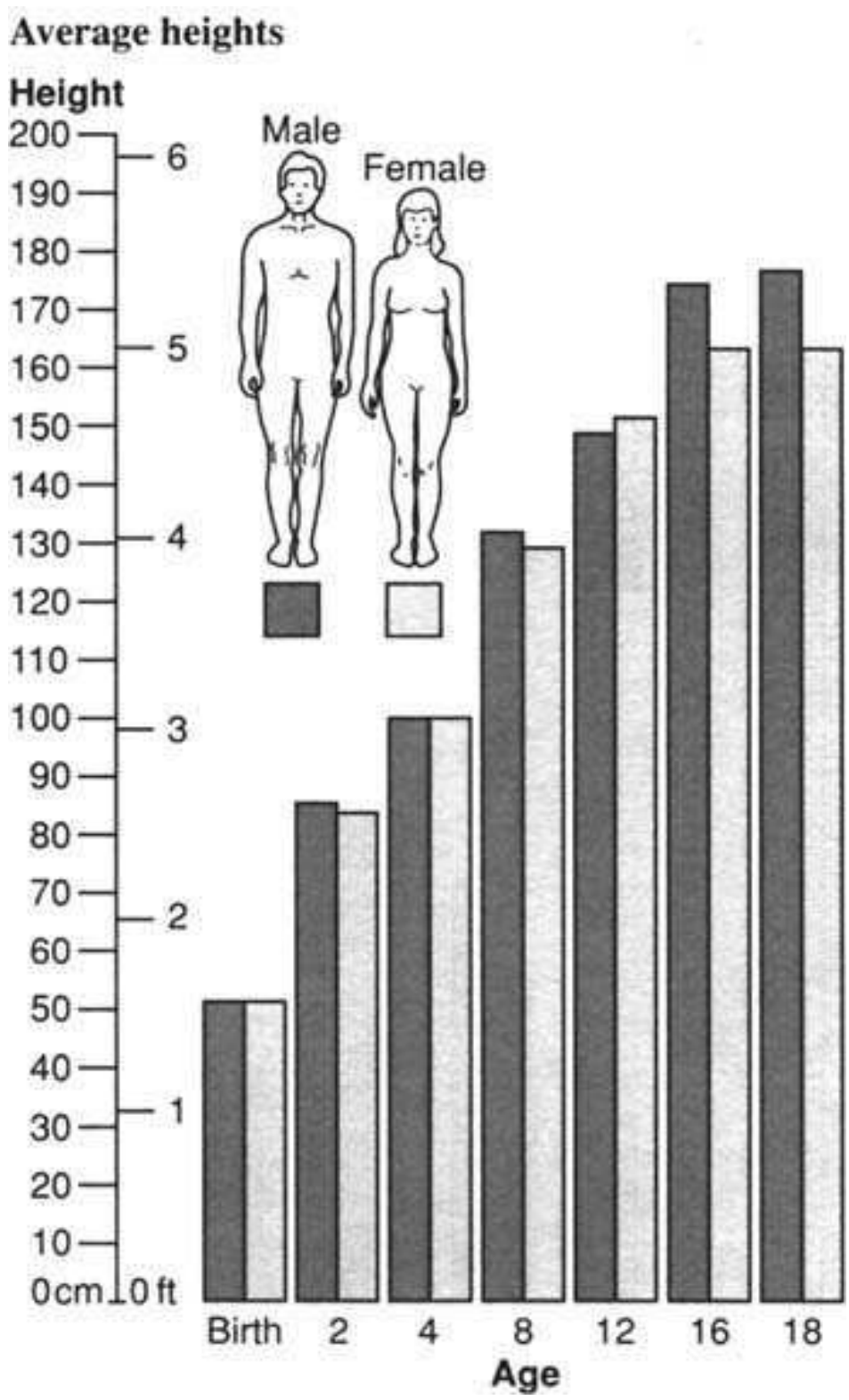
Back

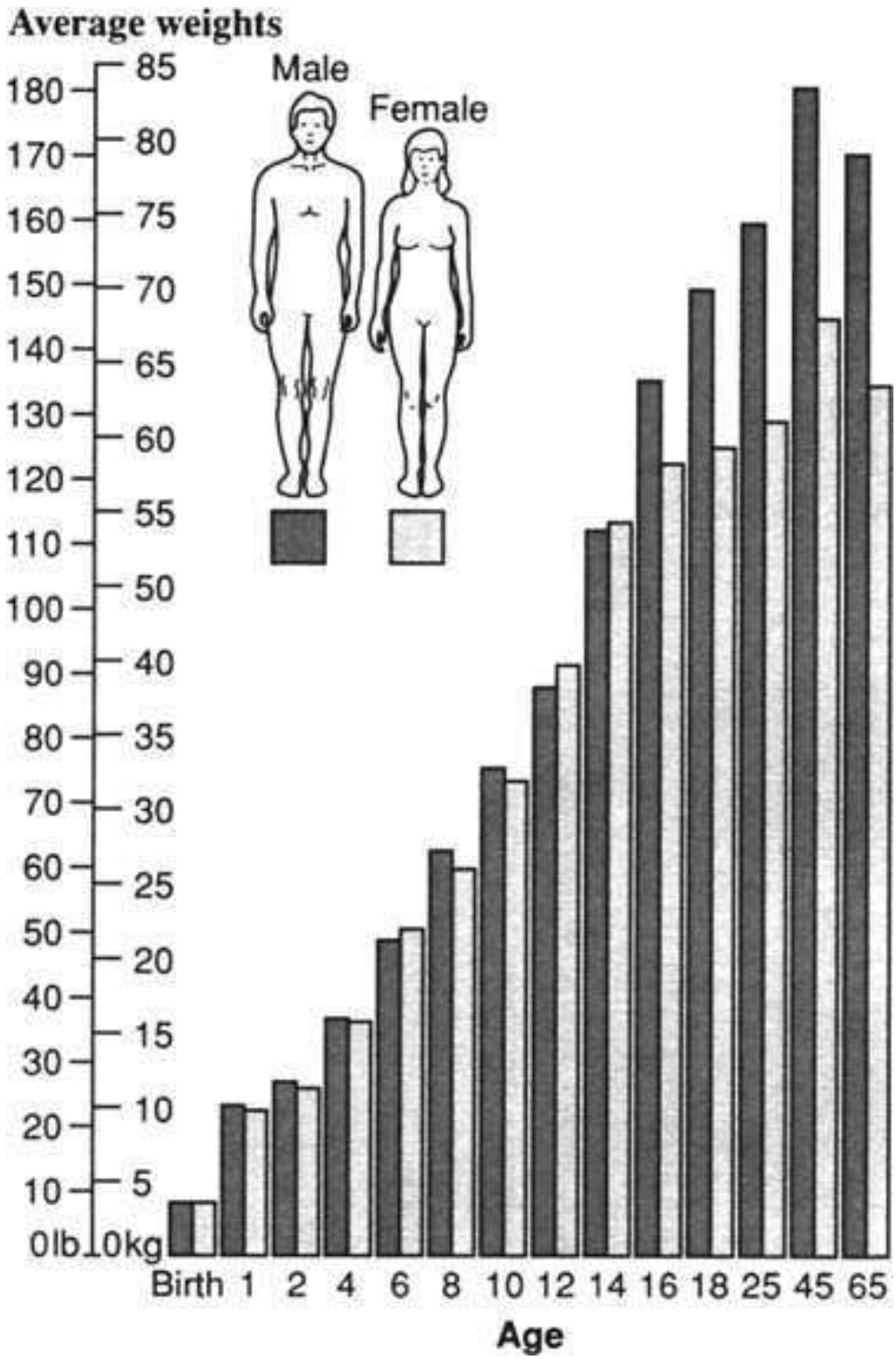
Measure from the prominent bone in the back of the neck down the center to the point at which you want the garment to end, e.g. the hips.

Life expectancy

The table below shows life expectancy figures for selected countries. Age in years appears at the top of each bar.




Average heights
Height
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0 cm
6
5
4
3
2
1
0 ft
Male
Female
Birth
2
4
8
12
16
18
Age

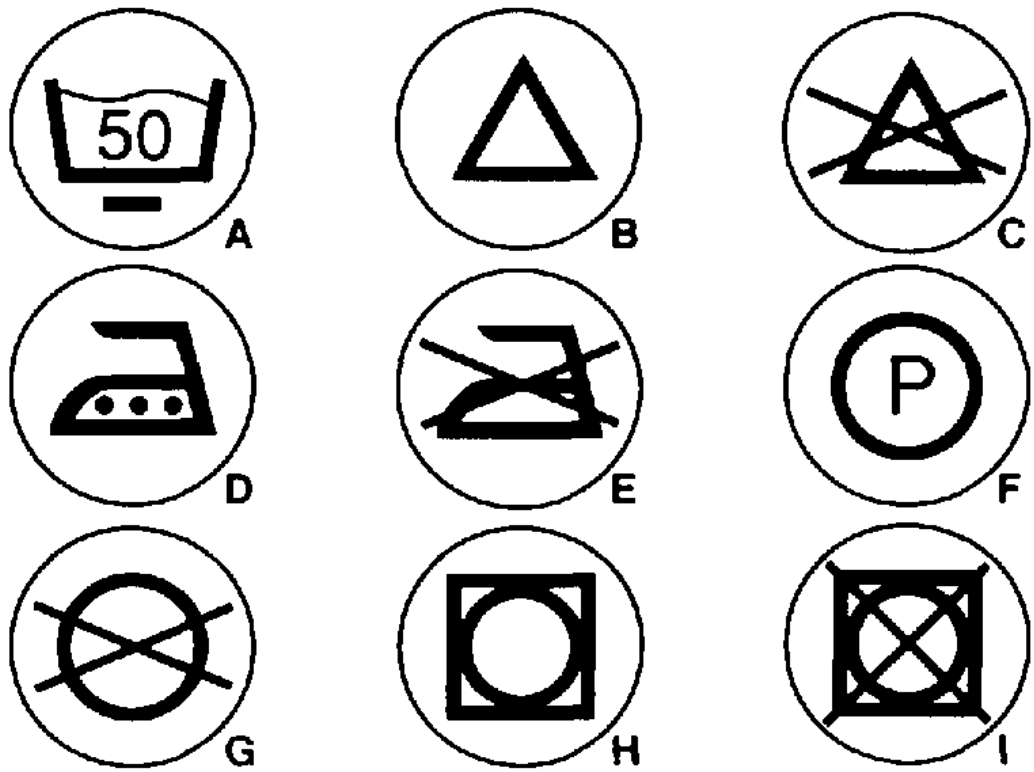

Average weights
Male
Female
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0lb
85
80
75
70
65
60
55
50
40
35
30
25
20
15
10
5
0kg
Birth 1 2 4 6 8 10 12 14 16 18 25 45 65
Age

Laundry codes

Most garments contain a label giving laundering instructions (the International Textile Care Labeling Code [ITCL]), usually shown in terms of symbols, that tell you if any item is washable (or should be dry-cleaned) and how to wash it. The codes are listed below.

The table on the following pages lists the old and new codes, recommended temperatures (for machine- or hand-washing), and other machine settings, and the types of fabric that should be washed according to that code.

A Machine or hand wash
B Can be bleached
C Do not bleach
D Iron
E Do not iron
F Dry cleanable
G Do not dry clean
H Tumble dry
I Do not tumble dry



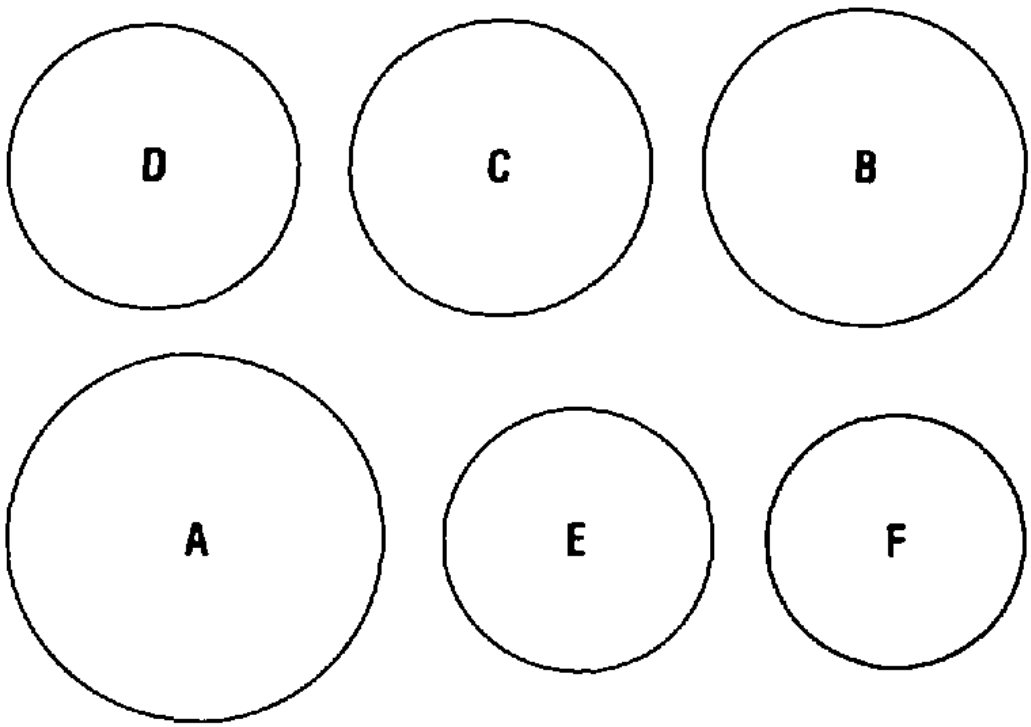
OLD	NEW	MACHINE WASH	HAND WASH
CODE		TEMPERATURE	
1 95 9 95		Very hot 95 °C (203 °F) to boil	Hand hot 50 °C (122 °F) or boil
2 60 3 60		Hot 60 °C (140 °F)	Hand hot 50 °C (122 °F)
4 50		Hand hot 50 °C (122 °F)	Hand hot 50 °C (122 °F)
5 40		Warm 40 °C (104 °F)	Warm 40 °C (104 °F)
6 40		Warm 40 °C (104 °F)	Warm 40 °C (104 °F)
7 40		Warm 40 °C (104 °F)	Warm 40 °C (104 °F)
8 30		Cool 30 °C (86 °F)	Cool 30 °C (86 °F)

AGITATION	RINSE	SPIN	FABRIC
Maximum	Normal	Normal	White cotton and linen with no special finish
Maximum	Normal	Normal	Cotton, linen, viscose, color-fast with no special finish
Medium	Cold	Short spin or drip dry	Colored nylon, polyester, cotton, and viscose with special finish
Maximum	Normal	Normal	Cotton, linen, viscose, color-fast to 40 °C (104 °F)
Minimum	Cold	Short spin	Acrylics, acetate, and mixtures with wool
Minimum: do not rub	Normal	Normal; do not hand wring	Wool and wool mixtures
Minimum	Cold	Short spin; do not hand wring	Silk and printed acetate, not color-fast at 40 °C (104 °F)

Gun gauge/caliber

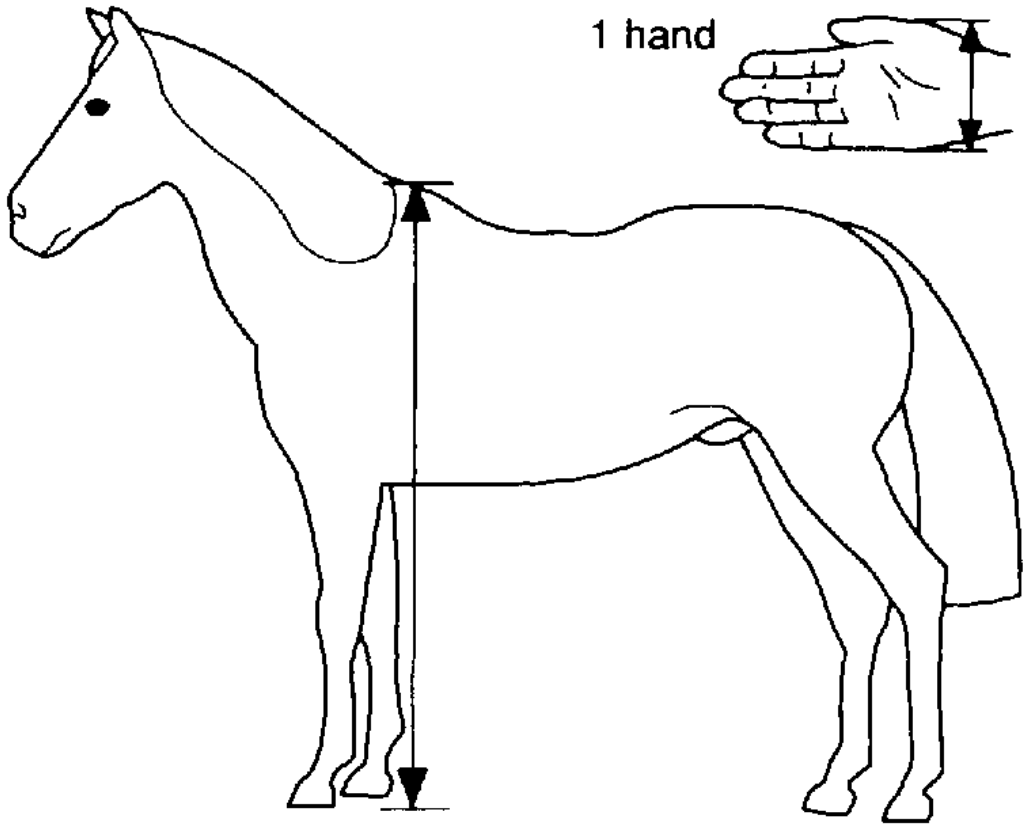
A shotgun bore (diameter) is expressed in terms of gauge. Gauge was originally determined by the number of round lead balls – each the size of the shotgun bore – in a pound. For example, a 10-gauge shotgun was one that used balls that were 10 to the pound. The exception is the 410 bore, which is measured in inches: .410 in diameter, using 67.5 gauge. The most popular size today is the 12-gauge.

The table below shows gauge and equivalent bore size.



	A	B	C	D	E	F
Gauge	6	10	12	14	16	20
Bore (mm)	23.34	19.67	18.52	17.60	16.81	15.90

Horse measurements



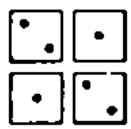
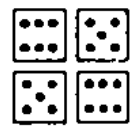
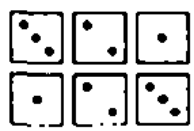
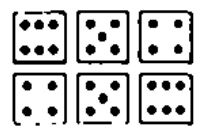
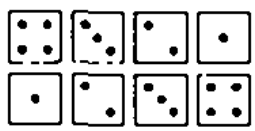
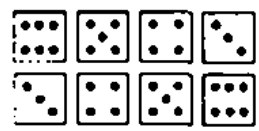
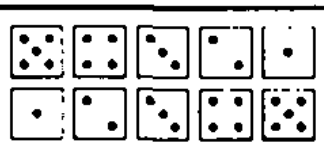
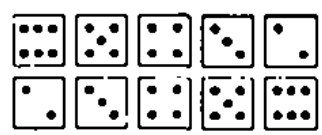
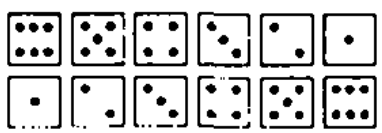
The height of a horse or pony is measured to its withers (on the highest point on its back at the neck base), as shown above. Height is expressed in "hands high" (hh). One hand is 4 in (10 cm), the average width of a person's hand. Height is given to the nearest inch – a pony measuring 50 in (127 cm) is said to measure 12.2 hands. The table below shows recommended heights of ponies for young riders.

Pony's height (hh)	**Child's age** (years)
11–12	7–9
12–13	10–13
13–14.2	13–15
14.2–15.2	15–17

Odds in dice and cards

Dice

Odds in dice-throwing are determined by comparing favorable results with unfavorable. With one die, you have six possible results – one for each side of the die; with two die, you have 36 possible results. Some results – a 12 or a 2 – you have only one chance to achieve. Thus the odds against throwing a 12 or 2 are 35 to 1. For results with two possible combinations, the chances are 35 to 2, or 17 to 1. The table below shows the odds for each possible combination.

Combination	Chances	Combination
2 	35–1	 12
3 	17–1	 11
4 	11–1	 10
5 	8.5–1	 9
6 	7–1	 8
7 	5–1	

Poker

Odds in poker are figured against a total number of possible combinations of 2,598,960. Thus, the odds of getting a royal flush (4 possible combinations) are 2,598,960 to 4, or 649,739 to 1.

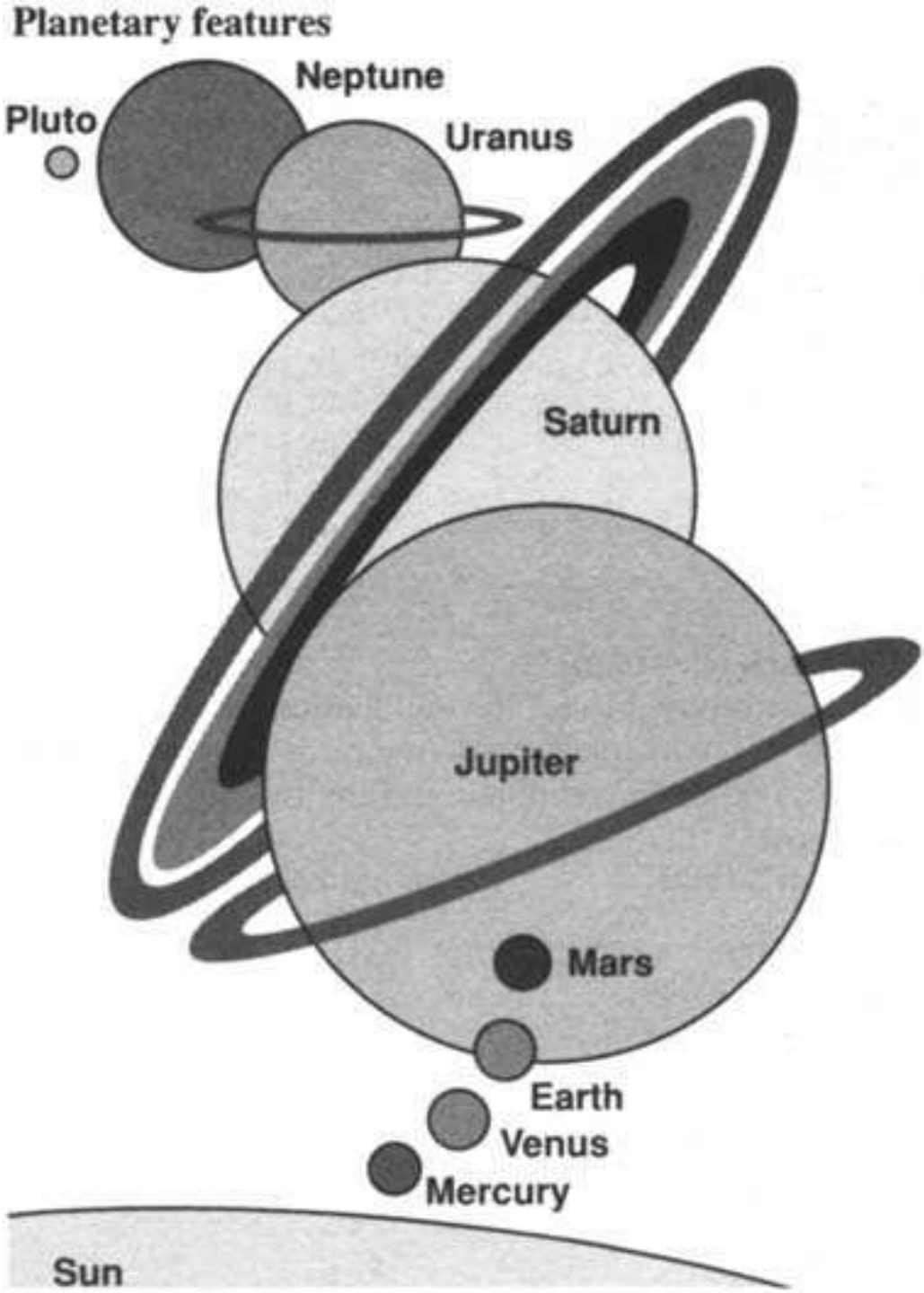
Hand	Chances
royal flush	649,739 to 1
straight flush	72,192 to 1
four of a kind	4,164 to 1
full house	693 to 1
flush	508 to 1
straight	254 to 1
three of a kind	46 to 1
two pairs	20 to 1
one pair	2.4 to 1
nil	2 to 1

Blackjack (Pontoon)

There are a possible 1,326 combinations in blackjack; the odds of reaching 21 with two cards from a 52-card deck (64 possible combinations) are thus 1,326 to 64, or 21 to 1.

Two-card total	Chances
21	21 to 1
20	9 to 1
19	16.5 to 1
18	15 to 1
17	14 to 1
16	15 to 1
15	14 to 1
14	13 to 1
13	11 to 1

11: Astronomy



Diameter at equator

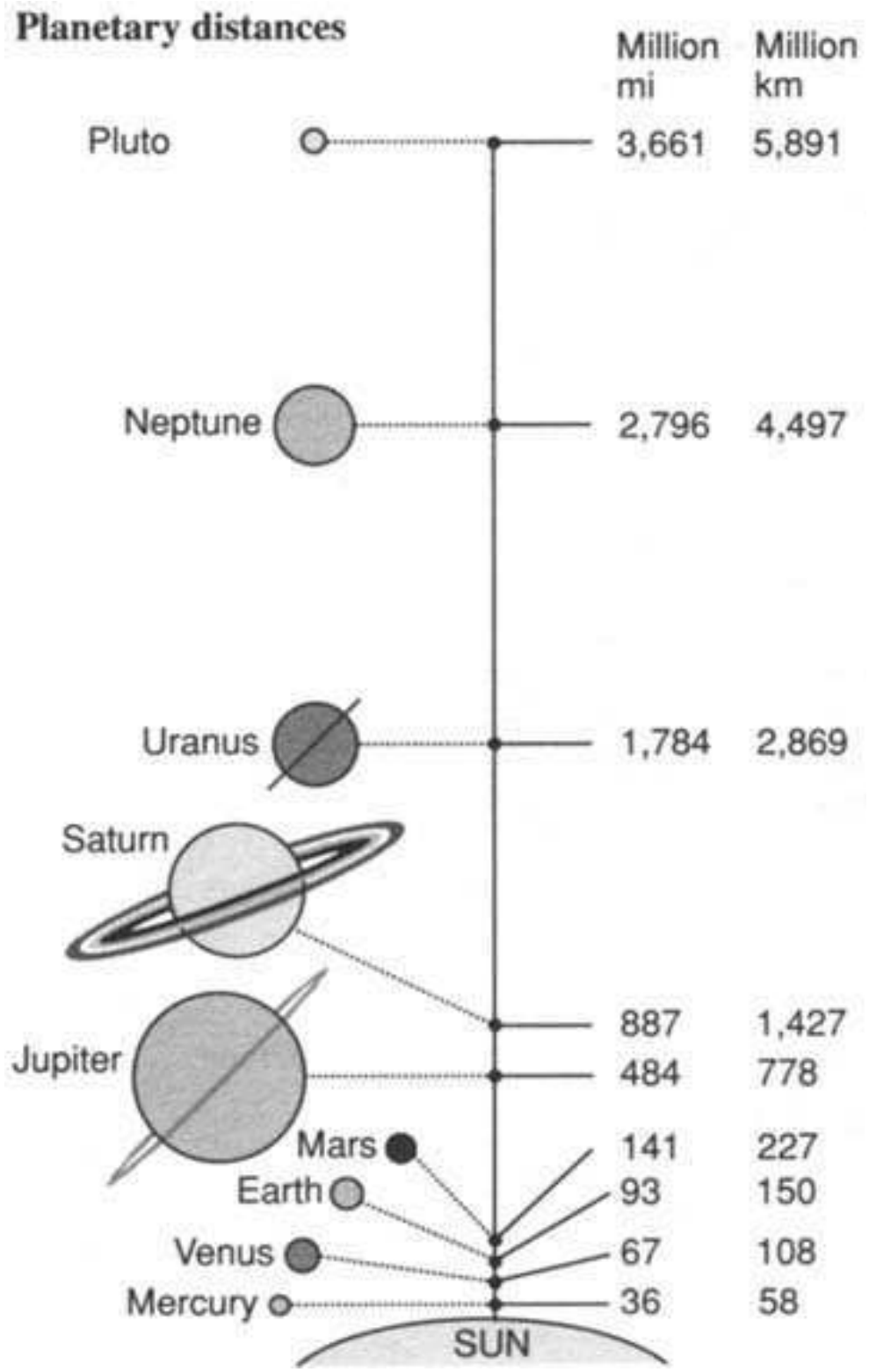
Planet	mi	km
Mercury	2,926.8	4,878
Venus	7,262.4	12,104
Earth	7,653.6	12,756
Mars	4,077.0	6,795
Jupiter	85,680.0	142,800
Saturn	72,000.0	120,000
Uranus	30,480.0	50,800
Neptune	29,100.0	48,500
Pluto	1,800.0	3,000

Rotation period

Mercury	58 days 15 hr
Venus	243 days
Earth	23 hr 56 min
Mars	24 hr 37 min
Jupiter	9 hr 50 min
Saturn	10 hr 14 min
Uranus	16 hr 10 min
Neptune	18 hr 26 min
Pluto	6 days 9 hr

Average surface temperatures

Solid surface		Cloud surface	
Mercury	662 °F (day) −274 °F (night)	Jupiter	−238 °F
		Saturn	−292 °F
Venus	896 °F	Uranus	−346 °F
Earth	72 °F	Neptune	−364 °F
Mars	−9 °F	Pluto	−382 °F


Planetary distances
Million mi
Million km
Pluto
3,661
5,891
Neptune
2,796
4,497
Uranus
1,784
2,869
Saturn
887
1,427
Jupiter
484
778
Mars
141
227
Earth
93
150
Venus
67
108
Mercury
36
58
SUN

Mean distance from the Sun

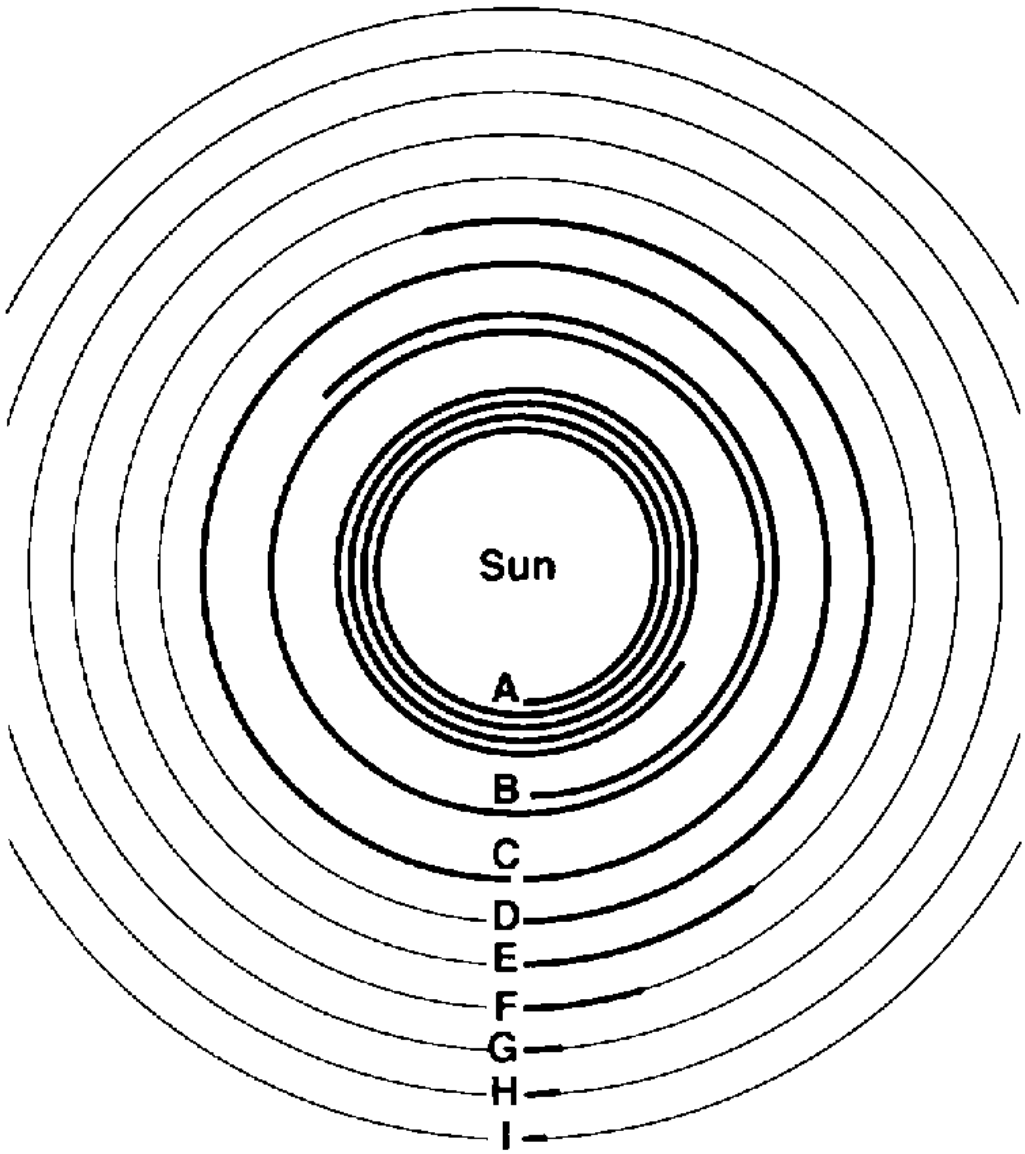
Planet	mi	km
Mercury	36,000,000	58,000,000
Venus	67,000,000	108,000,000
Earth	93,000,000	150,000,000
Mars	141,000,000	227,000,000
Jupiter	484,000,000	778,000,000
Saturn	887,000,000	1,427,000,000
Uranus	1,784,000,000	2,869,000,000
Neptune	2,796,000,000	4,497,000,000
Pluto	3,661,000,000	5,891,000,000

Closest distance to the Earth

Planet	mi	km
Mercury	50,000,000	80,800,000
Venus	25,000,000	40,400,000
Mars	35,000,000	56,800,000
Jupiter	367,000,000	591,000,000
Saturn	744,000,000	1,198,000,000
Uranus	1,607,000,000	2,585,000,000
Pluto*	2,670,000,000	4,297,000,000
Neptune	2,678,000,000	4,308,000,000

*Between 1979 and 1999 Pluto will be closer to the Earth than Neptune because of the unusual shape of its orbit.

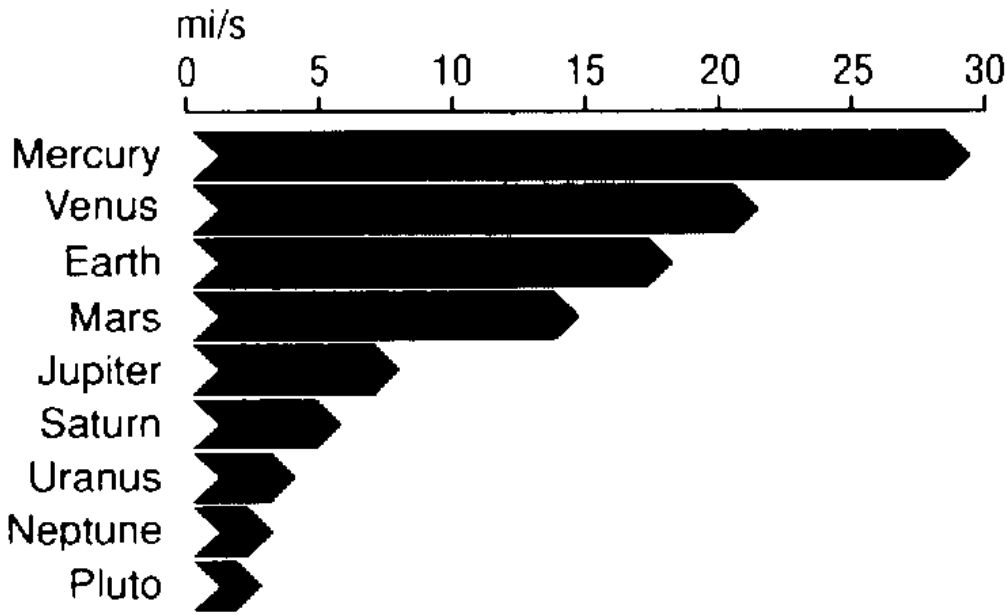
The solar system – Orbits and rotation



Sidereal period

Sidereal period is the time it takes a planet to orbit the Sun. Planets' orbital speeds vary, as does their distance from the Sun, so these periods are different for each planet. The diagram shows how far each planet travels in its orbit during the time it takes the Earth to complete one orbit (approximately 1 year).

	Sidereal period	**Average orbital speed**
A Mercury	88.0 days	28.75 mi/s
B Venus	224.7 days	21.7 mi/s
C Earth	365.3 days	18.5 mi/s
D Mars	687.0 days	14.97 mi/s
E Jupiter	11.86 years	8.14 mi/s
F Saturn	29.46 years	5.97 mi/s
G Uranus	84.01 years	4.23 mi/s
H Neptune	164.8 years	3.36 mi/s
I Pluto	247.7 years	2.92 mi/s



Light years

The table below lists standard abbreviations and equivalents for the units used in measuring astronomical distances. These are very large units and are related to the Earth's orbit.

A light year (ly) is the distance light travels – at its speed of 186,282 mi/s – through space over a tropical year.

An astronomical unit (au) is the mean distance between the Earth and the Sun.

A parsec (pc) is the distance at which a baseline of 1 au in length subtends an angle of 1 second.

1 au = 93,000,000 mi = 149,600,000 km
1 ly = 5,878,000,000,000 mi = 9,460,500,000,000 km
1 pc = 19,174,000,000,000 mi = 30,857,200,000,000 km
1 ly = 63,240 au
1 pc = 206,265 au = 3.262 ly

Planetary data

	Mercury	Venus	Earth
Mean distance from Sun	0.39 au	0.72 au	1.00 au
Distance at perihelion	0.31 au	0.72 au	0.98 au
Distance at aphelion	0.47 au	0.73 au	1.02 au
Closest distance to Earth	0.54 au	0.27 au	
Average orbital speed	28.75 mi/s	21.7 mi/s	18.5 mi/s
Rotation period	58 days 15 hr	243 days	23 hr 56 min
Sidereal period	88 days	224.7 days	365.3 days
Diameter at equator	3,030 mi	7,520 mi	7,926 mi
Mass (Earth's mass=1)	0.06	0.82	1
Surface temperature	662 °F (day) −274 °F (night)	896 °F	72 °F
Gravity (Earth's gravity = 1)	0.38	0.88	1
Density (density of water = 1)	5.5	5.25	5.517
Number of satellites known	0	0	1
Number of rings known	0	0	0
Main gases in atmosphere	no atmosphere	Carbon dioxide	Nitrogen, oxygen

Planetary data (continued)

	Mars	Jupiter
Mean distance from Sun	1.52 au	5.20 au
Distance at perihelion	1.38 au	4.95 au
Distance at aphelion	1.67 au	5.46 au
Closest distance to Earth	0.38 au	3.95 au
Average orbital speed	14.97 mi/s	8.14 mi/s
Rotation period	24 hr 37 min	9 hr 50 min
Sidereal period	687 days	11.86 years
Diameter at equator	4,222 mi	88,734 mi
Mass (Earth's mass=1)	0.11	317.9
Surface temperature	–9 °F	–238 °F
Gravity (Earth's gravity = 1)	0.38	2.64
Density (density of water = 1)	3.94	1.33
Number of satellites known	2	16
Number of rings known	0	1
Main gases in atmosphere	Carbon dioxide	Hydrogen, helium

Saturn	Uranus	Neptune	Pluto
9.54 au	19.18 au	30.06 au	39.36 au
9.01 au	18.28 au	29.80 au	29.58 au
10.07 au	20.09 au	30.32 au	49.14 au
8.01au	17.28 au	28.80 au	28.72 au
5.97 mi/s	4.23 mi/s	3.36 mi/s	2.92 mi/s
10 hr 14 min	16 hr 10 min	18 hr 26 min	6 days 9 hr
29.46 years	84.01 years	164.8 years	247.7 years
74,566 mi	31,566 mi	30,137 mi	3,725 mi
95.2	14.6	17.2	0.002–0.003
–292 °F	–346 °F	–364 °F	–382 °F
1.15	1.17	1.2	not known
0.71	1.7	1.77	not known
19	5	2	1
1,000+	9	0	0
Hydrogen, helium	Hydrogen, helium, methane	Hydrogen, helium, methane	Methane

12: Earth

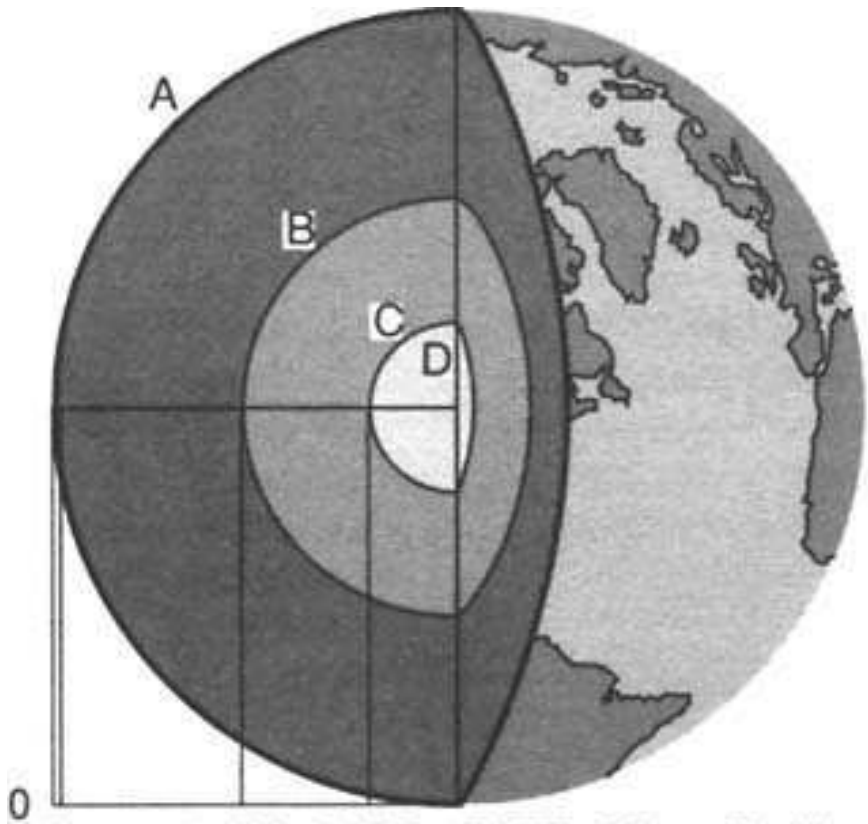
Earth's interior

A Crust (under oceans) 4 mi (6 km) deep; made of basalt (a type of rock). Crust (continental): average 22 mi (35 km) deep; made of granite

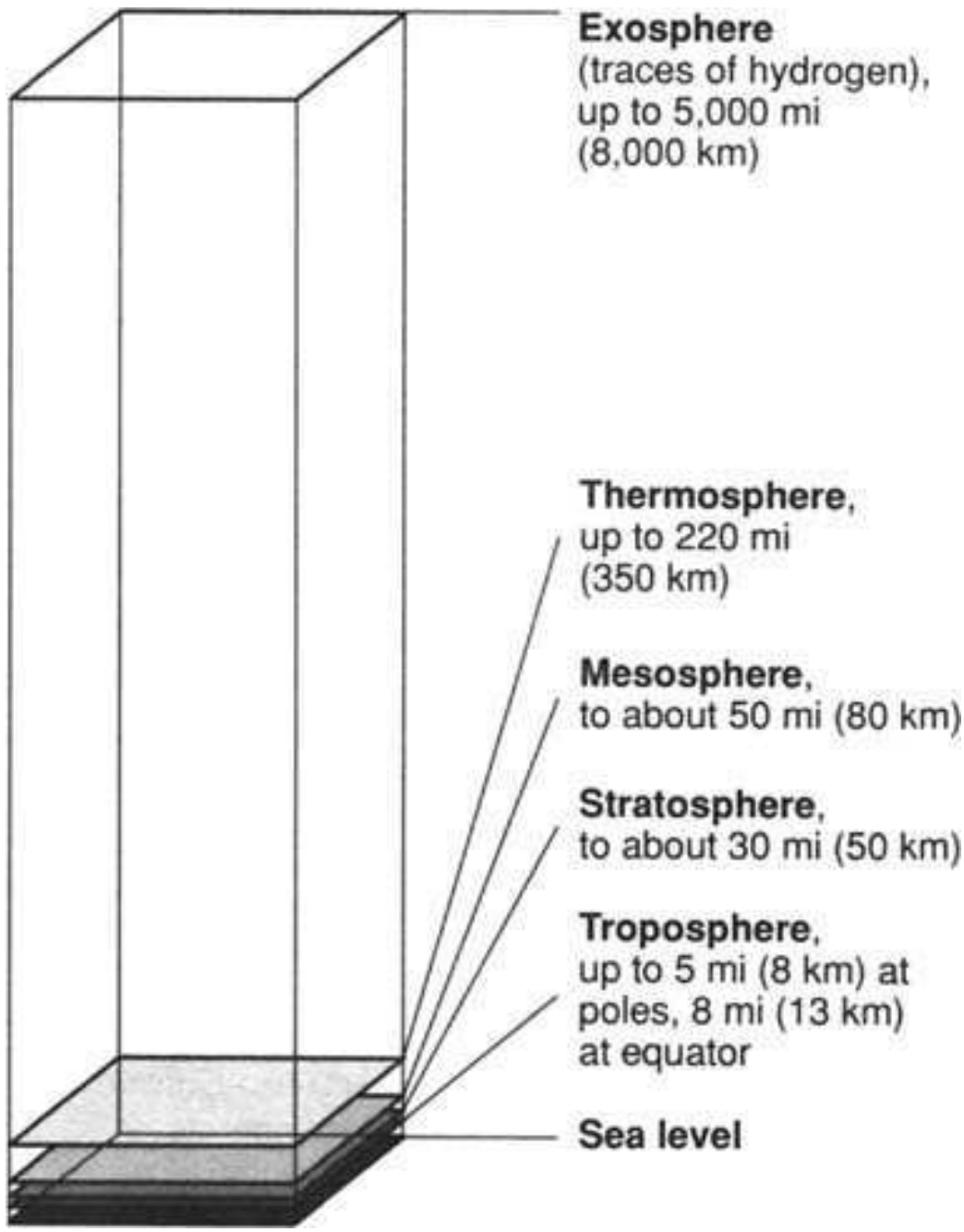
B Mantle 1,810 mi (2,912 km) deep; probably containing peridotite (a heavy, dark rock), dunite (olivine rock), and ecologite (a dense form of basalt)

C Outer core 1,242 mi (1,999 km) deep; probably liquid iron with some dissolved sulfur and silicon

D Inner core 842 mi (1,354 km) deep; probably solid iron

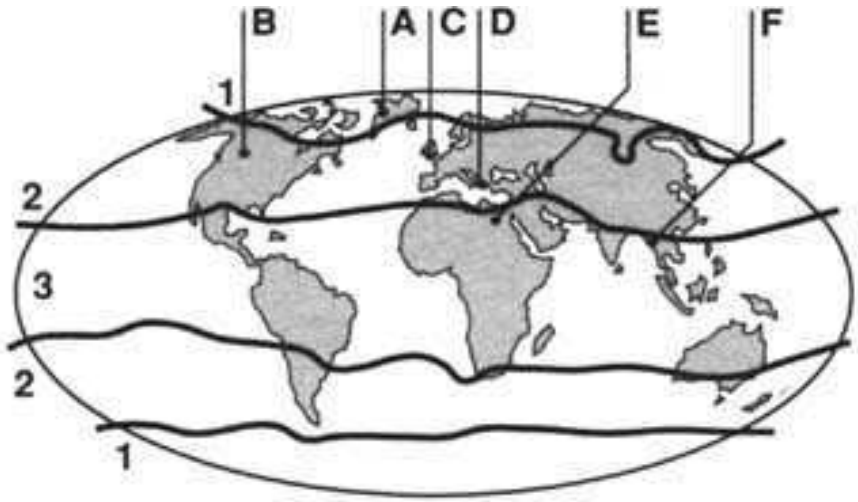


Atmospheric layers and depths of the Earth



Climate

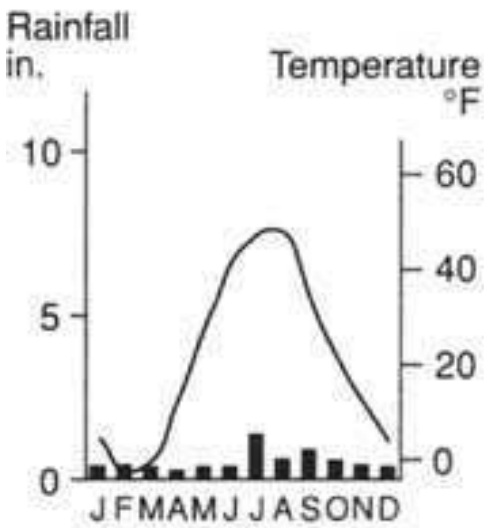
The climate of a region is primarily the result of location (latitude and longitude); altitude (height above sea level); the air pressure; the wind patterns; and the rainfall.



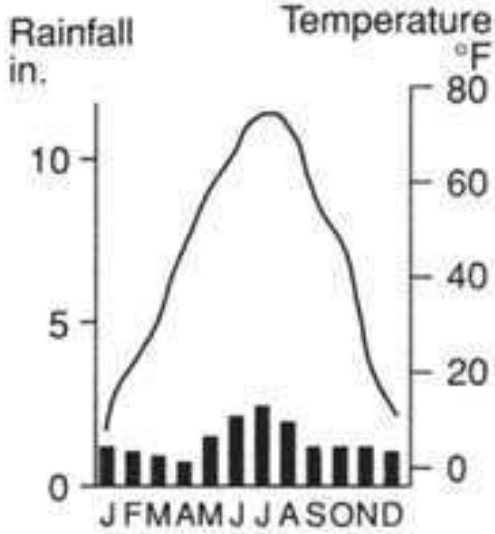
1 Polar climate zone
2 Temperate climate zone
3 Tropical climate zone

= Rainfall (in.)

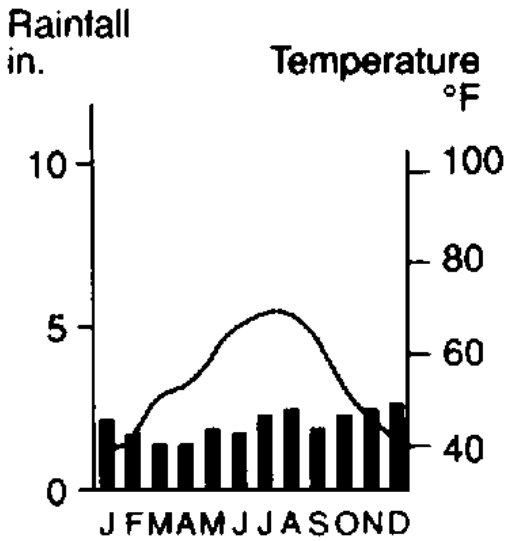
= Max. temperatures (°F)



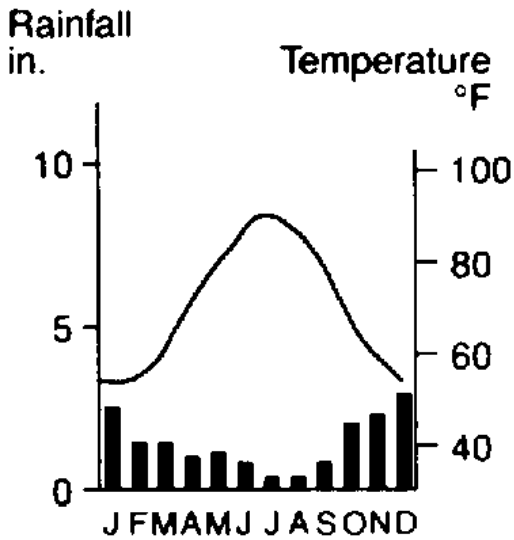
A Polar
Thule (Greenland)
Total: 4 in



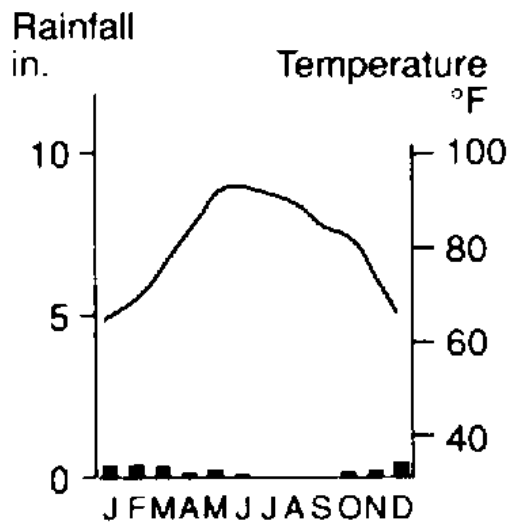
B Cold temperate (continental)
Peace River (Canada)
Total: 15 in



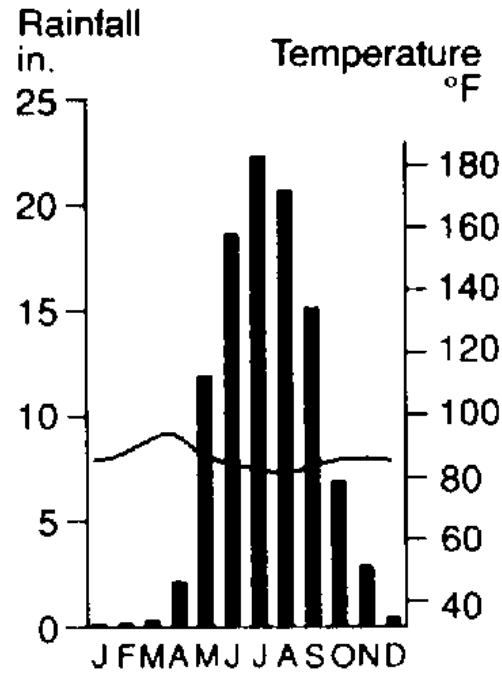
C Cool temperate (marine)
London (UK)
Total: 23 in



D Warm temperate
Athens (Greece)
Total: 16 in

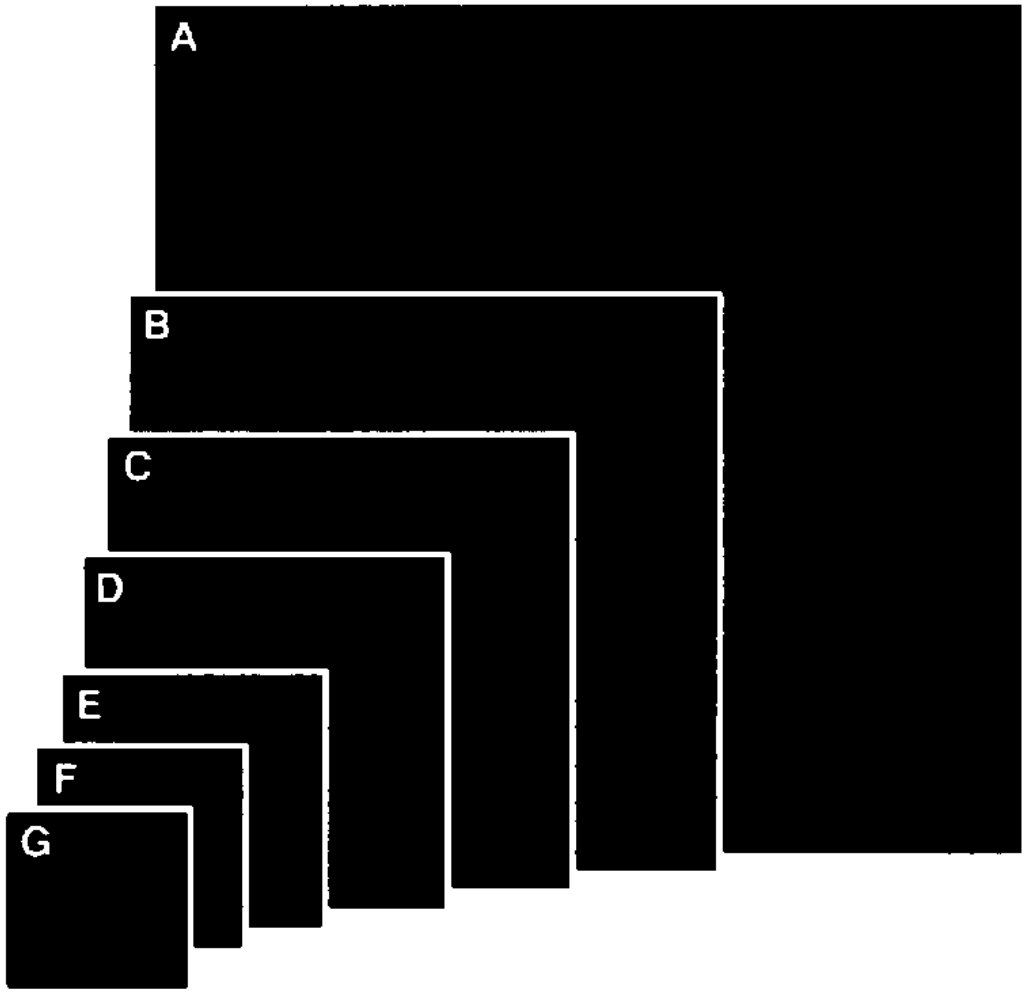


E Tropical (desert)
Cairo (Egypt)
Total: 1 in



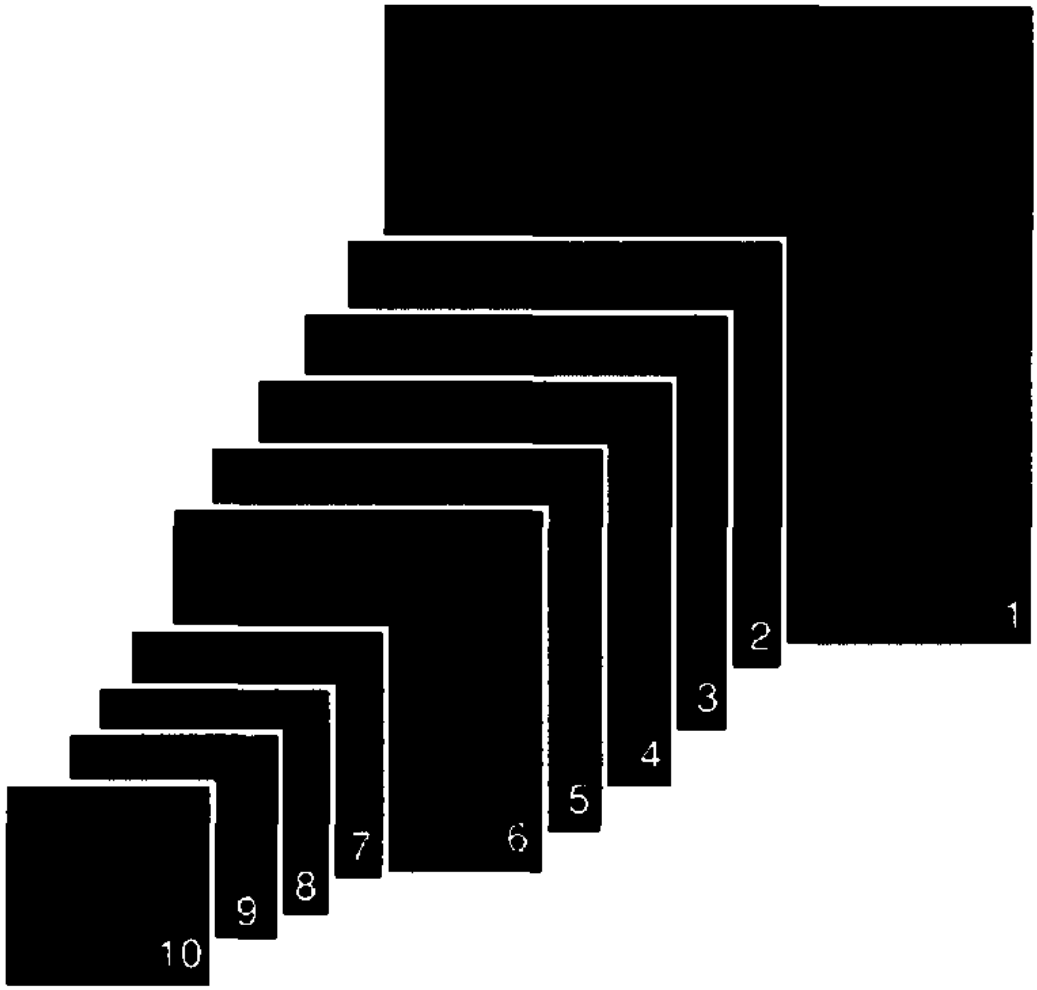
F Tropical (monsoon)
Yangon (Myanmar)
Total: 103 in

Continents



A Asia	17,085,000 mi²	44,250,000 km²
B Africa	11,685,000 mi²	30,264,000 km²
C N. America	9,420,000 mi²	24,398,000 km²
D S. America	6,870,000 mi²	17,793,000 km²
E Antarctica	5,100,000 mi²	13,209,000 km²
F Europe	3,825,000 mi²	9,907,000 km²
G Australasia	3,295,000 mi²	8,534,000 km²

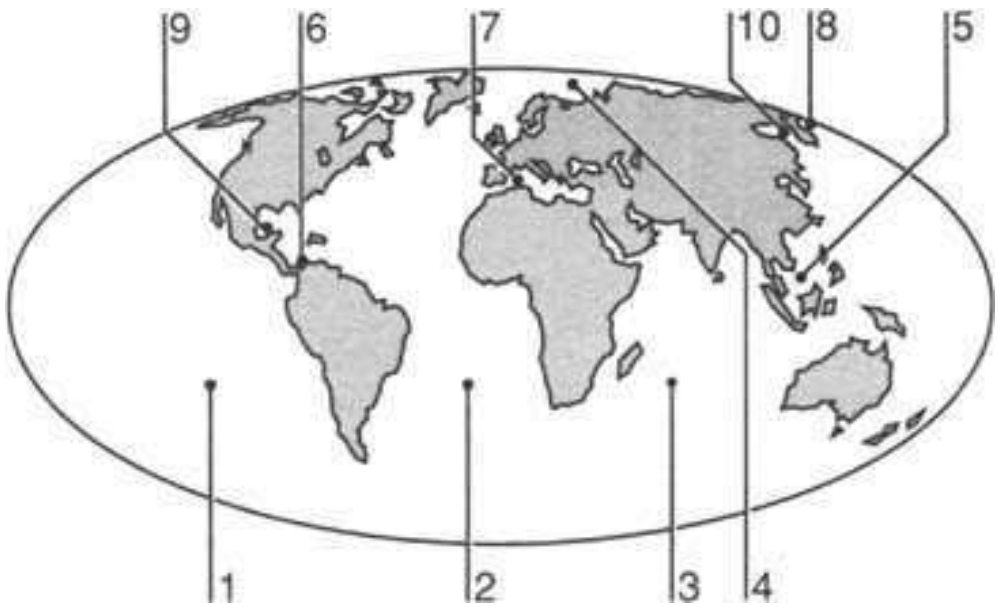
Largest countries



1	Russian Federation	6,593,000 mi²	17,075,000 km²
2	Canada	3,852,000 mi²	9,976,000 km²
3	China	3,692,000 mi²	9,561,000 km²
4	USA	3,676,000 mi²	9,520,000 km²
5	Brazil	3,286,000 mi²	8,512,000 km²
6	Australia	2,966,000 mi²	7,682,000 km²
7	India	1,269,000 mi²	3,288,000 km²
8	Argentina	1,072,000 mi²	2,777,000 km²
9	Sudan	968,000 mi²	2,506,000 km²
10	Zaïre	905,000 mi²	2,345,000 km²

Oceans and seas

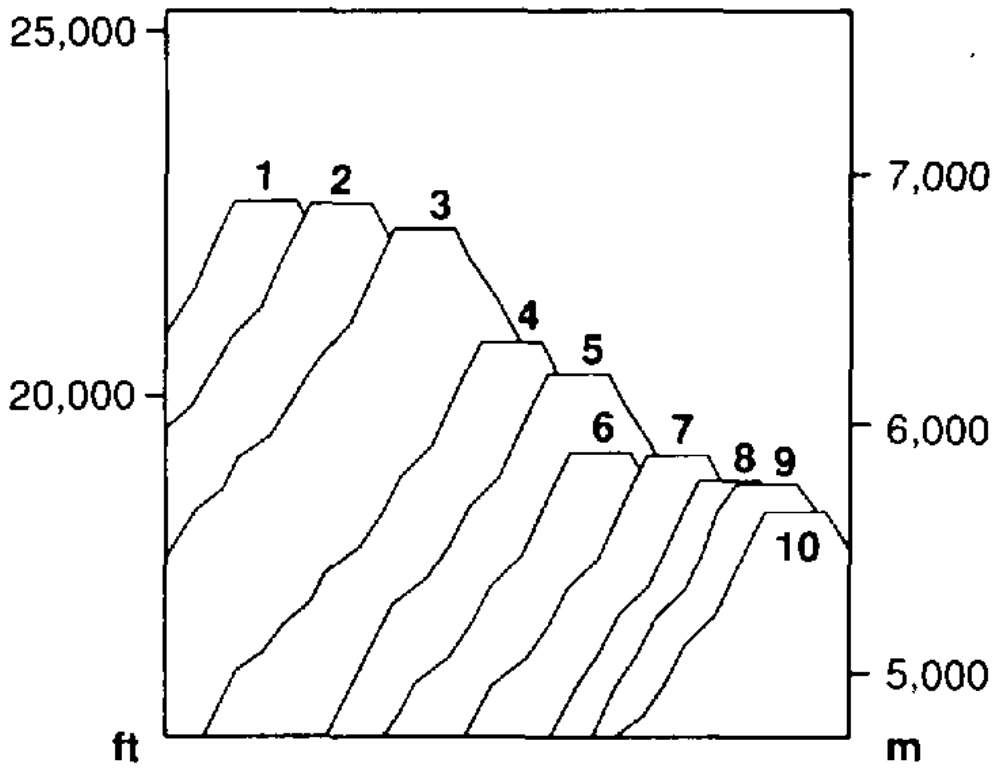
		mi²	km²
1	Pacific Ocean	63,800,000	165,242,000
2	Atlantic Ocean	31,800,000	82,362,000
3	Indian Ocean	28,400,000	73,556,000
4	Arctic Ocean	5,400,000	13,986,000
5	South China Sea	1,149,000	2,975,000
6	Caribbean Sea	1,063,000	2,753,000
7	Mediterranean Sea	967,000	2,505,000
8	Bering Sea	876,000	2,269,000
9	Gulf of Mexico	596,000	1,544,000
10	Sea of Okhotsk	590,000	1,528,000



Largest (single) islands

Volcanoes and mountains

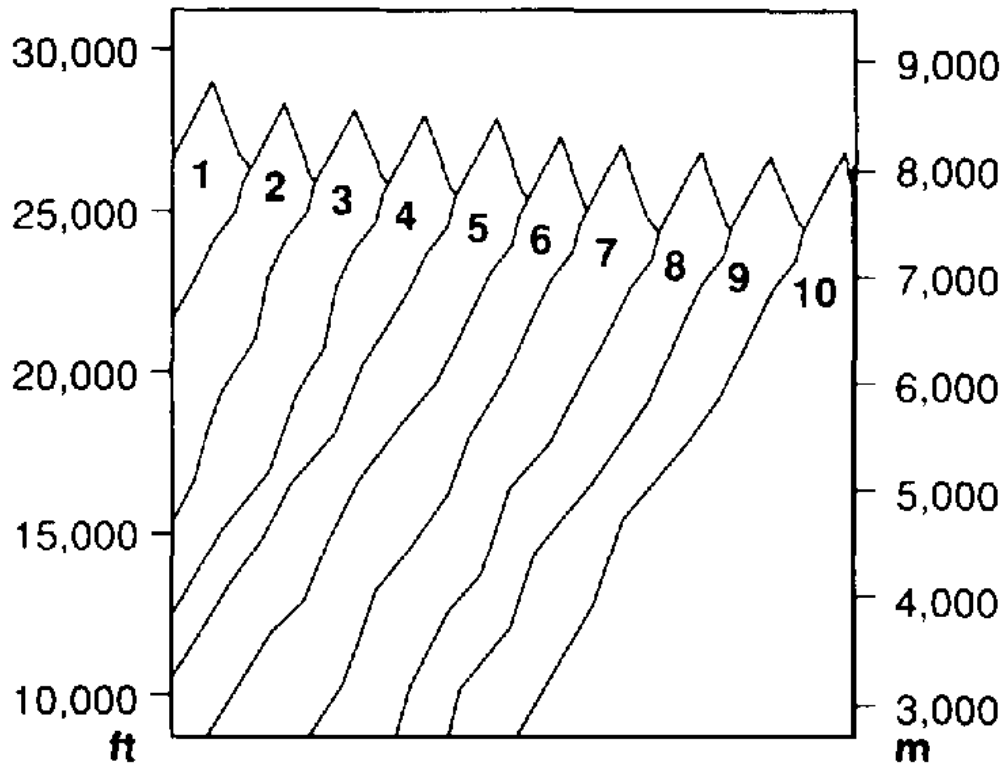
Highest volcanoes



1	Ojos del Salado	S. America	22,590 ft	6,885 m
2	Pissis	S. America	22,580 ft	6,882 m
3	Llullaillaco*	S. America	22,110 ft	6,739 m
4	Chimborazo	S. America	20,703 ft	6,310 m
5	McKinley	N. America	20,320 ft	6,194 m
6	Cotopaxi†	S. America	19,344 ft	5,896 m
7	Kilimanjaro	Africa	19,340 ft	5,895 m
8	Antisana†	S. America	18,892 ft	5,758 m
9	Citlaltepetl	N. America	18,853 ft	5,746 m
10	Elbrus	Europe	18,480 ft	5,633 m

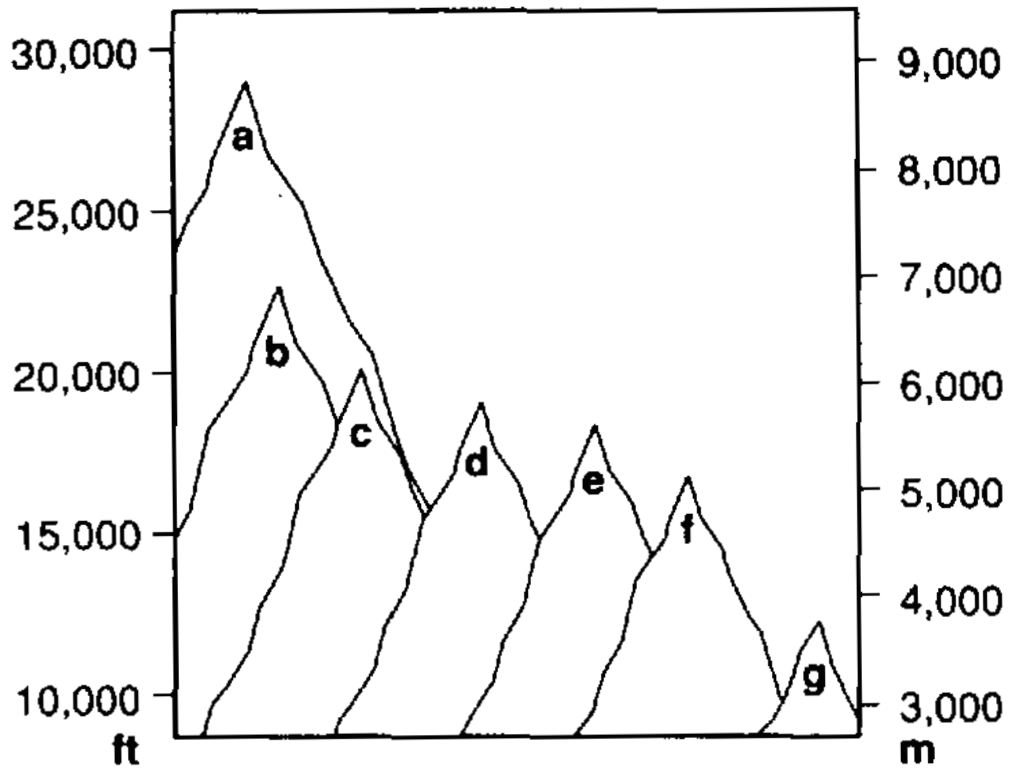
*Quiescent †Active

Highest mountains



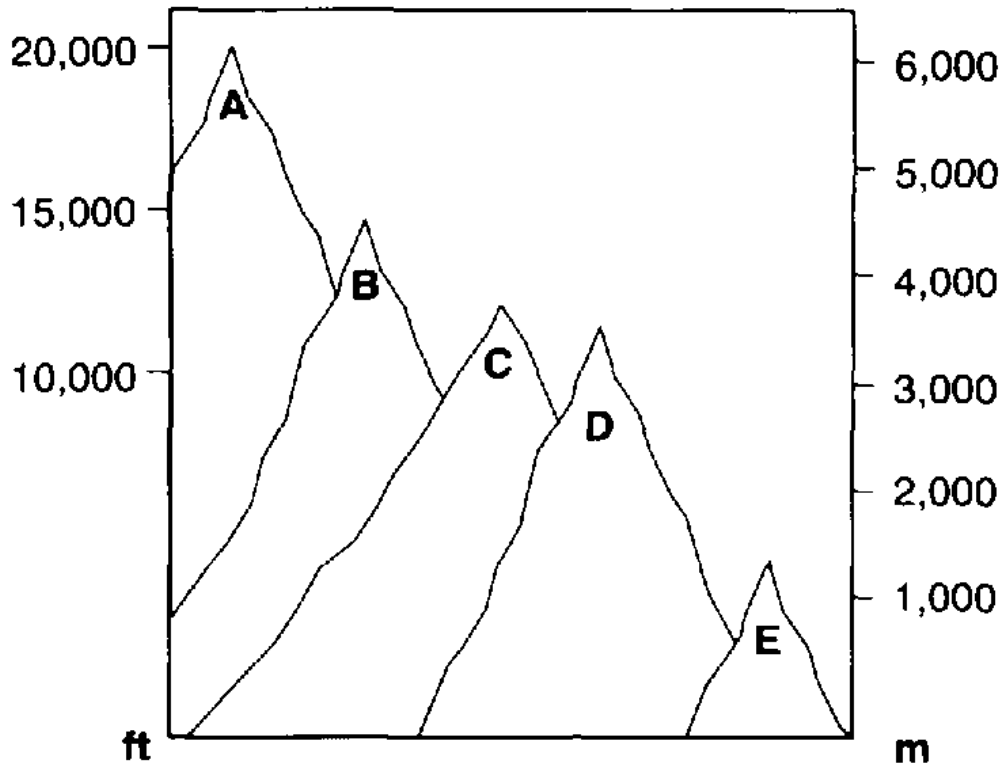
1	Everest	Himalayas	29,029 ft	8,848 m
2	K2 (Godwin Austen)	Himalayas	28,251 ft	8,611 m
3	Kanchenjunga	Himalayas	28,208 ft	8,598 m
4	Lhotse	Himalayas	27,923 ft	8,511 m
5	Yalung Kang	Himalayas	27,893 ft	8,502 m
6	Makalu	Himalayas	27,824 ft	8,481 m
7	Dhaulagiri	Himalayas	26,811 ft	8,172 m
8	Manaslu	Himalayas	26,758 ft	8,156 m
9	Cho Oyu	Himalayas	26,748 ft	8,153 m
10	Nanga Parbat	Himalayas	26,660 ft	8,126 m

Highest mountain in each continent



a Everest	Asia	29,029 ft	8,848 m
b Aconcagua	S. America	22,834 ft	6,960 m
c McKinley	N. America	20,320 ft	6,194 m
d Kilimanjaro	Africa	19,340 ft	5,895 m
e Elbrus	Europe	18,480 ft	5,633 m
f Vinson Massif	Antarctica	16,863 ft	5,140 m
g Cook	Australasia	12,349 ft	3,764 m

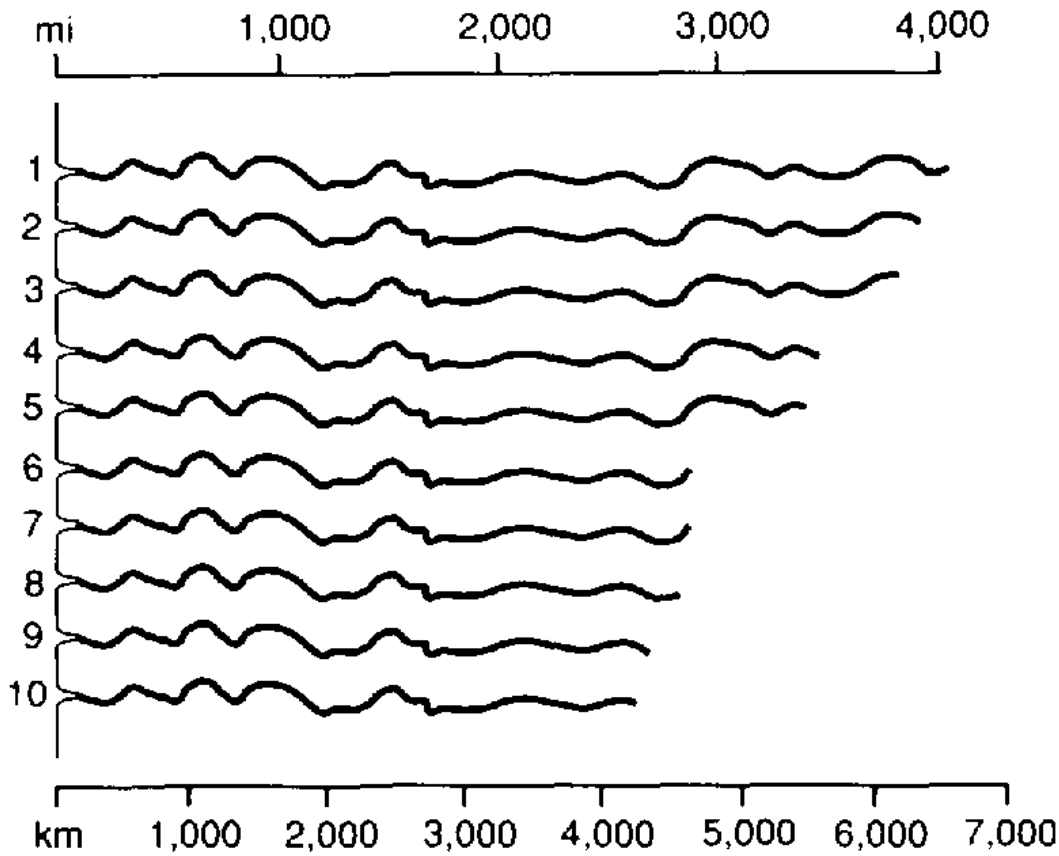
Highest mountain in selected countries



A McKinley	USA	20,320 ft	6,194 m
B Whitney	USA	14,494 ft	4,418 m
C Fujiyama (Fuji)	Japan	12,388 ft	3,776 m
D Cook	New Zealand	12,349 ft	3,764 m
E Ben Nevis	UK	4,406 ft	1,343 m

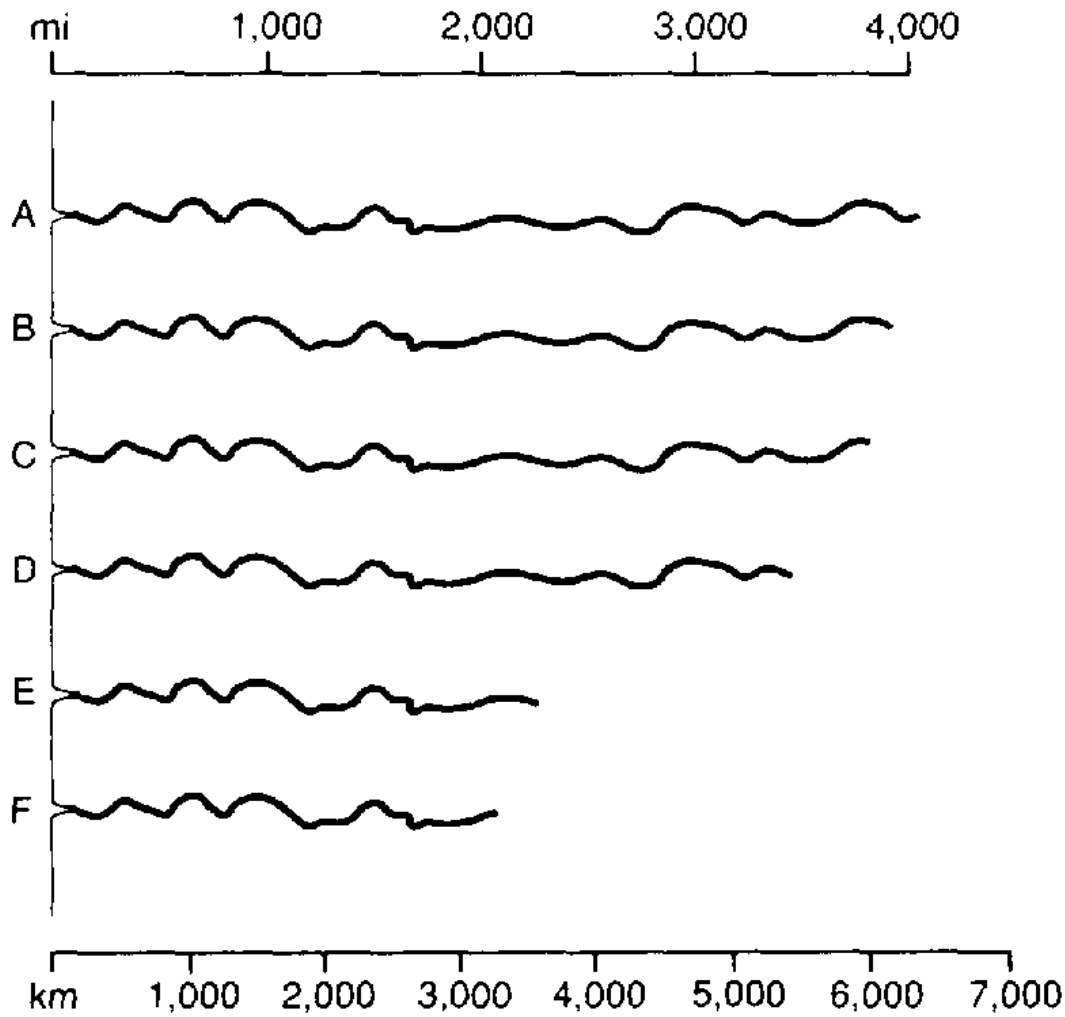
Longest rivers

1	Nile	Africa	4,132 mi	6,650 km
2	Amazon	S. America	4,000 mi	6,437 km
3	Mississippi-Missouri-Red Rock	N. America	3,860 mi	6,212 km
4	Ob-Irtysh	Asia	3,461 mi	5,570 km
5	Yangtze (Chang)	Asia	3,430 mi	5,520 km
6	Huang He	Asia	2,903 mi	4,672 km
7	Congo (Zaire)	Africa	2,900 mi	4,667 km
8	Amur	Asia	2,802 mi	4,509 km
9	Lena	Asia	2,653 mi	4,270 km
10	Mackenzie	N. America	2,635 mi	4,241 km

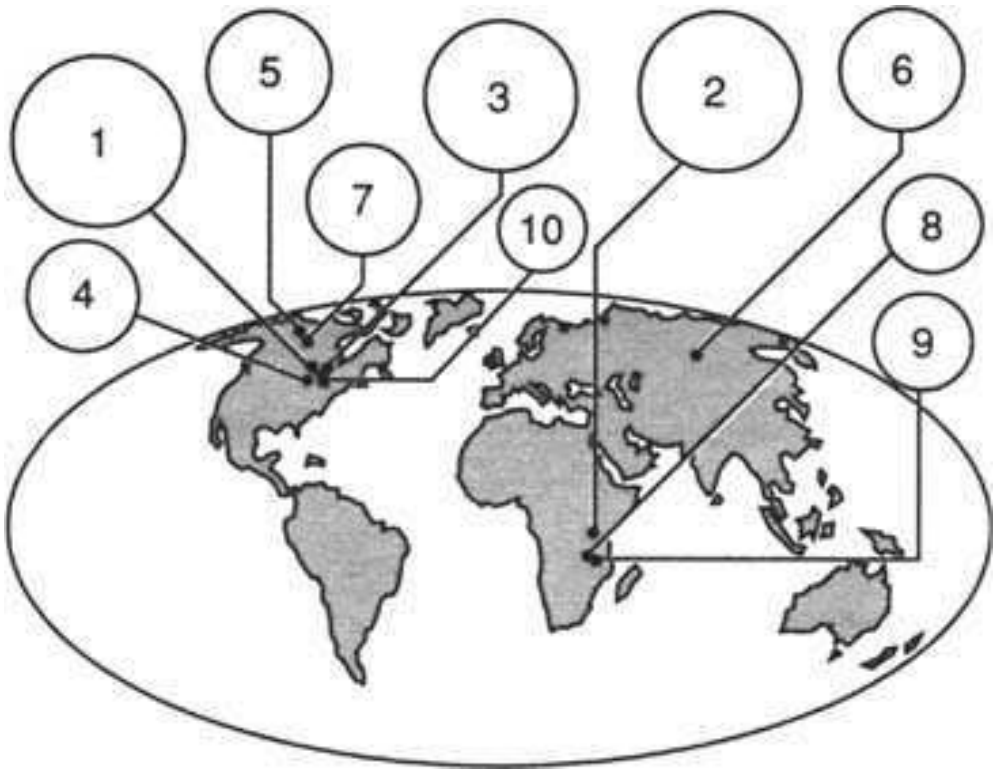


Longest in its continent

A Africa	Nile	4,132 mi	6,650 km
B S. America	Amazon	4,000 mi	6,437 km
C N. America	Mississippi-Missouri-Red Rock	3,860 mi	6,212 km
D Asia	Ob-Irtysh	3,461 mi	5,570 km
E Europe	Volga	2,293 mi	3,690 km
F Australasia	Murray	2,000 mi	3,219 km



Largest lakes



1	Superior	31,800 mi^2	82,400 km^2
2	Victoria	26,800 mi^2	69,500 km^2
3	Huron	23,000 mi^2	59,600 km^2
4	Michigan	22,400 mi^2	58,000 km^2
5	Great Bear	12,300 mi^2	31,800 km^2
6	Baykal	12,200 mi^2	31,500 km^2
7	Great Slave	11,000 mi^2	28,400 km^2
8	Tanganyika	11,000 mi^2	28,400 km^2
9	Malawi	10,900 mi^2	28,200 km^2
10	Erie	9,900 mi^2	25,700 km^2

Largest waterfalls

1 Angel, Venezuela
3,212 ft (979 m)

2 Tugela, S. Africa
3,110 ft (948 m)

3 Utigård, Norway
2,625 ft (800 m)

4 Mongefossen, Norway
2,540 ft (774 m)

5 Yosemite, USA
2,425 ft (739 m)

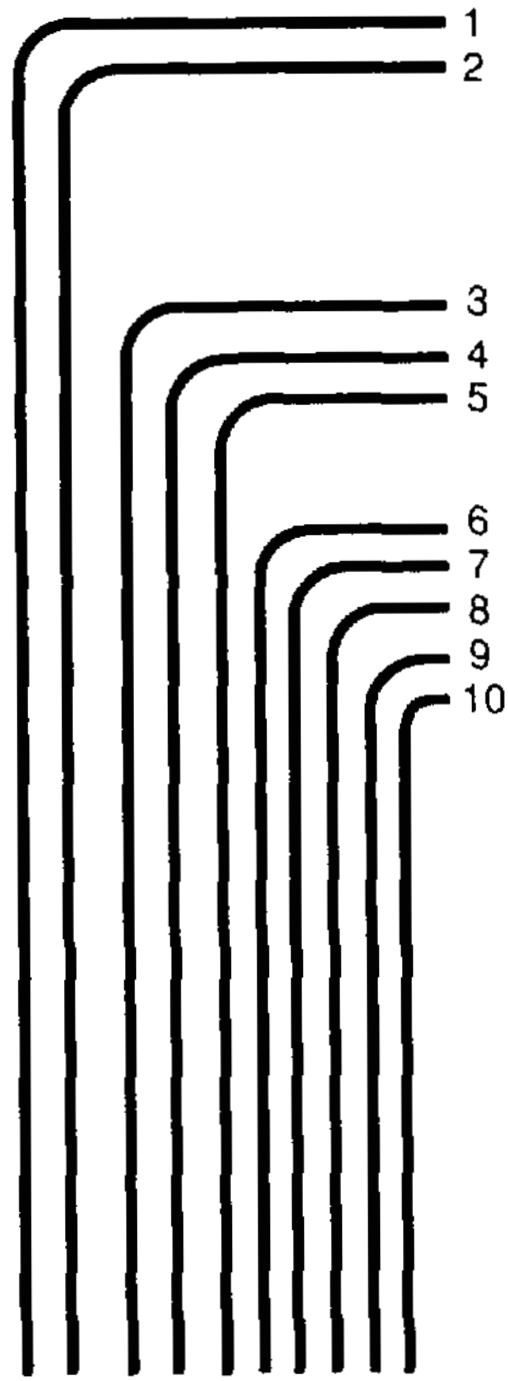
6 Østre Mardøla Foss, Norway
2,154 ft (657 m)

7 Tyssestrengane, Norway
2,120 ft (646 m)

8 Kukenaom, Venezuela
2,000 ft (610 m)

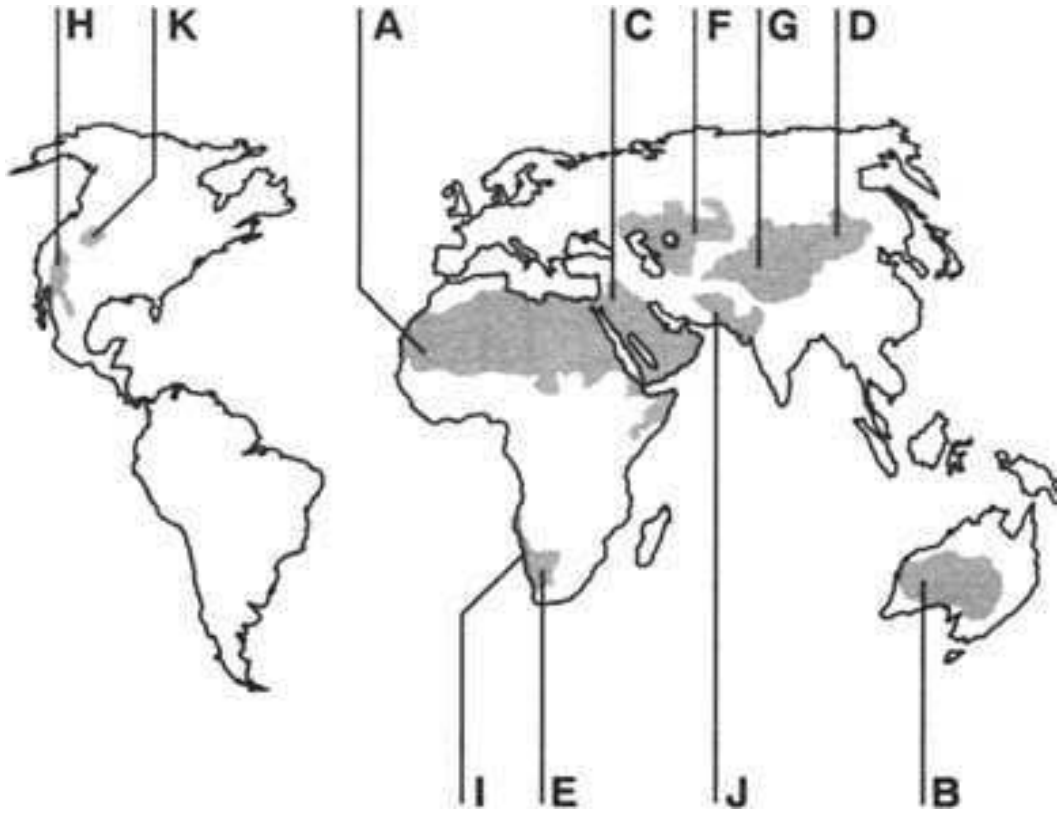
9 Sutherland, N. Zealand
1,904 ft (580 m)

10 Kjellfossen, Norway
1,841 ft (561 m)



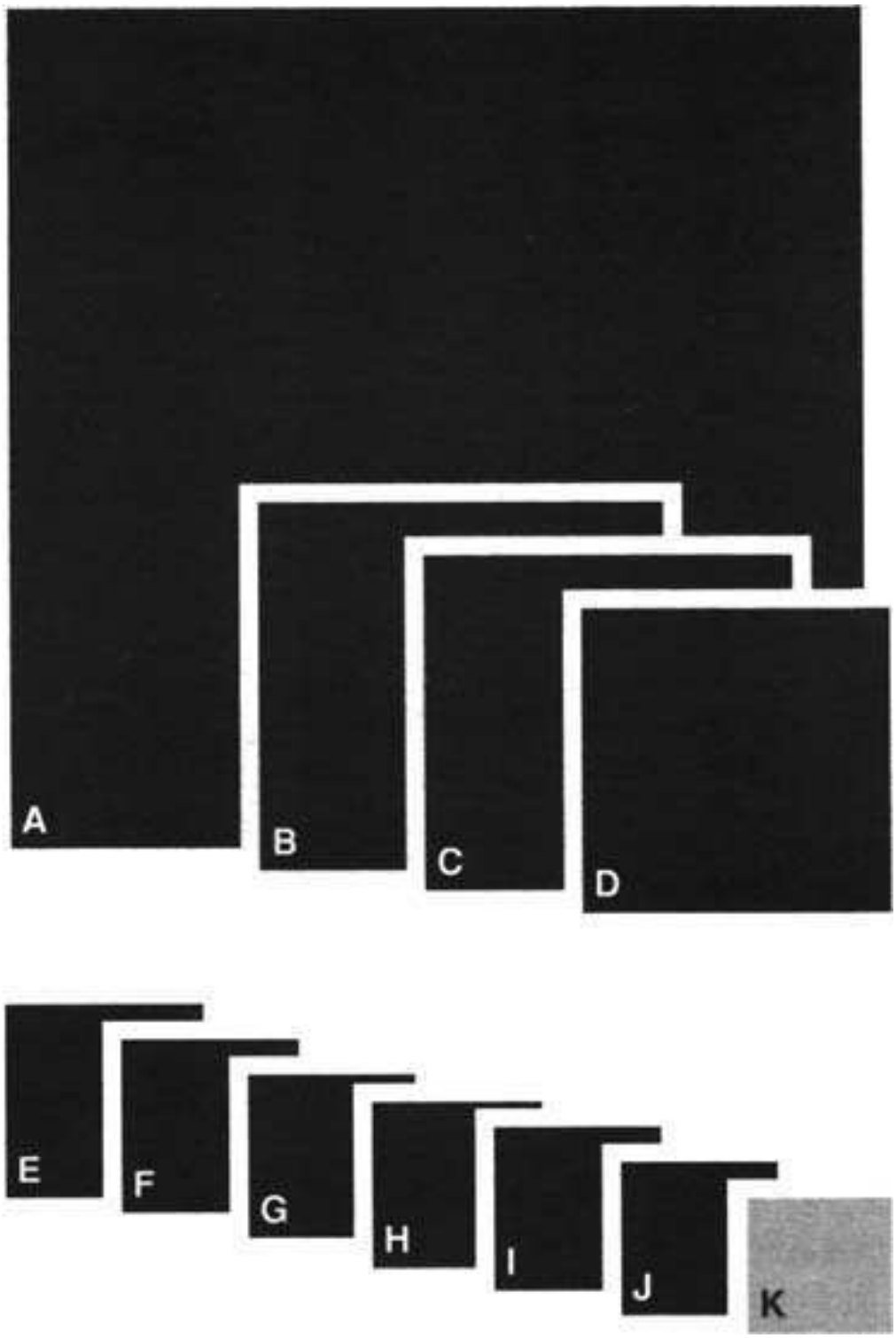
Largest deserts

A	Sahara	3,242,000 mi²	8,397,000 km²
B	Australian	598,000 mi²	1,549,000 km²
C	Arabian	502,000 mi²	1,300,000 km²
D	Gobi	401,000 mi²	1,039,000 km²
E	Kalahari	201,000 mi²	521,000 km²
F	Turkestan	139,000 mi²	360,000 km²
G	Takla Makan	124,000 mi²	321,000 km²
H	Sonoran	120,000 mi²	311,000 km²
I	Namib	120,000 mi²	311,000 km²
J	Thar	100,000 mi²	259,000 km²

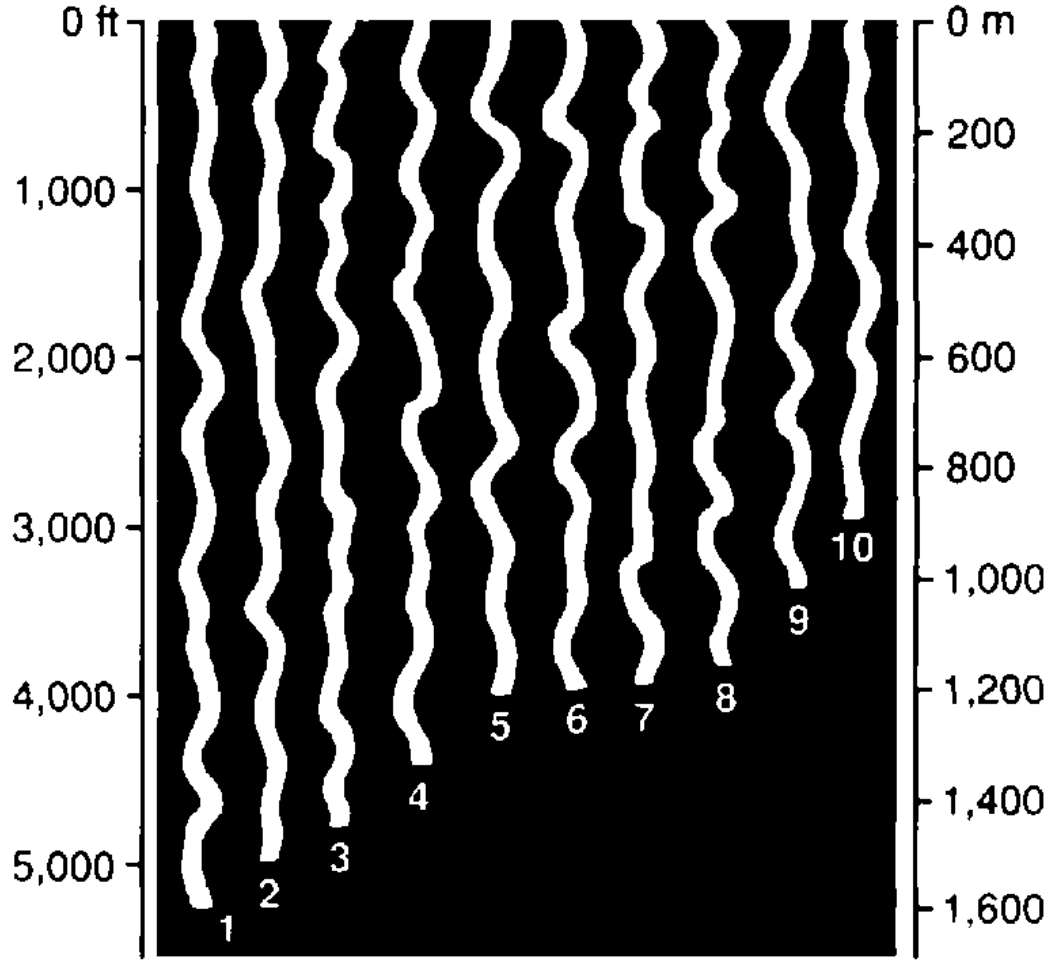


K	Wyoming	98,000 mi²	254,000 km²

The sizes of the largest deserts are compared (opposite) to the size of Wyoming.


A
B
C
D
E
F
G
H
I
J
K

Deepest caves



			ft	m
1	Réseau Jean Bernard	France	5,256	1,602
2	Shakta Pantjukhina	Russian Caucasus	4,947	1,508
3	Sistema del Trave	Spain	4,728	1,441
4	San Agustín	Mexico	4,439	1,353
5	Schwersystem	Austria	3,999	1,219
6	Abisso Olivifer	Italy	3,970	1,210
7	Veliko Fbrego	Former Yugoslavia	3,930	1,198
8	Anou Ifflis	Algeria	3,802	1,159
9	Siebenhengste System	Switzerland	3,346	1,020
10	Jama u Vjetrena brda	Former Yugoslavia	2,943	897

Capitals of the world

Africa

ALGERIA Algiers
ANGOLA Luanda
BENIN Porto-Novo
BOTSWANA Gaborone
BURKINA FASO Ouagadougou
BURUNDI Bujumbura
CAMEROON Yaoundé
CAPE VERDE Praia
CENTRAL AFRICAN REPUBLIC Bangui
CHAD N'Djamena
COMOROS Moroni
CONGO Brazzaville
DJIBOUTI Djibouti
EGYPT Cairo
EQUATORIAL GUINEA Malabo
ERITREA Asmara
ETHIOPIA Addis Ababa
GABON Libreville
GAMBIA Banjul
GHANA Accra
GUINEA Conakry
GUINEA-BISSAU Bissau
IVORY COAST (CÔTE D'IVOIRE) Yamoussoukro/Abidjan
KENYA Nairobi
LESOTHO Maseru
LIBERIA Monrovia
LIBYA Tripoli
MADAGASCAR Antananarivo
MALAWI Lilongwe
MALI Bamako
MAURITANIA Nouakchott
MAURITIUS Port Louis
MOROCCO Rabat
MOZAMBIQUE Maputo
NAMIBIA Windhoek
NIGER Niamey
NIGERIA Abuja
RWANDA Kigali
SÃO TOMÉ AND PRÍNCIPE São Tomé
SENEGAL Dakar
SEYCHELLES Victoria
SIERRA LEONE Freetown
SOMALIA Mogadishu
SOUTH AFRICA Cape Town/ Pretoria
SUDAN Khartoum
SWAZILAND Mbabane
TANZANIA Dodoma
TOGO Lomé
TUNISIA Tunis
UGANDA Kampala
ZAÏRE Kinshasa
ZAMBIA Lusaka

ZIMBABWE Harare

Asia and Middle East
AFGHANISTAN Kabul
BAHRAIN Manama
BANGLADESH Dhaka
BHUTAN Thimphu
BRUNEI Bandar Seri Begawan
CAMBODIA Phnom Penh
CHINA Beijing
INDIA New Delhi
INDONESIA Jakarta
IRAN Tehran
IRAQ Baghdad
ISRAEL Jerusalem
JAPAN Tokyo
JORDAN Amman
KAZAKHSTAN Alma-Ata
KIRGHIZIA Frunze
KOREA, NORTH Pyongyang
KOREA, SOUTH Seoul
KUWAIT Kuwait City
LAOS Vientiane
LEBANON Beirut
MALAYSIA Kuala Lumpur
MALDIVES Malé
MONGOLIA Ulan Bator
MYANMAR(Burma) Yangon (Rangoon)
NEPAL Kathmandu
OMAN Muscat
PAKISTAN Islamabad
PHILIPPINES Manila
QATAR Doha
SAUDI ARABIA Riyadh
SINGAPORE Singapore
SRI LANKA Colombo
SYRIA Damascus
TADZHIKISTAN Dushanbe
THAILAND Bangkok
TURKMENISTAN Ashkhabad
UNITED ARAB EMIRATES Abu Dhabi
UZBEKISTAN Tashkent
VIETNAM Hanoi
YEMEN Sana'a

Europe
ALBANIA Tirana
ANDORRA Andorra la Vella
ARMENIA Yerevan
AUSTRIA Vienna
AZERBAIJAN Baku
BELARUS Minsk
BELGIUM Brussels

BOSNIA-
HERZEGOVINA
Sarajevo
BULGARIA Sofia
CROATIA Zagreb
CYPRUS Nicosia
CZECH REPUBLIC
Prague
DENMARK Copenhagen
ESTONIA Tallinn
FINLAND Helsinki
FRANCE Paris
GEORGIA Tbilisi
GERMANY Berlin
GREECE Athens
HUNGARY Budapest
ICELAND Reykjavík
IRELAND (Eire) Dublin
ITALY Rome
LATVIA Riga
LIECHTENSTEIN Vaduz
LITHUANIA Vilnius
LUXEMBOURG
Luxembourg
MACEDONIA Skopje
MALTA Valletta
MOLDOVA Kishinev
MONACO Monaco-Ville
NETHERLANDS
The Hague/Amsterdam
NORWAY Oslo
POLAND Warsaw
PORTUGAL Lisbon
ROMANIA Bucharest
RUSSIA Moscow
SAN MARINO
San Marino
SLOVAKIA Bratislava
SLOVENIA Ljubljana
SPAIN Madrid
SWEDEN Stockholm
SWITZERLAND Bern
TURKEY Ankara
UKRAINE Kiev
UNITED KINGDOM
London
VATICAN CITY
Vatican city
YUGOSLAVIA Belgrade

Australasia

AUSTRALIA Canberra
FIJI Suva
KIRIBATI Tarawa
MARSHALL ISLANDS
Dalap-Uliga-Darrit
MICRONESIA
Kolonia
NAURU Yaren
NEW ZEALAND
Wellington
PALAU Koror
PAPUA NEW GUINEA
Port Moresby

SOLOMON ISLANDS Honiara
TONGA Nuku'alofa
TUVALU Funafuti
VANUATU Port-Vila
WESTERN SAMOA Apia

South America
ARGENTINA Buenos Aires
BOLIVIA La Paz/Sucre
BRAZIL Brasília
CHILE Santiago
COLOMBIA Bogotá
ECUADOR Quito
FRENCH GUIANA Cayenne
GUYANA Georgetown
PARAGUAY Asunción
PERU Lima
SURINAME Paramaribo
URUGUAY Montevideo
VENEZUELA Caracas

North and Central America
ANTIGUA AND BARBUDA St. John's
BAHAMAS Nassau
BARBADOS Bridgetown
BELIZE Belmopan
CANADA Ottawa
COSTA RICA San José
CUBA Havana
DOMINICA Roseau
DOMINICAN REPUBLIC Santo Domingo
EL SALVADOR San Salvador
GREENLAND Nuuk
GRENADA St. George's
GUATEMALA Guatemala City
HAITI Port-au-Prince
HONDURAS Tegucigalpa
JAMAICA Kingston
MEXICO Mexico City
NICARAGUA Managua
PANAMA Panama City
ST. LUCIA Castries
ST. CHRISTOPHER AND NEVIS Basseterre
ST. VINCENT AND THE GRENADINES Kingstown
TRINIDAD AND TOBAGO Port of Spain
UNITED STATES OF AMERICA Washington D.C.