UNITS & CONSTANTS

VISUAL CHEM CARDS

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Chemistry Units

Standard Units (SI)

There are **seven base units** in the SI system:

- the **kilogram (kg)**, for **mass**
- the **second (s)**, for **time**
- the **kelvin (K)**, for **temperature**
- the **ampere (A)**, for **electric current**
- the **mole (mol)**, for the **amount of a substance**
- the **candela (cd)**, for **luminous intensity**
- the **meter (m)**, for **distance**

All other units are derived units. They are built from the base units. for example, velocity is a quantity that is derived from the base quantities of time and length, and thus the SI derived unit is metre per second (symbol m/s).

Derived SI Units

Quantity	Symbol	Unit	Unit Symbol	Derived From
Force	*F*	newton	N	$kg{\cdot}m{\cdot}s^{-2}$
Energy	*U*	joule	J	$kg{\cdot}m^{2}{\cdot}s^{-2}$
Pressure	*P*	pascal	Pa	$kg{\cdot}m^{-1}{\cdot}s^{-2}$
Power		watt	W	$kg{\cdot}m^{2}{\cdot}s^{-3}$
Electrical charge	Q	coulomb	C	A·s
Electrical potential	*V*	volt	V	$J{\cdot}C^{-1}$

SI Prefix Units

SI Prefix Units

A prefix appears before a unit's symbol when expressing very large or very small quantities. For example: 0.001 kg = 1 g = 1000 mg.

Factor	Name	Symbol	Decimal
10^{24}	yotta	Y	1 000 000 000 000 000 000 000 000
10^{21}	zetta	Z	1 000 000 000 000 000 000 000
10^{18}	exa	E	1 000 000 000 000 000 000
10^{15}	peta	P	1 000 000 000 000 000
10^{12}	tera	T	1 000 000 000 000
10^{9}	giga	G	1 000 000 000
10^{6}	mega	M	1 000 000
10^{3}	kilo	k	1 000
10^{2}	hecto	h	100
10^{1}	deka	da	10

Factor	Name	Symbol	Decimal
10^{-1}	deci	d	0.1
10^{-2}	centi	c	0.01
10^{-3}	milli	m	0.001
10^{-6}	micro	μ	0.000 001
10^{-9}	nano	n	0.000 000 001
10^{-12}	pico	p	0.000 000 000 001
10^{-15}	femto	f	0.000 000 000 000 001
10^{-18}	atto	a	0.000 000 000 000 000 001
10^{-21}	zepto	z	0.000 000 000 000 000 000 001
10^{-24}	yocto	y	0.000 000 000 000 000 000 000 001

In chemistry, many quantities used are very large or very small.

When writing a number, we use **powers** and **indices** to show how manty times the original or base number will be multipled.

A positive **index** will multiply by the power, and a negative index will divide by the power.

Some indices have commonly used **prefixes** that provide a quick way of writing small or large values.

Chemistry Units

Volume

Volume Unit	Conversion	Mass of Water (4 °C)
1 L	= 1000 cm^3	1 kg
1 cm^3	= 1 mL	1 g
1 m^3	= 1000 L	1000 kg

Pressure

Name	Symbol	Conversion	
Atmosphere	atm	= 760 torr	= 101.325 kPa
Pascal	Pa	≈ 7.5 x 10^{-3} torr	
Torr (mm Hg)	torr	≈ 133.3 Pa	
Pound-per-square inch	psi	≈ 51.7 torr	≈ 6.894 kPa

Temperature

Name	Symbol	Abs. Zero	M.P. of Water	B.P. of Water
Fahrenheit	°F	-456.67 °F	32 °F	212 °F
Celsius	°C	-273.15 °C	0 °C	100 °C
Kelvin	K	0 K	273.15 K	373.15 K

Chemistry Units

Useful Physical/Chemical Constants

Constant	Value
Avogadro's Number	$N_A = 6.022\ 14 \times 10^{23}\ mol^{-1}$
Faraday Constant	$F = 96\ 485.33\ C\ mol^{-1}$
Atomic Mass Constant	$1\ amu = 1.660\ 538 \times 10^{-27}\ kg$
Molar Gas Constant	$R = 8.314\ 4\ J\ mol^{-1}\ K^{-1}$
Molar Gas Constant	$R = 0.082\ 057\ 46\ L\ atm\ K^{-1}\ mol^{-1}$
Coulomb's Constant	$k_e = 8.987\ 551 \times 10^{9}\ N\ m^2\ C^{-2}$
Speed of Light (Vacuum)	$c = 299\ 792\ 458\ m\ s^{-1}$
Boltzmann Constant	$k_b = 1.380\ 65 \times 10^{-23}\ J\ K^{-1}$
Charge on a Proton/Electron	$e = 1.602\ 176 \times 10^{-19}\ C$
Standard acceleration of gravity	$g = 9.806\ 65\ m\ s^{-2}$
Rydberg constant	$R_\infty = 1.0973\ 731\ 568\ 539 \times 10^{7}\ m^{-1}$
Planck's Constant	$h = 6.62607004 \times 10^{-34}\ J\ s$
Specific heat capacity of liquid water	$c = 4.18\ kJ\ kg^{-1}°C^{-1}$