

Physical Formulae



Energy

Force	$F = ma$
Work done by a force	$W = Fs$
Potential energy	$E_p = mgh$
Kinetic energy	$E_k = \frac{1}{2}mv^2$
Change in kinetic energy	? $E_k = \frac{1}{2}mv^2 - \frac{1}{2}mu^2$
Potential energy change and work	$W = \Delta E_p$
Kinetic energy change and work	$W = \Delta E_k$
Power and work	$P = \frac{W}{t}$
Ohm's Law	$V = IR$
Resistance in series	$R_T = R_1 + R_2 \dots$
Resistance in parallel	$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} \dots$
Electrical Power	$P = VI$
Electrical work	$W = VIt$

Change

Amount of substance	$n = cV$
	$n = \frac{V}{22.4}$ (at S.T.P.)
	$n = \frac{m}{M_r}$

Sound and Light

Speed of sound in air	$v = f\lambda$
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Engines and fuels

Efficiency of an ideal engine	Percentage efficiency = $\frac{\text{useful energy}}{\text{energy input}} \times \frac{100}{1}$
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Physical Science: Formulae, Constants & Data Sheet

Relevant units and definitions

Volume:	Volumes are given in the units of litres (L), or millilitres (mL).
Temperature:	Temperatures are given in the units of degrees Celsius ($^{\circ}\text{C}$) or Kelvin (K). It may be assumed that $0^{\circ}\text{C} = 273 \text{ K}$.
Energy Change:	Energy changes are given in the SI unit kilojoule (kJ).
Solution Concentration:	Solution concentrations are expressed in the unit moles per litre (mol L^{-1}).
Molar Volume:	The volume of 1.00 mol of a gas at 273 K and 101.3 kPa is 22.4 L.
S.T.P.	S.T.P. can be taken as 273 K and 101.3 kPa.

Acceleration due to gravity on Earth: $g = 9.80 \text{ m s}^{-2}$

Prefixes of the Metric System

Factor	Prefix	Symbol
10^9	giga	G
10^6	mega	M
10^3	kilo	k
10^{-3}	milli	m
10^{-6}	micro	μ

Standard Reduction Potentials at 25°C

Half-reaction	E° (volts)
$\text{Au}^{3+}(aq) + 3e^- \rightarrow \text{Au}(s)$	+ 1.50
$\text{Cl}_2(g) + 2e^- \rightarrow 2\text{Cl}^-(aq)$	+ 1.36
$\text{Br}_2(l) + 2e^- \rightarrow 2\text{Br}^-(aq)$	+ 1.07
$\text{Hg}^{2+}(aq) + 2e^- \rightarrow \text{Hg}(l)$	+ 0.85
$\text{O}_2(g) + 4\text{H}^+(aq) [1.00 \times 10^{-7}M] + 4e^- \rightarrow 2\text{H}_2\text{O}(l)$	+ 0.82
$\text{Ag}^+(aq) + e^- \rightarrow \text{Ag}(s)$	+ 0.80
$\text{Hg}_2^{2+}(aq) + 2e^- \rightarrow 2\text{Hg}(l)$	+ 0.80
$\text{I}_2(s) + 2e^- \rightarrow 2\text{I}^-(aq)$	+ 0.54
$\text{Cu}^+(aq) + e^- \rightarrow \text{Cu}(s)$	+ 0.52
$\text{O}_2(g) + 2\text{H}_2\text{O}(l) + 4e^- \rightarrow 4\text{OH}^-(aq)$	+ 0.40
$\text{Cu}^{2+}(aq) + 2e^- \rightarrow \text{Cu}(s)$	+ 0.34
$2\text{H}^+(aq) + 2e^- \rightarrow \text{H}_2(g)$	0.00
$\text{Pb}^{2+}(aq) + 2e^- \rightarrow \text{Pb}(s)$	- 0.13
$\text{Sn}^{2+}(aq) + 2e^- \rightarrow \text{Sn}(s)$	- 0.14
$\text{Ni}^{2+}(aq) + 2e^- \rightarrow \text{Ni}(s)$	- 0.26
$\text{Co}^{2+}(aq) + 2e^- \rightarrow \text{Co}(s)$	- 0.28
$\text{Cd}^{2+}(aq) + 2e^- \rightarrow \text{Cd}(s)$	- 0.40
$2\text{H}_2\text{O}(l) + 2e^- \rightarrow \text{H}_2(g) + 2\text{OH}^-(aq) [1.00 \times 10^{-7}M]$	- 0.41
$\text{Fe}^{2+}(aq) + 2e^- \rightarrow \text{Fe}(s)$	- 0.44
$\text{Cr}^{3+}(aq) + 3e^- \rightarrow \text{Cr}(s)$	- 0.73
$\text{Zn}^{2+}(aq) + 2e^- \rightarrow \text{Zn}(s)$	- 0.76
$\text{Mn}^{2+}(aq) + 2e^- \rightarrow \text{Mn}(s)$	- 1.18
$\text{Al}^{3+}(aq) + 3e^- \rightarrow \text{Al}(s)$	- 1.66
$\text{Mg}^{2+}(aq) + 2e^- \rightarrow \text{Mg}(s)$	- 2.37
$\text{Na}^+(aq) + e^- \rightarrow \text{Na}(s)$	- 2.71
$\text{Ca}^{2+}(aq) + 2e^- \rightarrow \text{Ca}(s)$	- 2.76
$\text{Sr}^{2+}(aq) + 2e^- \rightarrow \text{Sr}(s)$	- 2.89
$\text{Ba}^{2+}(aq) + 2e^- \rightarrow \text{Ba}(s)$	- 2.91
$\text{K}^+(aq) + e^- \rightarrow \text{K}(s)$	- 2.93

Periodic Table

1 H 1.0																	2 He 4.0
3 Li 6.9	4 Be 9.0											5 B 10.8	6 C 12.0	7 N 14.0	8 O 16.0	9 F 19.0	10 Ne 20.2
11 Na 23.0	12 Mg 24.3											13 Al 27.0	14 Si 28.1	15 P 31.0	16 S 32.1	17 Cl 35.5	18 Ar 39.9
19 K 39.1	20 Ca 40.1	21 Sc 45.0	22 Ti 47.9	23 V 50.9	24 Cr 52.0	25 Mn 54.9	26 Fe 55.8	27 Co 58.9	28 Ni 58.7	29 Cu 63.5	30 Zn 65.4	31 Ga 69.7	32 Ge 72.6	33 As 74.9	34 Se 79.0	35 Br 79.9	36 Kr 83.8
37 Rb 85.5	38 Sr 87.6	39 Y 88.9	40 Zr 91.2	41 Nb 92.9	42 Mo 95.9	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	57 *La 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 §Ac 227.0															
			*Lanthanide Series														
			§Actinide Series														
			58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.2	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0	
			90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np 237.0	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)	

6	← Atomic Number
C	← Symbol
12.0	← Atomic Weight (Relative Atomic Mass)

An atomic weight in brackets is the mass number of the isotope with the longest half-life.

Table of solubility of common ions

Low solubility	Exceptions – soluble compounds
Carbonates	Li_2CO_3 Na_2CO_3 K_2CO_3 $(\text{NH}_4)_2\text{CO}_3$
Phosphates	Na_3PO_4 K_3PO_4 $(\text{NH}_4)_3\text{PO}_4$
Sulfides	Li_2S Na_2S K_2S $(\text{NH}_4)_2\text{S}$
Hydroxides	LiOH NaOH KOH NH_4OH $\text{Ba}(\text{OH})_2$

Soluble compounds	Exceptions – low solubility
Nitrates	None
Chlorides	AgCl PbCl_2
Bromides	AgBr PbBr_2
Iodides	AgI PbI_2
Sulfates	Ag_2SO_4 PbSO_4 BaSO_4 CaSO_4