Motion, Forces, and Gravity

Equation	Meaning/Use	Equation	Meaning/Use
$\boldsymbol{s = ut + \frac{1}{2}at^2}$	SUVAT equations – Distance Travelled	$v = u + at$	SUVAT equations – Final speed
$v^2 = u^2 + 2as$	SUVAT equations – final velocity	$\vec{F}_{net} = m\vec{a}$	Newton's second law of motion
$\Delta U = mg\Delta \mathrm{h}$	Change in gravitational potential energy	$W = Fs \times \cos(\theta)$	Work = force parallel to distance travelled
$P = \frac{\Delta E}{\Delta t}$	Power formula	$K = \frac{1}{2}mv^2$	Kinetic Energy
$\sum \frac{1}{2}mv_{before}^2 = \sum \frac{1}{2}mv_{after}^2$	Conservation of energy (inelastic collisions)	$P = Fv \times \cos(\theta)$	Power formula 2
$\Delta\ \vec{p} = \vec{F}_{net}\Delta t$	Impulse (change in momentum)	$\sum \frac{1}{2}mv_{before} = \sum \frac{1}{2}mv_{after}$	Conservation of momentum (all collisions)
$\omega = \frac{\Delta\theta}{t}$	Angular momentum in radians per second	$a_c = \frac{v^2}{r}$	Centripetal Acceleration
$\tau = rF \times \sin(\theta)$	Torque	$F_c = \frac{mv^2}{r} = ma_c$	Centripetal Force
$v = \frac{2\pi r}{t}$	Orbital Velocity	$F = \frac{GMm}{r^2}$	Newton's Law of Universal Gravitation
$U = -\frac{GMm}{r}$	Gravitational Potential Energy	$\frac{r^3}{t^2} = \frac{GM}{4\pi^2}$	Kepler's Law of Periods
$v_{esc} = \sqrt{\frac{2GM}{r}}$	Escape velocity (not on DS)	$g = \frac{GM}{r^2}$	Gravity with changing heights (not on DS)
$F_{friction} = \mu F_N$	Friction force	$U + K = -\frac{GMm}{2r}$	Total gravitational energy

Waves and Thermodynamics

Equation	Meaning/Use	Equation	Meaning/Use
$v = f\lambda$	Speed of a wave	$f_{beat} = \lvert f_2 - f_1 \rvert$	Beat frequencies
$f = \frac{1}{T}$	Frequency-Period relationship	$f' = f\frac{(v_{wave} + v_{observer})}{(v_{wave} - v_{source})}$	Doppler shift
$dsin(\theta) = m\lambda$	Interference of light	$n_1 \sin(\theta_1) = n_2 \sin(\theta_2)$	Snell's Law (refraction of light)
$n_x = \frac{c}{v_x}$	Refractive index	$\sin(\theta_c) = \frac{n_1}{n_2}$	Critical angle of incidence
$I = I_{max}\cos^2(\theta)$	Malus' Law (2 polarising filters)	$I_1 r_1^2 = I_2 r_2^2$	Comparing the intensity of light at 2 points
$Q = mc\Delta T$	Specific Heat formula	$\frac{Q}{t} = \frac{kA\Delta T}{d}$	Energy transfer per unit area (thermodynamics)

Electricity and Magnetism

Equation	Meaning/Use	Equation	Meaning/Use
$E = \frac{V}{d}$	Electric Field Strength	$F = qE$	Force in electric fields
$V = \frac{\Delta U}{q}$	Voltage	$F = \frac{1}{4\pi\epsilon_0}\frac{q_1 q_2}{r^2}$	Force between 2 charges
$W = qV$	Work from voltage	$I = \frac{q}{t}$	Current
$W = qEd$	Work from electric field strength	$V = IR$	Ohm's Law
$B = \frac{\mu_0 I}{2\pi r}$	Magnetic field produced by wires with running current	$P = VI$	Power formula
$B = \frac{\mu_0 NI}{L}$	Magnetic field produced by a solenoid	$F = qvB \times \sin(\theta)$	Force in a magnetic field
$\Phi = BA \times cos(\theta)$	Magnetic flux	$F = BIl \times \sin(\theta)$	Motor effect
$\epsilon = -N\frac{\Delta\Phi}{\Delta t}$	Lenz's Law (change in flux per time)	$\frac{F}{l} = \frac{\mu_0}{2\pi}\frac{I_1 I_2}{r}$	Force between parallel wires
$\frac{V_p}{V_s} = \frac{N_p}{N_s}$	Transformer – voltage/coils relationship	$\tau = nIAB \times \sin(\theta)$	Torque in a motor
$E = Pt$	Fields in motion	$V_p I_p = V_s I_s$	Conservation of Energy (power) in Transformers
$\sum I = 0$	Kirchoff's Current Law	$R_{series} = R_1 + R_2 + R_3 \ldots$	Resistors in series
$\sum V = 0$	Kirchoff's Voltage Law	$\frac{1}{R_{parallel}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \ldots$	Resistors in parallel

Quantum, Special Relativity, and Nuclear

Equation	Meaning/Use	Equation	Meaning/Use
$\lambda = \frac{h}{mv}$	De Broglie Matter Waves	$t = \frac{t_0}{\sqrt{1-\frac{v^2}{c^2}}}$	Time dilation
$K\_\max = hf - \varphi$	Photoelectric Effect	$l = l_0\sqrt{1-\frac{v^2}{c^2}}$	Length contraction
$\lambda_{max} = \frac{b}{T}$	Wien's Law (wavelength – temperature relationship)	$p_v = \frac{m_0 v}{\sqrt{1-\frac{v^2}{c^2}}}$	Relativistic momentum
$E = mc^2$	Mass-Energy Equivalence	$E^2 = (mc^2)^2 + pc^2$	Mass-energy equivalence for objects in motion
$E = hf$	Wave energy	$N_t = N_0 e^{-\lambda t}$	Radioactive decay
$\frac{1}{\lambda} = R\left\|\frac{1}{n_f^2} - \frac{1}{n_f^2}\right\|$	Rydberg Emission Spectra	$\lambda = \frac{\ln(2)}{t_{\frac{1}{2}}}$	Decay constant

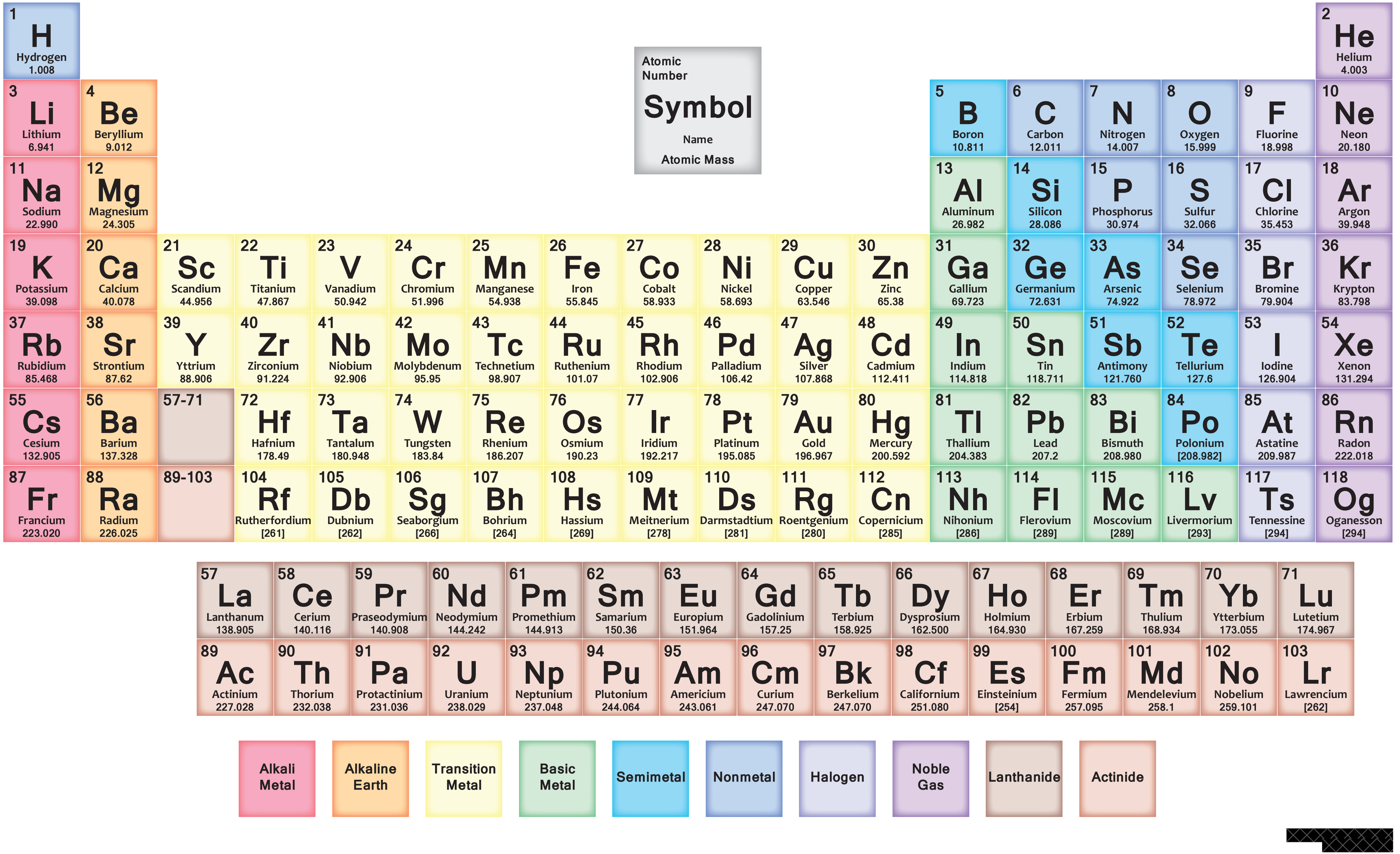
Symbols and Units

Symbol	Meaning	Unit	Symbol	Meaning	Unit
a	Acceleration	m/s^2	m/M	Mass	Kg
a_c	Centripetal acceleration	m/s^2	P	Power	W
ΔE	Change in energy	J	Δp	Momentum	$kg \cdot m \cdot s^{-1}$
F	Force	N	r	Radius	m
g	Gravity	m/s^2	S	Displacement	m
G	Gravitational Constant	$m^3kg^{-1}s^{-1}$	t	Time	s
Δh	Change in height	m	τ	Torque	Nm
U	Gravitational Potential Energy (GPE)	J	u	Initial velocity	m/s
ΔU	Change in GPE	J	v	Final velocity	m/s
ω	Angular Momentum	Radians/s	W	Work	J
$\Delta\theta$	Change in angle	Radians	c	Speed of light	m/s
d	Distance	m	f	Frequency	s^{-1}
I	Intensity (usually of light)	lux	n_x	Refractive Index	No Units
T	Period (time for 1 wave)	s	ΔT	Change in Temperature	K
Q	Energy	J	λ	Wavelength	m
A	Area	m^2	B	Magnetic field strength	T
d	Distance between plates	m	E	Electric field strength	V/m
ϵ	EMF/Voltage	V	E	Energy	J
I	Current	A	V	Voltage	V
L	Length of solenoid	m	N	Number of turns	No Units
q	Charge	C	R	Resistance	Ω
r	Distance between charges	M	μ_0	Magnetic constant	NA^{-2}

Φ	Magnetic Flux	Wb	θ	Angle	Degrees or Radians
b	Wien's Displacement Constant	mK	φ	Work function	No Units

Prefix Conversion

Prefix	Symbol	Power (10^n)
giga	G	9
mega	M	6
Kilo	k	3
-	-	0
centi	c	-2
milli	m	-3
micro	μ	-6
nano	n	-9


1 H Hydrogen 1.008
2 He Helium 4.003
3 Li Lithium 6.941
4 Be Beryllium 9.012
5 B Boron 10.811
6 C Carbon 12.011
7 N Nitrogen 14.007
8 O Oxygen 15.999
9 F Fluorine 18.998
10 Ne Neon 20.180
11 Na Sodium 22.990
12 Mg Magnesium 24.305
13 Al Aluminum 26.982
14 Si Silicon 28.086
15 P Phosphorus 30.974
16 S Sulfur 32.066
17 Cl Chlorine 35.453
18 Ar Argon 39.948
19 K Potassium 39.098
20 Ca Calcium 40.078
21 Sc Scandium 44.956
22 Ti Titanium 47.867
23 V Vanadium 50.942
24 Cr Chromium 51.996
25 Mn Manganese 54.938
26 Fe Iron 55.845
27 Co Cobalt 58.933
28 Ni Nickel 58.693
29 Cu Copper 63.546
30 Zn Zinc 65.38
31 Ga Gallium 69.723
32 Ge Germanium 72.631
33 As Arsenic 74.922
34 Se Selenium 78.972
35 Br Bromine 79.904
36 Kr Krypton 83.798
37 Rb Rubidium 85.468
38 Sr Strontium 87.62
39 Y Yttrium 88.906
40 Zr Zirconium 91.224
41 Nb Niobium 92.906
42 Mo Molybdenum 95.95
43 Tc Technetium 98.907
44 Ru Ruthenium 101.07
45 Rh Rhodium 102.906
46 Pd Palladium 106.42
47 Ag Silver 107.868
48 Cd Cadmium 112.411
49 In Indium 114.818
50 Sn Tin 118.711
51 Sb Antimony 121.760
52 Te Tellurium 127.6
53 I Iodine 126.904
54 Xe Xenon 131.294
55 Cs Cesium 132.905
56 Ba Barium 137.328
57-71
72 Hf Hafnium 178.49
73 Ta Tantalum 180.948
74 W Tungsten 183.84
75 Re Rhenium 186.207
76 Os Osmium 190.23
77 Ir Iridium 192.217
78 Pt Platinum 195.085
79 Au Gold 196.967
80 Hg Mercury 200.592
81 Tl Thallium 204.383
82 Pb Lead 207.2
83 Bi Bismuth 208.980
84 Po Polonium [208.982]
85 At Astatine 209.987
86 Rn Radon 222.018
87 Fr Francium 223.020
88 Ra Radium 226.025
89-103
104 Rf Rutherfordium [261]
105 Db Dubnium [262]
106 Sg Seaborgium [266]
107 Bh Bohrium [264]
108 Hs Hassium [269]
109 Mt Meitnerium [278]
110 Ds Darmstadtium [281]
111 Rg Roentgenium [280]
112 Cn Copernicium [285]
113 Nh Nihonium [286]
114 Fl Flerovium [289]
115 Mc Moscovium [289]
116 Lv Livermorium [293]
117 Ts Tennessine [294]
118 Og Oganesson [294]
Atomic Number
Symbol
Name
Atomic Mass
57 La Lanthanum 138.905
58 Ce Cerium 140.116
59 Pr Praseodymium 140.908
60 Nd Neodymium 144.242
61 Pm Promethium 144.913
62 Sm Samarium 150.36
63 Eu Europium 151.964
64 Gd Gadolinium 157.25
65 Tb Terbium 158.925
66 Dy Dysprosium 162.500
67 Ho Holmium 164.930
68 Er Erbium 167.259
69 Tm Thulium 168.934
70 Yb Ytterbium 173.055
71 Lu Lutetium 174.967
89 Ac Actinium 227.028
90 Th Thorium 232.038
91 Pa Protactinium 231.036
92 U Uranium 238.029
93 Np Neptunium 237.048
94 Pu Plutonium 244.064
95 Am Americium 243.061
96 Cm Curium 247.070
97 Bk Berkelium 247.070
98 Cf Californium 251.080
99 Es Einsteinium [254]
100 Fm Fermium 257.095
101 Md Mendelevium 258.1
102 No Nobelium 259.101
103 Lr Lawrencium [262]
Alkali Metal
Alkaline Earth
Transition Metal
Basic Metal
Semimetal
Nonmetal
Halogen
Noble Gas
Lanthanide
Actinide