Government of **Western Australia**
School Curriculum and Standards Authority

PHYSICS

ATAR COURSE YEAR 11

FORMULAE AND DATA

2025

Motion, forces and energy

Time difference	$\Delta t = t_f - t_i$
Displacement	$s = \Delta x = x_f - x_i$
Average velocity	$v = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i}$
Equations of motion	$a = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{t_f - t_i}$ $\quad v_f = v_i + a\Delta t$ $s = v_i \Delta t + \frac{1}{2} a \Delta t^2$ $\quad {v_f}^2 = {v_i}^2 + 2as$
Momentum	$p = mv \quad \Sigma m v_i = \Sigma m v_f$
Force	$\Sigma F = ma$
Change in momentum (impulse)	$\Delta p = mv_f - mv_i = F\Delta t$
Weight force	$F_{weight} = mg$
Friction	$F_f = \mu F_N$ where μ is the coefficient of static or kinetic friction

Mechanical and thermal energy

Kinetic energy	$E_k = \frac{1}{2} m v^2$
Gravitational potential energy	$E_p = mg\Delta h$
Conservation of energy	$\Sigma E_i = \Sigma E_f$
Elastic collisions	$\Sigma \frac{1}{2} m v_i^2 = \Sigma \frac{1}{2} m v_f^2$
Work done	$W = Fs \quad W = \Delta E$
Power	$P = \frac{W}{\Delta t} = \frac{\Delta E}{\Delta t}$
Change of temperature	$Q = mc\Delta T$
Change of state	$Q = mL$

Waves

Wave velocity	$v = f\lambda$	
Period	$T = \frac{1}{f}$	
Strings and open pipes	$\lambda = \frac{2\ell}{n}$	where *n* = the number of the appropriate harmonic
Closed pipes	$\lambda = \frac{4\ell}{n}$	where *n* = the number of the appropriate harmonic
Beat frequency	$f_{beat} = \lvert f_2 - f_1 \rvert$	

See next page

Ionising radiation and nuclear reactions

Half-life	$N = N_0\left(\frac{1}{2}\right)^n$
Absorbed radiation dose	$\text{absorbed dose} = \frac{E}{m}$
Dose equivalent	$\text{dose equivalent} = \text{absorbed dose} \times \text{quality factor}$
Mass–energy relationship	$\Delta E = \Delta m c^2$

Electrical forces and energy

Work and energy	$\Delta V = \frac{W}{q}$
Electric current	$I = \frac{q}{\Delta t}$
Power	$P = \frac{W}{\Delta t} = VI$
Ohm's law	$R = \frac{V}{I}$
Resistance in series (I = constant)	$V_t = V_1 + V_2 + V_3 \ldots$ $R_t = R_1 + R_2 + R_3 \ldots$
Resistance in parallel (V = constant)	$I_t = I_1 + I_2 + I_3 \ldots$ $\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \ldots$

Prefixes of the metric system

Factor	Prefix	Symbol	Factor	Prefix	Symbol
10^{12}	tera	T	10^{-3}	milli	m
10^{9}	giga	G	10^{-6}	micro	μ
10^{6}	mega	M	10^{-9}	nano	n
10^{3}	kilo	k	10^{-12}	pico	p

Physical constants

Speed of light in vacuum or air ..... $c = 3.00 \times 10^8$ m s^{-1}
Electron charge ..... $e = -1.60 \times 10^{-19}$ C
Electron volt ..... 1.00 eV = 1.60×10^{-19} J
Unified atomic mass unit ..... 1.00 u = 1.66×10^{-27} kg
Mass of electron ..... $m_e = 9.11 \times 10^{-31}$ kg
Mass of proton ..... $m_p = 1.67 \times 10^{-27}$ kg
Mass of neutron ..... $m_n = 1.67 \times 10^{-27}$ kg
Mass of alpha particle ..... $m_\alpha = 6.64 \times 10^{-27}$ kg
Mass–energy equivalent ..... 1.00 u = 931 MeV
Tonne ..... 1.00 t = 10^3 kg = 10^6 g
Absolute zero ..... 0 K = −273 °C

See next page

Physical data

Mean acceleration due to gravity on Earth	g	= 9.80 m s^{-2}
Specific heat capacity of water	c_w	= 4.18×10^3 J K^{-1} kg^{-1}
Specific heat capacity of ice	c_i	= 2.10×10^3 J K^{-1} kg^{-1}
Specific heat capacity of steam	c_s	= 2.00×10^3 J K^{-1} kg^{-1}
Latent heat of fusion for H_2O	L_f	= 3.34×10^5 J kg^{-1}
Latent heat of vaporisation for H_2O	L_v	= 2.26×10^6 J kg^{-1}
Speed of sound in air at 25 °C	v_s	= 346 m s^{-1}

Quality factors

Approximate quality factor for alpha radiation	QF_α	= 20
Approximate quality factor for beta radiation	QF_β	= 1
Approximate quality factor for gamma radiation	QF_γ	= 1
Approximate quality factor for slow neutrons	QF_{sn}	= 3
Approximate quality factor for fast neutrons	QF_{fn}	= 10

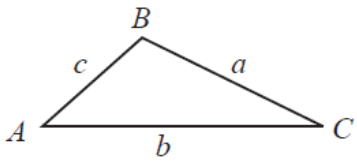
Mathematical expressions

Quadratic equations

Given $ax^2 + bx + c = 0$: $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Triangles

The following expressions apply to the triangle ABC as shown:



$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a = \sqrt{b^2 + c^2 - 2bc\cos A}$$

See next page

Periodic table of the elements

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 H hydrogen 1.008																	2 He helium 4.003
3 Li lithium 6.94	4 Be beryllium 9.012											5 B boron 10.81	6 C carbon 12.01	7 N nitrogen 14.01	8 O oxygen 16.00	9 F fluorine 19.00	10 Ne neon 20.18
11 Na sodium 22.99	12 Mg magnesium 24.31											13 Aℓ aluminium 26.98	14 Si silicon 28.09	15 P phosphorus 30.97	16 S sulfur 32.06	17 Cℓ chlorine 35.45	18 Ar argon 39.95
19 K potassium 39.10	20 Ca calcium 40.08	21 Sc scandium 44.96	22 Ti titanium 47.87	23 V vanadium 50.94	24 Cr chromium 52.00	25 Mn manganese 54.94	26 Fe iron 55.85	27 Co cobalt 58.93	28 Ni nickel 58.69	29 Cu copper 63.55	30 Zn zinc 65.38	31 Ga gallium 69.72	32 Ge germanium 72.63	33 As arsenic 74.92	34 Se selenium 78.97	35 Br bromine 79.90	36 Kr krypton 83.80
37 Rb rubidium 85.47	38 Sr strontium 87.62	39 Y yttrium 88.91	40 Zr zirconium 91.22	41 Nb niobium 92.91	42 Mo molybdenum 95.95	43 Tc technetium	44 Ru ruthenium 101.1	45 Rh rhodium 102.9	46 Pd palladium 106.4	47 Ag silver 107.9	48 Cd cadmium 112.4	49 In indium 114.8	50 Sn tin 118.7	51 Sb antimony 121.8	52 Te tellurium 127.6	53 I iodine 126.9	54 Xe xenon 131.3
55 Cs caesium 132.9	56 Ba barium 137.3	57–71 lathanoids	72 Hf hafnium 178.5	73 Ta tantalum 180.9	74 W tungsten 183.8	75 Re rhenium 186.2	76 Os osmium 190.2	77 Ir iridium 192.2	78 Pt platinum 195.1	79 Au gold 197.0	80 Hg mercury 200.6	81 Tℓ thallium 204.4	82 Pb lead 207.2	83 Bi bismuth 209.0	84 Po polonium [209]	85 At astatine [210]	86 Rn radon [222]
87 Fr francium [223]	88 Ra radium [226]	89–103 actinoids	104 Rf rutherfordium [267]	105 Db dubnium [268]	106 Sg seaborgium [269]	107 Bh bohrium [270]	108 Hs hassium [269]	109 Mt meitnerium [277]	110 Ds darmstadtium [281]	111 Rg roentgenium [282]	112 Cn copernicium [285]	113 Nh nihonium [286]	114 Fℓ flerovium [290]	115 Mc moscovium [290]	116 Lv livermorium [293]	117 Ts tennessine [294]	118 Og oganesson [290]

Key:

Atomic number
Symbol
Name
Standard atomic weight

57 La lanthanum 138.9	58 Ce cerium 140.1	59 Pr praseodymium 140.9	60 Nd neodymium 144.2	61 Pm promethium [145]	62 Sm samarium 150.4	63 Eu europium 152.0	64 Gd gadolinium 157.3	65 Tb terbium 158.9	66 Dy dysprosium 162.5	67 Ho holmium 164.9	68 Er erbium 167.3	69 Tm thulium 168.9	70 Yb ytterbium 173.0	71 Lu lutetium 175.0
89 Ac actinium [227]	90 Th thorium 232.0	91 Pa protactinium 231.0	92 U uranium 238.0	93 Np neptunium [237]	94 Pu plutonium [244]	95 Am americium [243]	96 Cm curium [247]	97 Bk berkelium [247]	98 Cf californium [251]	99 Es einsteinium [252]	100 Fm fermium [257]	101 Md mendelevium [258]	102 No nobelium [259]	103 Lr lawrencium [262]

Data from: International Union of Pure and Applied Chemistry. (2022). *IUPAC Periodic Table of the Elements*. Retrieved June, 2025, from https://iupac.org/what-we-do/periodic-table-of-elements/