



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



**PHYSICS**  
**ATAR COURSE YEAR 12**  
**FORMULAE AND DATA BOOKLET**  
**2026**

**Static equilibrium and centre of mass**

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Moment of a force  $\tau = rF \sin \theta$  where  $\theta =$  angle between the force  $F$  and the lever arm

Static equilibrium  $\Sigma F = 0$   $\tau = rF \sin \theta$   $\Sigma \tau = 0$

**Circular motion, gravity and relativity**

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Equations of circular motion  $v = \frac{2\pi r}{T}$   $a_c = \frac{v^2}{r}$  resultant  $F_c = ma_c = \frac{mv^2}{r}$

Law of conservation of energy  $E_p = mg\Delta h$   $W = \Delta E$   $E_k = \frac{1}{2}mv^2$

Newton's law of universal gravitation  $F_g = G \frac{m_1 m_2}{r^2}$

Force  $F_{\text{net}} = ma$

Weight force  $F_{\text{weight}} = mg$

Work done  $E_p = mg\Delta h$   $W = Fs$   $W = \Delta E$   $E_k = \frac{1}{2}mv^2$

Gravitational field strength  $g = \frac{F_g}{m} = G \frac{m}{r^2}$

Kepler's third law  $\frac{T^2}{r^3} = \frac{4\pi^2}{GM}$

Equations of motion  $v = \frac{s}{\Delta t}$   $a = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{t_f - t_i}$   $v_f = v_i + a\Delta t$

$s = v_i \Delta t + \frac{1}{2} a \Delta t^2$   $v_f^2 = v_i^2 + 2as$   $p = mv$

Relativistic effects  $\ell' = \ell \sqrt{\left(1 - \frac{v^2}{c^2}\right)}$   $\Delta t' = \frac{\Delta t}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}}$

$u = \frac{u' + v}{1 + \frac{u'v}{c^2}}$   $u' = \frac{u - v}{1 - \frac{uv}{c^2}}$

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**Electromagnetism**

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Work and energy	$\Delta V = \frac{W}{q}$	
Coulomb's law	$F = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r^2}$	
Electric field strength	$E = \frac{F}{q}$	
Electric field between parallel plates	$E = \frac{\Delta V}{d}$	
Magnetic flux density	$B = \frac{\mu_0 I}{2\pi r}$	
Magnetic force on a charged particle	$F = qvB \sin \theta$	where $\theta$ = angle between the field $B$ and the velocity $v$
Magnetic force on a current-carrying conductor	$F = I\ell B \sin \theta$	where $\theta$ = angle between the field $B$ and the conductor length $\ell$
Torque on a coil	$\tau = rF \sin \theta$	where $\theta$ = angle between the force $F$ and the lever arm
Magnetic flux	$\Phi = BA_{\perp}$	where $A_{\perp}$ = area perpendicular to the field $B$
Electromagnetic induction	induced emf: $\epsilon = \ell v B \sin \theta$	
	induced emf: $\epsilon = -N \frac{\Delta \Phi}{\Delta t} = \frac{\Delta BA_{\perp}}{\Delta t}$	where $A_{\perp}$ = area perpendicular to the field $B$
	AC generator emf <sub>max</sub> : $\epsilon_{\max} = 2N\ell v B = 2\pi N B A f$	
	$\epsilon_{\text{rms}} = \frac{\epsilon_{\max}}{\sqrt{2}}$	
Ohm's law	$V = IR$	
Electric current	$I = \frac{q}{t}$	
Transformer theory	$\frac{V_p}{V_s} = \frac{N_p}{N_s}$	$P = VI = I^2 R = \frac{V^2}{R}$

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**Particle accelerators**


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Motion of charged particles	$E = \frac{F}{q} = \frac{\Delta V}{d}$	$\Delta V = \frac{W}{q}$	$\frac{mv^2}{r} = qvB$
	$a = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{t_f - t_i}$	$v_f = v_i + a\Delta t$	
	$s = v_i\Delta t + \frac{1}{2}a\Delta t^2$	$v_f^2 = v_i^2 + 2as$	$p = mv$
Relativistic momentum	$p = \frac{mv}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}}$		
Mass-energy equivalence	$E = \frac{mc^2}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}}$		
Total energy	$E_{\text{rest}} = mc^2$	$E_k = E - E_{\text{rest}}$	
Energy-momentum relation	$E^2 = p^2c^2 + m^2c^4$		

**Wave particle duality and the quantum theory**

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Wave period  $T = \frac{1}{f}$

Wave equation  $c = f\lambda$

Energy of photon  $E = hf = \frac{hc}{\lambda}$        $E = pc$

Photoelectric effect  $E_k = hf - \phi$       where  $\phi$  = the work function of the surface

Energy transitions  $\Delta E = hf$        $E_2 - E_1 = hf$

de Broglie wavelength  $\lambda = \frac{h}{p}$

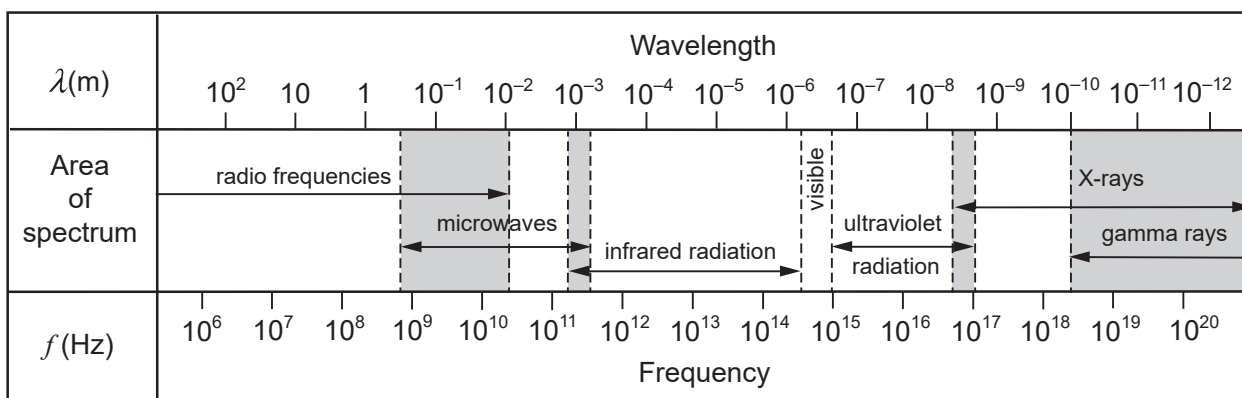
**Cosmology**

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Hubble's law  $v = H_0 d$

**Electromagnetic spectrum**

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Note: shaded areas represent regions of overlap.

**Physical data**

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Mean acceleration due to gravity on Earth .....  $g = 9.80 \text{ m s}^{-2}$

Mean acceleration due to gravity on Moon ....  $g_M = 1.62 \text{ m s}^{-2}$

Mean radius of the Earth .....  $R_E = 6.37 \times 10^6 \text{ m}$

Mass of the Earth .....  $M_E = 5.97 \times 10^{24} \text{ kg}$

Mean radius of the Sun .....  $R_S = 6.96 \times 10^8 \text{ m}$

Mass of the Sun .....  $M_S = 1.99 \times 10^{30} \text{ kg}$

Mean radius of the Moon .....  $R_M = 1.74 \times 10^6 \text{ m}$

Mass of the Moon .....  $M_M = 7.35 \times 10^{22} \text{ kg}$

Mean Earth-Moon distance .....  $= 3.84 \times 10^8 \text{ m}$

Mean Earth-Sun distance .....  $= 1.50 \times 10^{11} \text{ m} = 1.00 \text{ astronomical unit (AU)}$

Mass of electron .....  $m_e = 9.11 \times 10^{-31} \text{ kg}$

Mass of proton .....  $m_p = 1.67 \times 10^{-27} \text{ kg}$

Tonne .....  $1.00 \text{ t} = 10^3 \text{ kg}$

**Physical constants**

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Speed of light in vacuum or air .....  $c = 3.00 \times 10^8 \text{ m s}^{-1}$ Electron charge .....  $e = -1.60 \times 10^{-19} \text{ C}$ Planck constant .....  $h = 6.63 \times 10^{-34} \text{ J s}$ Newtonian constant of gravitation .....  $G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$ Electric constant .....  $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$ Magnetic constant .....  $\mu_0 = 4\pi \times 10^{-7} \text{ N A}^{-2} = 1.26 \times 10^{-6} \text{ N A}^{-2}$ **Conversions**

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Electron volt .....  $1.00 \text{ eV} = 1.60 \times 10^{-19} \text{ J}$ Light year .....  $1.00 \text{ ly} = 9.46 \times 10^{12} \text{ km}$ Megaparsec .....  $1.00 \text{ Mpc} = 3.09 \times 10^{19} \text{ km} = 3.26 \times 10^6 \text{ ly}$ **Prefixes of the metric system**

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

## Mathematical expressions

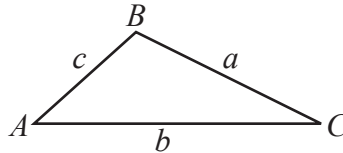
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### Quadratic equations

$$\text{Given } ax^2 + bx + c = 0, \quad x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

### Triangles

The following expressions apply to the triangle ABC as shown:



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

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

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