



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

PHYSICS

ATAR COURSE YEAR 12

FORMULAE AND DATA BOOKLET

2016

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This document is valid for teaching and examining until 31 December 2016.

Gravity and motion

Average velocity	$v_{av} = \frac{s}{t}$
Equations of motion	$v = u + at$ $s = ut + \frac{1}{2} at^2$ $v^2 = u^2 + 2as$
Force	$F_{net} = ma$
Weight force	$F = mg$
Kinetic energy	$E_k = \frac{1}{2} mv^2$
Gravitational potential energy	$E_p = m g \Delta h$
Work done	$W = Fs = \Delta E$
Centripetal acceleration	$a_c = \frac{v^2}{r}$ $v = \frac{2\pi r}{T}$
Centripetal force	$F_c = ma_c = \frac{mv^2}{r}$
Newton's law of universal gravitation	$F = G \frac{m_1 m_2}{r^2}$
Kepler's 3rd law	$T^2 = \frac{4\pi^2}{GM} r^3$
Gravitational field strength	$g = G \frac{M}{r^2}$
Moment of a force (force at angle θ to lever arm)	$\tau = r F \sin\theta$

Note: the variable t refers to the 'time taken', sometimes referred to as the 'change in time' or Δt .

Wave particle duality and the quantum theory

Wave period	$T = \frac{1}{f}$
Wave equation	$c = f\lambda$
Energy of photon	$E = hf$
Energy transitions	$\Delta E = E_2 - E_1 = hf$
Photoelectric effect	$E_k = hf - W$
De Broglie wavelength	$\lambda = \frac{h}{p}$

Electromagnetism

Coulomb's law	$F = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r^2}$
Electric field strength	$E = \frac{F}{q} = \frac{V}{d}$
Magnetic field strength	$B = \frac{\mu_0}{2\pi} \frac{I}{r}$
Magnetic force on a charged particle	$F = q v B$ where $v \perp B$
Magnetic force on a current-carrying conductor	$F = I \ell B$ where $\ell \perp B$
Torque on a coil	$\tau = r F$
Magnetic flux	$\Phi = B A_{\perp}$
Electromagnetic induction	induced emf = $\ell v B$ where $v \perp B$ induced emf = $-N \frac{(\Phi_2 - \Phi_1)}{t} = -N \frac{\Delta\Phi}{t} = -N \frac{\Delta(B A_{\perp})}{t}$ AC generator emf _{max} = $-2N\ell v B = -2\pi N B A_{\perp} f$ $emf_{rms} = \frac{emf_{max}}{\sqrt{2}}$
Ohm's law	$V = IR$
Electric current	$I = \frac{q}{t}$
Work and energy	$W = Vq$
Ideal transformer turns ratio	$\frac{V_p}{V_s} = \frac{N_p}{N_s}$
Power	$P = VI$

Special relativity

Relativistic effects	$\ell = \ell_0 \sqrt{\left(1 - \frac{v^2}{c^2}\right)}$	$t = \frac{t_0}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}}$
	$u = \frac{v + u'}{1 + \frac{v u'}{c^2}}$	$u' = \frac{u - v}{1 - \frac{v u}{c^2}}$
Relativistic momentum	$p_v = \frac{m v}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}}$	
Mass-energy equivalence	$E = \frac{m c^2}{\sqrt{1 - \frac{v^2}{c^2}}}$	

The Standard Model

Particle motion in a magnetic field

$$r = \frac{m v}{q B}$$

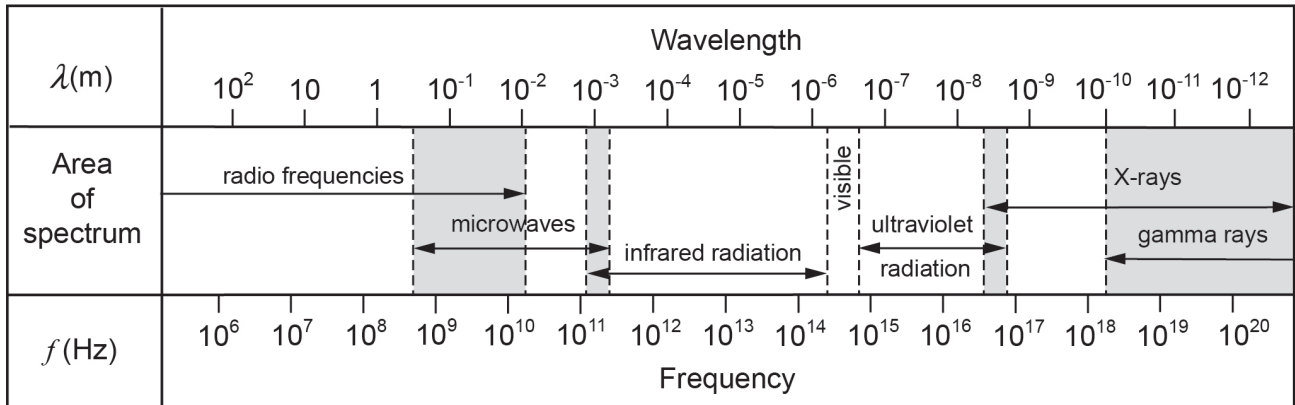
Physical data

Mean acceleration due to gravity on the Earth..... g	=	9.80 m s ⁻²
Mean acceleration due to gravity on the Moon..... g_M	=	1.62 m s ⁻²
Mean radius of the Earth..... R_E	=	6.37 × 10 ⁶ m
Mass of the Earth..... M_E	=	5.97 × 10 ²⁴ kg
Mean radius of the Sun..... R_S	=	6.96 × 10 ⁸ m
Mass of the Sun..... M_S	=	1.99 × 10 ³⁰ kg
Mean radius of the Moon..... R_M	=	1.74 × 10 ⁶ m
Mass of the Moon..... M_M	=	7.35 × 10 ²² kg
Mean Earth-Moon distance.....	=	3.84 × 10 ⁸ m
Mean Earth-Sun distance.....	=	1.50 × 10 ¹¹ m
Mass of electron..... m_e	=	9.11 × 10 ⁻³¹ kg
Mass of proton..... m_p	=	1.67 × 10 ⁻²⁷ kg
Tonne.....1 t	=	10 ³ kg

Physical constants

Speed of light in vacuum or air..... c	=	3.00 × 10 ⁸ m s ⁻¹
Electron charge..... e	=	-1.60 × 10 ⁻¹⁹ C
Planck constant..... h	=	6.63 × 10 ⁻³⁴ J s
Newtonian constant of gravitation..... G	=	6.67 × 10 ⁻¹¹ N m ² kg ⁻²
Electron volt.....1 eV	=	1.60 × 10 ⁻¹⁹ J
Electronic constant..... ϵ_0	=	8.85 × 10 ⁻¹² F m ⁻¹
Magnetic constant..... μ_0	=	4 π × 10 ⁻⁷ N A ⁻² = 1.26 × 10 ⁻⁶ N A ⁻²

Electromagnetic spectrum



Note: shaded areas represent regions of overlap.

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

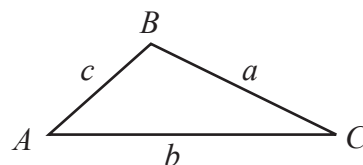
Mathematical expressions

Quadratic equations

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

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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