

Government of Western Australia School Curriculum and Standards Authority



PHYSICS ATAR COURSE YEAR 12

FORMULAE AND DATA BOOKLET

2020

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

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Gravity and motion			
Average velocity	$v = \frac{S}{t}$		
Average velocity	av t	. 1/ 2	
Equations of motion	v = u + at	$s = ut + \frac{1}{2} at^2$	$v^2 = u^2 + 2as$
	p = mv		
Force	$F_{net} = ma$		
Weight force	F = mg		
Kinetic energy	$E_{\rm k} = \frac{1}{2} mv^2$		
Gravitational potential energy	$E_{\rm p} = m g \Delta h$		
Work done	$W = Fs = \Delta E$		
Equations of circular motion	$v = \frac{2\pi r}{T}$	$a_{\rm c} = \frac{v^2}{r}$	$F_{\rm c} = ma_{\rm c} = \frac{mv^2}{r}$
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 $ heta$ to lever arm)	$\tau = r F \sin \theta$		

Wave particle duality and the quantum theory

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

See next page

Electromagnetism

Liectionagnetism				
Coulomb's law	$F = \frac{1}{4\pi\varepsilon_0} \frac{q_1 q_2}{r^2}$			
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 ℓ	$\ell \perp B$		
Particle motion in a magnetic field	$r = \frac{m \ v}{q \ B}$			
Torque on a coil	$\tau = r F$			
Magnetic flux	$\Phi = B A_{\perp}$			
Electromagnetic induction	induced emf: $\mathcal{E} = \ell \ v \ B$ where $v \perp B$			
	induced emf: $\mathcal{E} = -N \frac{(\Phi_2 - \Phi_1)}{t} = -N \frac{\Delta \Phi}{t} = -N \frac{\Delta (BA_\perp)}{t}$			
	AC generator emf _n	$\operatorname{anx}: \mathcal{E}_{\max} = 2N\ell vB = 2\pi NBA_{\perp}f$	$\mathcal{E}_{rms} = \frac{\mathcal{E}_{max}}{\sqrt{2}}$	
Ohm's law	V = IR			
Electric current	$I = \frac{q}{t}$	Work and energy $W = Vq$,	
Ideal transformer turns ratio	$\frac{V_{\rm P}}{V_{\rm s}} = \frac{N_{\rm P}}{N_{\rm s}}$	Power $P = VI$		
Special relativity				
Relativistic effects	$\ell = \ell_0 \sqrt{\left(1 - \frac{\nu^2}{c^2}\right)}$	$t = \frac{t_0}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}}$		
	$u = \frac{v+u'}{1+\frac{vu'}{c^2}}$	$u' = \frac{u - v}{1 - \frac{v u}{c^2}}$		
Relativistic momentum	$p = \frac{m v}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}}$			
Mass-energy equivalence	$E = \frac{m c^2}{\sqrt{1 - \frac{v^2}{c^2}}}$	Rest energy	$E = m c^2$	

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	Wavelength
$\lambda(m)$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$
Area	radio frequencies
spectrum	microwaves infrared radiation gamma rays
f(Hz)	10^{6} 10^{7} 10^{8} 10^{9} 10^{10} 10^{11} 10^{12} 10^{13} 10^{14} 10^{15} 10^{16} 10^{17} 10^{18} 10^{19} 10^{20}
5 (-/	Frequency

Electromagnetic spectrum



The Standard Model

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Physical data

Mean acceleration due to gravity on the Earth g	=	9.80 m s ⁻²
Mean acceleration due to gravity on the Moon $g_{_{ m M}}$	=	1.62 m s ⁻²
Mean radius of the Earth $R_{\rm E}$	=	6.37 × 10 ⁶ m
Mass of the Earth $M_{\rm E}$	=	5.97 × 10 ²⁴ kg
Mean radius of the Sun $R_{\rm s}$	=	6.96 × 10 ⁸ m
Mass of the Sun $M_{\rm s}$	=	1.99 × 10 ³⁰ kg
Mean radius of the Moon $R_{\rm M}$	=	1.74 × 10 ⁶ m
Mass of the Moon $M_{\rm M}$	=	7.35 × 10 ²² kg
Mean Earth-Moon distance	=	3.84 × 10 ⁸ m
Mean Earth-Sun distance	=	1.50 × 10 ¹¹ m
Mass (at rest) of electron $m_{\rm e}$	=	9.11 × 10 ⁻³¹ kg
Mass (at rest) of proton $m_{\rm p}$	=	1.67 × 10 ⁻²⁷ kg
Tonne1 t	=	10³ kg

Physical constants

Speed of light in vacuum or air <i>c</i>	=	3.00 × 10 ⁸ m s ⁻¹
Electron chargee	= -	-1.60 × 10 ⁻¹⁹ C
Planck constanth	=	6.63 × 10 ⁻³⁴ J s
Newtonian constant of gravitation G	=	6.67 × 10 ⁻¹¹ N m ² kg ⁻²
Electric constant \mathcal{E}_0	=	8.85 × 10 ⁻¹² F m ⁻¹
Magnetic constant $\mu_{_0}$	=	$4\pi \times 10^{-7}$ N A ⁻² = 1.26 × 10 ⁻⁶ N A ⁻²

Conversions

Electron volt1	1 eV =	1.60 × 10 ⁻¹⁹ J
Light year	y =	9.46 × 10 ¹² km
MegaparsecN	Mpc =	$3.09 \times 10^{19} \text{ km} = 3.26 \times 10^{6} \text{ ly}$

Prefixes of the metric system

Factor	Prefix	Symbol	Factor	Prefix	Symbol
10 ¹²	tera	Т	10 ⁻³	milli	m
10 ⁹	giga	G	10-6	micro	μ
10 ⁶	mega	М	10-9	nano	n
10 ³	kilo	k	10-12	pico	р

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:



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ACKNOWLEDGEMENTS

Elementary Adapted from Standard Model image: MissMJ. (2006). *File:Standard Model of Elementary Particles.svg.* Retrieved June, 2016, from https://commons.wikimedia.org/wiki/File:Standard_Model_of_Elementary_Particles.svg Used under Creative Commons Attribution 3.0 Unported licence.

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