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

WACE
Western Australian Certificate of Education

PHYSICS

STAGE 3

FORMULAE AND DATA

2013

This document is valid for teaching and examining until 31 December 2013.

Motion and forces in gravitational fields

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

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

Electricity and magnetism

Ohm's law	$V = IR$
Magnetic force on a current-carrying conductor	$F = I\ell B$
Electromagnetic induction	$emf = -N\frac{\Phi_2 - \Phi_1}{t}$; $emf = \ell v B$
Magnetic flux	$\Phi = BA$
Electric current	$I = \frac{q}{t}$
Work and energy	$W = Vq$
Ideal transformer turns ratio	$\frac{V_s}{V_P} = \frac{N_s}{N_P}$
Power	$P = VI = I^2R = \frac{V^2}{R}$

Particles, waves and quanta

Wave period	$T = \frac{1}{f}$
Wave equation	$v_{wave} = f\lambda$; $c = f\lambda$
Internodal distance	$d = \frac{1}{2}\lambda$
Energy of photon	$E = hf$
Energy transitions	$E_2 - E_1 = hf$

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Motion and forces in electric and magnetic fields

Electric field strength $E = \frac{F}{q} = \frac{V}{d}$

Magnetic force on a charged particle $F = qvB$

Physical constants

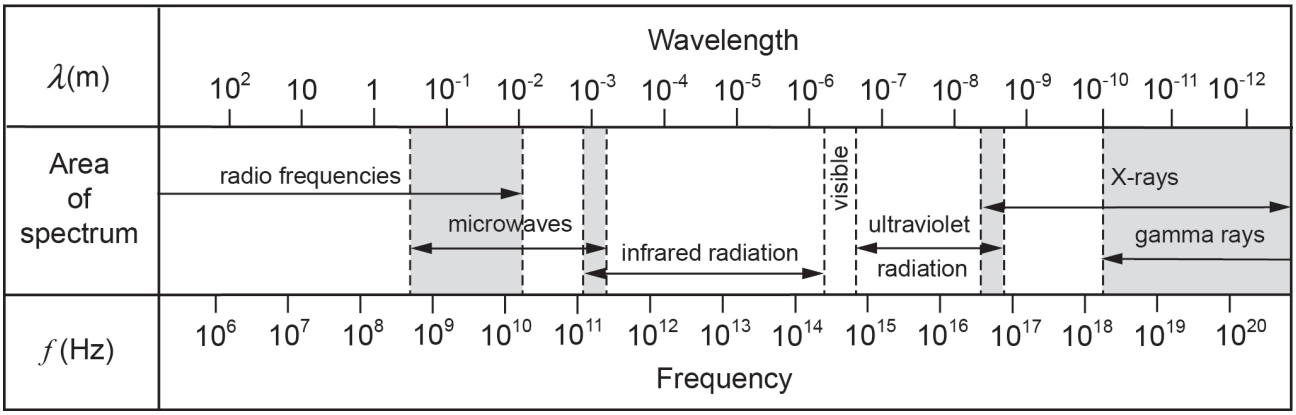
Speed of light in vacuum or air	c	=	3.00×10^{8} m s^{-1}
Speed of sound in air at 25°C	v	=	346 m s^{-1}
Electron charge	e	=	-1.60×10^{-19} C
Mass of electron	m_e	=	9.11×10^{-31} kg
Mass of proton	m_p	=	1.67×10^{-27} kg
Mass of alpha	m_α	=	6.64×10^{-27} kg
Planck constant	h	=	6.63×10^{-34} J s
Newtonian constant of gravitation	G	=	6.67×10^{-11} N m^2 kg^{-2}
Electron volt	1 eV	=	1.60×10^{-19} J

Physical data

Mean acceleration due to gravity on 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	=	6.38×10^{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
Tonne	1 t	=	10^{3} kg = 10^{6} g

Electromagnetic spectrum

Note: shaded areas represent regions of overlap



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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

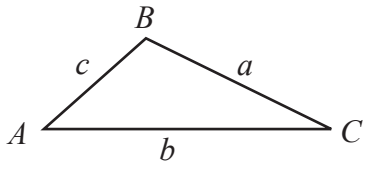
Mathematical expressions

Quadratic equations

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

Triangles

The following expressions apply to the triangle ABC as shown:

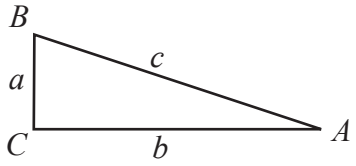


$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

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

Right-angled triangles

The following expressions apply to the right-angled triangle ABC as shown:



$$\sin A = \frac{a}{c}$$

$$\cos A = \frac{b}{c}$$

$$\tan A = \frac{a}{b}$$