



# On-Level Physics

## Equation Sheet

GravityKills.net

### Fall Semester

#### Constant Motion

$$\Delta d = v_c t$$

#### Changing Motion

$$\Delta d = v_{avg} t$$

$$v_f = v_i + at$$

$$\Delta d = v_i t + \frac{1}{2} at^2$$

$$v_f^2 = v_i^2 + 2a\Delta d$$

#### Newton's Laws

$$\Sigma F = F_{net} = ma$$

$$F_g = mg \text{ (weight)}$$

#### 2D Motion

$$d_y = \frac{1}{2} gt^2$$

$$d_x = v_x t$$

#### Graph Interpretation

##### Slope of a:

position vs. time = velocity  
 velocity vs. time = acceleration  
 momentum vs. time = force

##### Area Beneath the Curve of a:

velocity vs. time = displacement  
 acceleration vs. time = change in velocity  
 force vs. distance = work  
 force vs. time = impulse

#### UCM and Gravity

(Uniform Circular Motion)

$$F_{net} = F_{centripetal} = \frac{mv^2}{r}$$

$$F_g = \frac{Gm_1 m_2}{r^2} \text{ or } \frac{Gm_1 m_2}{d^2}$$

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

$$v = \frac{2\pi r}{T}$$

$$a_c = \frac{v^2}{r}$$

#### Work and Energy

$$W = F\Delta d$$

$$W_{net} = \Delta KE$$

$$W = \Delta E$$

$$PE_{gravity} = mgh$$

$$KE = \frac{1}{2} mv^2$$

$$PE_i + KE_i = PE_f + KE_f$$

$$P = \frac{W}{t} = \frac{E}{t}$$

$$Q = mc\Delta T$$

### Spring Semester

#### Impulse & Momentum

$$p = mv$$

$$m_1 v_1 + m_2 v_2 = m_1 v'_1 + m_2 v'_2$$

$$J = F_{net} \Delta t = \Delta p = m\Delta v$$

#### Mechanical Waves

$$v = \lambda f$$

#### Electromagnetic Waves

$$c = \lambda f$$

$$n = \frac{c}{v}$$

$$n_i \sin \theta_i = n_r \sin \theta_r$$

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

#### Electrostatics

$$Q = Ne$$

$$F_E = \frac{kq_1 q_2}{r^2} \text{ or } \frac{kq_1 q_2}{d^2}$$

$$E = \frac{F_E}{q}$$

$$V = \frac{W}{q}$$

#### Circuits

$$V = iR$$

$$P = iV = i^2 R = \frac{V^2}{R}$$

$$i = \frac{Q}{t}$$

$$R_{series} = R_1 + R_2 + \dots$$

$$\frac{1}{R_{parallel}} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$$

#### Magnetism

$$F_B = qvB$$

$$F_B = BiL$$

$F_B$  = palm;  $B$  = fingers  
 $i$  or  $v$  = thumb

$\times$  = Into;  $\bullet$  = out of  
 right hand is positive

$$\frac{V_p}{V_s} = \frac{i_s}{i_p}$$

#### Modern

$$E = Pt$$

$$E = hf$$

$$W = hf_t$$

$$KE = E - W$$

$$KE = hf - hf_t$$

$$E_n = \frac{E_1}{n^2} \text{ (Hydrogen ONLY)}$$

$$\lambda = \frac{h}{p} = \frac{h}{mv}$$

$$E = mc^2$$

**Working Equation** - Algebraically manipulate your equation(s) solving for the unknown variable. The working equation may only have variables identified in the given.

<u>Name</u>	<u>Variable</u>	<u>Unit</u>	<u>Prefixes</u>		
Acceleration .....	a.....	m/s <sup>2</sup>	<u>Factor</u>	<u>Prefix</u>	<u>Symbol</u>
Acceleration due to Gravity...	g.....	m/s <sup>2</sup>	10 <sup>9</sup>	giga	G
Average Velocity .....	v <sub>avg</sub> .....	m/s	10 <sup>6</sup>	mega	M
Average Speed.....	v <sub>avg</sub> .....	m/s	10 <sup>3</sup>	kilo	k
Charge .....	q or Q.....	C, coulomb	10 <sup>-2</sup>	centi	c
Constant Velocity .....	v <sub>c</sub> .....	m/s	10 <sup>-3</sup>	milli	m
Current .....	i or I.....	A, ampere	10 <sup>-6</sup>	micro	μ
de Broglie Wavelength .....	λ.....	m, meter	10 <sup>-9</sup>	nano	n
Displacement .....	Δd or d.....	m, meter	10 <sup>-12</sup>	pico	p
Distance .....	Δd or d.....	m, meter	<b><u>Useful Conversions</u></b>		
Electric Field.....	E .....	N/C	1 minute = 60 seconds		
Electrostatic Force.....	F <sub>E</sub> .....	N	1 hour = 60 minutes		
Elementary Charge .....	e.....	C, coulomb	1 km = 1000 meters		
Energy.....	E .....	J, joule	1 m = 100 cm		
Focal Length .....	f.....	m, meter	1m = 1000 mm		
Force .....	F.....	N, newton	1 kg = 1000 g		
Frequency .....	f.....	1/s or Hz, hertz	1 mile = 1600 meters		
Frictional Force.....	F <sub>f</sub> .....	N, newton	1 newton = 0.225 pounds		
Gravitational Force .....	F <sub>g</sub> .....	N, newton	<b><u>Ratio</u></b>		
Image Distance .....	d <sub>i</sub> .....	m, meter	A to B is $\frac{A}{B}$ OR    A:B is $\frac{A}{B}$		
Impulse.....	J.....	Ns	<b><u>Constants and Conversion Factors</u></b>		
Instantaneous speed .....	v.....	m/s	Acceleration due to gravity ...g = 9.8 m/s <sup>2</sup>		
Magnetic Field .....	B .....	T, tesla	Pi .....π = 3.14		
Magnetic Force.....	F <sub>B</sub> .....	N	Universal gravitational		
Mass .....	m.....	kg, kilogram	constant..... G = 6.67 X10 <sup>-11</sup> Nm <sup>2</sup> /kg <sup>2</sup>		
Momentum .....	p.....	kgm/s	Mass of the Earth .....5.97 X 10 <sup>24</sup> kg		
Net Force .....	F <sub>net</sub> or ΣF ..	N, newton	Radius of the Earth .....6.37 X 10 <sup>6</sup> m		
Normal Force .....	F <sub>N</sub> .....	N, newton	Mass of the Moon .....7.36 X 10 <sup>22</sup> kg		
Number .....	N .....	no unit	Radius of the Moon.....1.74 X 10 <sup>6</sup> m		
Kinetic Energy .....	KE.....	J, joule	Mass of the Sun .....1.99 X 10 <sup>30</sup> kg		
Object Distance.....	d <sub>o</sub> .....	m, meter	Distance between:		
Period.....	T.....	s, second	- Earth and Sun 1.5 X 10 <sup>11</sup> m		
Pitch .....	f.....	1/s or Hz, hertz	-Earth and Moon 3.82 X 10 <sup>8</sup> m		
Potential Difference .....	V .....	V, volt	Index of refraction of air .....n = 1		
Potential Energy			Speed of sound in air.....v = 343 m/s		
Gravitational .....	PE <sub>g</sub> .....	J, joule	Speed of light in a vacuum ...c = 3.00 X 10 <sup>8</sup> m/s		
Elastic .....	PE <sub>E</sub> .....	J, joule	Ludicrous speed .....v > 3.00 X 10 <sup>8</sup> m/s		
Power.....	P .....	W, watt	Elementary charge .....e = 1.60 X 10 <sup>-19</sup> C		
Radius.....	r.....	m, meter	Coulomb's law constant .....k= 9.0 X 10 <sup>9</sup> Nm <sup>2</sup> /C <sup>2</sup>		
Resistance .....	R .....	Ω, ohm	Planck's constant .....h = 4.14 X 10 <sup>-15</sup> eVs		
Speed.....	v.....	m/s	h = 6.63 X 10 <sup>-34</sup> Js		
Spring Constant.....	k.....	N/m	eV to Joule conversion.....1 eV = 1.6 X 10 <sup>-19</sup> J		
Summation of Forces .....	F <sub>net</sub> or ΣF ..	N, newton	Proton mass .....m <sub>p</sub> = 1.67 X 10 <sup>-27</sup> kg		
Tangential Velocity/Speed....	v <sub>T</sub> .....	m/s	Neutron mass .....m <sub>n</sub> = 1.67 X 10 <sup>-27</sup> kg		
Tension Force .....	F <sub>T</sub> .....	N, newton	Electron mass .....m <sub>e</sub> = 9.11 X 10 <sup>-31</sup> kg		
Time .....	t.....	s, second	Avogadro's number .....N <sub>o</sub> = 6.02 X 10 <sup>23</sup> mol <sup>-1</sup>		
Velocity.....	v.....	m/s			
Velocity (constant) .....	v <sub>c</sub> .....	m/s			
Velocity (average) .....	v <sub>avg</sub> .....	m/s			
Volts.....	V .....	V, volt			
Voltage.....	V .....	V, volt			
Wavelength .....	λ.....	m, meter			
Wave Speed.....	v.....	m/s			
Weight.....	F <sub>g</sub> .....	N, newton			
Work.....	W .....	J, joule			
Work Function .....	W .....	J, joule			