## Constants/Basic

$_{r}$ $-b$ $\pm$	$\pm \sqrt{b^2 - 4ac}$
х — —	2 <i>a</i>
$sin(\theta) =$	opposite
3111(0) —	hypotenuse
$cos(\theta) =$	adjacent
cos(0) —	hypotenuse
$tan(\theta)$ =	_ opposite
tail(0) -	adjacent

 $\tan(\theta) = \frac{opposite}{adjacent}$   $Radius \ of \ Earth = 6.38 \times 10^6 \ m$   $Mass \ of \ Earth = 5.98 \times 10^{24} \ kg$   $g = 9.80 \frac{m}{s^2}$   $G = 6.673 \times 10^{-11} \frac{Nm^2}{kg^2}$   $N_A = 6.02 \times 10^{23}$   $q_e = -1.60 \times 10^{-19} \ C$   $\epsilon_0 = 8.85 \times 10^{-12} C^2/(N \cdot m^2)$   $\mu_0 = 4\pi \times 10^{-7} \frac{Tm}{s}$   $h = 6.63 \times 10^{-34} \ J \cdot s$   $1 \ u = 931.5 \frac{MeV}{c^2}$   $m_e = 9.11 \times 10^{-31} \ kg$   $m_p = 1.6726 \times 10^{-27} \ kg$   $m_n = 1.6749 \times 10^{-27} \ kg$ 

Speed of sound in air at 20°C

Density of water =  $1000 \frac{kg}{m^3}$ 

 $= 343 \, m/s$ 

#### 01 Motion

$$\begin{split} \Delta d &= d_f - d_0 \\ v_{ave} &= \frac{dist}{\Delta t} \\ v_{ave} &= \frac{\Delta d}{\Delta t} = \frac{d_f - d_0}{t_f - t_0} \\ \overline{a} &= \frac{v_f - v_0}{t_f - t_0} \\ d &= \overline{v}t + d_0 \\ \overline{v} &= \frac{v_0 + v}{2} \\ v &= at + v_0 \\ d &= \frac{1}{2}at^2 + v_0t + d_0 \\ v^2 &= v_0^2 + 2a(d - d_0) \\ r &= \frac{v_0^2 si \, n \, 2\theta}{a} \end{split}$$

## 02 Forces

$$F_{net} = ma$$

$$W = mg$$

$$f_s \le \mu_s F_N$$

$$f_k = \mu_k F_N$$

$$F_s = k\Delta x$$

# 03 Uniform Circular Motion and Torque

$$\Delta\theta = \frac{\Delta s}{r}$$

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

$$F_c = \frac{mv^2}{r} = mr\omega^2$$

$$\tau = Fr\sin\theta$$

$$\alpha = \frac{\Delta\theta}{\Delta t}$$

$$v = r\omega$$

$$\alpha = \frac{\Delta\omega}{\Delta t}$$

$$a_t = r\alpha$$

$$\theta = \overline{\omega}t$$

$$\omega = \omega_0 + \alpha t$$

$$\theta = \omega_0 t + \frac{1}{2}\alpha t^2$$

$$\omega^2 = \omega_0^2 + 2\alpha\theta$$

$$\tau = I\alpha$$

Hoop about cylinder axis:  $I = MR^2$ Hoop about any diameter:  $I = \frac{MR^2}{2}$ Ring:  $I = \frac{M}{2}(R_1^2 + R_2^2)$ 

Solid cylinder (or disk) about

Solid Cyllider (of disk) a  $MR^2$ 

cylinder axis:  $I = \frac{MR^2}{2}$ 

Solid cylinder (or disk) about

central diameter:  $I = \frac{MR^2}{4} + \frac{M\ell^2}{12}$ 

Thin rod about axis through center

 $\perp$  to length:  $I = \frac{M\ell^2}{12}$ 

Thin rod about axis through one end

 $\perp$  to length:  $I = \frac{M\ell^2}{3}$ 

Solid sphere:  $I = \frac{2MR^2}{5}$ 

Thin spherical shell:  $I = \frac{2MR^2}{3}$ 

Slab about ⊥ axis through center:

$$I = \frac{M(a^2 + b^2)}{12}$$

### 04 Momentum

$$J = F\Delta t$$

$$p = mv$$

$$F\Delta t = mv_f - mv_0$$

$$p_0 = p_f$$

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

$$L = I\omega$$

$$\tau_{net} = \frac{\Delta L}{\Delta t}$$

$$L_0 = L_f$$

## 05 Kepler's Laws and Gravity

$$\frac{T_1^2}{T_2^2} = \frac{r_1^3}{r_2^3}$$

$$a = \frac{r_a + r_p}{2}$$

$$b = \sqrt{r_a r_b}$$

$$c = r_a - a$$

$$e = \frac{c}{a}$$

$$F_G = \frac{GmM}{r^2}$$

$$g = \frac{GM}{r^2}$$

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

$$v = \sqrt{\frac{GM}{r}}$$

$$T^2 = \frac{4\pi^2}{GM}$$

$$T^2 = \frac{4\pi^2}{GM}$$

## 06 Energy

$$W = Fd \cos \theta$$

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

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

$$KE = \frac{1}{2}I\omega^{2}$$

$$PE_{g} = mgh$$

$$PE_{s} = \frac{1}{2}kx^{2}$$

$$PE_{f} + KE_{f} = PE_{0} + KE_{0}$$

$$E_{0} + W_{net} = E_{f}$$

$$IMA = \frac{F_{r}}{F_{e}} = \frac{d_{e}}{d_{r}}$$

## Physics Formula Sheet

Lever:  $IMA = \frac{L_e}{L_r}$ 

Wheel and Axle:  $IMA = \frac{R}{r}$ 

Inclined Plane:  $IMA = \frac{L}{h}$ 

Wedge:  $IMA = \frac{L}{t}$ Screw:  $IMA = \frac{2\pi L}{P}$ Pulley: IMA = N

Efficiency (Eff) =  $\frac{W_{out}}{W_{in}} \times 100\%$ 

## 07 Static Electricity

$$F = k \frac{|q_1 q_2|}{r^2}$$

$$E = \frac{F}{q_0} = \frac{kq}{r^2}$$

$$V = \frac{\Delta PE}{q_0} = \frac{kq}{r}$$

$$E = \frac{\Delta V}{x_f - x_0}$$

## 08 Circuits

$$I = \frac{\Delta Q}{\Delta t}$$

$$I = qnAv_a$$

$$V = IR$$

$$R_S = R_1 + R_2 + R_3 + \cdots$$

$$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots$$

$$P = IV$$

$$P = I^2R$$

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

$$P_{ave} = \frac{1}{2}I_0V_0$$

$$I_{rms} = \frac{I_0}{\sqrt{2}}$$

$$V_{rms} = \frac{V_0}{\sqrt{2}}$$

## 09 Magnetism

$$\vec{F} = qvB \sin \theta$$

$$r = \frac{mv}{qB}$$

$$F = ILB \sin \theta$$

$$\tau = NIAB \sin \phi$$

$$\sum \vec{B} \cdot \Delta \vec{\ell} = \mu_0 I$$

$$B = \frac{\mu_0 I}{2\pi r}$$

## Name:

# 12 Dual Nature of Light

$$\sin \theta = m \frac{\lambda}{d}$$

$$\sin \theta = \left(m + \frac{1}{2}\right) \frac{\lambda}{d}$$

$$\sin \theta = m \frac{\lambda}{W}$$

$$\theta = 1.22 \frac{\lambda}{D}$$

$$E = nhf = n \frac{hc}{\lambda}$$

$$KE_e = hf - BE$$

$$p = \frac{h}{\lambda} = \frac{hf}{c}$$

## 10 Waves and Sound

 $B = N \frac{\mu_0 I}{2R}$ 

 $B = \mu_0 n I$   $\frac{F}{l} = \frac{\mu_0 I_1 I_2}{2\pi r}$ 

 $emf = -N\left(\frac{\Phi - \Phi_0}{t - t_0}\right) = -N\frac{\Delta\Phi}{\Delta t}$ 

 $F = qvB \sin \theta$ 

emf = vBL

 $emf = NBA\omega \sin \omega t$  $\omega = 2\pi f$ 

 $\frac{I_P}{I_S} = \frac{V_S}{V_P} = \frac{N_S}{N_P}$ 

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

$$v = \frac{\lambda}{T} = f \cdot \lambda$$

$$Beats = |f_1 - f_2|$$

$$I = \frac{P}{A}$$

$$A_{sphere} = 4\pi r^2$$

$$I = \frac{(\Delta p)^2}{2\rho v_w}$$

$$\beta = (10 dB) \log \left(\frac{I}{I_0}\right)$$

$$f_o = f_s \left(\frac{v_w \pm v_o}{v_w \mp v_s}\right)$$

$$f_n = n \left(\frac{v_w}{2L}\right)$$

$$f_n = n \left(\frac{v_w}{4L}\right)$$

#### 11 Electromagnetic Rays

$$c = f\lambda$$

$$\theta_r = \theta_i$$

$$f = \frac{1}{2}R$$

$$f = -\frac{1}{2}R$$

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

$$m = \frac{h_i}{h_o} = -\frac{d_i}{d_o}$$

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

$$\theta_c = \sin^{-1}\frac{n_2}{n_1}$$

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

# 13 Radioactivity, Fission, and Fusion

$${}_{Z}^{A}X \rightarrow {}_{Z-2}^{A-4}Y + {}_{2}^{4}\text{He}$$

$${}_{Z}^{A}X \rightarrow {}_{Z+1}^{A}Y + e^{-} + \nu$$

$${}_{Z}^{A}X \rightarrow {}_{Z}^{A}X + \gamma$$

$$N = N_{0}e^{-\lambda t}$$

$$\lambda = \frac{\ln(2)}{t_{1/2}}$$

$$E = mc^{2}$$

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2 <b>BA</b> Helium 4.003	<b>Neon</b> 20.180	<b>AF</b> Argon 39.948	36 <b>Kr</b> Krypton 83.798	<b>Xe</b> Xenon 131.294	<b>86 RI</b> Radon 222.018	<b>118 Oganesson</b> [294]
VIIA VIIA	9 Fluorine 18.998	7 Chlorine 35.453	<b>35 Br</b> Bromine 79.904	<b>53</b> Iodine 126.904	At Astatine 209.987	TS Tennessine [294]
16 VIA 64	Oxygen 15.999	16 Sulfur 32.066	34 <b>Selenium</b> 78.971	<b>Te</b> Tellurium 127.6	<b>PO</b> Polonium [208.982]	116 LV Livermorium [293]
15 VA 54	Nitrogen 14.007	15 Phosphorus 30.974	<b>33 AS</b> Arsenic 74.922	<b>51 Sb</b> Antimony 121.760	83 Bismuth 208.980	Moscovium [289]
14 A A	6 Carbon 12.011	28.086	<b>32 Ge</b> Germanium 72.631	<b>Sn</b> Tin 118.711	<b>82 Pb</b> Lead 207.2	114 <b>F</b> Flerovium [289]
13 IIIA 3A	<b>S</b> Boron 10.811	13 Aluminum 26.982	31 <b>Gall</b> ium 69.723	49 Indium 114.818	<b>81</b> Thallium 204.383	Nihonium [286]
Elements		12 IIB 2B	30 <b>Zn</b> Zinc 65.38	<b>48 Cadmium</b> 112.414	80 Mercury 200.592	Copernicium [285]
		18 18 18	29 <b>Copper</b> 63.546	47 Ag Silver 107.868	<b>AU</b> Gold 196.967	Roentgenium [280]
ble of the		10	28 Nickel 58.693	<b>Pd</b> Palladium 106.42	<b>78 Pt</b> Platinum 195.085	DS Darmstadtium [281]
		6 H 8	27 <b>Co</b> Cobalt 58.933	Rhodium 102.906	77 <b>Ir</b> Iridium 192.217	Meitnerium [278]
Periodic Ta		∞ <b>√</b>	26 Fe Iron 55.845	Ruthenium 101.07	76 <b>OS</b> 0Smium 190.23	<b>Hassium</b> [269]
Peri		7 VIIB 7B	Manganese 54.938	43 TC Technetium 98.907	<b>Re</b> Rhenium 186.207	<b>Bh</b> Bohrium [264]
		6 VIB 6B	Chromium 51.996	42 Molybdenum 95.95	74 <b>W</b> Tungsten 183.84	Seaborgium [266]
		5 VB 5B	<b>23</b> Vanadium 50.942	Niobium 92.906	<b>73 Ta</b> Tantalum 180.948	105 Dbbnium [262]
		4 IVB	<b>22</b> Titanium 47.867	40 <b>ZF</b> Zirconium 91.224	<b>72 Hf</b> Hafnium 178.49	Rutherfordium [261]
		3 IIIB 3B	<b>Sc</b> Scandium 44.956	39 Yttrium 88.906	57-71	89-103
2 IIA	Beryllium 9.012	<b>Magnesium</b> 24.305	20 <b>Cal</b> Calcium 40.078	Strontium 87.62	<b>Ba</b> Barium 137.328	<b>Radium</b> 226.025
<b>1</b> Hydrogen 1.008	3 Lithium 6.941	<b>Sodium</b> 22.990	Fotassium 39.098	Rb Rubidium 85.468	<b>Cesium</b> 132.905	<b>87 Fr</b> Francium 223.020

5 Lanthanide	27 —	28 C	59 <b>Dr</b>	ح ا	61 <b>D3</b>	62 <b>7 1</b>	<b>E</b> 9	\$ <b>U</b>	65 <b>T</b>	99	C L	<b>1</b> <b>1</b> 89	69 <b>Tu</b>	<b>2</b>	71 -
	Lanthanum 138.905	Cerium 140.116	Praseodymium 140.908	Neodymium 144.243	Promethium 144.913	Samarium 150.36	Europium 151.964	Gadolinium 157.25	Terbium 158.925	Dysprosium 162.500	Holmium 164.930	Erbium 167.259	Thulium 168.934	Ytterbium 173.055	Lutetium 174.967
	68	06	91	92	93	94	95	96	97	86	66	100	101	102	103
Actinide Series	Ac	F	Pa		Q Z	Pu	Am	E	쓢	უ	Es	F	Σ	٥ Z	1
	Actinium	Thorium	Protactinium	Uranium	Neptunium	Plutonium	Americium	Curium	Berkelium	Californium	Einsteinium	Fermium	Mendelevium	Nobelium	Lawrencium
	227.028	232.038	231.036	238.029	237.048	244.064	243.061	247.070	247.070	251.080	[254]	257.095	258.1	259.101	[597]