

Physics Formula Sheet

Name: _____

Constants/Basic

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$\sin(\theta) = \frac{\text{opposite}}{\text{hypotenuse}}$$

$$\cos(\theta) = \frac{\text{adjacent}}{\text{hypotenuse}}$$

$$\tan(\theta) = \frac{\text{opposite}}{\text{adjacent}}$$

$$\text{Radius of Earth} = 6.38 \times 10^6 \text{ m}$$

$$\text{Mass of Earth} = 5.98 \times 10^{24} \text{ kg}$$

$$g = 9.80 \frac{\text{m}}{\text{s}^2}$$

$$G = 6.673 \times 10^{-11} \frac{\text{Nm}^2}{\text{kg}^2}$$

$$N_A = 6.02 \times 10^{23}$$

$$q_e = -1.60 \times 10^{-19} \text{ C}$$

$$\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/(\text{N} \cdot \text{m}^2)$$

$$\mu_0 = 4\pi \times 10^{-7} \frac{\text{Tm}}{\text{s}}$$

$$h = 6.63 \times 10^{-34} \text{ J} \cdot \text{s}$$

$$1 \text{ u} = 931.5 \frac{\text{MeV}}{c^2}$$

$$m_e = 9.11 \times 10^{-31} \text{ kg}$$

$$m_p = 1.6726 \times 10^{-27} \text{ kg}$$

$$m_n = 1.6749 \times 10^{-27} \text{ kg}$$

$$\text{Speed of sound in air at } 20^\circ\text{C} \\ = 343 \text{ m/s}$$

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

01 Motion

$$\Delta d = d_f - d_0$$

$$v_{ave} = \frac{\text{dist}}{\Delta t}$$

$$v_{ave} = \frac{\Delta d}{\Delta t} = \frac{d_f - d_0}{t_f - t_0}$$

$$\bar{a} = \frac{v_f - v_0}{t_f - t_0}$$

$$d = \bar{v}t + d_0$$

$$\bar{v} = \frac{v_0 + v}{2}$$

$$v = at + v_0$$

$$d = \frac{1}{2}at^2 + v_0t + d_0$$

$$v^2 = v_0^2 + 2a(d - d_0)$$

$$r = \frac{v_0^2 \sin 2\theta}{g}$$

02 Forces

$$F_{net} = ma$$

$$W = mg$$

$$f_s \leq \mu_s F_N$$

$$f_k = \mu_k F_N$$

$$F_s = k\Delta x$$

03 Uniform Circular Motion and Torque

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

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

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

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

$$x = r\theta$$

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

$$v = r\omega$$

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

$$a_t = r\alpha$$

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

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

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

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

$$\tau = I\alpha$$

$$\text{Hoop about cylinder axis: } I = MR^2$$

$$\text{Hoop about any diameter: } I = \frac{MR^2}{2}$$

$$\text{Ring: } I = \frac{M}{2}(R_1^2 + R_2^2)$$

$$\text{Solid cylinder (or disk) about}$$

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

$$\text{Solid cylinder (or disk) about}$$

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

$$\text{Thin rod about axis through center}$$

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

$$\text{Thin rod about axis through one end}$$

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

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

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

$$\text{Slab about } \perp \text{ axis through center:}$$

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

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

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

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

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

$$c = r_a - a$$

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

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

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

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

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

$$\frac{T^2}{r^3} = \frac{4\pi^2}{GM}$$

$$T^2 = \frac{4\pi^2}{GM} r^3$$

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

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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

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

$$I = qnAv_d$$

$$V = IR$$

$$R_s = R_1 + R_2 + R_3 + \dots$$

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$$

$$P = IV$$

$$P = I^2 R$$

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

$$P_{ave} = \frac{1}{2} I_0 V_0$$

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

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

09 Magnetism

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

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

$$F = ILB \sin \theta$$

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

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

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

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

$$B = \mu_0 n I$$

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

$$\Phi = BA \cos \phi$$

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

$$F = qvB \sin \theta$$

$$emf = vBL$$

$$emf = NBA\omega \sin \omega t$$

$$\omega = 2\pi f$$

$$\frac{I_p}{I_s} = \frac{V_s}{V_p} = \frac{N_s}{N_p}$$

10 Waves and Sound

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

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

$$Beats = |f_1 - f_2|$$

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

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

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

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

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

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

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

11 Electromagnetic Rays

$$c = f\lambda$$

$$\theta_r = \theta_i$$

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

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

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

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

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

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

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

12 Dual Nature of Light

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

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

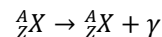
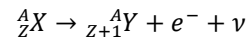
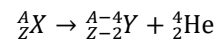
$$\sin \theta = m \frac{\lambda}{W}$$

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

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

$$KE_e = hf - BE$$

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

13 Radioactivity, Fission, and Fusion

$$N = N_0 e^{-\lambda t}$$

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

$$E = mc^2$$

Periodic Table of the Elements

Periodic Table of the Elements

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---------|---------|--|---------|--|--------|--|---------|--|--------|--|---------|--|--------|--|---------|--|---------|--|---------|--|---------|--|---------|--|---------|--|---------|--|-----------|--|---------|--|---------|--|
| 1 | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | 11 | | 12 | | 13 | | 14 | | 15 | | 16 | | 17 | | 18 | |
| H | He | | Li | | Be | | B | | C | | N | | O | | F | | Ne | | Na | | Mg | | Al | | Si | | P | | S | | Cl | | Ar | |
| 1.008 | 4.003 | | 6.941 | | 9.012 | | 10.811 | | 12.011 | | 14.007 | | 15.999 | | 18.998 | | 20.180 | | 22.990 | | 24.305 | | 26.982 | | 28.086 | | 30.974 | | 32.066 | | 35.453 | | 39.948 | |
| K | Ca | | Sc | | Ti | | V | | Cr | | Mn | | Fe | | Co | | Ni | | Cu | | Zn | | Ga | | Ge | | As | | Se | | Br | | Kr | |
| 39.098 | 40.078 | | 44.956 | | 47.867 | | 50.942 | | 51.996 | | 54.938 | | 55.845 | | 58.933 | | 58.693 | | 63.546 | | 65.38 | | 69.723 | | 72.631 | | 74.922 | | 78.971 | | 79.904 | | 83.798 | |
| Rb | Sr | | Y | | Zr | | Nb | | Mo | | Tc | | Ru | | Rh | | Pd | | Ag | | Cd | | In | | Sn | | Sb | | Te | | I | | Xe | |
| 85.468 | 87.62 | | 88.906 | | 91.224 | | 92.906 | | 95.95 | | 98.907 | | 101.07 | | 102.906 | | 106.42 | | 107.868 | | 112.414 | | 114.818 | | 118.711 | | 121.760 | | 127.6 | | 126.904 | | 131.294 | |
| Cs | Ba | | La | | Hf | | Ta | | W | | Re | | Os | | Ir | | Pt | | Au | | Hg | | Tl | | Pb | | Bi | | Po | | At | | Rn | |
| 132.905 | 137.328 | | 138.905 | | 178.49 | | 180.948 | | 183.84 | | 186.207 | | 190.23 | | 192.217 | | 195.085 | | 196.967 | | 200.592 | | 204.383 | | 207.2 | | 208.980 | | [208.982] | | 209.987 | | 222.018 | |
| Fr | Ra | | Ac | | Rf | | Db | | Sg | | Bh | | Hs | | Mt | | Ds | | Rg | | Cn | | Nh | | Fl | | Mc | | Lv | | Ts | | Og | |
| 223.020 | 226.025 | | [261] | | [262] | | [266] | | [266] | | [264] | | [269] | | [278] | | [281] | | [280] | | [285] | | [286] | | [289] | | [289] | | [293] | | [294] | | [294] | |