

2023 Physics Bowl Exam Equations

$$\Delta x = v_0 t + \frac{1}{2} a t^2$$

$$v = v_0 + at$$

$$v^2 = v_0^2 + 2a\Delta x$$

$$\sum \vec{F} = m\vec{a}$$

$$F_{fric} \leq \mu F_N$$

$$F_g = G \frac{m_1 m_2}{r^2}$$

$$F_g = mg$$

$$\vec{p} = m\vec{v}$$

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

$$v_t = r\omega$$

$$a_t = r\alpha$$

$$\tau = RF \sin \theta = R_{\perp} F = RF_{\perp}$$

$$\sum \vec{\tau} = I\vec{\alpha}$$

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

$$\Delta PE_g = mg\Delta y$$

$$W = Fd \cos \theta = F_{\parallel} d = Fd_{\parallel}$$

$$PE_s = \frac{1}{2} kx^2$$

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

$$\vec{F} = -k\vec{x}$$

$$T = 2\pi \sqrt{\frac{m}{k}}$$

$$T = 2\pi \sqrt{\frac{L}{g}}$$

$$\rho = \frac{m}{V}$$

$$F_{buoy} = \rho g V$$

$$P_1 + \frac{1}{2} \rho v_1^2 + \rho g y_1 = P_2 + \frac{1}{2} \rho v_2^2 + \rho g y_2$$

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

$$PV = nRT = Nk_B T$$

$$\Delta U = Q + W_{on\ system}$$

$$Q = mc\Delta T$$

$$Q = \pm mL$$

$$\Delta S = \frac{Q}{T}$$

$$v = f\lambda$$

$$f_o = f_s \left(\frac{v_{snd} \pm v_{obs}}{v_{snd} \mp v_{src}} \right)$$

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

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

$$m\lambda = d \sin \theta$$

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

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

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

$$\vec{E} = \frac{\vec{F}}{q}$$

$$V = \frac{kq}{r}$$

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

$$\Delta V = -Ed \cos \theta = -E_{\parallel} d = -Ed_{\parallel}$$

$$PE_e = \frac{kq_1 q_2}{r}$$

$$Q = CV$$

$$PE = \frac{1}{2} CV^2$$

$$V = RI$$

$$P = IV$$

$$F = qvB \sin \theta = qvB_{\perp}$$

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

$$B = \mu_0 nI$$

$$F = ILB \sin \theta = ILB_{\perp}$$

$$\varepsilon = vBL = \left(\frac{B\Delta A}{t} \right)$$

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$$E = \gamma m_0 c^2 = mc^2$$

$$E = hf$$

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

$$hf = KE_e + W_0$$

$$Q = e\sigma T^4 At$$

$$p = \frac{mv}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$E = \frac{mc^2}{\sqrt{1 - \frac{v^2}{c^2}}}$$

Moments of Inertia:

Solid disk or cylinder for a perpendicular axis through its center: $I = \frac{1}{2}MR^2$

Thin rod about the center, perpendicular to rod: $I = \frac{1}{12}MR^2$

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