FINAL EXAM FORMULA SHEET

PHYS 211 SECTIONS 1 & 70
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The following are formulas that you might find useful on the exam. Some equations apply only when certain conditions hold, while others are always true. You will only need some of these equations for the exam.

$$\bar{s} = \frac{d}{\Delta t} = \frac{d}{t_f - t_i} \tag{1}$$

$$\bar{v} = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i} \tag{2}$$

$$\bar{a} = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{t_f - t_i} \tag{3}$$

$$v = v_o + at \tag{4}$$

$$x = x_o + \frac{1}{2}(v + v_o)\,t \tag{5}$$

$$x = x_o + v_o t + \frac{1}{2}at^2 \tag{6}$$

$$v^2 = v_o^2 + 2a(x - x_o) \tag{7}$$

$$v = v_o - gt \tag{8}$$

$$y = y_o + v_o t - \frac{1}{2}gt^2 \tag{9}$$

$$y = y_o + \frac{1}{2}(v + v_o)\,t \tag{10}$$

$$v^2 = v_o^2 - 2g(y - y_o) \tag{11}$$

$$x = x_o + v_{xo} t + \frac{1}{2}a_x t^2 \tag{12}$$

$$y = y_o + v_{yo} t + \frac{1}{2}a_y t^2 \tag{13}$$

$$v_x = v_{xo} + a_x t \tag{14}$$

$$v_y = v_{yo} + a_y t \tag{15}$$

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$$\vec{\mathbf{v}}_{AB} = -\vec{\mathbf{v}}_{BA} \tag{16}$$

$$\vec{\mathbf{v}}_{AB} = \vec{\mathbf{v}}_{AC} + \vec{\mathbf{v}}_{CB} \tag{17}$$

$$\vec{\mathbf{F}}_{\text{net}} = \sum \vec{\mathbf{F}}_i \tag{18}$$

$$\vec{\mathbf{a}} = \frac{1}{m}\vec{\mathbf{F}} \tag{19}$$

$$W = mg \tag{20}$$

$$F_x = ma_x \tag{21}$$

$$F_y = ma_y \tag{22}$$

$$f_s \leq \mu_s N \tag{23}$$

$$f_s^{\max} = \mu_s N \tag{24}$$

$$f_k = \mu_k N \tag{25}$$

$$W = (F\cos\theta)d \tag{26}$$

$$F_s = -kx \tag{27}$$

$$W_s = \frac{1}{2}kx^2 \tag{28}$$

$$K = \frac{1}{2}mv^2 \tag{29}$$

$$W = K - K_0 = \Delta K \tag{30}$$

$$U = \frac{1}{2}kx^2 \tag{31}$$

$$U = mgy \tag{32}$$

$$\sum E = \text{const} \tag{33}$$

$$\bar{P} = W/t \tag{34}$$

$$\epsilon = \frac{W_{\text{out}}}{E_{\text{in}}} \tag{35}$$

$$\vec{\mathbf{p}} = m\vec{\mathbf{v}} \tag{36}$$

$$\vec{\mathbf{P}} = \sum_i \vec{\mathbf{p}}_i = \vec{\mathbf{p}}_1 + \vec{\mathbf{p}}_2 + \cdots \tag{37}$$

$$\vec{\mathbf{F}}_{\text{net}} = \frac{\Delta\vec{\mathbf{p}}}{\Delta t} \tag{38}$$

$$\vec{\mathbf{I}} = \vec{\mathbf{F}}_{\text{avg}}\Delta t = \Delta\vec{\mathbf{p}} = \vec{\mathbf{p}} - \vec{\mathbf{p}}_0 \tag{39}$$

$$\vec{\mathbf{x}}_{\text{CM}} = \frac{\sum_i m_i\vec{\mathbf{x}}_i}{\sum_i m_i} \tag{40}$$

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$$s = r\theta \tag{41}$$

$$\theta = \bar{\omega}t \tag{42}$$

$$\bar{\omega} = \frac{\Delta\theta}{\Delta t} \tag{43}$$

$$\bar{\alpha} = \frac{\Delta\omega}{\Delta t} \tag{44}$$

$$\bar{\omega} = \frac{\omega + \omega_0}{2} \tag{45}$$

$$\omega = \omega_0 + \alpha t \tag{46}$$

$$\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2 \tag{47}$$

$$\omega^2 = \omega_0^2 + 2\alpha\left(\theta - \theta_0\right) \tag{48}$$

$$v_t = r\omega \tag{49}$$

$$f = \frac{1}{T} \tag{50}$$

$$a_c = \frac{v^2}{r} = \omega^2 r \tag{51}$$

$$F_c = ma_c = \frac{mv^2}{r} \tag{52}$$

$$a_t = r\alpha \tag{53}$$

$$F_g = \frac{Gm_1m_2}{r^2} \tag{54}$$

$$a_g = \frac{GM_E}{\left(R_E + h\right)^2} \tag{55}$$

$$g = \frac{GM_E}{R_E^2} \tag{56}$$

$$U = -\frac{GmM_E}{r} \tag{57}$$

$$T^2 = Kr^3 \tag{58}$$

$$K = 2.97 \times 10^{-19}\mathrm{s}^2/\mathrm{m}^3 \tag{59}$$

$$v_{\mathrm{esc}} = \sqrt{\frac{2GM_E}{R_E}} = \sqrt{2gR_E} \tag{60}$$

$$r_{\mathrm{blackhole}} = \frac{2MG}{c^2} \tag{61}$$

$$\Delta S = Q/T \tag{62}$$

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$$v_{\rm CM} = r\omega \tag{63}$$

$$a_{\rm CM} = r\alpha \tag{64}$$

$$\tau = r_\perp F = rF\sin\theta \tag{65}$$

$$\vec{\mathbf{F}}_{\rm net} = \sum_i \vec{\mathbf{F}}_i = \mathbf{0} \quad \text{and} \quad \vec{\tau}_{\rm net} = \sum_i \vec{\tau}_i = 0 \tag{66}$$

$$I = \sum_i m_i r_i^2 \tag{67}$$

$$\vec{\tau}_{\rm net} = I\vec{\alpha} \tag{68}$$

$$I = I_{\rm CM} + Md^2 \tag{69}$$

$$W = \tau\theta \tag{70}$$

$$P = \tau\omega \tag{71}$$

$$W_{\rm net} = \frac{1}{2}I\omega^2 - \frac{1}{2}I\omega_0^2 = \Delta K_{\rm rot} \tag{72}$$

$$K = \frac{1}{2}I\omega^2 \tag{73}$$

$$K = \frac{1}{2}I_{\rm CM}\omega^2 + \frac{1}{2}Mv_{\rm CM}^2 \tag{74}$$

$$L = r_\perp p = mr_\perp v = mr_\perp^2\omega \tag{75}$$

$$\vec{\mathbf{L}} = I\vec{\omega} \tag{76}$$

$$\vec{\tau}_{\rm net} = \frac{\Delta\vec{\mathbf{L}}}{\Delta t} \tag{77}$$

$$F_s = -kx \tag{78}$$

$$f = \frac{1}{T} \tag{79}$$

$$E = \frac{1}{2}kA^2 = \frac{1}{2}mv^2 + \frac{1}{2}kx^2 \tag{80}$$

$$y = A\sin\omega t = A\sin(2\pi ft) = A\sin\left(\frac{2\pi}{T}t\right) \tag{81}$$

$$y = -A\sin\omega t = -A\sin(2\pi ft) = -A\sin\left(\frac{2\pi}{T}t\right) \tag{82}$$

$$y = A\cos\omega t = A\cos(2\pi ft) = A\cos\left(\frac{2\pi}{T}t\right) \tag{83}$$

$$y = -A\cos\omega t = -A\cos(2\pi ft) = -A\cos\left(\frac{2\pi}{T}t\right) \tag{84}$$

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$$T = 2\pi\sqrt{\frac{m}{k}} \tag{85}$$

$$\omega = 2\pi f = \sqrt{\frac{k}{m}} \tag{86}$$

$$T = 2\pi\sqrt{\frac{L}{g}} \tag{87}$$

$$v = \omega A\cos\omega t \tag{88}$$

$$a = -\omega^2 A\sin\omega t = -\omega^2 y \tag{89}$$

$$v = \frac{\lambda}{T} = \lambda f \tag{90}$$

$$y = y_1 + y_2 \tag{91}$$

$$1 = \sin^2\theta + \cos^2\theta \tag{92}$$

$$\sin 2\theta = 2\sin\theta\cos\theta \tag{93}$$

$$\theta = \tan^{-1}\left|\frac{C_y}{C_x}\right| \tag{94}$$

$$C = \sqrt{C_x^2 + C_y^2} \tag{95}$$

$$0 = ax^2 + bx + c \tag{96}$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \tag{97}$$

$$2\pi \text{ rad} = 1 \text{ rev} = 360^\circ \tag{98}$$

$$g = 9.80\frac{\text{m}}{\text{s}^2} \tag{99}$$

$$G = 6.67 \times 10^{-11}\frac{\text{N m}^2}{\text{kg}^2} \tag{100}$$

$$c = 3.00 \times 10^8 \text{ m/s} \tag{101}$$

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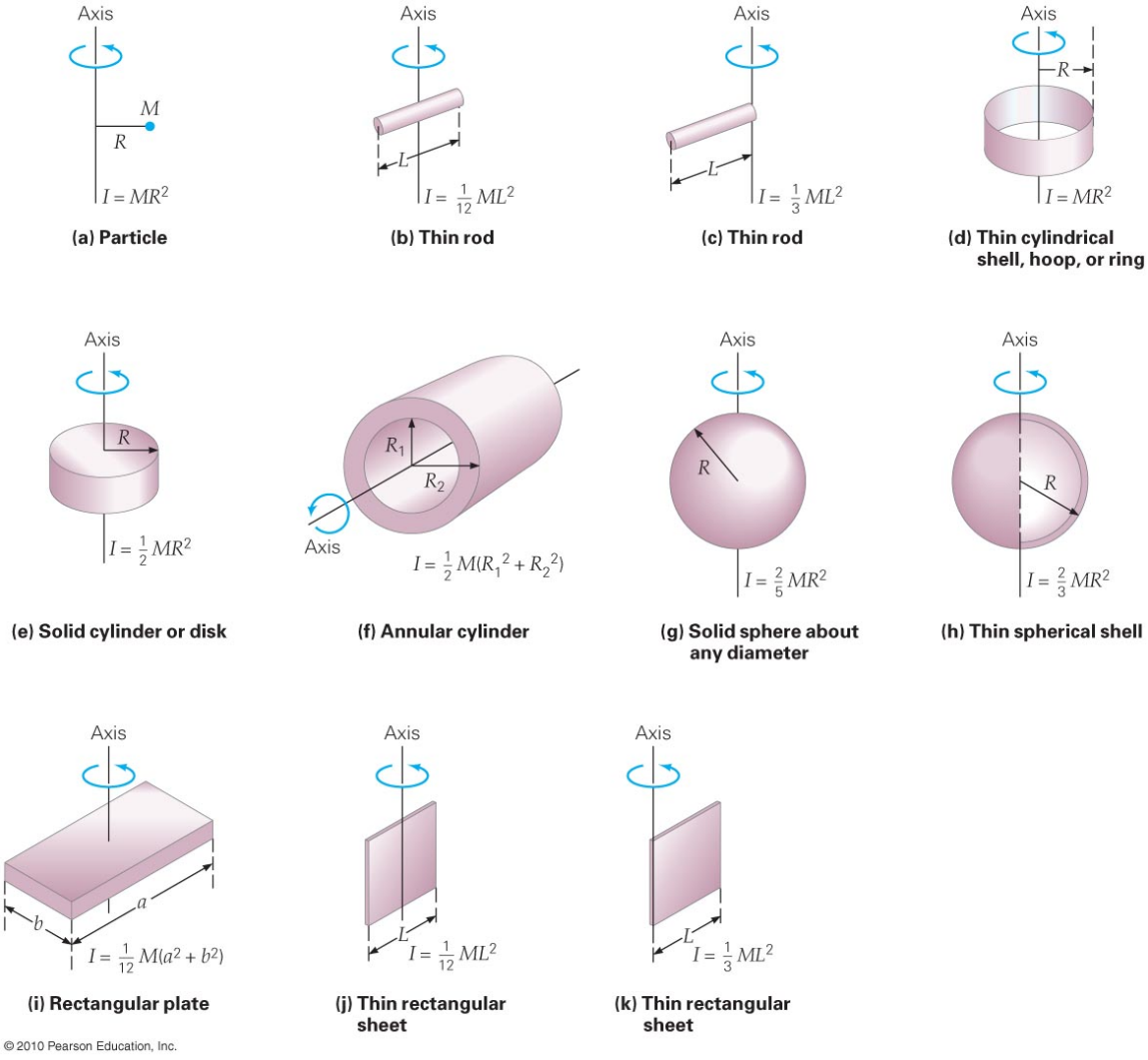

FIGURE 1. Moment of inertia for common shapes.