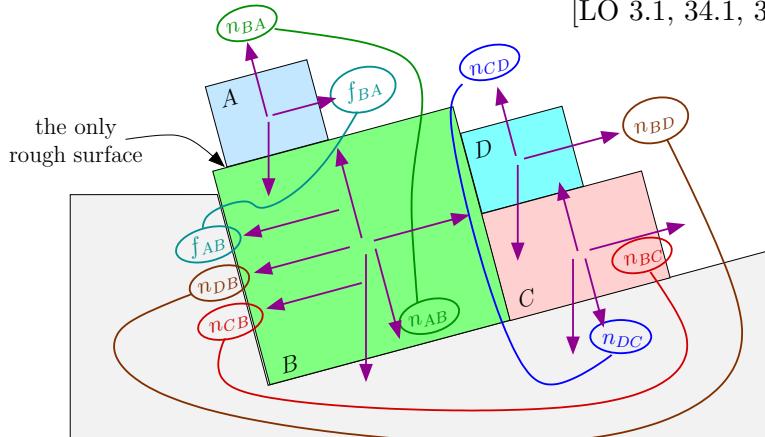


# Phys 218 – Fall 2017

## Comprehensive Exam – All *University Physics* Sections

**Short Answer:** A)

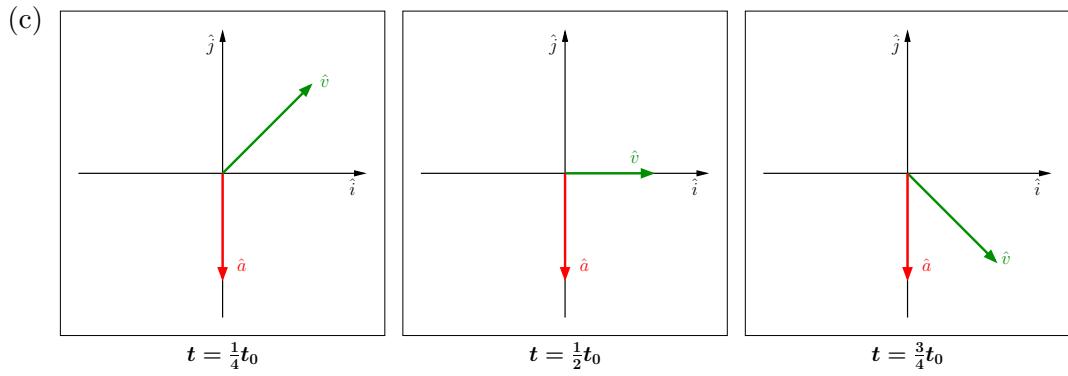
[LO 3.1, 34.1, 35.1, 38.1, 40.1, 51.1]



- B) (a) Scenario I:  $L_{\text{rod}} = \frac{1}{3}ML^2\omega_0$  and  $L_{\text{mass}} = -\frac{2}{3}mv_0L$  [LO 57.1, 57.2]  
 Scenario II:  $L_{\text{rod}} = \frac{1}{12}ML^2\omega_0$  and  $L_{\text{mass}} = -\frac{1}{6}mv_0L$  [LO 57.3, 57.4]
- (b) i. No, there is an external force from the axle on the rod which is external to the rod+mass system. [LO 48.1]  
 ii. Yes, there are no external torques; the force from the axle is on the axis of rotation so does not contribute a torque. [LO 59.1]
- C) (a)  $v_h = \sqrt{v_0^2 - 2gh}$  [LO 3.1, 14.1]  
 (b)  $\langle \vec{v} \rangle = \frac{h}{t} \hat{j}$  [LO 11.1]
- D) (a)  $t = \frac{v_0^2 \pm \sqrt{v_0^2 - 2g(y-y_0)}}{g}$  [LO 3.2, 5.1]  
 (b)  $x = 2$  and  $y = -3$  [LO 4.1]  
 (c)  $\alpha = 3$  and  $\beta = -7$  [LO 4.2]
- E) (a)  $K = 3.6 \times 10^7 \text{ kg cm}^2/\text{min}^2$  [LO 10.1]  
 (b)  $U = 0.1 \text{ J}$  [LO 10.2]  
 (c)  $T = 1 \text{ s}$  [LO 10.3]
- F) (a) Kepler's 2<sup>nd</sup> or  $\vec{L}$ -conservation  $\Rightarrow r_p v_p = r_a v_a$  and since  $r_p < r_a$ ,  $v_p > v_a$  [LO 63.1]  
 (b)  $r_p = a(1 - e)$  [LO 64.1]

- Problem 1:** (a)  $I_{\text{roulette}} = 104MR^2$  [LO 51.1, 51.2, 53.1]  
 (b)  $\omega_f = \left(\frac{72}{113}\right)\omega_0$  [LO 3.3, 57.5, 57.6, 59.2]  
 (c)  $K_i = 84MR^2\omega_0^2$  and  $K_f = \left(\frac{2592}{113}\right)MR^2\omega_0^2$  [LO 34.1, 35.1, 35.2]  
 (d) Since  $K_f = 36\frac{72}{113}MR^2\omega_0^2 < 36MR^2\omega_0^2$  is less than  $K_i = 84MR^2\omega_0^2$ , the collision is inelastic. [LO 50.1]

- Problem 2:** (a)  $|\vec{v}(t_0)| = \sqrt{\left(\frac{d}{t_0}\right)^2 + (gt_0)^2}$  [LO 1.1, 11.2, 14.2]  
 (b)  $\theta = \tan^{-1} \left( \frac{gt_0^2}{2d} \right)$  [LO 1.2, 3.4, 11.3, 14.3]



[LO 13.1, 13.2, 13.3, 13.4, 13.5, 13.6]

**Problem 3:** (a)  $\vec{F}_{\text{tot}} = Gm_1 \left( \frac{m_2}{a^2} \hat{i} + \frac{m_3}{b^2} \hat{j} \right)$  [LO 60.1, 60.2, 60.3]

(b)  $U_{\text{tot}} = -G \left( \frac{m_1 m_2}{a} + \frac{m_1 m_3}{b} + \frac{m_2 m_3}{\sqrt{a^2 + b^2}} \right)$  [LO 61.1, 61.2, 61.3, 61.4]

(c)  $W = Gm_2 \left( \frac{m_1}{a} + \frac{m_3}{\sqrt{a^2 + b^2}} \right)$  [LO 39.1, 61.6]

**Problem 4:** (a)  $I_p = \frac{3}{2}ML^2$  [LO 51.3, 53.2]

(b) From  $\sum \tau = I_P \alpha$  show  $\alpha = -\left(\frac{k}{2M}\right)\theta$  [LO 1.3, 55.1, 54.1, 66.1]

(c)  $\omega = \sqrt{\frac{k}{2M}}$  [LO 66.2]

(d)  $\Omega_{\text{max}} = \sqrt{\frac{k}{2M}} \theta_0$  [LO 3.5, 66.3]

**Problem 5:** (a)  $H = \frac{k(\Delta x)^2}{2mg}$  [LO 3.6, 38.1, 38.2, 40.1]

(b)  $K_A = \frac{1}{2}k(\Delta x)^2 - mgh_A$  [LO 38.3, 38.4, 40.2]

(c)  $\cos \theta = \frac{v_A}{\sqrt{v_A^2 + 2gh}}$  [LO 1.4, 4.3, 34.2, 38.5, 40.3]