

Physics 10154 - Exam #3c

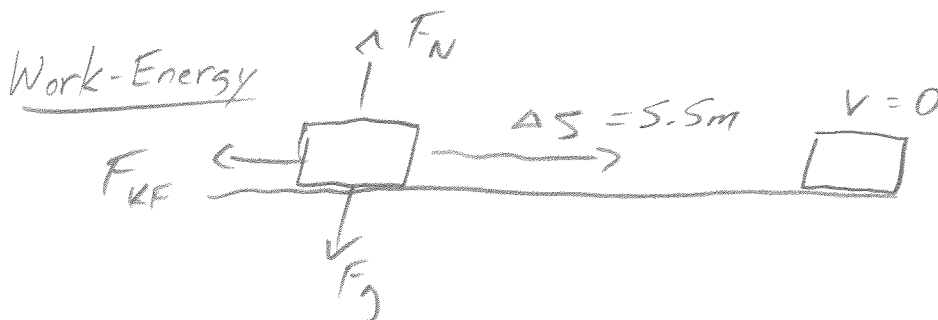
Partial credit will be given provided you show all work and are solving parts of the problem correctly. Points will be deducted if you don't show your work (or if some parts are incorrect) even if you get the right answer. Clearly indicate your answer with a circle or box and remember to include correct units and significant figures.

1. (35 pts) A puck moving with a speed of 22 m/s in the +x direction has an elastic collision with a block that is twice as massive as the puck. After the collision, the block slides 55 ~~m/s~~ meters before coming to rest. What is the coefficient of kinetic friction between the block and the surface?

Collision:

$$v_{2f} = \left(\frac{2m_1}{m_1 + m_2} \right) v_{1i} + (\dots)(0) = \left(\frac{2m}{m + 2m} \right) (22) = \left(\frac{2}{3} \right) (22)$$
$$= 14.67 \text{ m/s}$$

↑
 v_0 for part 2



$$W_N = 0$$

$$W_g = 0$$

$$W_{KF} = \mu_k F_N \Delta S \cos 180^\circ$$

$$= -\mu_k mg \Delta S$$

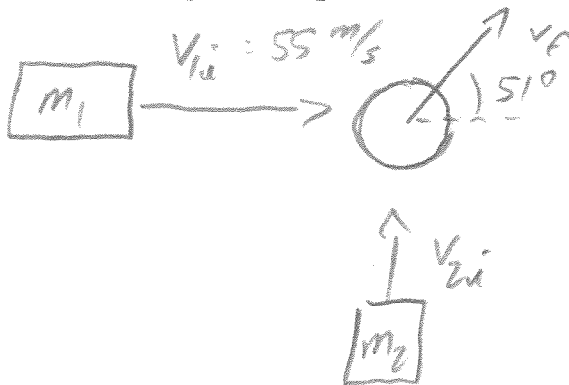
Ends at rest ↓

$$0 + 0 - \mu_k mg \Delta S = 0 - \frac{1}{2} m v_0^2$$

$$\mu_k = \frac{v_0^2}{2g \Delta S}$$

$$= \boxed{0.20}$$

2. (30 pts) A 2500 kg car (car 1) is moving East at 55 m/s. It has a collision with a 3500 kg car (car 2) moving North at an unknown speed. After the collision, the two cars stick together and move off at an angle of 51° North of East. What was the original speed of car 2?



$$x: m_1 v_{1i,x} + m_2 v_{2i,x} = (m_1 + m_2) v_{F,x}$$

$$(2500)(55) + 0 = (6000) v_F \cos 51^\circ$$

$$v_F = \frac{(2500)(55)}{6000 \cos 51^\circ} = 36.4 \text{ m/s}$$

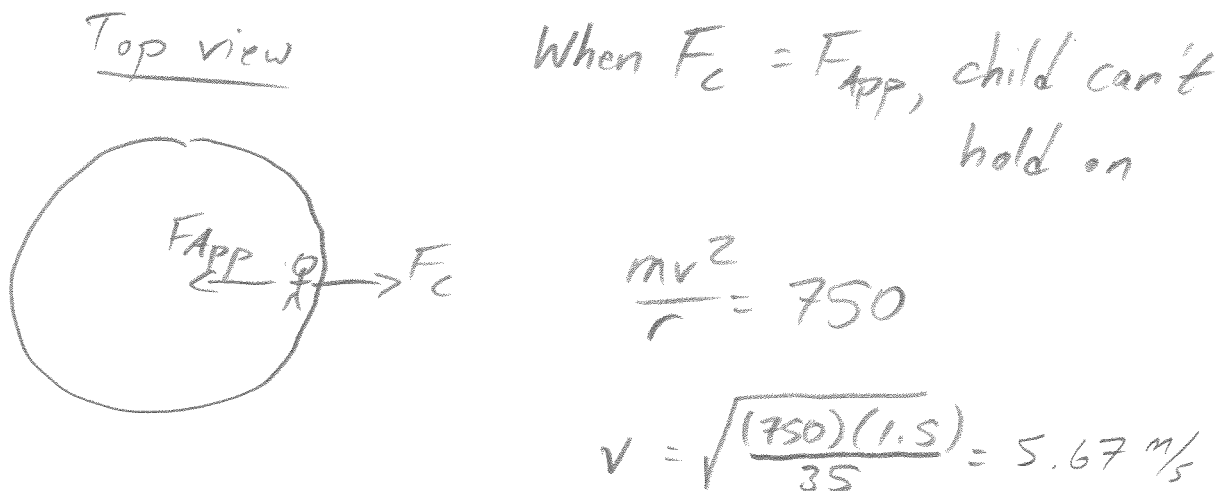
$$y: m_1 v_{1i,y} + m_2 v_{2i,y} = (m_1 + m_2) v_{F,y}$$

$$0 + (3500) v_{2i} = (6000) v_F \sin 51^\circ$$

$$v_{2i} = \frac{(6000)(36.4) \sin 51^\circ}{3500}$$

$$= 49 \text{ m/s}$$

3. (35 pts) A 35 kg child is initially at rest on the rim of a merry-go-round of radius 1.5 meters. The merry-go-round accelerates tangentially at a rate of ~~0.33~~ ^{0.33} m/s². If the maximum force the child can exert to hang on to a railing is 750 Newtons, how many seconds elapse from the beginning of the motion until the time when the child can no longer hold on to the merry-go-round? How many revs?



$$\Delta s = ?$$

$$v_0 = 0$$

$$v = 5.67$$

$$a = 0.33$$

$$t = ?$$

$$v = v_0 + at$$

$$5.67 = 0 + 0.33t$$

$$t = 17 \text{ s}$$

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

$$(5.67)^2 = 2(0.33)\Delta s$$

$$\Delta s = 48.7 \text{ m}$$

$$1 \text{ rev} = 2\pi r = 9.42 \text{ m}$$

$$48.7 \text{ m} \cdot \frac{1 \text{ rev}}{9.42 \text{ m}}$$

$$= 5.2 \text{ rev}$$