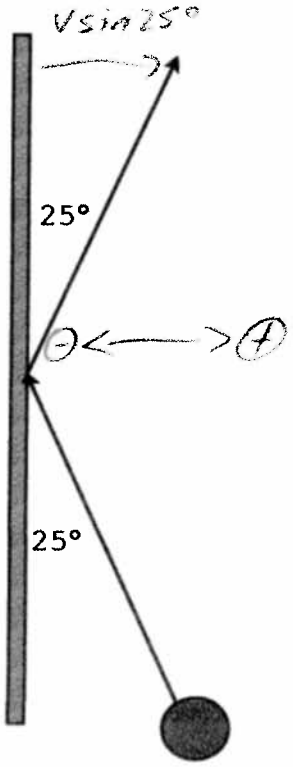
Physics 10154 - Exam #3a

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. (30 pts) A 220 gram air hockey puck strikes the boundary of a playing surface as shown below. Heading into the boundary, the puck is moving 12 meters/sec. Leaving the boundary, the puck moves with the same speed but in a different direction. If the impact with the boundary takes 0.035 seconds, determine the magnitude and direction of the force exerted on the puck by the boundary.



$$\Delta P_x = mV_{1f,x} - mV_{1i,x}$$

$$= (.220)(12\sin 25) - (.220)(-12\sin 25)$$

$$= 2.23$$

$$\Delta P_y = mV_{1f,y} - mV_{2f,y}$$

$$= (.220)(12\cos 25) - (.220)(12\cos 25)$$

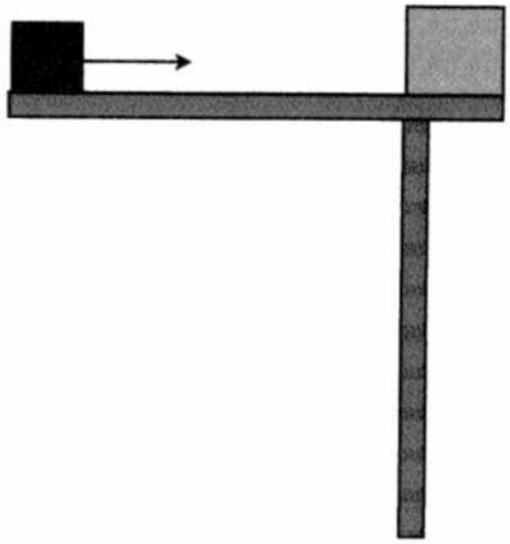
$$= 0$$

$$\vec{\Delta p} = 2.23, +x \text{ dir}$$

$$\vec{F} = \frac{\vec{\Delta p}}{\Delta t} = \frac{2.23}{.035}$$

$$= 64\,N, +x \text{ dir}$$

2. (35 pts) Block A is 3.0 times more massive than block B. Block A slides across a frictionless table with a speed of 4.0 meters/sec and has an elastic collision with block B, originally at rest on the edge of a table 85 cm above the ground. How far away horizontally from the base of the table does block B land?



Part 1 - Collision

$$v_{2f} = \frac{2m_1}{m_1+m_2} v_{1i} + (\;)0$$

$$= \frac{2(3m)}{3m+m}(4.0)$$

$$= \frac{6}{4}(4.0) = 6.0\ m/s$$

$\downarrow$

v_0 for part 2

Part 2

x	y
$\Delta x = ?$	$\Delta y = 0.85\ m$
$v_{0x} = 6.0\ m/s$	$v_{0y} = 0$
$v_x = 6.0\ m/s$	$v_y = ?$
$a_x = 0$	$a_y = 9.8\ m/s^2$
$t = ?$	$t = ?$

$$\Delta y = v_{0y}t + \tfrac{1}{2}a_y t^2$$

$$0.85 = 0 + \tfrac{1}{2}(9.8)t^2$$

$$t = \sqrt{\frac{.85}{4.9}} = .416\ s$$

$$\Delta x = v_{0x}t + \tfrac{1}{2}a_x t^2$$

$$\Delta x = (6.0)(.416)$$

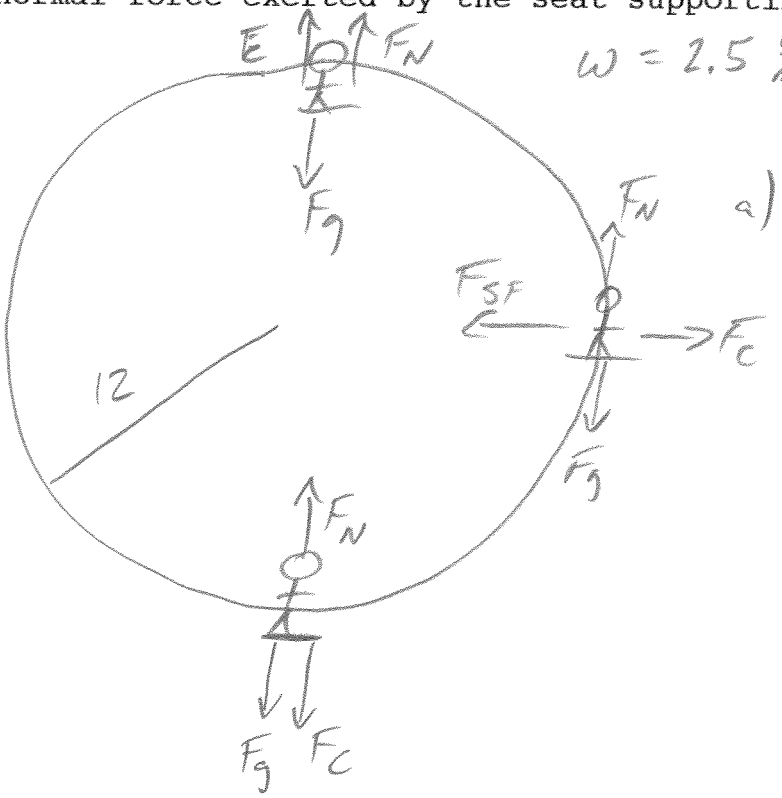
$$= 2.5\ m$$

3. (35 pts) A 35-kg child rides a Ferris wheel of radius 12 meters making 2.5 rev/min.

a) At the lowest point of the motion, what is the magnitude of the normal force exerted by the seat supporting the child?

b) Midway between top and bottom, what is the <u>magnitude and direction</u> of the force of static friction holding the child in place?

c) At the top of the motion, what is the magnitude of the normal force exerted by the seat supporting the child?



$\omega = 2.5 \frac{rev}{min} \cdot \frac{2\pi\ rad}{rev} \cdot \frac{1\ min}{60\ s} = 0.262$

a) $\Sigma F_{rad} = F_g + F_c - F_N = 0$

$F_N = F_g + F_c$

$= mg + \frac{mv^2}{r}$

$= mg + mr\omega^2$

$= 343 + 29$

$= 370\ N$

b) $\Sigma F_{rad} = F_c - F_{SF} = 0$

$F_{SF} = F_c = mr\omega^2 = 29\ N$

c) $\Sigma F_{rad} = F_c + F_N - F_g = 0$

$F_N = F_g - F_c$

$= 343 - 29$

$= 310\ N$