Physics 10154 - Exam #6A

Each problem is worth 50 points. 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. A 2.0 kg basketball initially at rest is dropped from a height of 2.5 meters and is contact with the floor for 0.065 seconds. It rebounds to a maximum height of 2.0 meters. What is the average force exerted by the floor on the ball during the bounce?

Falling: $\Delta y = -2.5$, $v_{oy} = 0$, $v_y = ?$, $a = -9.8$, $t = ?$

$v_y^2 = v_{oy}^2 + 2a\Delta y$

$v_y = \sqrt{2(-9.8)(-2.5)}$

$= -7$ m/s

Rising: $\Delta y = 2.0$, $v_{oy} = ?$, $v_y = 0$, $a = -9.8$, $t = ?$

$v_y^2 = v_{oy}^2 + 2a\Delta y$

$0 = v_{oy}^2 + 2(-9.8)(2)$

$v_{oy} = \sqrt{-2(-9.8)(2)}$

$= 6.26$ m/s

$$F = \frac{\Delta p}{\Delta t} = \frac{mv_f - mv_i}{\Delta t}$$

$$= \frac{(2)(6.26) - (2)(-7)}{.065} = \boxed{410\ N}$$

2. Two masses collide on a frictionless, linear air track in a one-dimensional, elastic head-on collision in this problem. Mass #1 is 2.0 kg and moving to the right at 3.0 m/s. Mass #2 is 6.0 kg and moving to the left at 3.0 m/s.

After the collision, mass #1 travels along the air track until it encounters a spring with k = 150 N/m.

a) What is the velocity of each mass after the collision?
b) What is the maximum compression of the spring by mass #1?

$m_1 = 2.0\ kg \qquad m_2 = 6.0\ kg$

$V_{1i} = 3.0\ m/s \qquad V_{2i} = -3.0\ m/s$

$$V_{1f} = \frac{2-6}{2+6}(3) + \frac{12}{2+6}(-3)$$

$$= -1.5 - 4.5 = \boxed{-6.0\ m/s}$$

$$V_{2f} = \frac{4}{2+6}(3) + \frac{6-2}{2+6}(-3)$$

$$= 1.5 - 1.5 = \boxed{0\ m/s}$$

Pt 2: $V_0 = 6.0\ m/s$

$$W_{spr} = \Delta K$$

$$-\tfrac{1}{2}kx^2 = 0 - \tfrac{1}{2}mv_0^2$$

$$x^2 = \frac{mv_0^2}{k} = 0.48 \qquad \boxed{x = 0.69\ m}$$