Physics 101Rec
Quiz#7-8-Sect04
Chapter 9-10

Name: Key Id:

1. A body of mass $m_1 = 1$ kg moving with a velocity $\vec{v}_{1i} = \hat{i} - 3\hat{j}\,(m/s)$ collides completely inelastically with another body of mass $m_2 = 2$ kg having a velocity $\vec{v}_{2i} = 7\hat{i} - 6\hat{j}\,(m/s)$. Find the final speed of the combined system

Conservation of linear momentum $\vec{p}_i = \vec{p}_f$

$$m_1\vec{v}_{1i} + m_2\vec{v}_{2i} = (m_1+m_2)\vec{v}_f$$

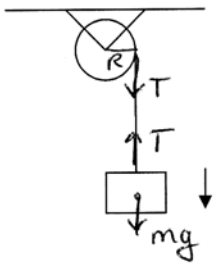
$$\vec{v}_f = \frac{m_1\vec{v}_{1i} + m_2\vec{v}_{2i}}{m_1+m_2} = \frac{(\hat{i}-3\hat{j}) + (14\hat{i}-12\hat{j})}{3}$$

$$= 5\hat{i} - 5\hat{j} \quad m/s$$

Speed $|\vec{v}_f| = \boxed{\sqrt{50}\ m/s}$

2. Consider a pulley (disk) of radius 20 cm and M = 2.0 kg. A mass m = 1.0 kg is hung at the end of a string. The mass is falling down as shown in the figure

(a) Find the linear acceleration of the hanging mass m.



block m: $mg - T = ma$ (1)

pulley: $TR = I\alpha = \frac{Ia}{R}$ (2)

(2) $\Rightarrow$ $T = \frac{I}{R^2}a$ (3)

(1) $\Rightarrow$ $mg - \frac{I}{R^2}a = ma$

$$a\left(m + \frac{I}{R^2}\right) = mg \Rightarrow a = \frac{g}{1+\frac{I}{mR^2}} = \frac{g}{1+\frac{1}{2}\frac{MR^2}{mR^2}}$$

$$a = \frac{9.8}{1+\frac{M}{2m}} = \frac{9.8}{1+\frac{2}{2\times 1}} = \frac{9.8}{2} = \boxed{4.9\ m/s^2}$$

(b) Find the tension in the string.

$$T = m(g-a) = 1\times(9.8-4.9) = \boxed{4.9\,N}$$