PHYS 211 College Physics I
Exam 5A

November 29, 2017

Name J.C. Daly

1. An electric fan is running on HIGH. After the LOW button is pressed, the angular speed of the fan decreases to 93.8 rad/s in 2.25 s. The deceleration is 39.0 rad/s^2.

   What was the initial angular speed of the fan? 182 rad/s

Grades

100 | 100,100
99,99
98,98,98,98
97
96,96

92,92
91
90 | 90
88

83
82
80 | 80
79

76

70 | 70

$\omega = \omega_0 + \alpha t$

$\omega_0 = \omega - \alpha t$

$= 93.8 - (-39 * 2.25)$

$\omega_0 = 181.55$ rad/s

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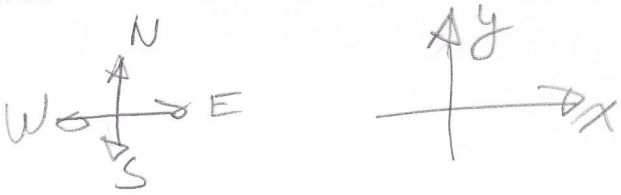
2. A 65.0 kg skater is traveling due east at a speed of 5.50 m/s. A 83 kg skater is moving north at a speed of 2.25 m/s. They collide and hold on to each other after the collision, managing to move off at an angle θ north of east, with a speed v_f.



Find

a. the angle θ _____ and

b. the speed v_f _____.

$\vec{P}_f = \vec{P}_0 = m_1\vec{v}_1 + m_2\vec{v}_2$

$m_1\vec{v}_1 = 65 * 5.5\hat{x} = 357.5$

$m_2\vec{v}_2 = 83 * 2.25\hat{y} = 186.75\hat{y}$

$\vec{P}_0 = 357.5\hat{x} + 186.75\hat{y}$

Conservation of Momentum

$\vec{P}_f = \vec{P}_0$

$m_1 + m_2 = 65 + 83 = 148$

$\vec{P}_f = (m_1 + m_2)\vec{v}_f = P_0 = 357.5\hat{x} + 186.75\hat{y}$

$\vec{v}_f = \frac{357.5}{148}\hat{x} + \frac{186.75}{148}\hat{y}$

$= 2.42\hat{x} + 1.26\hat{y}$

$v_f = \sqrt{(2.42)^2 + (1.26)^2} = \underline{2.73}$ m/s

$\theta = \tan^{-1}\left(\frac{1.26}{2.42}\right) = \underline{27.5^\circ}$

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Figure 3

3. A railroad car with a mass of 1550 kg is moving to the right with a velocity of 0.750 m/s at the top of the 1.25 m hill shown in Figure 3. The car rolls down the hill and crashes into a stationary car of mass 2520 kg. After the collision the cars are coupled and move together. Assume friction can be ignored.

   a. What is the speed of the cars after the collision? 1.91 m/s

   b. How much energy is lost in the collision? 12000 J

v_1 = speed of car #1 just before the collision

Use conservation of Energy on car #1

$$m_1 g h + \frac{1}{2} m_1 v_0^2 = \frac{1}{2} m_1 v_1^2$$

$$2gh + v_0^2 = v_1^2$$

$$v_1 = \sqrt{v_0^2 + 2gh} = \sqrt{(0.75)^2 + 2 \times 9.8 \times 1.25}$$

$$v_1 = 5.01 \text{ m/s}$$

Use conservation of Momentum to describe the collision

$$\vec{P}_f = \vec{P}_0$$

$$P_f = (m_1 + m_2) v_f = m_1 v_1 + m_2 v_2 \quad (v_2 = 0)$$

$$v_f = \left(\frac{m_1}{m_1 + m_2}\right) v_1 = \left(\frac{1550}{1550 + 2520}\right) \times 5.01$$

$$1550 + 2520 = 4070$$

$$v_f = \frac{1550}{4070} \times 5.01$$

$$v_f = 1.91 \text{ m/s}$$

EXAM A Problem 3

Energy Before the collision $= \frac{1}{2} m_1 v_1^2$

$$E_0 = \frac{1}{2} m_1 v_1^2 = \frac{1550}{2} * (5.01)^2 = 19,453 \text{ J}$$

After the collision

$$E_f = \frac{(m_1 + m_2)}{2} v_f^2 = \frac{1550 + 2520}{2} * (1.91)^2$$

$$= \frac{4070}{2} * (1.91)^2$$

$$E_f = 7,424$$

Energy Lost $= E_0 - E_f = 19,453 - 7,424$

$$E_0 - E_f = 12,029 \text{ J}$$