PHYS 211 College Physics I
Exam 5B

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 73.8 rad/s in 2.50 s. The deceleration is 48.0 rad/s^2.

   What was the initial angular speed of the fan? 194 rad/s

$\omega = \omega_0 + \alpha t$

$\omega_0 = \omega - \alpha t$

$\alpha = -48.0$

$\omega_0 = 73.8 - (-48 * 2.5)$

$= 193.8$ 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

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2. A 53.0 kg skater is traveling due east at a speed of 6.50 m/s. A 77.2 kg skater is moving north at a speed of 4.25 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 43.6° and

b. the speed v_f 3.65 m/s.

Momentum is conserved

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

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

$m_1\vec{v}_1 = 53 * 6.50\,\hat{x} = 344.5\,\hat{x}$

$m_2 v_2 = 77.2 * 4.25\,\hat{y} = 328.1\,\hat{y}$

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

$m_1 + m_2 = 130.2\ kg$

$130.2\,\vec{v}_f = 344.5\,\hat{x} + 328.1\,\hat{y}$

$\vec{v}_f = \frac{344.5}{130.2}\,\hat{x} + \frac{328.1}{130.2}\,\hat{y}$

$\vec{v}_f = 2.65\,\hat{x} + 2.52\,\hat{y}$

$v_f = \sqrt{(2.65)^2 + (2.52)^2} = 3.65\ m/s$

$\theta = \tan^{-1}\left(\frac{2.52}{2.65}\right) = 43.6°$

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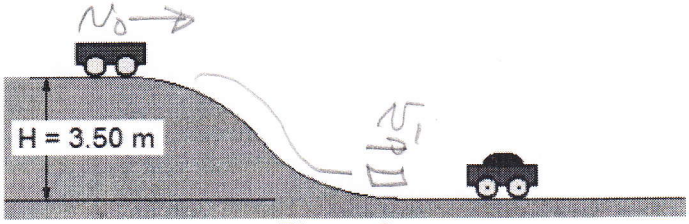

Figure 3

3. A railroad car with a mass of 1250 kg is moving to the right with a velocity of 0.500 m/s at the top of the 3.50 m hill shown in Figure 3. The car rolls down the hill and crashes into a stationary car of mass 3520 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? 2.17 m/s

   b. How much energy is lost in the collision? 31,900 J

v_1 = speed of car #1 at the bottom of the hill just before the collision

Use conservation of Energy

$$E_f = E_0$$

$$\frac{1}{2}mv_1^2 = \frac{1}{2}mv_0^2 + mgh$$

$$v_1 = \sqrt{v_0^2 + 2gh} = \sqrt{(0.5)^2 + 2 * 9.8 * 3.50}$$

$$v_1 = 8.30 \text{ m/s}$$

Use conservation of momentum to describe the collision.

$$m_1 v_1 = (m_1 + m_2) v_f$$

$$v_f = \left(\frac{m_1}{m_1 + m_2}\right) v_1 = \frac{1250}{(1250 + 3520)} * 8.30$$

$$= \frac{1250}{4770} \times 8.30 = 2.17 \text{ m/s}$$

Energy Before the Collision =

$$\frac{1}{2}mv_1^2 = \frac{1250}{2} * (8.3)^2 = 43,100 \text{ J}$$

Prob 3 EXAM 3

Energy Lost in the collision

Energy Before the collision = E_0

$$E_0 = \frac{1}{2} M_1 v_1^2 = \frac{1250}{2} * (8.3)^2 = 43,100 \text{ J}$$

Energy After the collision

$$E_f = \frac{1}{2} (m_1 + m_2) v_f^2$$

$$= \frac{4770}{2} * (2.17)^2 = 11,230 \text{ J}$$

Energy Lost = $E_0 - E_f = 43100 - 11,230$

$$= 31,900 \text{ J}$$