Homework Discussion, Week 7

Physics 1301 Dr. Andersen

Chapter 9

23.) It's a 1-D problem. Taking the direction of the moving cart to be positive, momentum conservation reads

$$mv = 2mv_f$$

(since the carts stick together.) So $v_f = v/2$. The final kinetic energy will thus be $\frac{1}{2}m(\frac{v}{2})^2$.

35.) a) Since it's a 1-D elastic collision, use momentum conservation

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

and, from kinetic energy conservation

$$v_{1i} + v_{1f} = v_{2i} + v_{2f}.$$

Taking the elephant to be moving in the positive direction, and labeling it as object 1, $v_1 i = 4.45\ m/s$ and for the ball $v_{2i} = -7.91\ m/s$. Stick those in the above equations and plug and chug.

Chapter 10

29.) a) use $v = \omega r$, and solve for ω. b) Use $a_{cp} = \frac{v^2}{r} = \omega^2 r$. b) The centripetal acceleration is produced by the tension in the vine.

54.) a) Use $KE_{rot} = \frac{1}{2}I\omega^2$, with $I = \frac{1}{12}mL^2$ (see table 10-1). b) Set the rotational kinetic energy equal to the gravitational potential $\frac{1}{2}I\omega^2 = mgh$, and solve for h.
Answers: a) 1020 J, b) 180 m.

60.) a) This is a conservation of energy problem, with both translational and rotational kinetic energy, so

$$\frac{1}{2}mv_{CMi}^2 + \frac{1}{2}I\omega_i^2 + mgy_i = \frac{1}{2}mv_{CMf}^2 + \frac{1}{2}I\omega_f^2 + mgy_f.$$

Because it is rolling without slipping, the speed of the center of mass will just be the tangential speed of a point on the ball in contact with the ground

$v_{CM} = v_t = \omega R$, and the moment of inertial will just be that of a solid sphere rotating around its center $I = \frac{2}{5}mR^2$. Put all this together and solve for v_{CMf}. b) Notice that the final answer for part (a) didn't depend on the radius of the ball, so changing the radius of the ball won't change the final answer.
Answer: a) 0.83 m/s.