Ch6 Q14,19; P47,67 Ch7 Q4,Q10; P6 P18

Ch6 Q14. Experienced hickers prefer to step over a fallen log in their path rather than stepping on top and stepping down on the other side. Explain.

Stepping on top involves working against gravity, and not all the energy is recovered when walking down.

Ch6 Q19. Describe the energy transformations when a child hops around on a pogo stick.

At the bottom of the jump, the energy is fully elastic potential. That energy turns into kinetic energy which lifts the child up. Upon leaving the ground, that kinetic energy turns into gravitational potential until all kinetic becomes such potential and the child stops mid air, and comes back down. Then, that potential becomes kinetic.

Ch6 P47. A 16.0 Kg child descends a slide 2.20 m high and starting from rest, reaches the bottom with a speed of 1.25 m/s. How much thermal energy due to friction was generated in the process?

We have that her initial potential is 2.20 m $g16.0 = 345\,\mathrm{J}$. Her final energy is

$$\frac{1}{2}16\,\mathrm{Kg}(1.25\mathrm{m/s})^2 \;=\; 12.5\,\mathrm{J}$$

So $345 - 12.5 = 333\mathrm{J}$ was generated as heat.

Ch6 P67. A pump lifts 27.0 Kg per minute through a height of 3.50 m. What minimum output rating (watts) must the pump motor have?

We have that the power is $W \cdot \mathrm{rate}$. We have that

$$27.0\,\frac{\mathrm{Kg}}{\mathrm{min}}\frac{1\mathrm{min}}{60\,\mathrm{s}}\cdot 3.50\mathrm{m}\,g \;=\; 15.4\,\mathrm{J/s}.$$

Ch7 Q4. When you release an inflated balloon but untied balloon, why does it fly across the room?

The air inside the balloon is at a high pressure. This air leaves the mass and by conservation of momentum, propels the balloon forward.

Ch7 Q10. It is said that in ancient times a rich man witha bag of gold coins was stranded on the surface of a frozen lake. Because the ice was frictionless, he could not push himself to shore and froze to death. What could he have doen to save himself had he not been so miserly?

Throw his money and use the recoil to get back to the shore.

Ch7 P6. A 7700 Kg boxcar traveling 14 m/s strikes a second car at rest. The two stick together and move off witha speed of 5.0 m/s. What is the mass of the second car.

Draw picture. Conservation of momentum:

$$\begin{aligned}
p_i &= p_f \\
7700\,\mathrm{Kg}\cdot 14\mathrm{m/s}+0 &= 7700\,\mathrm{Kg}\cdot 5\mathrm{m/s}+m5\mathrm{m/s}. \\
\Rightarrow 7700\,\mathrm{Kg}\cdot(14\mathrm{m/s}-5\mathrm{m/s}) &= m5\mathrm{m/s} \\
\Rightarrow 7700\,\mathrm{Kg}\cdot(14\mathrm{m/s}-5\mathrm{m/s})/5\mathrm{m/s} &= m \\
\Rightarrow &= 13860\,\mathrm{Kg}
\end{aligned}$$

Ch7 P18. A tennis ball of mass $m = 0.060\,\mathrm{Kg}$ and speed $v = 28\mathrm{m/s}$ strikes a wall at an 45° angle and rebounds with the same speed at 45°. What is the impulse (magnitude and direction) given to the ball?

No change in momentum up or down, so the only change was is normal to the wall. Clearly,

$$\begin{aligned} p_{x\,i} &= -0.060\text{Kg}\cdot 28\text{m/s}\frac{1}{\sqrt{2}} \\ p_{x\,f} &= 0.060\text{Kg}\cdot 28\text{m/s}\frac{1}{\sqrt{2}} \\ \Rightarrow J &= p_{x\,f} - p_{x\,i} \\ &= 0.060\text{Kg}\cdot 28\text{m/s}\frac{2}{\sqrt{2}} \\ &= \sqrt{2}\,0.060\text{Kg}\cdot 28\text{m/s} \\ &= 2.4\,\text{Kg}\,\text{m/s} \end{aligned}$$

normal to the wall (outward).