**ENERGY & MOMENTUM PROBLEM SET**

1. A rope, at an angle of 18.5o above the horizontal, provides a tension force of 11.8 N to pull a toboggan along a smooth, horizontal surface. The rope does 214 J of work. Calculate how far the toboggan moves.
2. A spring with spring constant 3.50 x 102 N/m, is at the bottom of a 15.0o inclined plane. It is compressed 25.0 cm by a 1.50 kg mass. The entire system is held at rest. When the system is released, determine the speed of the mass after the spring has moved the mass 15.0 cm.
3. When a person parachutes, the impact velocity is equal to that attained in free fall from a height of 4.5 m. After contacting the ground, the jumper’s momentum is quickly brought to zero by the Earth. Determine:
4. the impact velocity
5. the impulse of the ground on the jumper, assuming a mass of 80.00 kg
6. the average force on the jumper’s feet if they land stiff-legged and the impulse only lasts 0.019 s
7. the average force on the jumper’s feet if they land with their knees flexed, so that the impulse is extended over a time interval of 0.050 s
8. An atom of uranium decomposes into two particles, one of which has a mass of 60 times greater than the other. If the larger particle moves to the left with a velocity 2.3 x 106 m/s, with what velocity does the lighter particle move?
9. A block of ice of mass 50.0 g slides along a frictionless, frozen lake at a speed of 0.30 m/s. It collides with a 100.0 g block of ice that is sliding in the same direction at 0.25 m/s. After the collision, the two blocks are stuck together.
10. How fast are the two blocks moving after the collision?
11. How much kinetic energy is lost?
12. Is the collision elastic or inelastic? How do you know?
13. A steel ball of mass 0.50 kg, moving with a velocity of 2.0 m/s, strikes a second ball of mass 0.30 kg, initially at rest. The collision is a glancing one, causing the first ball to be deflected by an angle of 30.0o, with a speed of 1.50 m/s. Determine the velocity of the second ball after the collision, giving both its speed and direction.
14. A 70.0 kg student sits in a 30.0 kg canoe at rest on the water. The student has two 10.0 kg stones in the canoe, but no paddles. Assuming friction to be negligible, determine how the student can travel the fastest: by throwing both stones out of the canoe at the same time, or by throwing first one stone and then the other.