

1. A baseball with a mass of 200 grams is pitched with a speed of 80 m/s. The catcher catches it. His hands recoil a distance of 30 cm while catching the ball. What force does his glove experience?

2. A teaspoon of sugar contains approximately 17 kJ of chemical potential energy. How many storeys in a building would a 70 kg person have to climb to use up the energy in one teaspoon of sugar? Assume that each storey is 3 meters.

3. A person eats a teaspoon of sugar and then climbs high enough in a building to use up all the energy provided by the sugar. He then leaps from the building and strikes the ground. If, after striking the ground, the person “decelerates” (yuck) in 5 ms, coming to a complete (and messy) stop, what power will be dissipated in the impact?

What was the person’s speed just prior to impact?

4. A rubber ball with a mass of 300 grams is dropped from a height of 27 meters. The diameter of the ball is 10 cm. If the ball's deformation on impact with the ground can be modeled as a spring with a constant of $k=3 \times 10^5$ N/m, by how much will the ball deform on impact?

5. Consider again the ball in the previous problem. What maximum force will the ball exert on the ground? What will its maximum acceleration be?

6. A rubber ball with a mass of 300 grams is dropped from a height of 27 meters. The diameter of the ball is 10 cm. The ball drops onto a puddle of nitroglycerine with a mass of 3 grams. Nitroglycerine has a chemical potential energy of 6.5 MJ/kg. The nitroglycerine detonates on impact. How high do the fragments of the ball rise? (Assume that the system is conservative.)