

CP Physics - Mythbusters - Paper Crossbow -- Follow Up Questions

Name: _____

Answer these questions on a separate sheet. For numerical solutions, show all of your work clearly and completely, including symbolic equations and appropriate units. Written responses should be given in complete sentences. (5 pts each)

1. In the Mythbusters episode titled, "Paper Crossbow," Adam and Jamie built crossbows out of newspaper and rubber bands that fired projectiles with kinetic energies in an approximate range of 4 ft-lbs to 8 ft-lbs. A ft-lb is a unit of energy in the English system of units. Convert these numbers to Joules (N-m). Be sure to clearly show the conversion factor(s) that you use.
2. Let's assume that the bolt (projectile), fired from Adam's crossbow with 8 ft-lbs of kinetic energy, had a mass of 20g. How much velocity, in m/s, did the bolt have? (Hint: use your converted values from question 1, which are in N-m, and convert 20g to Kg)
3. Using the same information from question 2, how much momentum did Adam's crossbow bolt have?
4. Let's also assume that the crossbow was 90% efficient (90% of the stored energy of the crossbow went into the bolt). How much energy was stored in the crossbow?
5. Now, imagine that Adam fires a 40g crossbow bolt from the same crossbow. We know from our Interactive Physics simulations, that firing a more-massive bolt will result in a slightly higher efficiency. Let's assume that the crossbow is now 95% efficient. How much kinetic energy will this 40g bolt have?
6. Using the same information from question 5, how fast will this bolt be fired?
7. Using the same information from question 5, how much momentum will the 40g bolt have?
8. From the above questions, compare the kinetic energies of the 20g and 40g bolts. Also compare their momenta. Which quantity, *kinetic energy* or *momentum*, increases more by using the 40g bolt?