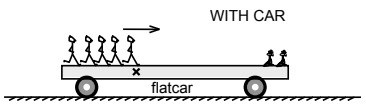
Note that all of these problems are from Fletch's book (that means you have the solutions to them!).

Momentum

Five 300 pound football players stand at one end of a relatively light barge (a few thousand pounds) facing two 200 pound football players at the other end. The center of mass of the barge/player system is shown in the sketch with an x. Someone blows a whistle and the five 300 pounders run toward the two terrified, stationary 200 pounders, tackling them in a heap at the right end of the barge. Ignoring any frictional effects:



a.) In which direction has the center of mass of the barge/players system shifted as a consequence of the motion of the five monsters?

b.) What would the boat's motion be as the 500 pounders ran?

Assuming both are moving with the same speed, which takes more force to stop, a large truck or a small car? If you said the large truck, you may be wrong. How so?

A friend inadvertently shoots you with a low powered bee bee gun. In theory, which would hurt more, for the bee bee to hit and stick without penetrating or for the bee bee to hit and bounce? Explain.

Jack (the idiot) fixes a large fan to his sailboat (note: he may be an idiot, but he's a rich idiot) thinking the boat will move forward if he directs the fan toward the sail. Will this work? Explain.

When a ball freefalls, is momentum conserved? Explain.

A woman initially standing still on a frictionless ice patch pushes a box that is three times her mass.
a.) After the push, how will her momentum compare to the box's momentum (i.e., the same, her momentum is less, her momentum is more, what?)?
b.) Explain your response to *Part a* using the idea of *impulse*.

Two objects have the same momentum. One is twice as massive as the other. Which requires more work to stop? Explain.

Two objects have the same kinetic energy. One is twice as massive as the other. Which will experience the greater momentum change as they come to rest?

A system of particles has some non-zero amount of mechanical energy involved within its assembly. Could the system's total momentum be zero? How about the other way around?

Responding to a very early paper written by Robert Goddard (he would, with time, become the father of rocket science), a January 1920 editorial printed in the *New York Times* chided Goddard for suggesting that space travel was possible. The article pointed out that without atmosphere to push against, a rocket would go nowhere. Space travel is obviously possible, so how does a rocket go "without atmosphere to push against?"

Which would you prefer to tackle, a 100 kg (220 lb) football player running at 5 m/s or a 50 kg (110 lb) football player running at 10 m/s? Explain.

Would you prefer to be hit by a 8800 pound truck moving at 10 mph, or a marble moving with the same momentum?

5.)