

Homework Problem Set 5 - Solution

Exercise 1

To calculate the **net** momentum of the whole swarm, you have to add the momenta of all the insects **vectorially**. If some insects fly to the left, others to the right, etc., their momenta can cancel in this addition, so that the total sum comes out to be zero. Of course, the swarm **as a whole** wouldn't be moving in any particular direction in this case, only the individual members.

Exercise 2

If zero momentum is imparted to the ball, no oppositely directed momentum will be imparted to the thrower. Going through the motions of throwing has **no net** effect. If at the beginning of the throw we begin recoiling backward, at the end of the throw where we pull backward on the ball to keep it from leaving, we recoil forward. No net momentum change means No net recoil.

Exercise 3

The magnitude of force, impulse, and change in momentum will be the same for each. The Ford Escort undergoes the greater acceleration because its mass is less: $\mathbf{a} = \mathbf{F}/m$

Exercise 6

Airbags extend the time over which the driver's body is slowed down when the car suddenly stops (due to a crash). The change in momentum is the same for the driver, but without an airbag, that change has to occur in a much shorter time (when he hits the dashboard), which means that the force will be much larger.

Exercise 7

The momentum of recoil is the same as the momentum of the ball. But velocity is momentum divided by mass. If the momentum of "the world" changes by 24 units (kgm/s), the change in velocity is so miniscule (24 divided by mass of world) that we don't detect it.