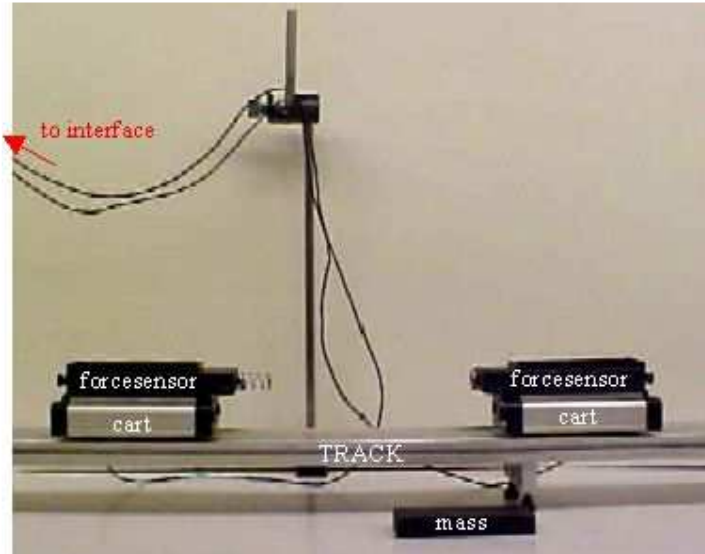


Who is the strongest in a collision?

Aim: To show that Action=-Reaction is always true.

Subjects: 1H10 (Action and Reaction)

Diagram:



Equipment:

- Track, 2.2m.
- Two collision carts.
- Two force sensors, one of them mounted with a spring.
- Mass, 1kg.
- Interface and data-acquisition system (we use PASCO ScienceWorkshop).
- Beamer to project monitorscreen.

Who is the strongest in a collision?

Presentation: Each cart is mounted with a force sensor. The force sensors are connected to the interface (see Diagram). The software is prepared to read and graphically display both forces (-1 to +12N) during about 10 seconds. Both carts are positioned on the track at about .5m away from each other. Recording data is started and by hand both carts are given a push towards each other. A collision occurs and after that the recording of data is stopped. Students see the registered force data (see Figure1).

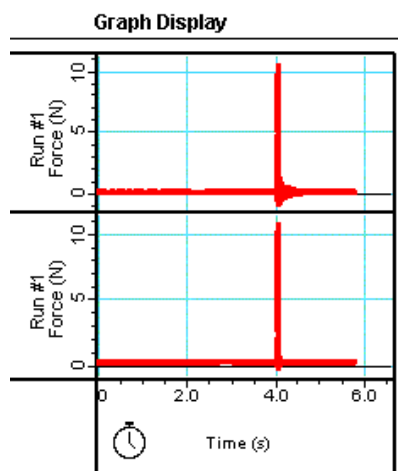


Figure 1

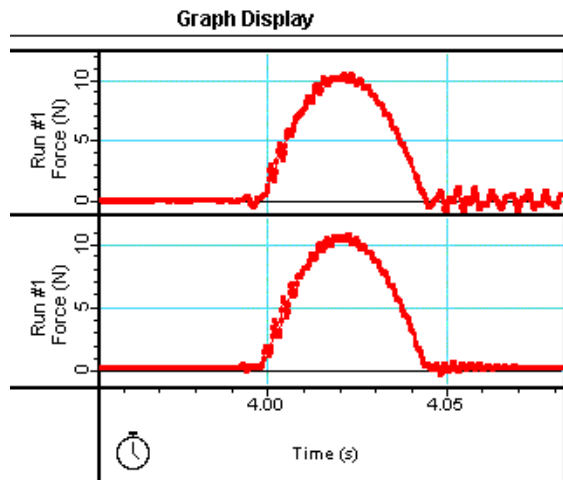


Figure 2

The collision part of the data is magnified (see Figure2). Clearly can be seen that at any moment the force on both carts is the same.

1kg is added to one of the carts. The demonstration is repeated. Also now the forces registered during the collision show that at any time these forces are the same for both carts!

Explanation: Newton's third law states $\vec{F}_{A \rightarrow B} = -\vec{F}_{B \rightarrow A}$ and that is what is supported by the results of these demonstrations.

Remarks:

- The speed you give the carts by hand is, of course, not important. But when students doubt, make also a run with one cart standing still or even moving at a different speed into the same direction. The data-registration will always show $\vec{F}_{A \rightarrow B} = -\vec{F}_{B \rightarrow A}$.
- In Figure2 can be seen which cart has the spring mounted to its force sensor: A damped vibration is seen after the collision. Also the force sensor itself is vibrating after the collision as can be seen in the graph of the other force sensor.

Sources:

- [Mansfield, M and O'Sullivan, C., Understanding physics](#), pag. 119