PHY 211 Homework 8

Due March 11, 2020

$m_E = 2000.0$ kg

$m_{hunter} = 90.0$ kg

$m_{dart} = 0.0400$ kg

$\vec{v}_{dart} = (600 \text{ m/s})(-\hat{\imath})$

$\vec{v}_E = (7.50 \text{ m/s})\hat{\imath}$

$\vec{v}_{hunter} = (7.40 \text{ m/s})\hat{\imath}$

Problem 1. An elephant and a hunter are having a confrontation.
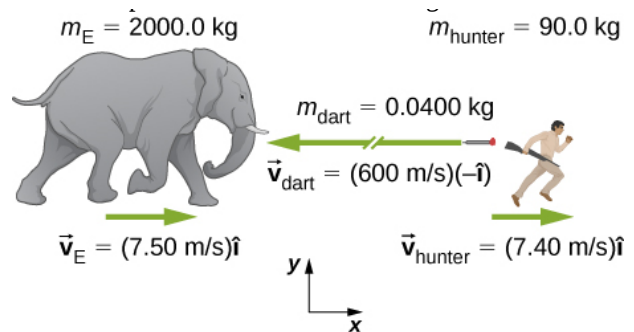
(a) Calculate the momentum of the 2000.0 kg elephant charging the hunter at a speed of 7.50 m/s.

(b) Calculate the ratio of the elephant's momentum to the momentum of a 0.0400 kg tranquilizer dart fired at a speed of 600 m/s.

(c) What is the momentum of the 90.0 kg hunter running at 7.40 m/s after missing the elephant?

Problem 2. A 0.450 kg hammer is moving horizontally at 7.00 m/s when it strikes a nail and comes to rest after driving the nail 1.00 cm into a board. Assume constant acceleration of the hammer–nail pair.

(a) Calculate the duration of the impact.

(b) What was the average force exerted on the nail?

Problem 3. A 20 kg child is coasting at 3.3 m/s over flat ground in a 4.0 kg wagon while carrying a 1.0 kg ball. The child drops the ball out the back of the wagon without pushing it backwards relative to the wagon. What is the speed of the child and wagon after letting go of the ball?

Problem 4. A child sleds down a hill and collides at 5.6 m/s into a stationary sled that is identical to his. The child is launched forward at the same speed, leaving behind the two sleds that lock together and slide forward more slowly. What is the speed of the two sleds after this collision?

Problem 5. One hazard of space travel is debris left by previous missions. There are several thousand objects orbiting Earth that are large enough to be detected by radar, but there are far greater numbers of very small objects, such as flakes of paint. Consider what happens if a $0.100\,\text{mg}$ chip of paint strikes a spacecraft window at a relative speed of $2.0 \times 10^3\,\text{m/s}$, if the collision lasts $1.25 \times 10^{-7}\,\text{s}$.

(a) What is average force exerted on the spacecraft by the paint chip? Is that large compared to the typical forces we see between everyday objects?

(b) What is the change in the momentum of the spacecraft?

(c) If the spacecraft has a mass of $4 \times 10^5\,\text{kg}$, how much would it's velocity change? Is the change large or small?

Problem 6. Two cars approach an extremely icy four-way perpendicular intersection. Assume the two cars have the same mass, and slide frictionlessly on the roads. Car A travels northward at $30\,\text{m/s}$ and car B is travelling eastward. They collide and stick together, traveling at $28°$ north of east. What was the initial speed of car B?

Problem 7. Two identical pucks collide on an air hockey table. Puck 1 was originally at rest; puck 2 has an incoming speed of $6.00\,\text{m/s}$ and scatters at an angle of $\theta = 30°$ with respect to its incoming direction. Puck 1 scatters at an angle $\phi = 60°$ with respect to the same direction. What is the magnitude of the velocity of each puck after the collision?

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