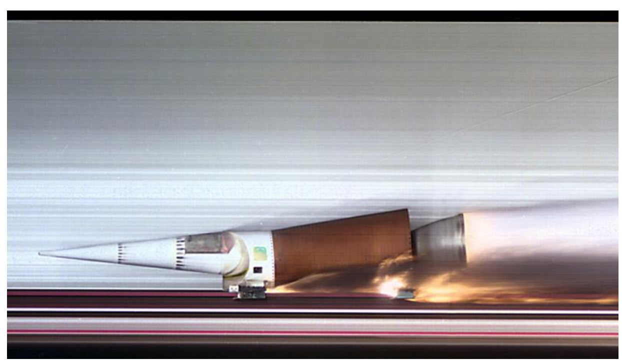
Conservation of Momentum

1. A 5000 kg boxcar moving at 5.2 m/s on a level, frictionless track runs into a stationary 8000 kg tank car. If they hook together in the collision, how fast will they be moving afterwards?
2. A 75 kg girl running at 3.0 m/s jumps onto a sled that has a mass of 10kg and that is already moving in the same direction as the girl, at 2.0 m/s. What will be the final velocity of the girl and the sled assuming that the sled is on level snow and that there is no friction?
3. A 100g ball moving at a constant velocity of 200 cm/s strikes a 400 g ball that is at rest. After the collision, the first ball rebounds straight back at 120cm/s. Calculate the final velocity of the second ball.
4. A 25 kg object moving with a velocity of 3.0 m/s to the right collides with a 15kg object moving to the left at 6.0 m/s. Find the velocity of the 25 kg object after the collision, if the 15 kg object (a) continues to move to the left but only at 0.30 m/s, (b) rebounds to the right at 0.45 m/s. and (c) sticks together with the 25 kg object.
5. A 1.5 kg wooden trolley on wheels is stationary on a horizontal, frictionless track. What will be the final velocity of the trolley if a bullet of mass 2.0 g is fired into it with a horizontal velocity of 300m/s along the direction of the track? (the bullet remains embedded in the trolley, although its mass is really negligible).
6. An experimental rocket sled on a level frictionless track has a mass of $1.4\text{x}10^4$kg. For propulsion, it expels gases from its' rocket engines at a rate of 10 kg/s and at an exhaust speed of $2.5\text{x}10^4$ m/s relative to the rocket. For how many seconds must the engines burn in order that the sled acquire a velocity of 50 m/s starting from rest? (You may ignore the small decrease in mass of the sled and the small speed of the rocket compared to the exhaust gas).



*Hint : Start out by using the **Impulse=Change in Momentum** equation, to figure out how much force the gas is exerting. Apply this force to the mass of the rocket sled.*

Answers: 1. 2.0m/s[forward], 2. 2.9m/s[forward], 3. 80cm/s[forward], 4a. 0.42m/s[left], 4b. 0.87m/s[left], 4c. 0.38m/s[left] 5. 0.40m/s[forward], 6. 2.8s