1. A boxer throws a punch and delivers an impulse of 100 kg m/s to his opponent. What force would his opponent feel if the punch was delivered over a time of 0.1 seconds ? What force would his opponent feel if the punch was delivered over a time of 0.8 seconds ? Does it matter to the punchee how long it takes to get punched ?

2. How long would it take to slow down a 1,000,000 kg super tanker traveling at a speed of 10 m/s to stop if the pilot shuts down the engines, and the maximum force of friction with the water would be 8,000 N, how long will it take to stop the ship ?

3. A large caliber howitzer has a mass of 2,000 kg, and fires a shell with a mass of 100 kg at a speed of 500 m/s. What would be the recoil speed of the gun after the shell is fired ?

4. A 10 year old kid shoots his bb gun at a tin can, and hits it so that the bb gets caught in the can,knocking the can off of the fence. If the mass of the bb is 2 grams, and the can's mass is 60 grams, what must the muzzle velocity of the bb gun be if the can and bb fall together at a speed of 5 m/s ?

5. If a little kid tees off on a golf ball, using a club which has a mass of 1.2 kg. If the club approaches the 102 gram ball with a velocity of 20 m/s, what velocity will the kid give to the ball if the club continues forward after the impact with a velocity of 17 m/s ?

6. What change in momentum does a 2 kg hammer experience if it pushes with a force of 50 N on a 10 gram nail for a period of .2 second ? What impulse will be given to the nail ? What force does the nail experience ? What would be the change in velocity for both objects ?

7. Super Dave runs toward a tightly suspended sheet of rubber at a rate of 7 m/s. If Dave's mass is 80 kg, and the sheet supplies him with enough force to toss him backwards at 6 m/s, what impulse has he experienced ?

8. Deion Sanders, touching the ball perhaps once too often for a man so pretty, runs at 8 m/s toward the goal line in the 2000 Super Duper Bowl. At the goal line, Fat Albert whose mass is a healthy 175 kg, approaches steadily at 5 m/s. As a result of their collision, Deion is bounced backward at a speed of 5 m/s. If his mass is 95 kg, and the time of contact between the athletes was 0.2 seconds, what force does the nimble little guy experience ?

9. In a mosh pit at a Violent Femmes concert, a 70 kg kid runs into an unsuspecting 150 kg bouncer who is looking the other way. The bouncer is less than amused, and, after both guys pick themselves up, the bouncer heaves the kid into the crowd at a rate of 5 m/s. What force must he have applied to the fan in the one second it took to accelerate him from rest, and what will be the recoil speed of the bouncer ?

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1. 1,000 N - ouch !, 125 N - if I had to get punched, I think I'd try to stretch the punch out over a week or two.
2. 1250 seconds, or around 21 minutes - no kidding ! 3. 25 m/s in the opposite direction
4. 155 m/s, which is actually pretty slow by bb gun standards 5. 35 m/s
6. 10 N•s, 10 N•s, 50 N ! Ah - now that part's different, isn't it ? v_{hammer} = 5 m/s, v_{nail} = 1,000 m/s Yikes !
7. 1040 kg m/s, or 1040 N•s worth of impulse 8. 6175 N - bring out the stretcher.....
9. 350 N, - 2.3 m/s, or 2.3 m/s in the opposite direction