Momentum Conservation (key)

1. $m = p/v$; $m$ = (10.0 kg·m/sec) / (1.5 m/sec); $m$ = 6.7 kg
2. $v = p/m$; $v$ = (1000 kg·m/sec) / (2.5 kg); $v$ = 400 m/sec

3. $p = mv$
   (mass is conventionally expressed in kilograms)
   $p$ = (0.045 kg)(75.0 m/sec)
   $p$ = 3.38 kg·m/sec
4. $p_{(\text{before firing})} = p_{(\text{after firing})}$
   $m_1v_1 + m_2v_2 = m_3v_3 + m_4v_4$
   400 kg(0 m/sec) + 10 kg(0 m/sec) = 400 kg($v_2$) + 10 kg(20 m/s)
   0 = 400 kg(v2) + 200 kg·m/sec ($v_2$) = (-200 kg·m/sec)/400 kg ($v_2$) = -0.50 m/sec
5. $p_{(\text{before throwing})} = p_{(\text{after throwing})}$
   $m_1v_1 + m_2v_2 = m_3v_3 + m_4v_4$
   0 = $m_1$(0.05 m/sec) + 0.5 kg(10.0 m/sec)
   $m_1$ = (-0.5 kg)(10.0 m/sec)/ (0.05 m/sec)
   "Big" Al's mass + the skateboard ($m_1$) = 100 kg
6. Answers are:
   a. $p = mv + \Delta p$; $p = mv + F\Delta t$
      $p$ = (80 kg)(3.0 m/sec) + (800 N)(0.30 sec)
      $p$ = 480 kg·m/sec
   b. $v = p/m$; $v$ = (480 kg·m/sec)/80 kg; $v$ = 6.0m/sec
7. Answers are:
   a. $p = mv$; $p$ = (2000 kg)(30 m/sec); $p$ = 60,000kg·m/sec
   b. $F\Delta t = m\Delta v$
      $F = (m\Delta v)/(\Delta t)$; $F$ = (60,000 kg·m/sec)/(0.72 sec)
      $F$ = 83,000 N
8. Answers are:
   a. $P$ = (# of people)($mv$); $p = (2.0 \times 10^9)$(60 kg)(7.0 m/sec);
      $p = 8.4 \times 1{,}0^{11}$ kg·m/sec
   b. $p_{(\text{before jumping})} = p_{(\text{after jumping})}$
      $m_1v_1 + m_2v_2 = m_3v_3 + m_4v_4$
      $0 = 8.4 \times 10^{11}$ kg·m/sec + $5.98 \times 10^{24}(v_4)$;
      $(v_4) = (-8.4 \times 10^{11}$ kg·m/sec)/ 5.98 x $10^{24}$
      Earth moves beneath their feet at the speed,
      $v_4 = -1.4 \times 10^{-13}$ m/sec
9. Answers are:
   a. $p = mv$; $p$ = (60 kg)(6.00 m/sec); $p$ = 360 kg·m/sec
   b. $v_{av} = (v_i + v_f)/2$; $v_{av}$ = (6.00 m/sec + 0 m/sec)/2 = 3.00 m/sec

      $\Delta t$ = d/$\Delta$V; $\Delta$t = 0.10 m/3.00 m/sec; $\Delta$t = 0.033 sec
      F$\Delta$t = m$\Delta$V; F = (m$\Delta$V)/$\Delta$t;
      F = (60 kg)(6.00 m/sec)/(0.033 sec); F = 11,000 N
10. Since the gun and bullet are stationary before being fired, the momentum of the system is zero. The "kick" of the gun is the momentum of the gun that is equal but opposite to that of the bullet maintaining the "zero" momentum of the system.
11. It means that momentum is transferred without loss.