Multiple choice. Indicate the best answer.

1. What are the units of momentum?
   1. J/s
   2. N/s
   3. kg/m/s
   4. kg m/s
2. What is the momentum of a 6.0 kg bowling ball moving at 3.0 m/s?
   1. 0.5 m/s/kg
   2. 2.0 kg/m/s
   3. 9.0 kg m/s
   4. 18 kg m/s
3. How fast would a 75 kg person have to be running in order to have 450 kg m/s of momentum?
   1. 0.17 m/s
   2. 6.0 m/s
   3. 525 m/s
   4. 33,750 m/s
4. Two toy cars have the same momentum. One has a mass of 1.5 kg and is moving at 3 m/s. the other is moving at 4.5 m/s. What is the mass of the second car?
   1. 1 kg
   2. 2.25 kg
   3. 9.0 kg
   4. 20.25 kg
5. What is the impulse delivered to a 0.125 g golf ball when a force of 250 N is applied for 0.2 seconds?
   1. 6.25 N s
   2. 50 N s
   3. 250.2 N s
   4. 1250 N s
6. Which of the following equations is NOT true?
   1. Ft = mΔv
   2. J = Δp
   3. Ft = m/v
   4. J = Δmv
7. A force of 3 N is applied to a 0.250 kg baseball for 2 seconds. A force of 2 N is applied to a 4.5 kg bowling ball for 3 seconds. Which experiences a greater change in momentum?
   1. The baseball
   2. The bowling ball
   3. They experience the same change in momentum
   4. It is impossible to tell without additional information.
8. A 2 kg skateboard is subject to a variable force shown in the graph to the right. What is the change in momentum of the skateboard?
   1. 0 kg m/s
   2. 3 kg m/s
   3. 9 kg m/s
   4. 18 kg m/s

**Long Answer. Answer the following questions, showing all work.**

1. At what speed must a 35 kg cheetah move in order to have the same momentum as a 25 kg gazelle running at 20 m/s?
2. A 1200 kg car accelerates from rest to 25 m/s in 6 seconds.
   1. What was the car’s change in momentum?
   2. What impulse was delivered to the car?
   3. What was the net force on the car?
3. A 0.15 kg baseball, moving to the left at 35 m/s is hit to the right by a baseball bat. The bat is in contact with the ball for 0.025 s and applies a force of 730 N.
   1. What was the change in momentum of the ball?
   2. What is the new speed of the ball?
4. James Bond’s Aston Martin with combined mass 1250 kg (car and driver) is driving at 55 m/s when Dr. No’s evil forces approach him from the rear. To escape, Bond fires his internal rocket engine which provides a force of 2.5 × 104 N for 2.5 seconds. What is the final velocity of Bond’s Car?
5. The 80,000 kg space shuttle has an orbital speed of 7500 m/s.
   1. What impulse is necessary to get the space shuttle to orbital speed from rest?
   2. If we were to assume a constant force of 7.7 × 105 Newtons of force on the shuttle during launch, how long does it take to reach orbital speed?