Practice Problems, Chapter 4

Sum \( \sum \vec{F} = m\vec{a} \) \quad Weight = F_g = mg

1. Why do you lunge forward when your car suddenly comes to a halt? Why are you pressed backwards against a seat when your car rapidly accelerates? In your explanations refer to Newton’s Laws.

2. The net external force acting on an object is zero. Is it possible for the object to be traveling with a velocity that is not zero? If your answer is yes, state what conditions must be placed on the magnitude and direction of the velocity. If your answer is no, provide a reason for your answer.

3. Newton’s second Law indicates that when a net force acts on an object, it must accelerate. Does this mean that when two or more forces are applied to an object simultaneously, it must accelerate? Explain

4. A 7.00 kg bowling ball experiences a net force of 5.00 N. What will be its acceleration?

5. An astronaut applies a force of 500 N to an asteroid and it accelerates at 7.00 m/s^2. What is the asteroid’s mass?

6. Acceleration due to gravity on the moon’s surface is 1/6th that on Earth. An astronaut’s life support backpack weighs 300 lb on Earth. In pounds, what does it weigh on the moon?
7. Two ropes are attached to a 40.0 kg object. The first rope applies a force of 25.0 N and the second a force of 40.0 N. If the two ropes are perpendicular to each other, what is the resultant acceleration of the object? (Hint: Draw a force diagram showing the forces acting on the object. Find the net force by adding the two forces vectorally. Use the net force to find the magnitude and direction of the acceleration. Keep in mind that the direction of the acceleration is in the same direction as the net force.)

8. An 8.00 kg rock is rolled in the sand. It starts at 5.00 m/s, moves in a straight line for a distance of 3.00 m, and then stops. What is its average acceleration? What was the average net force acting on the rock as it slowed down?

9. Rita accelerates a 0.400 kg ball from rest to 9.00 m/s during the 0.150 s in which her foot is in contact with the ball. What average force does she apply to the ball during the kick?

10. An elevator weighing 20,000 N (weight = \(F_g\)) is supported by a steel cable. What is the tension in the cable, \(F_T\), when the elevator is being accelerated upward at a rate of 3.00 m/s\(^2\)? (\(g = 9.80 \text{ m/s}^2\)) (Hint: Use Newton’s 2\(^{nd}\) Law and add the force vectors up to find \(F_{\text{net}}\))
11. An automobile of mass 2000. kg moving at 30.0 m/s, is braked suddenly, with a constant braking force of 10,000. N. How far does the car travel before stopping?

12. When you jump up, does the world recoil downward? Explain.

13. When a rifle is fired, how does the size of the force of the rifle on the bullet compare to the force of the bullet on the rifle?

   b) How do the accelerations of the rifle and bullet compare? Why?

14. If a bicycle and a massive truck have a head-on collision, upon which vehicle is the impact force greater?

   b) Which vehicle undergoes the greater change in acceleration? Why?

15. Suppose two carts, one twice as massive as the other, fly apart when the compressed spring that joins them is released. How fast does the heavier cart roll compared to the lighter cart? Explain.
16. A semi-truck collides with a car with a force of 5000N. The semi-truck has a mass of 2000kg and the car has a mass of 500kg.

a) What force did the car exert on the semi-truck at impact?

b) What was the acceleration of the truck when it hit the car?

c) How much did the car accelerate when it was hit?

d) If the action statement is ‘The semi-truck exerts a force on the car,’ what is the reaction statement?