Name: _____ **Date:** _____ **Period:** _____

Newton's Laws Practice Worksheet

Instructions: Read each question carefully. Show all work for short-answer problems. For multiple-choice questions, circle the letter of the best answer. Use the space provided for any diagrams or labels.

1. A 5.0 kg box is pushed across a frictionless floor with a constant force of 20 N. What is the acceleration of the box?

2. Which of the following best describes Newton's First Law of Motion?

   (a) Force equals mass times acceleration.

   (b) For every action, there is an equal and opposite reaction.

   (c) An object at rest stays at rest, and an object in motion stays in motion with the same speed and direction unless acted upon by an unbalanced force.

   (d) The acceleration of an object is directly proportional to the net force and inversely proportional to its mass.

3. A 12 kg object experiences a net force of 48 N. Calculate the acceleration of the object.

4. Label the forces acting on a book resting on a table. Draw and label arrows for the gravitational force (weight) and the normal force. Assume the book is stationary.

5. Two students push on a 150 kg cart. One pushes with 75 N to the right, and the other pushes with 45 N to the left. What is the net force on the cart? What is its acceleration?

6. According to Newton's Third Law, if you push against a wall with a force of 100 N, what force does the wall exert on you?

7. A 0.50 kg ball is thrown with an acceleration of 15 m/s^2. What is the net force acting on the ball?

8. A car is moving at a constant velocity of 20 m/s on a straight, level road. Which of the following is true about the forces acting on the car?

   (a) The net force is zero.

   (b) The net force is in the direction of motion.

   (c) The net force is opposite the direction of motion.

   (d) The net force is increasing.

9. A 60 kg person is standing on a scale in an elevator. The elevator is accelerating upward at 2.0 m/s^2. What is the reading on the scale? (Use $g = 9.8$ m/s^2.)

10. A 10 kg crate is pulled across a rough floor with a force of 50 N at an angle of 30° above the horizontal. The frictional force opposing motion is 15 N. Draw a free-body diagram showing all forces acting on the crate. Then calculate the net horizontal force on the crate.

Answer Key

1. $F = ma \Rightarrow a = \frac{F}{m} = \frac{20\text{ N}}{5.0\text{ kg}} = 4.0\text{ m/s}^2$
2. (c) An object at rest stays at rest, and an object in motion stays in motion with the same speed and direction unless acted upon by an unbalanced force.
3. $F = ma \Rightarrow a = \frac{F}{m} = \frac{48\text{ N}}{12\text{ kg}} = 4.0\text{ m/s}^2$
4. Diagram should show: an upward arrow labeled "Normal Force" from the table on the book, and a downward arrow labeled "Weight" (or F_g) from the center of the book. Both arrows are equal in length.
5. Net force: $75\text{ N} - 45\text{ N} = 30\text{ N}$ to the right. Acceleration: $a = \frac{F_{\text{net}}}{m} = \frac{30\text{ N}}{150\text{ kg}} = 0.20\text{ m/s}^2$ to the right.
6. The wall exerts a force of 100 N back on the person, in the opposite direction.
7. $F = ma = (0.50\text{ kg})(15\text{ m/s}^2) = 7.5\text{ N}$
8. (a) The net force is zero. (Constant velocity implies zero net force.)
9. The scale reads the normal force. $F_{\text{net}} = ma = (60\text{ kg})(2.0\text{ m/s}^2) = 120\text{ N}$ upward. $F_{\text{net}} = F_N - mg \Rightarrow F_N = mg + F_{\text{net}} = (60\text{ kg})(9.8\text{ m/s}^2) + 120\text{ N} = 588\text{ N} + 120\text{ N} = 708\text{ N}$
10. Free-body diagram: weight down, normal force up, applied force at 30° above horizontal (rightward), friction leftward. Net horizontal force: $F_{\text{applied},x} = 50\text{ N}\cos 30° \approx 43.3\text{ N}$. $F_{\text{net},x} = 43.3\text{ N} - 15\text{ N} = 28.3\text{ N}$ to the right.