**Newton's Second Law Pre-Lab**
**Student Worksheet Answer Key**

**Use Newton's Second Law to solve the following work problems. In each one, record the measurements for force, mass, and acceleration, and write out the formula you will use to solve it.**

**Force = mass x acceleration** **acceleration = Force / mass** **mass = Force / acceleration**

1. What net force is required to accelerate a car at a rate of 5 $m/s^2$ if the car has a mass of 5,000 kg?

   F = ? Force = mass x acceleration

   m = 5,000 kg Force = 5,000kg x 5 $m/s^2$

   a = 5 $m/s^2$ Force = 25,000 N

2. What is the mass of a truck if it produces a force of 20,000 N while accelerating at a rate of 5 $m/s^2$ ?

   F = 20,000 N mass = Force / acceleration

   m = ? mass = 20,000 N / 5 $m/s^2$

   a = 5 $m/s^2$ mass = 4,000 kg

3. A 12 kg ball would require what force to accelerate down the bowling alley at a rate of 4 $m/s^2$?

   F = ? Force = mass x acceleration

   m = 12 kg Force = 12kg x 4 $m/s^2$

   a = 4 $m/s^2$ Force = 48 N

4. A car with a mass of 1000 kg produces a force of 5000 N. How fast will it accelerate?

   F = 5000 N acceleration = Force / mass

   m = 1000kg acceleration = 5000 N / 2000 kg

   a = ? acceleration = 5 $m/s^2$

5. What is the acceleration of a baseball if it has a mass of 0.5 kg and hits the catcher's glove with a force of 38 N?

   F = 38 N acceleration = Force / mass

   m = 0.5 kg acceleration = 38 N / 0.5 kg

   a = ? acceleration = 76 $m/s^2$

6. A car accelerates at 5 $m/s^2$. If the car has a mass of 1000 kg, how much force does the car produce?

| | |
|---|---|
| F = ? | Force = mass x acceleration |
| m = 1000 kg | Force = 5000 N / 800 kg |
| a = 5 $m/s^2$ | Force = 5000 N |

7. The owner of the car in #6 wants to accelerate even faster, he removes 200 kg of mass from his car. How fast will the car accelerate if it produces 5000 N of force?

| | |
|---|---|
| F = 5000 N | acceleration = Force / mass |
| m = 800 kg | acceleration = 5000 N / 800 kg |
| a = ? | acceleration = 6.25 $m/s^2$ |

8. A marathon runner exerts a force of 50 N in order to accelerate 1 $m/s^2$. What is the runner's mass?

| | |
|---|---|
| F = 50 N | mass = Force / acceleration |
| m = ? | mass = 50 N / 1 $m/s^2$ |
| a = 1 $m/s^2$ | mass = 50 kg |

9. Two cars are racing around a track. One car runs off the track and strikes a large bale of hay. The car still produces 6000 N of force, but now it accelerates at only 3 $m/s^2$. What is the mass of the car now that the bale of hay is stuck to it?

| | |
|---|---|
| F = 6000 N | mass = Force / acceleration |
| m = ? | mass = 6000 N / 3 $m/s^2$ |
| a = 3 $m/s^2$ | mass = 2000 kg |

10. Even though the car in #9 is losing, the driver activates the engine to run on nitrous oxide fuel. The nitrous oxide allows his car to develop 20,000 N of force. If the mass of the car hasn't changed, what is the car's new acceleration?

| | |
|---|---|
| F = 20,000 N | acceleration = Force / mass |
| m = 2000 kg | acceleration = 20,000 N / 2000 kg |
| a = ? | acceleration = 10 $m/s^2$ |