Newton’s Second Law of Motion

1. A little boy pushes a wagon with his dog in it. The mass of the dog and wagon together is 45 kg. The wagon accelerates at 0.85 m/s². What force is the boy pulling with?

2. A 1650 kg car accelerates at a rate of 4.0 m/s². How much force is the car’s engine producing?

3. A 68 kg runner exerts a force of 59N. What is the acceleration of the runner?

4. A crate is dragged across an ice covered lake. The box accelerates at 0.08 m/s² and is pulled by a 47 N force. What is the mass of the object?

5. Three women push a stalled car. Each woman pushes with a 425 N force. What is the mass of the car if the car accelerates at 0.85 m/s²?

6. A tennis ball, 0.314 kg, is accelerated at a rate of 164 m/s² when hit by a professional tennis player. What force does the player’s tennis racket exert on the ball?

7. In an airplane crash a woman is holding an 8.18 kg baby. In the crash the woman experiences a horizontal de-acceleration of 88.2 m/s². How much force must the woman exert to hold the baby in place?

8. When an F-14 airplane takes-off an aircraft carrier it is literally catapulted off the flight deck. The plane’s final speed at take-off is 68.2 m/s. The F-14 starts from rest. The plane accelerates in 2 seconds and has a mass of 29,545 kg. What is the total force that gets the F-14 in the air?

9. A sports car accelerates from 0 to 60 mph, 27 m/s, in 6.3 seconds. The car exerts a force of 4106 N. What is the mass of the car?

10. A sled is pushed along an ice covered lake. It has some initial velocity before coming to a rest in 15 m. It took 23 seconds before the sled and rider came to a rest. If the rider and sled have a combined mass of 52.5 kg, what is the magnitude of the stopping force?

11. A car is pulled with a force of 10,000 N. The car’s mass is 1267 kg. But, the car covers 394.6 m in 15 seconds. What is the expected acceleration of the car from the 10,000 N force?

12. A boy can accelerate at 1.00 m/s² over a short distance. If the boy were to have an energy drink and suddenly have the ability to accelerate at 5.6 m/s², then how would his new energy drink force compare to his earlier force? If the boy’s earlier force was 45N, what is the size of his energy drink force?

13. A race car exerts 19,454 N while the car travels at an acceleration of 91.36m/s². What is the mass of the car?
Newton’s Laws – Activity

Directions: Mark each of the following situations as an example of Newton’s First (1\textsuperscript{st}), Second (2\textsuperscript{nd}), or Third (3\textsuperscript{rd}) Law. Then explain in complete sentences how the situation is an example of that particular law.

1. A magician pulls a tablecloth out from under dishes and glasses on a table without disturbing them. 
   Explain Your Answer:

2. A person’s body is thrown outward as a car rounds a curve on a highway.
   Explain Your Answer:

3. Rockets are launched into space using jet propulsion where exhaust accelerates out from the rocket and the rocket accelerates in an opposite direction.
   Explain Your Answer:

4. A picture is hanging on a wall and does not move.
   Explain Your Answer:

5. A person not wearing a seatbelt flies through a car window when someone slams on the breaks because the person’s body wants to remain in continuous motion even when the car stops.
   Explain Your Answer:

6. Pushing a child on a swing is easier than pushing an adult on the same swing, because the adult has more inertia.
   Explain Your Answer:

7. A soccer ball accelerates more than a bowling ball when thrown with the same force.
   Explain Your Answer:

8. A soccer player kicks a ball with their foot and their toes are left stinging.
   Explain Your Answer:

9. A student leaves a pencil on a desk and the pencil stays in the same spot until another student picks it up.
   Explain Your Answer:

10. Two students are in a baseball game. The first student hits a ball very hard and it has a greater acceleration than the second student who bunts the ball lightly.
    Explain Your Answer: