# Newton's 2nd Law
## **Show all of your work!!**

1) The net external force on the propeller of a .75 kg model airplane is 17 N forward. What is the acceleration of the airplane?

2) The net external force on a golf cart is 390 N north. If the cart has a total mass of 270 kg, what are the magnitude and direction of its acceleration?

3) A car has a mass of 1500 kg. What force is required to accelerate the car at 4.5 m/s squared to the east?

4) A 6.0 kg object undergoes an acceleration of 2.0 m/s squared.
   a) What is the magnitude of the net external force acting on it?

   b) If this same force is applied to a 4.0 kg object, what acceleration is produced?

5) A type of elevator called a *cage* is used to raise and lower miners in a mine shaft. Suppose the cage carries a group of miners down the shaft. If the unbalanced force on the cage is 60.0 N, and the mass of the loaded cage is 150 Kg, what is the **acceleration** of the cage?

6) The whale shark is the largest of all fish and can have the mass of three adult elephants. Suppose that a crane is lifting a whale shark into a tank for delivery to an aquarium. The crane must exert an unbalanced force of 25,000 N to lift the shark from rest. If the shark's acceleration equals 1.25 m/s$^2$, what is the shark's **mass**?

7) In drag racing, acceleration is more important than speed, and therefore drag racers are designed to provide high accelerations. Suppose a drag racer has a mass of 1250 Kg and accelerates at a rate of 16.5 m/s$^2$. How large is the unbalanced **force** acting on the racer?

8) Assume that a catcher in a professional baseball game exerts a force of -65.0 N to stop the ball. If the baseball has a mass of 0.145 Kg, what is its **acceleration** as it is being caught?

9) The Petronas Twin Towers in Malaysia is 452 meters tall. Suppose a tourist tosses an apple off of the very top of one of the buildings and it falls with a force of 3.6 N, and its acceleration is 9.8 m/s$^2$, what is the apple's **mass**?

10) If a 52,200,000 Kg luxury cruise ship is accelerating at a rate of -0.357 m/s$^2$ as it comes into port. How large is the **unbalanced force** acting on the ship to make it stop in the proper location?

## 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/s$^2$.  What force is the boy pulling with?

2.  A 1650 kg car accelerates at a rate of 4.0 m/s$^2$.  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/s$^2$ 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/s$^2$?

6.  A tennis ball, 0.314 kg, is accelerated at a rate of 164 m/s$^2$ 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/s$^2$ .  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/s$^2$ over a short distance.  If the boy were to have an energy drink and suddenly have the ability to accelerate at 5.6 m/s$^2$, 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/s$^2$.  What is the mass of the car?