

Chapter 3: Forces and Newton's Laws

Section 3: Using Newton's Laws

Car accidents – what happens:

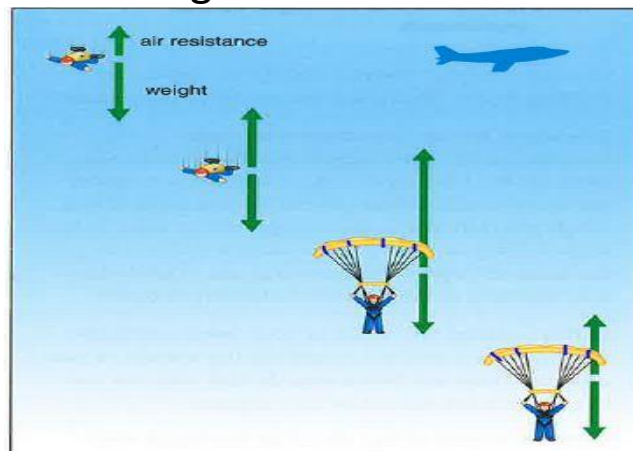
- When a car crashes into an object, the car slows down and stops within 0.1 s. The passengers of the car still move because of Newton's first law. This is why seat belts and air bags are important.
- Activity time!

Weight in physics:

- Remember $F = ma$
 - When working with mass and weight, it changes to $F_g = mg$
 - F_g = weight in Newtons
 - m = mass in kg
 - g = acceleration due to gravity = 9.8 m/s^2 (Earth)

Air resistance: a friction-like force that opposes the motion of objects that move through the air

- Sometimes called “drag”



- $F_{ar} = ma$
 - F_{ar} = Force of air resistance in N
 - m = mass in kg
 - a = acceleration in m/s^2
- Air resistance always opposes motion. So, if you are falling down, air resistance is up. If you are driving east and you have a head wind, the wind is the air resistance traveling west.
- The amount of air resistance depends on the size, shape, and speed of the object.
 - Air resistance, not mass, is the reason feathers, leaves, and paper fall more slowly than a ball.
- If there was no air resistance, two objects would hit the floor at exactly the same time.
 - Activity time! (two balls vs. paper ball and paper)

Terminal velocity: the maximum speed an object will reach when falling through a substance, such as air

- In the above picture, the second and last images have reached terminal velocity.
 - The object will be falling at a constant speed.
 - Look at picture above and identify the net force.

Free fall: when gravity is the only force acting on an object

- There is no air resistance acting on the object
- Earth is in free fall around the Sun

Stepping on a scale:

- You push down on the scale (weight) and the scale pushes back an equal force on you (scales reading of your weight).
 - The net force between the two readings is zero.

Centripetal force: a force exerted toward the center of a curved path

- The net force is also towards the center of the curved path.
- Gravity is the centripetal force that keeps planets orbiting the Sun.
- Vehicle going around a curve has friction between the road and tires that act like the centripetal force. When the friction is small (think icy roads), there is not enough to keep the person on the road, and they go straight into the ditch.

Law of conservation of momentum: when no external forces act on a group of objects, their total momentum does not change

- This is assuming that friction is too small to cause a noticeable change.
 - FRICTION is always in play though!
- Think of two billiard balls. When you hit the cue ball and it strikes another ball, the momentum of the cue is “lost” and then “gained” by the second ball.

