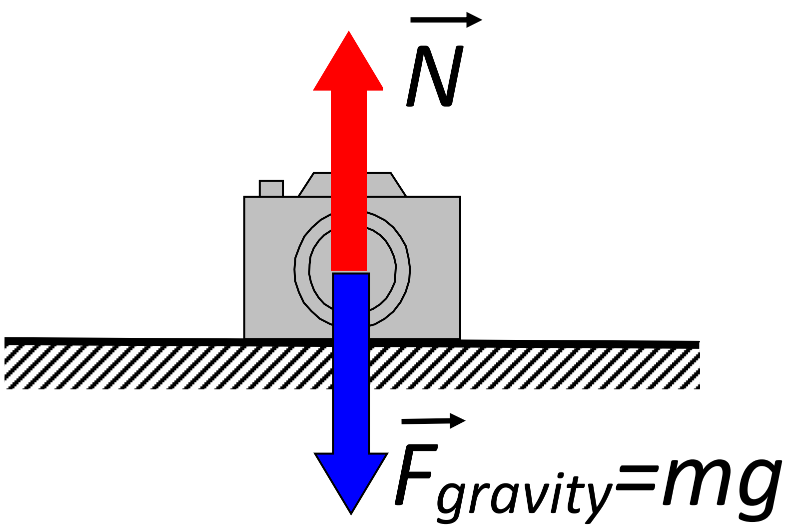
Normal force.

Any time we put an object (a camera) on a table, floor or any other surface this object apply force to this surface. The origin of this force may be just the gravity (the camera is attracted by Earth). You can also apply additional force to the camera by pressing it down with your hand. Since the camera is still not moving in vertical direction (in case you a not too strong☺) – the vertical acceleration of the camera is zero. This means that the gravity force is compensated by some other force or forces.

The camera applies force to the table because the camera is attracted by the Earth. According to the third Newton’s law the surface of the table applies the force of equal magnitude and opposite direction to the camera. This force does not allow the camera to go down through the table. We will call this force as “normal force”. Normal force is directed perpendicularly to the supporting surface. (Just to remind: two straight lines are called perpendicular if they cross at the right angle. A straight line is called perpendicular (“normal”) to the plane if the line is perpendicular to any straight line belonging to the plane)



As we can see in the picture, if the camera just lies on the table, the magnitude of the normal force is equal to the magnitude of the gravity force.

$$ma = N - mg = 0$$

$$N = mg$$

Here our “positive” axis is directed up.

If we will press the camera down with a force F_{press} the normal force will increase to compensate both the gravity force and the pressure force.

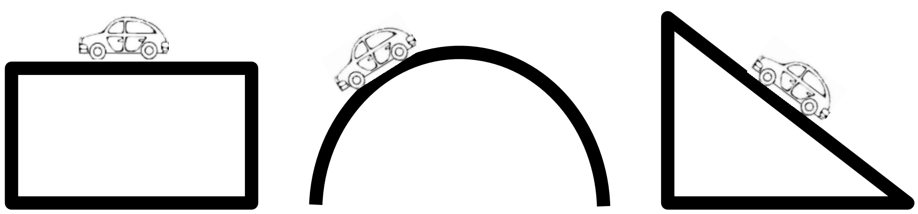
$$ma = N - mg - F_{press} = 0$$

$$N = mg + F_{press}$$

We will define the ***weight*** of an object as total force applied by the object to the support. The magnitude of the weight is equal to the magnitude of the normal force.

Problems:

1. Mark the direction of the normal force applied to the car:



2. You are staying in an elevator on big spring scales. The elevator starts moving with acceleration. Your weight (as the spring scales show) has increased 1.5 times. Find the acceleration of the elevator? Make a picture and explain.

3. The gravity force on the surface of the Moon is about 6 times less than this on the Earth. What will happens with your weight and mass on the Moon?

4. Weigh a small metal object using spring scales. Then without taking object off spring scales dip the object in the water (please leave the scales over the water surface). What happens to the weight?

5. A slightly compressed very light coiled spring is released and pushes two carts in opposite directions (see figure below). The carts are different. After the spring is fully stretched the left cart has a velocity of 4cm/s and the right cart has a velocity of 60cm/s. Which cart has higher mass and how many times this mass is higher than the mass of the other cart?