NORMAL FORCE CONTINUED.

NOVEMBER 20, 2023

Theory recap

Today we continued discussing normal force. As we derived last time, when object has no vertical acceleration, normal force cancels the gravity force acting on the object:

$$mg - N = 0 \;\Rightarrow\; N = mg$$

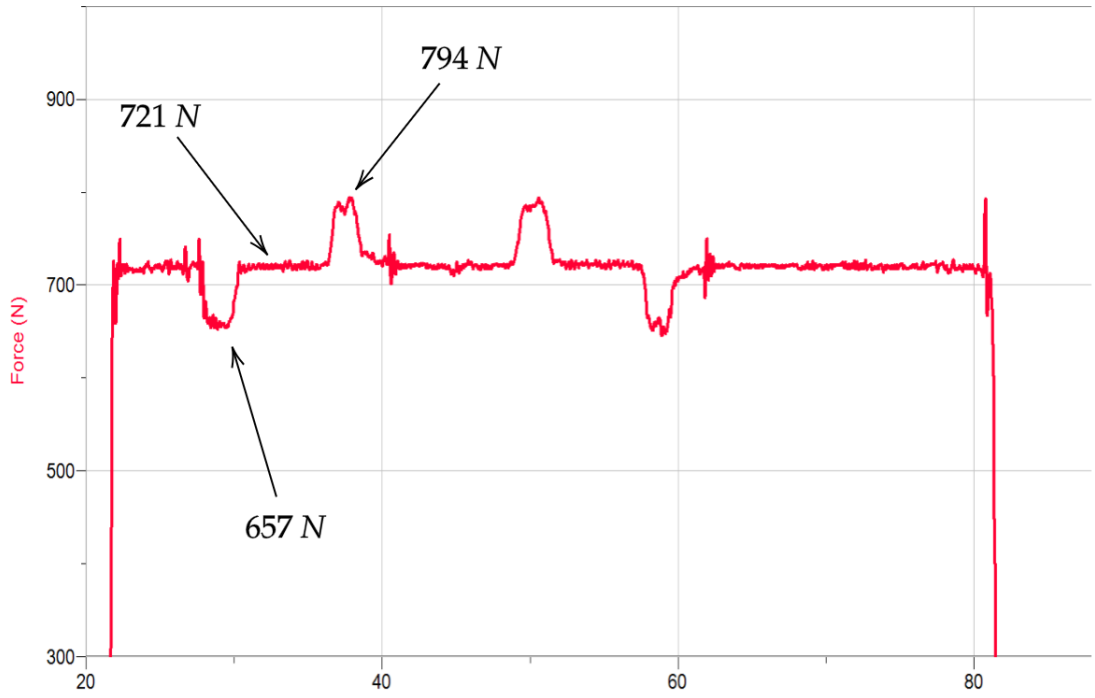
If an object is moving with acceleration, normal force changes compared to when it is at rest. Let us assume that an object of mass m is in an elevator which is moving with acceleration a directed up. The net force up in terms of normal and gravitational forces is $F_{net} = N - mg$, and by Newton's second law for the this object:

$$F_{net} = N - mg = ma \Longrightarrow \boxed{N = mg + ma}$$

We see that for positive a (acceleration up) normal force is increased (compared to normal force at rest) and for negative a (acceleration down) normal force is decreased.

Homework

1. In this problem using the data obtained in the elevator experiment you will need to calculate the upwards and downwards acceleration of the elevator. On the next page there is the plot (which is the result of our experiment) of how normal force acting on a person riding an elevator changes with time. It has the relevant data points provided. In order to find the person's mass, use the fact that when there is no acceleration, normal force measured by the scales is equal to the gravitational force acting on the person. Knowing the mass and normal force during downward acceleration you will **find the downward acceleration**. Then similarly **find the upward acceleration**. You can use $10\ \frac{\mathrm{m}}{\mathrm{s}^2}$ for the free fall acceleration.



2. A tiger has mass 200 kg. It jumps vertically upwards so that normal force acting on it is 3500 N. Find acceleration of the tiger at this moment.

The problem below is a bonus problem.

***3.** Find the force with which a 1 kg block attracts the Earth due to gravity. What is Earth's acceleration due to this force (assuming this was the one and only force acting on the Earth)? Earth's mass is approximately $6 \cdot 10^{24}$ kg.