Elevators Revisited

We last looked at elevators in terms of tension and the total force.

While studying them, we made a few observations:

- when accelerating up, we feel heavier
- when accelerating down, we feel lighter
- when at uniform motion, we feel normal

We will now explain these observations in terms of gravity.

Situation 1: Accelerating Up

- Disregard tension in the elevator.

Q - What forces are acting on the rider?

$\vec{F}_g$ acting down
$\vec{F}_N$ acting up
$\vec{F}_{Tot}$ acting up

In this type of question, we have two weights:

1. **True Weight**: the force of gravity acting downwards.

2. **Apparent Weight**: the opposite of the normal force, which makes the rider "feel" lighter or heavier.

- Our rider has a true weight, F_g, acting downwards. This weight stays the same throughout the problem.
- Our rider is on a scale which will measure the rider's apparent weight, which varies depending on the direction the elevator moves in.

Finding Apparent Weight (Acceleration Up)

Step 1: Write total force statement.

$$\vec{F}_{Tot} = \vec{F}_g + \vec{F}_N$$

$$\boxed{\vec{F}_N = \vec{F}_{Tot} - \vec{F}_g}$$

acceleration of elevator

where: $\vec{F}_{Tot} = m\vec{a}$

$\vec{F}_g = m\vec{g}$

ex) An elevator has an upwards acceleration of 3.5 m/s^2. What is the true and apparent weight of a rider with mass of 75 kg?

Note: You will need to reverse the sign on the normal force for the apparent weight to make sense.

Hint: Be careful of your signs on the accelerations!

What about accelerating downwards?

ex) An elevator has a downwards acceleration of -8.5 m/s^2. What is the true and apparent weight of a rider with mass of 75 kg?

Free Fall

Free fall occurs when there is no balancing normal force present.

Without a normal force, there is no apparent weight, and the rider experiences "weightlessness".

This is what happens to astronauts in orbit and was also simulated for movies.

NASA's Vomit Comet or the Weightless Wonder.