Elevator Problem

This is a classic problem is physics, and it can be examined using the ideas of Newton's First and Second Laws. Here is the situation: *"You are standing on a bathroom scale in an elevator. You are holding an apple. You weigh 490 Newtons, so your mass is 50 kg."* Your job is to follow through the ideas below and fill in the appropriate answers.

Part A: The Elevator is at Rest.

You have just boarded the elevator. The elevator, you, and the apple are at rest.

What are the two forces acting on you? ___________________ and _______________________.
Your acceleration is equal to _____________ (remember units).
The net force acting on you is _____________.

Since the net force on you is _______, the upward forces and downward forces must be balanced. Therefore, the scale must push on you with a force of __________ and **the scale must read** __________ Newtons.

Now, if you let go of the apple, what will be its acceleration relative to you and the earth? ___________.

Part B: The elevator is accelerating upwards.

The elevator with you inside begins to accelerate $2 m/s^2$ upwards.

What is the net force on you? (use F=ma!) ____________ N in the _________ direction.

Therefore, since your weight is 490 N, and the net force is _______ the scale must push up with a force of ________ N.

The **scale must read** _______ N as the elevator accelerates upward.

If you let the apple go, what is its acceleration relative to the earth? _________.
What would be its acceleration relative to you? _________.
So to you, the apple seems to be falling (faster or slower or the same) (*circle one)* than it would in normal free fall. So to you, gravity appears to be (stronger or weaker or the same).

Part C: The Elevator Moves Up at a Constant Velocity

The elevator, you, and the apple accelerate for 5 seconds, at which time it stops accelerating and stays at a ***constant velocity*** *of 10 m/s.*

Your acceleration is __________.

The net force on you is equal to _________.

The same two forces are still acting on you. The force of the scale pushing up on you therefore is now equal to ________ N.

The **scale must read** __________ N.

If you let go of the apple, what does it do? Is this different than part A? Why?

If instead the elevator were moving *down* at a constant velocity, would any of your answers change? Why?

Part D: The Elevator Slows Down While Going Up.

The elevator, you, and the apple begin to slow down as it approaches its destination. Its acceleration (or deceleration if you want to call it that) is 2 m/s^2 ***downward****.*

What is the net force on you? (use F=ma!) ____________ Newtons in the ______ direction.

Therefore, since your weight is 490 N, the scale pushes up with a force of ________ N.

The **scale must read** _______ N as the elevator accelerates downward.

If you let the apple go, what is its acceleration relative to the earth? _________.
What would be its acceleration relative to you? _________.
So to you, the apple seems to be falling (faster or slower or the same) (*circle one)* than it would in normal free fall. So to you, gravity appears to be (stronger or weaker or the same).

If instead the elevator was moving down with an acceleration of 2 m/s^2 (same acceleration direction, just different direction elevator is moving) would any of your answers here change? Why?

Part E: Dagnabbit!

The elevator cable snaps and the elevator, you, and the apple begin to fall in freefall.

Your acceleration is _______.

Therefore, the net force on you is _______ N in the __________ direction. (use F=ma!)

Your weight, or the force of gravity on you, is equal to _________ N.

Therefore, since the net force is _______, and your weight is ______, the force of the scale pushing up on you has to be _________ Newtons.

The **scale must read** ________ Newtons.

If you let go of the apple now, what does it do now?