Elevator Problem (ANSWER KEY)

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? __**Your weight**__ and __**The Floor Pushing up**__.
Your acceleration is equal to __**0 m/s**^{s}__(remember units).
The net force acting on you is __**0 N**________.

Since the net force on you is __**0 N**__, the upward forces and downward forces must be balanced. Therefore, the scale must push on you with a force of __**490N**__ and **the scale must read** __**490N**__ Newtons.

Now, if you let go of the apple, what will be its acceleration relative to you and the earth? __9,8m/s^{2}__.

Part B: The elevator is accelerating upwards.

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

What is the net force on you? (use F=ma __**100**__ N in the __**upward**__ direction.

Therefore, since your weight is 490 N, and the net force is___100N__ the scale must push up with a force of __**590**__ N.

The **scale must read** __190__N as the elevator accelerates upward.

If you let the apple go, what is its acceleration relative to the earth? __9.8 m/s^{2}__.
What would be its acceleration relative to you? __11.8 m/s^{2}__.
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 __**0m/s**^{2}______________.

The net force on you is equal to __**0N**________.

The same two forces are still acting on you. The force of the scale pushing up on you therefore is now equal to __**490**__N.

The **scale must read** __**490**__ N.

If you let go of the apple, what does it do? Is this different than part A? Why? It accelerates down at 9.8m/s^{2}.
To you no. To the outside observer it goes up a little then comes down.

If instead the elevator were moving *down* at a constant velocity, would any of your answers change? Why?
They would be the opposite for the opposite reasons.

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/s² **downward**.*

What is the net force on you? (use F=ma!) **-100** Newtons in the **Downward** direction.

Therefore, since your weight is 490 N, the scale pushes up with a force of **390** N.

The **scale must read** **390**________N as the elevator accelerates downward.

If you let the apple go, what is its acceleration relative to the earth? **9.8m/s²**.
What would be its acceleration relative to you? **7.8m/s²**
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/s² (same acceleration direction, just different direction elevator is moving) would any of your answers here change? Why?
They would the opposite.

Part E: Dagnabbit!

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

Your acceleration is 9.8 m/s².

Therefore, the net force on you is **490** N in the **downward** direction. (use F=ma!)

Your weight, or the force of gravity on you, is equal to 490 N.

Therefore, since the net force is **490 N**, and your weight is **490 N**, the force of the scale pushing up on you has to be **0 N** Newton's.

The **scale must read** **0** Newton's.

If you let go of the apple now, what does it do now?
It will hover in front of you.