# Physics Lab: Elevator Simulation

**This lab involves a half-period each spent on the computer and with low-tech equipment, done in either order.**

## Part A: Computer

### Procedure:

1) In “Logger Pro” under “File” go to “Open”, “Probes and Sensors”, “Force Sensors”, “ULI Force”, “ULI Force Probe”.

2) With zero mass hanging, point the sensor downward and hit “Zero”.

3) Hit “Collect” and verify that the signal actually reads zero.

4) Hang the mass from the sensor. Hit “Collect” and read the value of force (use the “STAT” button to take average). This is the computer’s measurement of the weight of the object.

5) Calculate the actual weight of the mass using W = mg.

6) Divide the actual weight by the force measured by the computer. (This is your calibration correction).

7) Hang the mass again. Hit “Collect”, wait for the signal to appear, then give the sensor a gentle upward tug, then stop. Get approval of your signal from Mr. P.

8) Using the “Examine” button, scan to get the maximum value of force.

9) Scan again to get the minimum value of force.

10) Remove the mass and hit “Collect”. If the signal does not read zero, hit the “Zero” button again.

11) Hang the mass again. Hit “Collect”; after the signal appears, give the mass a downward motion, then stop (simulating the downward elevator ride).

12) Use “Examine” to get the maximum and minimum values of force.

13) Each group member choose one of the following, and document who chose which:

a) upward, maximum force　　b) upward, minimum force

c) downward, maximum force　　d) downward, minimum force

### Analysis (each individual based on 13 a, b, c, or d)

1) Multiply your chosen maximum or minimum force (from step 13 of procedure) by the calibration correction. The result is the *actual* maximum or minimum force for that signal.

2) Calculate the (actual) net force.

3) Using the (actual) net force from step 2, calculate the acceleration.

**Part B: Old-school equipment (note: step 5 can be done at any time. Groups should take turns).**

**Procedure:**

1) With zero weight hanging from the scale, note the scale reading (be sure to specify if it is plus or minus). This is your zero correction.

2) Hang the mass and note the scale reading. This is the weight (slightly inaccurate due to zero correction).

**Note: for steps 3 and 4 you must answer each question either "greater than weight", "less than weight", or "equal to weight". DO NOT answer "up" or "down" - that does not make it clear whether the needle reading is increasing or decreasing.**

3) Give the scale a gentle upward tug, lift it at constant speed for about a half meter, and then stop. While doing so, note what happens to the scale reading (greater than weight, less than weight, or equal to weight) at the following parts of the ride:

a) initial upward movement
b) while moving up at constant rate
c) while stopping.

4) Hold the scale high, then move it downward at a constant rate, then stop. While doing so, note what happens to the scale reading (greater than weight, less than weight, or equal to weight) at the following parts of the ride:

a) initial downward movement
b) while moving down at constant rate
c) while stopping.

5) Standing on the table, drop the weight and scale into the newspaper bin. As it falls, note as accurately as possible the scale reading.

**Analysis (one per group):**

1) For each of the six parts of the up and down motions (steps 3a, 3b, 3c, 4a, 4b ,4c of procedure), indicate the direction of acceleration, based on your observations or the needle and Newton's Second Law: **up, down, or zero.**

2) Are any of the results to #1 different from what you expect, based on the definition of acceleration? If so, explain.

3) Using Newton's Second Law, calculate the expected value of the spring force when the spring scale and weight are in free fall. (For this calculation it will be useful to define up as positive, down as negative, and therefore acceleration = -- g ).