Chapter Four: Forces in One Dimension
Section 2: Using Newton's Laws

Consider a free-falling object in midair…nothing is touching it and air resistance can be neglected…therefore the only force acting on it is $\mathbf{F_g}$.

Newton's second law then becomes $\mathbf{F_g} = m\mathbf{g}$.

Both the force and the acceleration are downward.

The magnitude of an object's weight is equal to its mass times the acceleration due to gravity.

How does a bathroom scale work?

When you stand on the scale, the spring in the scale exerts an upward force on you because you are in contact with it.

Because you are not accelerating, the net force acting on you must be zero.

The spring force, $\mathbf{F_{sp}}$, upwards must be the same magnitude as your weight, $\mathbf{F_g}$, downwards.

A bathroom scale provides the only upward force on you, then it reads your weight.

But, if you have one foot on the floor and one on the scale, a friend pushes on your elbows, or if you are in an elevator and it moves then other contact forces are on you and the scale is not reading your weight.

Consider an elevator moving upward.

- You are the system
- Upward is the positive direction
- The upward force of the scale is greater than the downward force of your weight.
- Therefore, the scale reading is greater than your weight (increase in weight)

Apparent weight: the force of an object experiences as a result of all the forces acting on it, giving the object acceleration

- The force exerted by the scale in the above situation is the apparent weight

Weightlessness: there are no contact forces pushing up on the object and the object's apparent weight is zero.

- Does not mean that an object's weight is actually zero
- Ex. Elevator and the cable breaks…**a = -g**
- Falling with no forces pushing up on you

It is true that particles in air around an object exert forces on it but in most cases it exerts a balanced force on all sides, and therefore it has no effect.

When an object moves through any fluid, such as air or water, the fluid exerts a drag force on the moving object in the direction opposite to its motion.

Drag Force: the force exerted by a fluid on the object moving through the fluid

This force is dependent on the motion of the object, the properties of the object, and the properties of the fluid (viscosity and temperature) that the object is moving through.

As the ball's velocity increases, so does the drag force.

Terminal Velocity: the constant velocity that is reached when the drag force equals the force of gravity