Free Fall from FBD

Benjamin Bauml

Winter 2025

XX-1: Free Fall from FBD

Using Newton's 2nd law, show that if air resistance is negligible the acceleration of a freely falling object equals the acceleration due to gravity. [Hint: see your free-body diagram from Activity 1(b).]

Newton's 2nd law states that the net force (the sum of **all** forces on an object) is proportional to the acceleration of the object. In particular,

$$\vec{F}_{net} = m\vec{a}.$$

In the specific case of an object in free fall, the only (non-negligible) force on the object is the force of gravity, $\vec{F}_g = m\vec{g}$. As such, $\vec{F}_{net} = m\vec{g}$, and we can apply Newton's 2nd law to see

$$\cancel{m}\vec{a} = \cancel{m}\vec{g}$$
$$\vec{a} = \vec{g}.$$

As such, acceleration in free fall has no dependence upon the mass of the object. Though a more massive object weighs more (has a greater force of gravity upon it), it also has more inertia, and its velocity is therefore more resistant to change.