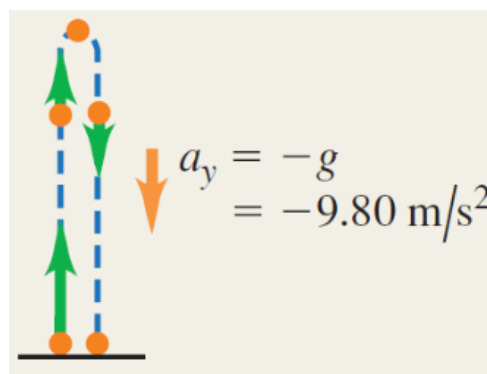




2. Kinematics

Problem Set 1 Solutions



VECTORS AND DIRECTIONS

- Final displacement will be the bottom as it is FALLING. Or, the height is taken as the INITIAL displacement.
- The g is negative according to the direction of the dimension $y = \hat{j}$.

2.42 •• A brick is dropped (zero initial speed) from the roof of a building. The brick strikes the ground in 2.50 s. You may ignore air resistance, so the brick is in free fall. (a) How tall, in meters, is the building? (b) What is the magnitude of the brick's velocity just before it reaches the ground? (c) Sketch a_y - t , v_y - t , and y - t graphs for the motion of the brick.

$$\vec{y} = \vec{y}_0 + \vec{v}_0 t + \frac{1}{2} \vec{a} t^2$$

\vec{y}_0 \vec{v}_0 \vec{a}
 \downarrow \downarrow $-\hat{j}$

At $t = 2.5 \text{ s}$

$$0 = y_0 - \frac{1}{2} g t^2 \hat{j}$$

$$\Rightarrow |y_0| = \frac{1}{2} g t^2 = 30.625 \text{ m}$$

Displacement

$$\Delta x = x_2 - x_1$$

Average Velocity

$$v_{av-x} = \frac{\Delta x}{\Delta t}$$

Instantaneous Velocity

- Instantaneous Velocity is defined as the limit of the average velocity as the time interval Δt becomes infinitesimally small:

$$\vec{v}_x = \lim_{\Delta t \rightarrow 0} \frac{\Delta \vec{x}}{\Delta t} = \frac{d\vec{x}}{dt}$$

- The instantaneous speed of an object, which is a scalar quantity, is defined as the **absolute magnitude of the instantaneous velocity**.
- Whenever you are integrating always pay attention to the **initial displacement** (it comes as the constant $+c$).

$$x = x_0 + \int_{t_1}^{t_2} v_x dt$$

Average Acceleration

$$a_{av-x} = \frac{v_{2x} - v_{1x}}{t_2 - t_1} = \frac{\Delta v}{\Delta t}$$

Instantaneous Acceleration

$$a_x = \lim_{\Delta t \rightarrow 0} \frac{\Delta v_x}{\Delta t} = \frac{dv_x}{dt}$$

Always pay attention to the initial velocity (it comes as the constant v_0)

$$v_x = v_0 + \int_{t_1}^{t_2} a_x dt$$

Equations of Motion with constant acceleration

$$v_x = v_{0x} + a_x t$$

$$x = x_0 + v_{0x} t + \frac{1}{2} a_x t^2$$

$$v_x^2 = v_{0x}^2 + 2(x - x_0)$$

$$x - x_0 = \left(\frac{v_{0x} + v_x}{2} \right) t$$