Motion Examples

A car accelerates from zero to 35 m/s in 7.3 seconds.
a) What is the average acceleration?
b) What distance was covered during the acceleration?

a) $v_0 = 0\ m/s$ $\quad t = 7.3\ s$

$v_f = 35\ m/s$ $\quad a = ?$

$$\vec{a} = \frac{\vec{v}_f - \vec{v}_0}{t} = \frac{35 - 0}{7.3} = \boxed{4.8\ m/s^2}$$

b) $\vec{d}_f = \vec{d}_0 + v_0 t + \frac{1}{2} a t^2$

$d_0 = 0$, $v_0 = 0$, $t = 7.3$

$d_f = 0 + 0(7.3) + \frac{1}{2}(4.8)(7.3)^2$

$$\boxed{d_f = 128\ m}$$

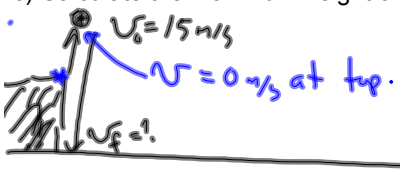
•

Standing near the edge of a cliff a baseball is launched straight up with a velocity of 15 m/s. The ball is in the air for a total of 4.5 s before it hits the ground at the bottom of the cliff.

a) Find the height of the cliff.

b) How long was the ball moving upwards?

c) Calculate the maximum height of the ball.



$a = -9.81 \text{ m/s}^2$

a) $v_0 = 15$ m/s $\quad \vec{d}_0 = ?$ (height)

$a = -9.81$ $\quad d_f = 0$

$t = 4.5$ s

$$\vec{d}_f = d_0 + v_0 t + \tfrac{1}{2} a t^2$$

$$0 = d_0 + (15)(4.5) + \tfrac{1}{2}(-9.81)(4.5)^2$$

$$0 = d_0 + 67.5 - 99.3$$

$$\boxed{32 \text{ m} = d_0}$$

b) $t = ?$ $\quad a = -9.81$

$v_0 = 15$ $\quad v_f = 0$ m/s (@ the top)

$$a = \frac{v_f - v_0}{t}$$

$$-9.81 = \frac{0 - 15}{t}$$

$$-9.81 = \frac{-15}{t}$$

$$-9.81t = -15$$

$$\boxed{t = 1.5 \text{ s}}$$

c) Max height? $\quad d_f = d_0 + v_0 t + \tfrac{1}{2} a t^2$

$t = 1.5$ s

$v_0 = 15$ m/s

$a = -9.81$ m/s^2

$d_0 = 32$ m

$$d_f = 32 + (15)(1.5) + \tfrac{1}{2}(-9.81)(1.5)^2$$

$$d_f = 32 + 22.5 - 11$$

$$\boxed{d_f = 43.5 \text{ m}}$$