Exemplo 2.4

$a = 4{,}0\ m/s^2$

$x_1 = 5{,}0\ m$

$v_1 = 15\ m/s$

a) Posição (x_2) e velocidade (v_2) em $t_2 = 2{,}0\ s$

$$x_2 = x_1 + v_1 \Delta t + \frac{a \Delta t^2}{2} \qquad \Delta t = t_2 - t_1 = 2 - 0$$

$$\Delta t = 2{,}0\ s$$

$$x_2 = 5{,}0 + 15 \cdot 2 + \frac{4{,}0 \cdot 2^2}{2}$$

$$x_2 = 5{,}0 + 30 + 8{,}0 \Rightarrow x_2 = 43\ m$$

$$v_2 = v_1 + a \Delta t$$

$$v_2 = 15 + 4{,}0 \cdot 2{,}0^2 \Rightarrow \boxed{v_2 = 31\ m/s}$$

b) Posição (x_2) em $v = 25\ m/s$

$$v_2^2 = v_1^2 + 2 a \Delta x$$

$$25^2 = 15^2 + 2 \times 4{,}0 \times \Delta x$$

$$\Delta x = \frac{25^2 - 15^2}{8} \Rightarrow \Delta x = 50\ m$$

$$\Delta x = x_2 - x_1$$

$$50 = x_2 - 5{,}0 \Rightarrow x_2 = 50 + 5{,}0 \Rightarrow \boxed{x_2 = 55\ m}$$

Exemplo 2.5

Motorista: $v = 15\ m/s$ (MRU)

Policial: $a = 3{,}0\ m/s^2$

Motorista: $x_2 = x_1 + v\,\Delta t$

$x_2 = 0 + 15.\Delta t$

Policial: $x_2 = x_1 + v_1\,\Delta t + \frac{a\,\Delta t^2}{2}$

$x_2 = 0 + 0.\Delta t + \frac{3{,}0.\Delta t^2}{2}$

$x_2 = 1{,}5.\Delta t^2$

a) Encontro: $15\,\Delta t = 1{,}5\,\Delta t^2$

$1{,}5\,\Delta t^2 - 15\,\Delta t = 0$

$\Delta t\,(1{,}5\,\Delta t - 15) = 0$

$\Delta t = 0$ ou

$1{,}5\,\Delta t - 15 = 0$

$1{,}5\,\Delta t = 15 \Rightarrow \Delta t = \frac{15}{1{,}5} = 10\ s$

$\boxed{\Delta t = 10\ s}$

b) Vel. do Policial: $v_2 = v_1 + a\,\Delta t \Rightarrow v_2 = 0 + 3{,}0 \times 10 \Rightarrow \boxed{v = 30\ m/s}$

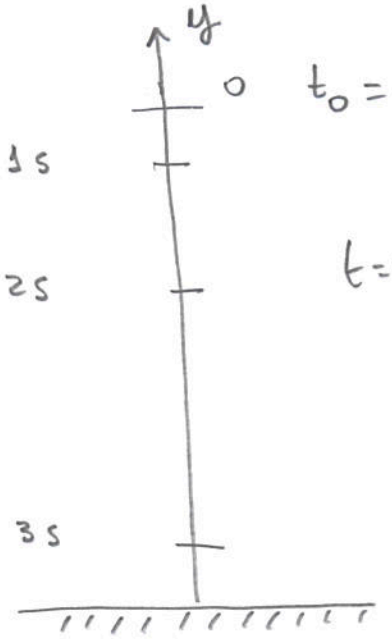
c) Distância $\Rightarrow$ Motorista $\Rightarrow x_2 = 15.\Delta t \Rightarrow x_2 = 15 \times 10 \Rightarrow$

$x_2 = 150\ m$

ou

Policial $\Rightarrow x_2 = 1{,}5 \times 10^2 \Rightarrow \boxed{x_2 = 150\ m}$

Exemplo 2.6



$t_0 = 0\,s \quad v_0 = 0\,m/s \quad a = -9{,}81\,m/s^2$ (↓)

$t = 1\,s \Rightarrow x_2 = x_1 + v_1 \Delta t + \frac{a \Delta t^2}{2}$

$x_2(1) = 0 + 0.1 - \frac{9{,}81 \cdot 1^2}{2}$

$\boxed{x_2(1) = -4{,}90\ m}$

$v_2 = v_1 + a \Delta t \Rightarrow v_2 = 0 - 9{,}81 \cdot 1{,}0 \Rightarrow \boxed{v_2 = 9{,}8\ m/s}$

OU $\Rightarrow v_2^2 = v_1^2 + 2.a.\Delta x \Rightarrow v_2^2 = 0^2 + 2.(-9{,}81)(-4{,}90)$

$v_2 = 9{,}8\ m/s$

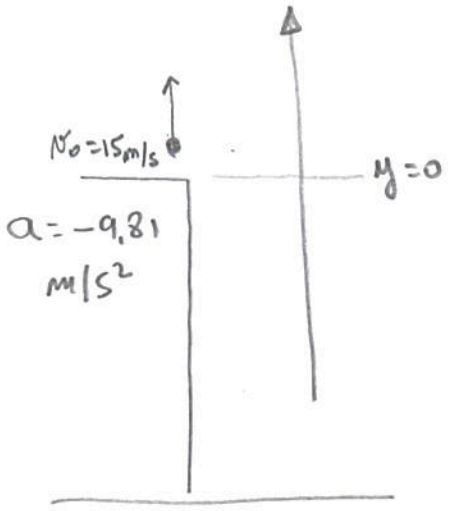
$t = 2\,s \Rightarrow x_2(2) = 0 + 0.2 - \frac{9{,}81 \cdot 2^2}{2} \Rightarrow \boxed{x_2(2) = -19{,}6\ m}$

$v_2 = 0 - 9{,}81 \cdot 2{,}0 \Rightarrow \boxed{v_2(2) = -19{,}6\ m/s}$

$t = 3\,s \Rightarrow x_2(3) = 0 + 0.3{,}0 - \frac{9{,}81 \cdot 3{,}0^2}{2} \Rightarrow \boxed{x_2(3) = -44{,}2\ m}$

$v_2 = 0 - 9{,}81 \cdot 3{,}0 \Rightarrow \boxed{v_2(3) = -29{,}4\ m/s}$

Exemplo 2.7



a) Posição e velocidade da bola em:

$\rightarrow t = 1,0\ s$

$$x_2 = x_1 + v_1 \Delta t + \frac{a \Delta t^2}{2}$$

$$x_2(1) = 0 + 15 \cdot 1 - \frac{9,81 \cdot 1^2}{2}$$

$$x_2(1) = 15 - 4,90 \Rightarrow \boxed{x_2(1) = 10,1\ m}$$

$$v_2 = v_1 + a \Delta t \Rightarrow v_2(1) = 15 - 9,81 \cdot 1 \Rightarrow \boxed{v_2(1) = 5,2\ m/s}$$

$\rightarrow t = 4,0\ s \Rightarrow$ $x_2(4) = 0 + 15 \cdot 4 - \frac{9,81 \cdot 4^2}{2} \Rightarrow \boxed{x_2(4) = -18,5\ m}$

$$v_2(4) = 15 - 9,81 \cdot 4 \Rightarrow \boxed{v_2(4) = -24,2\ m/s}$$

b) Velocidade 5,0 m acima de $y = 0$

$$v_2^2 = v_1^2 + 2 \cdot a \cdot \Delta x \Rightarrow v_2^2(5) = 15^2 + 2 \cdot (-9,81) \cdot 5,0$$

$$v_2^2(5) = 127 \Rightarrow \boxed{v_2(5) = \pm 11,3\ m/s}$$ $\therefore$ subindo e descendo

c) Altura máxima ($v_2 = 0$)

$$v_2^2 = v_1^2 + 2\,a \cdot \Delta x \Rightarrow 0^2 = 15^2 + 2 \cdot (-9,81) \cdot \Delta x$$

$$-225 = -19,6\ \Delta x \Rightarrow \Delta x = \frac{-225}{-19,6} \Rightarrow \boxed{\Delta x = 11,5\ m}$$

Exemplo 2.7 - continuação

d) aceleração da bola na altura máxima

$$\boxed{a = -9{,}81\ m/s^2}$$

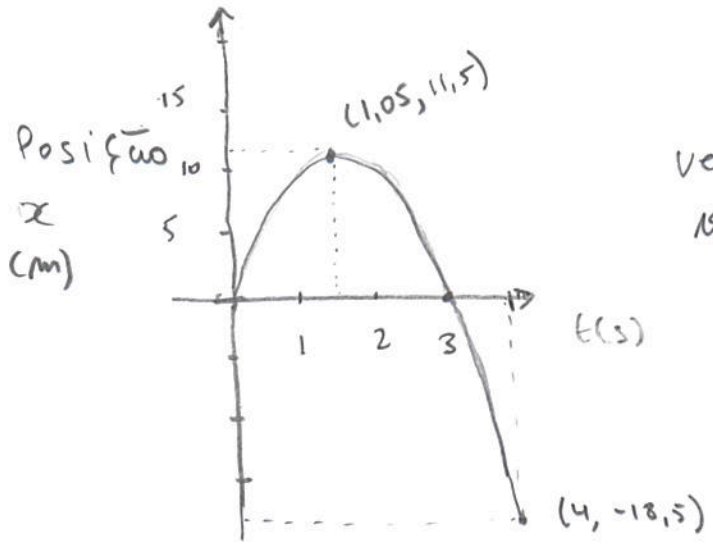
e) tempo p/ retornar ao pto de arremesso ($x_2 = 0$)

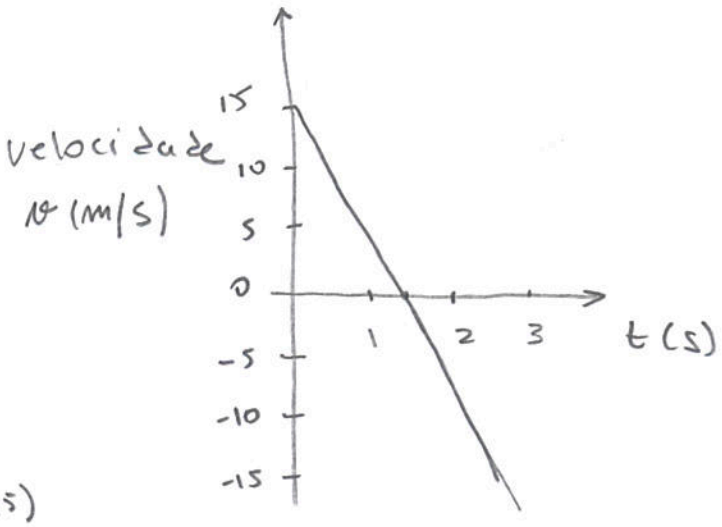
$$x_2 = x_1 + v_1 \Delta t + \frac{a \Delta t^2}{2} \Rightarrow 0 = 0 + 15 \cdot \Delta t - \frac{9{,}81 \cdot \Delta t^2}{2}$$

$$-4{,}90\,\Delta t^2 + 15\,\Delta t = 0 \Rightarrow \Delta t(-4{,}90\,\Delta t + 15) = 0$$

$$\Delta t = 0 \quad \text{ou} \quad -4{,}90\,\Delta t + 15 = 0 \Rightarrow \Delta t = \frac{-15}{-4{,}90} \Rightarrow \boxed{\Delta t = 3{,}1\ s}$$

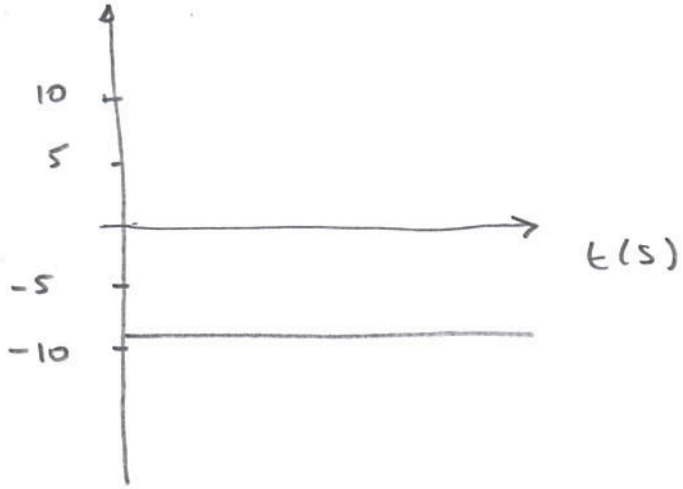
f) Análise gráfica





$x(t) = 15t - 4{,}90t^2$

$v(t) = 15 - 9{,}81t$



$a(t) = 9{,}81\ m/s^2$