CINEMÁTICA

23) página 253.

moto	policía	
$s_1 = 20t$	$s_2 = 1{,}5t^2$	
$s_1 = 20 \cdot 10$	$v_2 = 3t$	$s_1 = 200 + 20(t - 10)$
$s_1 = 200\ m$	$s_2 = 1{,}5 \cdot 10^2$	$s_2 = 150 + 30(t - 10)$
	$s_2 = 150\ m$	

$s_1 = s_2$ ==> $200 + 20(t - 10) = 150 + 30(t - 10)$ ==> $200 + 20t - 200 = 150 + 30t - 300$

$$10t = 150 \Rightarrow \boxed{t = 15\,s}$$

$$s_1 = 200 + 20(15 - 10) \Rightarrow \boxed{s_1 = 300\,m}$$

Se detienen (mrua):

$$\Delta s_1 = 20t + \frac{1}{2}a_1 t^2 \qquad v_1 = 20 + a_1 t \qquad 0 = 20 + a_1 t$$

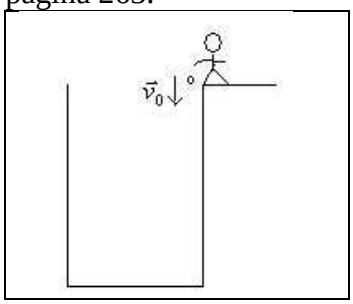
$$\Rightarrow \quad t = -\frac{20}{a_1} = -\frac{30}{a_2}$$

$$\Delta s_2 = 30t + \frac{1}{2}a_2 t^2 \qquad v_2 = 30 + a_2 t \qquad 0 = 30 + a_2 t$$

$$100 = 20\left(-\frac{20}{a_1}\right) + \frac{1}{2}a_1\left(-\frac{20}{a_1}\right)^2 = -\frac{400}{a_1} + \frac{200}{a_1} = -\frac{200}{a_1} \Rightarrow \boxed{a_1 = -2\,m/s^2}$$

$$100 = 30\left(-\frac{30}{a_2}\right) + \frac{1}{2}a_2\left(-\frac{30}{a_2}\right)^2 = -\frac{900}{a_2} + \frac{450}{a_2} = -\frac{450}{a_2} \Rightarrow \boxed{a_2 = -4{,}5\,m/s^2}$$

74) página 263.



Piedra	Sonido
$\Delta h = -5t_1 - 5t_1^2$	$-\Delta h = 340 \cdot (6{,}5 - t_1)$
$v = -5 - 10t_1$	

$$-5t_1 - 5t_1^2 = -340 \cdot (6{,}5 - t_1)$$

$$5t_1^2 + 345t_1 - 2210 = 0 \Rightarrow \qquad t_1^2 + 69t_1 - 442 = 0$$

$$t_1 = \frac{-69 \pm \sqrt{69^2 + 1768}}{2} = \frac{-69 \pm 80{,}8}{2} \Rightarrow \quad t_1 = \frac{11{,}8}{2} \Rightarrow \boxed{t_1 = 5{,}9\,s}$$

$\Delta h = -5 \cdot 5{,}9 - 5 \cdot 5{,}9^2$ ==> $\Delta h = -203{,}6\,m$

Cuestión de decimales.

$\Delta h = -340(6{,}5 - 5{,}9)$ ==> $\Delta h = -204\,m$

65) página 263.

mru	mrua	
$\Delta t = 0{,}3$ s		
$\Delta s_1 = 33{,}3t$	$\Delta s_2 = 33{,}3t + \frac{a}{2}t^2$	$\Delta s_1 + \Delta s_2 = 112\,m$
$\Delta s_1 = 33{,}3 \cdot 0{,}3$		
$\Delta s_1 = 10$ m	$v = 33{,}3 + at$	$0 = 33{,}3 + at \Rightarrow t = -\frac{33{,}3}{a}$

$10 + \Delta s_2 = 112$ ==> $\Delta s_2 = 102$ m

$$102 = 33{,}3\left(-\frac{33{,}3}{a}\right) + \frac{a}{2}\left(-\frac{33{,}3}{a}\right)^2 \Rightarrow 102 = \frac{33{,}3^2}{2a} - \frac{33{,}3^2}{a} \Rightarrow 2a \cdot 102 = 33{,}3^2 - 2 \cdot 33{,}3^2$$

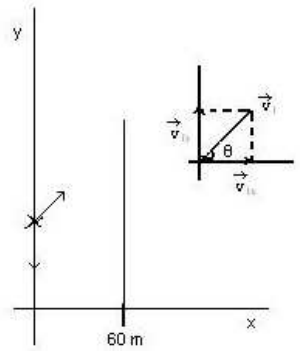
$204a = -1110$ ==> $\boxed{a = -5{,}4\,m/s^2}$ $\qquad t = \frac{-33{,}3}{-5{,}4}$ ==> $t = 6{,}2\,s$

$$t_{(total)} = 6{,}2 + 0{,}3 \Rightarrow \boxed{t_{(total)} = 6{,}5\,s}$$

¿?) Se quiere cruzar un río de 60 m de ancho en una barca. La velocidad de la corriente es de 1 m/s y la de la barca es de 2,5 m/s.

a) ¿Qué ángulo debe formar la dirección de la velocidad de la barca para llegar la punto de enfrente del de partida?

b) ¿Qué tiempo tarda en llegar?



a) $v_{1x} = 2{,}5\cos\theta$

$v_{1y} = 2{,}5\,\text{sen}\theta$

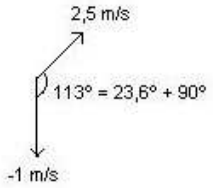
$$eje\ x\{x = 2{,}5t\cos\theta \quad (mru) \qquad eje\ y\{y = (2{,}5sen\theta - 1)t \quad (mru)$$

Cuando la barca llega a la otra orilla: x = 60 m e y = 0 m

$$60 = 2{,}5t\cos\theta \Rightarrow t = \frac{24}{\cos\theta}$$

$$0 = (2{,}5sen\theta - 1)t \Rightarrow 0 = (2{,}5sen\theta - 1)\frac{24}{\cos\theta}$$

$$Soluciones\begin{cases} 0 = 2{,}5 sen\theta - 1 ==> \theta = 23{,}6^0 \\ 0 = \dfrac{24}{\cos\theta} ==> no\ tiene\ solución \end{cases} \quad ==>$$



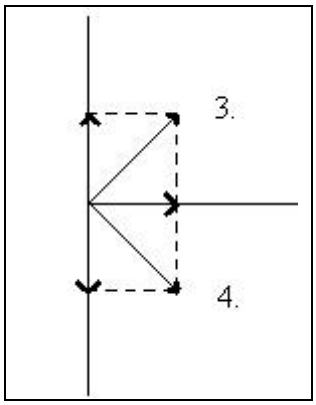
b) $t = \dfrac{24}{\cos 23{,}6^0}$ ==> $t = 26{,}19\,s$

41) página 286.

$y_0 = 9$ m $\qquad v_0 = 10$ m/s

1. $y = 9 + 10t - 5\,t^2$
   $v = 10 - 10t$

2. $y = 9 - 10t - 5\,t^2$
   $v = -10 - 10t$

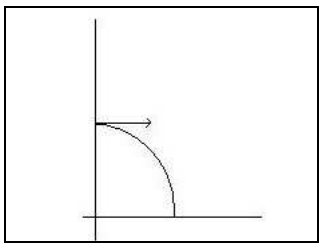


$v_{03x} = 10\cos 30^o = v_{04x}$
$v_{03x} = v_{04x} = 8{,}7$ m/s

3. $x = 8{,}7t$
   $y = 9 + 5t - 5t^2$
   $v_y = 5 - 10t$

$v_{03y} = 10\ sen\ 30^o = -v_{04y}$
$v_{03y} = 5$ m/s $= -v_{04y}$

4. $x = 8{,}7t$
   $y = 9 - 5t - 5t^2$
   $v_y = -5 - 10t$



5. $v_x = v_{0x} = 10$ m/s
   $x = 10t$
   $y = 7 - 5t^2$
   $v_y = -10t$

$v_{0y} = 0$ m/s

a) En el suelo: y = 0 m.

1. $0 = 5t^2 - 10t - 9$ $\qquad t = \dfrac{10 \pm \sqrt{100+180}}{10}$ ==> $t_1 = 2{,}673s$

$v = 10 - 10\cdot 2{,}673$ ==> $\vec{v}_1 = -16{,}73\vec{j}\,m/s$ ==> $\boxed{v_1 = 16{,}73\,m/s}$

2. $0 = 5t^2 + 10t - 9$ $\qquad t = \dfrac{-10 \pm \sqrt{100+180}}{10}$ ==> $t_2 = 0{,}673s$

$v = -10 - 10\cdot 0{,}673$ ==> $\vec{v}_2 = -16{,}73\vec{j}\,m/s$ ==> $\boxed{v_2 = 16{,}73\,m/s}$

3. $0 = 5t^2 - 5t - 9$ $\qquad t = \dfrac{5 \pm \sqrt{25+180}}{10}$ ==> $t_3 = 1{,}93s$

$v_y = 5 - 10\cdot 1{,}93 = -14{,}3\,m/s$ ==> $\vec{v}_3 = (8{,}7\vec{i} - 14{,}3\vec{j})\,m/s$ ==> $\boxed{v_3 = 16{,}73\,m/s}$

4. $0 = 5t^2 + 5t - 9$ $\qquad t = \dfrac{-5 \pm \sqrt{25+180}}{10} \Longrightarrow \qquad t_4 = 0{,}93\,s$

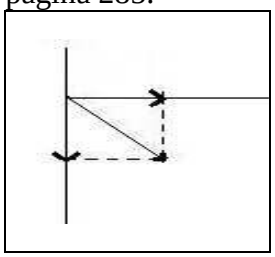
$v_y = -5 - 10 \cdot 0{,}93 = -14{,}3\,m/s \Longrightarrow \vec{v}_4 = (8{,}7\vec{i} - 14{,}3\vec{j})\,m/s \Longrightarrow \boxed{v_4 = 16{,}73\,m/s}$

5. $0 = 5t^2 - 9$ $\qquad t_5 = 1{,}34\,s$

$v_y = -10 \cdot 1{,}34 = -13{,}4\,m/s \Longrightarrow \vec{v}_5 = (10\vec{i} - 13{,}4\vec{j})\,m/s \Longrightarrow \boxed{v_5 = 16{,}73\,m/s}$

b) $t_2 = 0{,}673$ s; $t_4 = 0{,}93$ s; $t_5 = 1{,}34$ s; $t_3 = 1{,}93$ y $t_1 = 2{,}673$ s.

29) página 285.



$v_{0x} = 9 \cos 30^o \Longrightarrow v_{0x} = 7{,}8$ m/s $\qquad x = 7{,}8t$

$v_{0y} = -9 \operatorname{sen} 30^o \Longrightarrow v_{0y} = -4{,}5$ m/s $\qquad y = 30 - 4{,}5t - 5t^2$

$v_y = -4{,}5 - 10t$

a) $t = \dfrac{x}{7{,}8} \qquad y = 30 - 4{,}5\left(\dfrac{x}{7{,}8}\right) - 5\left(\dfrac{x}{7{,}8}\right)^2 \Longrightarrow \qquad y = 30 - 0{,}58x - 0{,}08x^2$

c) $x_{máx} \Longrightarrow y = 0$ m $\Longrightarrow 5t^2 + 4{,}5t - 30 = 0$

$t = \dfrac{-4{,}5 \pm \sqrt{20{,}25+600}}{10} \Longrightarrow \qquad t = 2{,}04\,s$

b) $x = 7{,}8 \cdot 2{,}04 \Longrightarrow x_{máx} = 15{,}9$ m (llega al suelo, y no a la pared)

d) $v_y = -4{,}5 - 10 \cdot 2{,}04 \Longrightarrow \qquad v_y = -24{,}9\,m/s$

$\vec{v} = (7{,}8\vec{i} - 24{,}9\vec{j})\,m/s \Longrightarrow \boxed{v = 26\,m/s}$