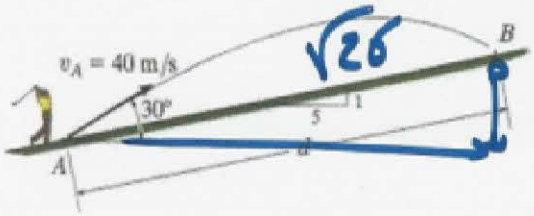
(10)

12–107. The golf ball is hit at A with a speed of $v_A = 40\,\text{m/s}$ and directed at an angle of 30° with the horizontal as shown. Determine the distance d where the ball strikes the slope at B.



Prob. 12–107

X-dir

$\Delta x = v_A \cos\theta\, t$

$\frac{5}{\sqrt{26}} d = 40 \cos 30\, t \quad \therefore t = 0.0283\, d$

y-dir

$\Delta y = v_{0y} t + \frac{1}{2} a_y t^2$

$\frac{d}{\sqrt{26}} = 40 \sin 30\,(0.0283\, d) - 4.9\,(0.0283\, d)^2$

$\therefore d = 94.4\ \text{m}$

Dynamics

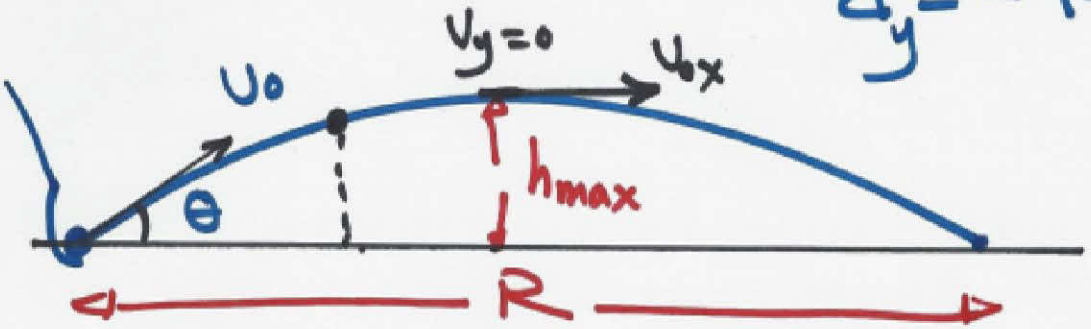
Lecture #3

Projectiles

Projectiles المقذوفات

حركتان منفصلتان متحدتان في الوقت فقط

$a_y = -9.81\ m/s^2$



X - dir

$$V_{ox} = V_0 \cos\theta$$

$$a_x = 0$$

$$\Delta x = V_{ox} t$$

$$R = \frac{V_0^2 \sin 2\theta}{g}$$

$$h_{max} = \frac{V_0^2 \sin^2\theta}{2g}$$

Y-dir

$$V_{oy} = V_0 \sin\theta$$

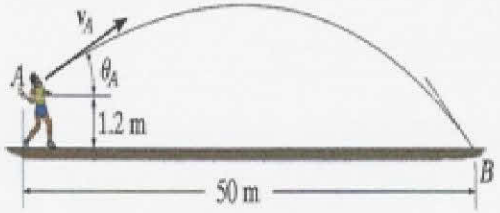
$$V_y = V_{oy} + a_y t$$

$$V_y^2 = V_{oy}^2 + 2 a_y \Delta y$$

$$\Delta y = V_{oy} t + \frac{1}{2} a_y t^2$$

$$\Delta y = \left(\frac{V_{oy} + V_y}{2}\right) t$$

12–89. It is observed that the time for the ball to strike the ground at B is 2.5 s. Determine the speed v_A and angle θ_A at which the ball was thrown.



Prob. 12–89

X-dir

$$\Delta x = v_{0x} t$$

$$50 = V_A \cos\theta_A (2.5) \quad \therefore V_A \cos\theta_A = 20$$

y-dir

$$\Delta y = v_{0y} t + \frac{1}{2} a_y t^2$$

$$-1.2 = V_A \sin\theta (2.5) - 4.9 t^2 \rightarrow 2.5^2$$

$$29.425 = 2.5 \frac{20}{\cos\theta_A} \sin\theta$$

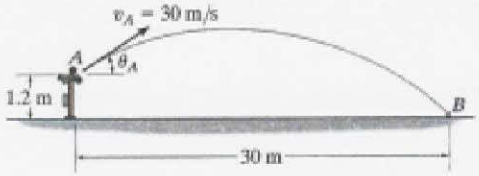
$$\tan\theta = 0.5885$$

$$\therefore \theta = 30.5^\circ$$

$$\therefore V_A = 23.2 \text{ m/s}$$

(4)

12–91. The pitching machine is adjusted so that the baseball is launched with a speed of $v_A = 30\,\text{m/s}$. If the ball strikes the ground at B, determine the two possible angles θ_A at which it was launched.



Prob. 12–91

X-dir

$\Delta x = v_{0x} t$

$30 = 30 \cos\theta_A \, t \quad \therefore t \cos\theta_A = 1$

y-dir

$\Delta y = v_{0y} t + \frac{1}{2} a_y t^2$

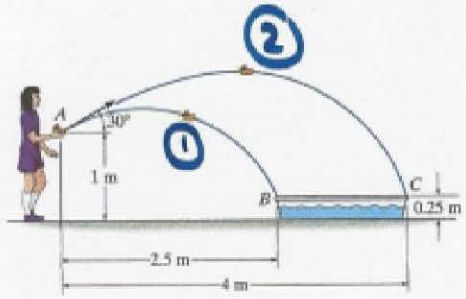
$-1.2 = 30 \sin\theta_A \left(\frac{1}{\cos\theta_A}\right) - 4.9 \left(\frac{1}{\cos\theta_A}\right)^2$

$\therefore \theta_{A,1} = 7.18^\circ$

$\theta_{A,2} = 80.53^\circ$

5

*12–92. The girl always throws the toys at an angle of 30° from point A as shown. Determine the time between throws so that both toys strike the edges of the pool B and C at the same instant. With what speed must she throw each toy?



Prob. 12–92

toy 1

X-dir

$\Delta x = V_0 \cos\theta\, t$

$2.5 = V_0 \cos 30\, t$

y-dir

$\Delta y = V_0 \sin\theta\, t - 4.9 t^2$

$-1 = \frac{2.5}{\cos\theta} \sin\theta - 4.9 t^2 \quad \therefore t_1 = 0.706\ s$

$V_{01} = 4.1\ m/s$

toy 2

X-dir

$4 = V_0 \cos 30\, t$

y-dir

$-1 = V_0 \sin 30\, t - 4.9 t^2 \quad \therefore t_2 = 0.822\ s$

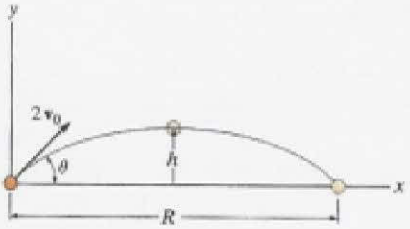
$V_{0,2} = 5.62\ m/s$

$\therefore \text{interval} = t_2 - t_1$

$= 0.116\ s$

الجزع عن المصيبة، مصيبة أخرى.

12–94. The projectile is launched with a velocity $2v_0$. Determine the range R, the maximum height h attained, and the time of flight. Express the results in terms of the angle θ and v_0. The acceleration due to gravity is g.



Prob. 12–94

$$R = \frac{V_0^2 \sin 2\theta}{g}$$

$$= \frac{4 V_0^2 \sin 2\theta}{g} = \frac{8 V_0^2 \sin\theta \cos\theta}{g}$$

$$h_{max} = \frac{V_0^2 \sin^2\theta}{2g}$$

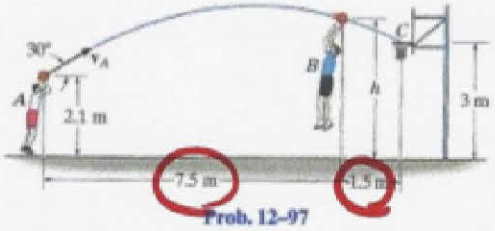
$$= \frac{4 V_0^2 \sin^2\theta}{2g} = \frac{2 V_0^2 \sin^2\theta}{g}$$

$$t = 2\,\frac{V_0 \sin\theta}{g}$$

$$= \frac{4 V_0 \sin\theta}{g}$$

(7)

12–97. Measurements of a shot recorded on a videotape during a basketball game are shown. The ball passed through the hoop even though it barely cleared the hands of the player B who attempted to block it. Neglecting the size of the ball, determine the magnitude v_A of its initial velocity and the height h of the ball when it passes over player B.



Prob. 12–97

x-dir

$\Delta x = V_A \cos 30\, t$

$g = V_A t \cos 30$

y-dir

$\Delta y = V_A \sin 30\, t - 4.9 t^2$

$0.9 = V_A \sin 30 \left(\frac{9}{V_A \cos 30}\right) - 4.9 \left(\frac{9}{V_A \cos 30}\right)^2$

$\therefore V_A = 11.1$ m/s

---

x-dir (11.1)

$7.5 = \Delta x = V_A \cos 30\, t \quad \therefore t = 0.78$ s

y-dir

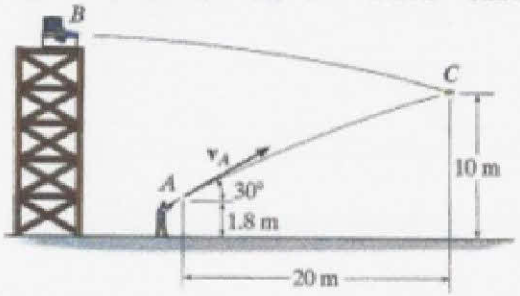
$\Delta y = V_A \sin 30\, t - 4.9 t^2 = 1.35$ m

$\therefore h = 2.1 + \Delta y = 3.45$ m

إذا كان السفهاء والحمقى يقررون كيف يعيشون فمن المؤكد أن هذا الحق مكفول لنا.

(8)

12–98. A projectile is fired from the platform at B. The shooter fires his gun from point A at an angle of 30°. Determine the muzzle speed of the bullet if it hits the projectile at C.



Prob. 12–98

X-dir

$$20 = V_A \cos 30\, t$$

y-dir

$$\Delta y = v_{0y} t - 4.9 t^2$$

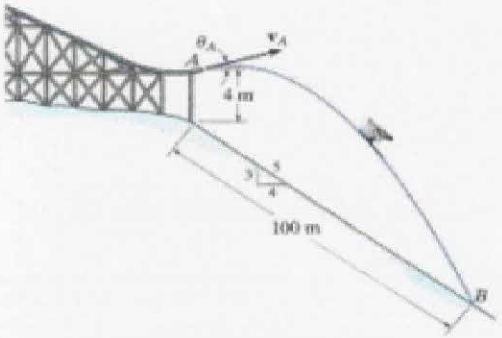
$$8.2 = V_A \sin 30\, t - 4.9 t^2$$

$$8.2 = V_A \sin 30 \left(\frac{20}{V_A \cos 30}\right) - 4.9 \left(\frac{20}{V_A \cos 30}\right)^2$$

$$0.683 = \frac{400}{V_A^2 \cos^2 30}$$

$$\therefore V_A = 27.94 \text{ m/s}$$

12–101. It is observed that the skier leaves the ramp A at an angle $\theta_A = 25°$ with the horizontal. If he strikes the ground at B, determine his initial speed v_A and the speed at which he strikes the ground.



Probs. 12–100/101

X-dir

$\Delta x = V_A \cos\theta \; t$

$80 = V_A \cos 25 \; t$

y-dir

$\Delta y = V_{oy} t - \frac{1}{2} 9.8 t^2$

$-64 = V_A \sin 25 \left(\frac{80}{V_A \cos 25}\right) - 4.9\left(\frac{80}{V_A \cos 25}\right)^2$

$V_A = 19.4 \text{ m/s}$

$V_{Ax} = 19.4 \cos 25 = 17.6 \text{ m/s}$

$V_y = V_A \sin 25 - 9.8\left(\frac{80}{19.4 \cos 25}\right)$

$= -36.4 \text{ m/s}$

$\therefore |V_y| = 40.4 \text{ m/s}$