SMU Physics 1313 : Fall 2008

Quiz 1

Problem 1 : A driver traveling $v_0 = 30\,\mathrm{m/s}$ passes a policeman who is stopped by the side of the road. At that moment the policeman begins to accelerate at $A = 2\,\mathrm{m/s^2}$, while the driver maintains constant speed.

a) How much time t_1 does it take for the policeman to reach the same speed $V_1 = v_0$ as the driver? How far x_1 has the driver gone in this time? How far X_1 has the policeman gone in this time?

b) How much time t_2 does it take for the policeman to reach the same position as the driver? How far $X_2 = x_2$ have both vehicles gone during this time? How fast V_2 is the policeman going at this time?

In general : $V = V_0 \quad x = V_0 t$ $\qquad V_0 = 30\,m/s$

$V = At \quad X = \frac{1}{2} A t^2$ $\qquad A = 2\,m/s^2$

a) $V = V_0 = A t_1 \qquad t_1 = V_0/A = \underline{15s}$

$X_1 = V_0 t_1 = \underline{450m} \qquad X_1 = \frac{1}{2} A t_1^2 = \underline{225m}$

b) $X_2 = x_2 \Rightarrow \frac{1}{2} A t_2^2 = V_0 t_2 \quad$ or $\quad \frac{1}{2} A t_2 = V_0$

so, $t_2 = 2V_0/A = \underline{30s}$

$X_2 = V_0 t_2 = \underline{900m} \qquad V_2 = A t_2 = \underline{60\,m/s}$

$X_2 = \frac{1}{2} A t_2^2 = \underline{900m}$

(check)

Problem 2 : A golfball is struck at ground level and travels a horizontal distance of $x_f = 300\,\text{m}$ before striking the ground after a total time of flight of $t_f = 6\,\text{s}$.

a) What were the initial velocity components V_{0x} and V_{0y} of the ball? What was the initial angle θ_0 that the trajectory of the ball made with the ground? What was magnitude $|\vec{V}_0|$ of the initial velocity vector? What is the maximum height y_m that the ball reaches?

b) What are the horizontal x_1 and vertical y_1 positions of the ball after $t_1 = 5\,\text{s}$? What are the velocity components V_x and V_y of the ball at this time? What is the angle θ that the trajectory of the ball makes with the ground at this time? What is magnitude $|\vec{V}|$ of the velocity vector at this time?

In general: $V_x = V_{ox}$ $\quad x = V_{ox}t$

$(g = 9.8\,\text{m/s}^2)$ $\quad V_y = V_{oy} - gt$ $\quad y = V_{oy}t - \tfrac{1}{2}gt^2$

a) $x_f = V_{ox}t_f$ $\quad V_{ox} = x_f/t_f = \underline{50\,\text{m/s}}$ $\quad x_f = 300\,\text{m}$, $t_f = 6\,\text{s}$

$y_f = V_{oy}t_f - \tfrac{1}{2}gt_f^2 = 0$ $\quad$ so, $V_{oy} = \tfrac{1}{2}gt_f = \underline{29.4\,\text{m/s}}$

$\tan\theta_0 = V_{oy}/V_{ox}$ $\quad \theta_0 = \underline{30.46^\circ}$

$|\vec{V}_0| = (V_{ox}^2 + V_{oy}^2)^{1/2} = \underline{58.0\,\text{m/s}}$

$y = y_m$ at some time t_m when $V_y = V_{oy} - gt_m = 0$

so, $y_m = V_{oy}t_m - \tfrac{1}{2}gt_m^2 = \tfrac{1}{2}V_{oy}^2/g = \underline{44.1\,\text{m}}$

b) $t_1 = 5\,\text{s}$ $\quad x_1 = V_{ox}t_1 = \underline{250\,\text{m}}$

$y_1 = V_{oy}t_1 - \tfrac{1}{2}gt_1^2 = \underline{24.5\,\text{m}}$

$V_x = V_{ox} = \underline{50\,\text{m/s}}$ $\quad \tan\theta = \dfrac{V_y}{V_x}$ $\quad \theta = \underline{-21.4^\circ}$

$V_y = V_{oy} - gt_1 = \underline{-19.6\,\text{m/s}}$ $\quad |\vec{V}| = (V_x^2 + V_y^2)^{1/2} = \underline{53.7\,\text{m/s}}$