General Physics IA Dr. Pogo

Name: Solution

# Quiz #2

(10 points; 5 minutes)

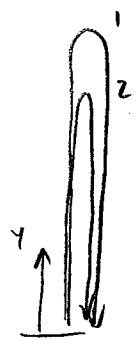
**Full credit will be given if you get the correct answer, regardless of method.**
**Partial credit may given only if you follow the methods from class.**
**Use at least 3 sig-figs throughout.**

8. Two arrows are shot vertically upward. The second arrow is shot while the first is still on its way up. Both arrows reach their maximum heights at the same instant, although these heights are different. The initial speed of the first arrow is $v_1$ and that the second arrow is fired $\Delta t$ after the first. Determine the initial speed $v_2$ of the second arrow.

**Your answer:**

$v_2 = 7.26$ m/s

$v_1 = 20$ m/s
$\Delta t = 1.3$ s




Arrow 1

$y_0 = 0$

$v_{f_1} = 0$

$a_y = -g$

$v_{1_{0_y}} = v_1$

Arrow 2

$y_0 = 0$

$v_{f_2} = 0$

$a_y = -g$

$v_{2_{0_y}} = v_2$

$t_2 = t_1 - \Delta t$

EQ 2, Arrow 1: $v_{f_{y1}} = v_{0y1} + a_y t_1$

$$t_1 = \frac{v_1}{g}$$

EQ 2, Arrow 2 $v_{f_{y2}} = v_{0y2} + a_y t_2$

$$v_2 = +g t_2$$

$$v_2 = g(t_1 - \Delta t)$$

$$v_2 = g\left(\frac{v_1}{g} - \Delta t\right)$$

$$\boxed{v_2 = v_1 - g\Delta t}$$

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13. A rock climber throws a first aid kit to a climber who is higher up the mountain. The initial velocity of the kit is $v_0$ at an angle of $\theta_0$ above the horizontal. When caught, the kit is traveling horizontally. What is the vertical height $H$ between the two climbers?

$x_0 = 0$
$x_f = ?$
$v_{0x} = v_0 \cos\theta_0$
$a_x = 0$
$v_{fx} = ?$

$y_0 = 0$
$y_f = H = ?$
$v_{0y} = v_0 \sin\theta_0$
$a_y = -g$
$v_{fy} = 0$

**Your answer:**

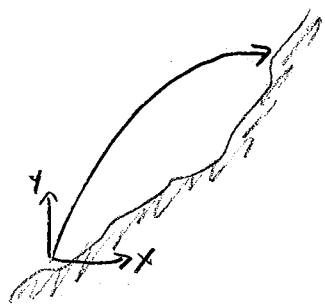
$H = 4.93$ m

$v_0 = 12$ m/s
$\theta_0 = 55°$

Eq 3y: $v_y^2 = v_{0y}^2 + 2a_y(y_f - y_0)$

$0 = v_0^2 \sin^2\theta_0 - 2g(H - 0)$

$$H = \frac{v_0^2 \sin^2\theta_0}{2g}$$



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14. A pitcher throws a baseball horizontally at a speed $v_0$. What is the vertical drop $H$ when it reaches a catcher who is a distance $L$ away from the point of release?

$x_0 = 0$ | $y_0 = H$

$x_f = L$ | $y_f = 0$

$v_{0x} = v_0$ | $v_{0y} = 0$

$a_x = 0$ | $a_y = -g$

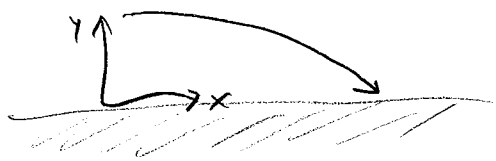
**Your answer:**

$H = 1.296$ m

$v_0 = 35$ m/s
$L = 18$ m

Trajectory:

$$y = y_0 + (x - x_0)\frac{v_{0y}}{v_{0x}} - \frac{1}{2}g\frac{(x-x_0)^2}{v_{0x}^2}$$




$$0 = H + 0 - \frac{gL^2}{2v_0^2}$$

$$H = \frac{+gL^2}{2v_0^2}$$

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10. A golf ball soars into the air at with an initial speed of $v_0$ and initial angle $\theta_0$. It flies over flat ground. How much time $\Delta t$ passes before the ball strikes the ground?

$y_0 = 0$

$y_f = ?$

$v_{0y} = v_0 \sin\theta_0$

$y_0 = 0$

$y_f = 0$

$a_y = -g$

**Your answer:**

$\Delta t = 5.606\ s$

$v_0 = 65$ m/s
$\theta_0 = 25°$


EQ 1Y: $y = y_0 + v_{0y}t + \frac{1}{2}a_y t^2$

$0 = 0 + v_0 \sin\theta t - \frac{1}{2}gt^2$

$\frac{1}{2}gt^2 = v_0 \sin\theta \cdot t$

$$t = \frac{2v_0 \sin\theta_0}{g}$$