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College Physics 1

Projectile Motion Worksheet

Impact velocities - before it hits ground what is x velocity & what is y velocity at that point. Pythagorean to find total

Please write your answer in the corresponding blank for each assigned problem. When a problem requires work to solve, please show all work next to that corresponding problem. In order to gain proper credit, all corresponding work (if applicable) must be shown to the right of and/or below the corresponding answer blank. ***All responses should ALWAYS take into account significant figures and proper applicable units.***

1. An Alaskan rescue plane drops a package of emergency rations to stranded hikers (*as shown similarly in lecture Figure 3.19, but with different measurements*). The plane is traveling horizontally at 50.0 m/s at a height of 3.00 x 10^2 m above the ground. **(a)** Where does the package strike the ground relative to the point at which it was released? **(b)** What are the horizontal and **(c)** vertical components of the velocity of the package just before it hits the ground? **(d)** Find the angle of impact (relative to the ground).

3SF

4 min

(a) 391 m

(b) 50.0 m/s

(c) -76.6 m/s

(d) 56.9° South of East / -56.90

$\Delta x = 391$ m, $\Delta y = -300$ m, $a =$, $t = 7.825$, $V_{ox} = 50.0$ m/s, $V_{oy} = 0$ m/s

(B) Horizontal: $V_{fx} = V_{ox}$, $50.0 \text{ m/s} = 50.0 \text{ m/s}$

(C) $V_{oy} + gt = V_{fy}$, $0 + -9.80 \text{ m/s}^2 (7.82)$ s, $V_{fy} = -76.6$ m/s

(a1) $V_o t + \frac{1}{2} g t^2 = \Delta y$, $-300 = 0 + -4.9 t^2$, $\frac{-300}{-4.9} = \frac{-4.9 t^2}{-4.9}$, $\sqrt{61.22} = \sqrt{t^2}$, $t = 7.825$

(D.) 50.0, θ, -76.6; $\tan\theta = \frac{-76.6}{50}$, $\tan^{-1}\left(\frac{-76.6}{50}\right) = \theta$, $\theta = -56.90$

(a2) $V_{ox} t = \Delta x$, $50.0 (7.82) = 391 \frac{\text{m/s}}{\text{m}}$, $\Delta x = 391$ m

2. A bartender slides a beer mug at 1.50 m/s toward a customer at the end of a frictionless bar that is 1.20 m tall. The customer makes a grab for the mug and misses, and the mug sails off the end of the bar. **(a)** How far away (in meters) from the end of the bar does the mug hit the floor? **(b)** What are the total speed and direction of the mug at impact?

3SF

4 min

(a) .742 m

(b) 5.08 m/s

$x = .742$ m, $y = -1.20$ m, $t =$, $t = .4955$, $V_{ox} = 1.5$ m/s, $V_{fy} = -4.851$ m/s, $V_{ox} = 1.5$ m/s, $V_{oy} = 0$

(a2) $\Delta x = V_{ox} t$, $\Delta x = 1.5 \text{ m/s} (.4955)$, $\Delta x = .742$ m

(a1.) $\Delta y = V_o t + \frac{1}{2} g t^2$, $-1.20 = 0t + \frac{1}{2}(9.80) t^2$, $\frac{-1.20}{-4.9} = \frac{-4.9 t^2}{-4.9}$, $\sqrt{.2449} = \sqrt{t^2}$, $t = .4955$

B $V_{fy} = V_{yo} + gt$, $V_{fy} = 0 + -9.8(.495)$, $V_{fy} = -4.85$ m/s

1.5 m/s, R, -4.85 m/s; $R = \sqrt{a^2 + b^2}$, $R = 5.08$ m/s

3. A long jumper named Pat (*as shown similarly in lecture Figure 3.20, but with different measurements*) leaves the ground at an angle of 35.0° to the horizontal and at a speed of 10.5 m/s. **(a)** How long does it take for Pat to reach maximum height? **(b)** What is the maximum height? **(c)** How far does Pat jump? (Assume his motion is equivalent to that of a particle, disregarding the motion of Pat's arms and legs.) **(d)** Use equation 3.14c to find the maximum height he reaches.

3SF
Kms

(a) .352 s

(b) 1.85 m

(c) 3.03 m

(d) 1.82 m

x: $t = .352$ s, $V_{fx} =$, $V_{ox} = 8.60$ m/s

y: $t = .352$ s, $V_{fy} = 0$ m/s, $V_{oy} = 6.02$ m/s

(a1) $10.5\cos 35 = 8.60$ m/s

$10.5 \sin 35 = 6.02$ m/s

(a2) $V_y = V_{oy}\sin\theta - gt = 0$

$t_{max} = \frac{V_{oy}\sin\theta}{g}$

$t = \frac{(6.02 \text{ m/s})(\sin 35)}{9.8 \text{ m/s}^2}$

$t = .352$ s

(B) $\Delta y = \frac{V_f^2 - V_0^2}{2g}$

$\frac{0 - 6.02^2}{2(-9.8)} = \frac{-36.24}{-19.6} = 1.85$ m

(C) $\Delta x = V_{ox} t$

$\Delta x = 8.60 \text{ m/s}(.352 \text{ s})$

$\Delta x = 3.03$ m

(B) $y_{max} = V_{oy}\sin\theta\, t + \frac{1}{2}gt^2$

$6.02(\sin 35)(.352 \text{ s}) + \frac{1}{2}(9.8)(.352)^2$

$1.21543 + .60712$

$y_{max} = 1.82$ m

4. A ball is thrown upward from the top of a building at an angle of 40.0° to the horizontal and with an initial speed of 18.5 m/s (*as shown similarly in lecture Figure 3.21, but with different measurements*). The point of release is 45.0 m above the ground. **(a)** How long (in seconds) does it take for the ball to hit the ground? **(b)** Find the ball's total speed (m/s) at impact. **(c)** Find the horizontal range of the stone. Neglect air resistance.

3sf
Kms

(a) 4.38 s

(b) 44.2 m/s

(c) 62.2 m

x: $t = 4.38$, $V_{fx} =$, $V_{ox} = 14.2$ m/s

y: $y = -45.0$ m, $t = 4.38$, $V_{fy} = 0$ m/s, $V_{oy} = 11.9$ m/s

(a1) $18.5 \sin 40 = 14.2$ m/s

$18.5 \cos 40 = 11.9$ m/s

(a2) $V_{oy} t + \frac{1}{2} g t^2 = \Delta y$

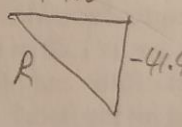
$45 + 11.9t + -4.9t^2 = -45 + 45$

$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$\frac{-11.9 \pm \sqrt{11.9^2 - 4(-4.9)(45)}}{-9.8}$

$\frac{-11.9 \pm 31.0}{-9.8} = \frac{-42.9}{-9.8} = t = 4.38$ s

(B)



$R = \sqrt{(14.2)^2 + (41.9)^2}$

$R = 44.2$ m/s

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

$\Delta y = 11.9(4.38) + \frac{1}{2}(9.8)(4.38)^2$

$52.122 + 94.0$

$\Delta y = 41.9$ m/s

(C) $\Delta x = V_{ox} t$

$\Delta x = 14.2(4.38)$

$\Delta x = 62.2$ m