Projectile Problems

Set 2 horizontal and off the ground

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|  | A projectile is launched horizontally off a building 4.5 m high and lands a distance of 25 m from the building on the flat ground below. Determine initial velocity of the ball.  **From Y information:**  **h = ½ at2 t = (2h/a)1/2  = 0.96 s**  **This time and the horizontal distance can be used to find the x velocity.**  **vx = x/t = 25/0.96s = 26.0 m/s**  How will the velocity of the ball when it hits the ground compare to the initial velocity of the ball?  **Greater than because it has a vertical component**  Justify your answer with some math?  **While the ball has a constant vx of 26.0 m/s, as it falls, its vy increases. When it hits the ground,**  **vfy = voy + at = – 9.8(0.96) = – 9.4 m/s**  **With both x and y velocity, the ball now has a resultant which = (vx2 + vy2)1/2 or (262 + 9.42)1/2so the total velocity is 27.6 m/s (in a direction that is about 20° below the horizontal ground)** |
|  | A projectile is launched horizontally off a tower with a velocity of 10.5 m/s. If the projectile lands a distance of 31.5 m from the base of the tower, from what height was it launched?  **Use x data to find time it is in the air:**  **V = x/t so t = x/v = 3 s**  **This time is then used to determine the height:**  **H = ½(– 9.8 m/s/s)(3 s)2 = 44.1 m** |
|  | A ball is kicked at 37° above the horizontal on level ground with a velocity of 20 m/s.  Is the ball moving in both the x and y direction equally?  **NO: vx = (cos 37)(20m/s) = 16 m/s x**  **vy = (sin 27)(20 m/s) = 12 m/s y**  Show some math to justify your answer above.  Find the max height of the ball above the ground.  **vf2 = vo2 + 2ax; x 7.35 m**  How long will the ball be in the air before it lands?  **vf = vo +at; 12/9.8 = t = 1.22 s**  How far will the ball go before it lands?  **Ttot = 2(tup) = 2(1.22) = 2.44 s**  **From x motion; x = vxt = 16.0 m/s (2.44s) = 39.04 m**  Is there another angle that the ball can be kicked at with a velocity of 20 m/s and still hit the same spot on the ground? Justify your answer with some math?  **Yes; If the ball is kicked at 20 m/s at an angle of 53° it will go the same distance.**  **Sin53(20) = 16m/s y; 16/9.8 = tup = 1.63 s)(2) = ttot**  **ttot = 3.27 s**  **vx = cos53(20m/s) = 12.0 m/s x**  **12 m/s)(3.27 s)** **= 39.12** **8cm difference to rounding** |
|  | Now place the ball on a building that is 10.0 m above the ground. If the ball is kicked at 20 m/s at 37° above the horizon, how far above or below the 10 m mark will the ball hit the next building over which is 25 m away?  **vx = (cos 37)(20) = 16 m/s; vy = (sin37)(20) = 12 m/s**  **t = x/v (constant v) = 25m/16m/s = 1.56 s (when it gets to other building)**  **y = yo + vot + ½ a t2 = 10 + 12 m/s)(1.56 s) -4.9(1.56)2**  **y = 16.8 m, or 6.8 m above the 10 m height.** |