Projectile motion – Motion in the X and Y Simultaneously

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|  | An object is launched horizontally off a tower, building, roof, etc. with some initial velocity, Vox. This means the initial vertical velocity, voy = 0. There are several different questions/answers we could look for, but commonly, knowing the initial velocity and height, we would try to determine how far away the ball will land.  Motion must be dealt with in each dimension, X and Y, separately.  X dimension, acceleration is zero  Y dimension, a is due to gravity  **TIME is the thing they have in common** | |
| **Y motion**  y = 0  yo = h  voy = 0  vfy = ????  a = – a  **tfall = t**  To find t, use an equation that will allow you to relate height fallen to time and acceleration.  x = xo + vot+ ½ at2  0 = h + 0 + ½( – a)t2  h = ½ at2 and  **t =**  **This is the time the ball will be in the air** | | **X motion**  xo = 0  x = ????? (asked to find)  a = zero so that  vox = vfx  **tfall = t =**  How far will the ball travel? YOU can use position time equation for the x dimension.  x = xo + vot+ ½ at2 Where a = 0 to get  x = xo + vot or Δx = vt  In this specific case then  x = vox( ) |
| **Basically, the ball will be in the air based upon how high it starts, or how far it falls. According to the equation above.** | | **During this entire time of flight or fall,** the ball will be moving in the x direction at whatever horizontal velocity it had initially because there is no acceleration in the x direction. |

For the immediate situation, if you know the initial velocity in the x, say 15 m/s, and the height of the fall, say 20.0 m, then substitute values to find t and x.

**t = =** = 2.02 s; x = vt = 2.02(15m/s) = 30.3 m. If you stand at 30.3 m, the object will hit at your feet.

If a marble is launched horizontally off a table top from a height of 2.25 m with a velocity of 4.0 m/s, how far from the base of the table will the ball land?

An arrow is lauchned from a castle wall that is 8 m above the flat ground below with a horizontal velocity of 25 m/s. How far will the arrow fly beofre it lands?