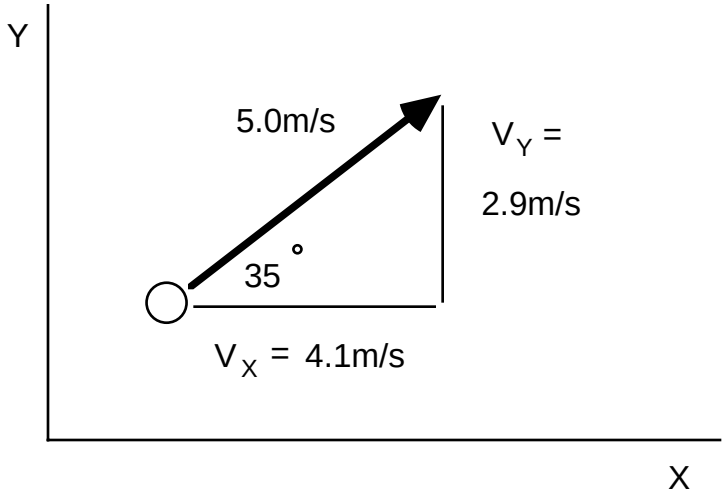
Kinematics 2-D : Notes-15

Suppose that a marble rolls on the floor with a constant velocity. If it moves at an angle to the X-axis of 35° and has a speed of 5.0 m/s, then the X-component of the velocity is 5.0xcos35 = 4.1m/s, and the Y-component of the velocity is 5.0xsin35 = 2.9m/s.



The velocity vector is 5.0m/s [35° above the X-axis]. It can also be written as [4.1, 2.9] m/s. The motion can be seen as having two parts; the X-direction motion and the Y-direction motion. These two motions are separate. The equations of kinematics apply separately. In this case, the equations are:

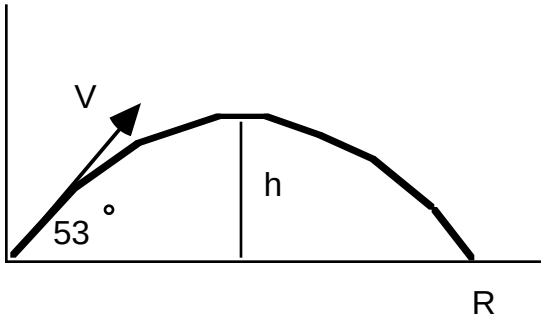
$$D_X = V_X \cdot T$$

$$D_Y = V_Y \cdot T$$

The equations give the x-displacement and y-displacement in terms of the x and y components of the velocity and the time. In this case, the acceleration is zero, so V_X and V_Y remain constant.

Projectile Motion

When analyzing projectile motion, the vertical and horizontal components of the displacement and velocity of a projectile are handled separately. For the horizontal motion, the velocity is constant. For the vertical motion, the acceleration is -9.8m/s^2.



The projectile above, is fired with a velocity V, at an angle of 53° to the horizontal. The initial X-component of the velocity is Vcos53. This horizontal component remains constant because there is no acceleration in the horizontal direction. The initial Y-component of the velocity is Vsin53. The Y-component of the velocity changes because the acceleration in the y-direction is -9.8m/s^2. The two motions are treated separately using the kinematics equations.

$$V_X = \text{constant} = V\cos 53$$

$$V_Y = V\sin 53 - 9.8T$$

$$D_X = V_X \cdot T$$

$$D_Y = V(\sin 53)T - \frac{1}{2}9.8T^2$$

Using these equations, we can find the maximum height, the range, (maximum horizontal distance traveled), the displacement, and the velocity. We can also find the time it takes to reach the maximum height h.