Answer on Question # 68492, Physics - Mechanics - Relativity

Question: A cart is moving horizontally along a straight line with constant speed of 30 m/s. A projectile is fired from the moving cart in such a way that it will return to the cart after the cart has moved 80 m. At what speed (relative to the cart) and at what angle (to the horizontal) must the projectile be fired?

Solution: Suppose the particle is fired with a velocity v_0 at an angle Θ with respect to horizontal.

To move horizontally with the cart , the projectile must be fired vertically (i.e Θ = 90^0) .

Given, cart velocity = 30 m/sec. and horizontal distance travelled is 80 m.

Now the time of flight t = $\frac{80}{30}$ sec. = 2.67 sec.

Horizontal component of velocity with respect to cart = v_{0x} = 0 m/sec. (As particle move with the cart.)

So, let's vertical velocity v_{0y} m/sec.

We know, y = $v_{0y}t - \frac{1}{2}gt^2$ [g = acceleration due to gravity = 9.8 m/sec^2.]

At , t = 2.67 sec. , y= 0.

So, $v_0 = v_{0y} = \frac{1}{2}gt = \frac{1}{2} \times 9.8 \times 2.67 = 13.083$ m/sec.

So, initial velocity of the particle is **13.083** m/sec.

The angle is $\theta = \tan^{-1}\left(\frac{v_{0y}}{v_{0x}}\right) = \tan{-1}\left(\frac{13.083}{0}\right) = \tan^{-1}(\infty) =$ **90°**

Answer: Velocity is 13.083 m/sec . , angle = 90° to horizontal . [Correct answer.]

Actually all options in the question are incorrect.