Answer on Question #59414, Physics / Mechanics | Relativity |

A cart is moving horizontally along a straight with constant speed of 30 m/s. A projectile 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?

a)35.8 m/s at 24 degrees
b)38.6 m/s at 54 degrees
c)27.2 m/s at 35 degrees
d)24.3 m/s at 44 degrees

Solution:

The equation of motion for the cart is

$$x = v_x t$$

The equations for the projectile are

$$x = v_x t$$

and

$$y = v_{0y} t - ½ g t^2$$

In our case:
$v_x = 30$ m/s,
$x = 80$ m,
$y = 0$,
$v_0 = ?$

$$t = \frac{x}{v_x} = \frac{80}{30} = \frac{8}{3} \text{ s}$$

$$v_{0y} t - ½ g t^2 = 0$$

$$v_{0y} = 0.5gt = 0.5 \cdot 9.8 \cdot \frac{8}{3} = 13.07 \text{ m/s}$$

To move horizontally with cart projectile must be fired vertically.

Output: $v_0 = 13.07$ m/s; $\theta = 90°$.
All other answers do not satisfy the conditions of the problem.