Answer on Question #57842-Physics- Mechanics

A particle of mass m is accelerated along the positive x-direction by a constant force; It starts from rest at the origin of an inertial frame. A second reference frame moves with constant speed V0 along the negative x-direction; initially, the frame coincides with an inertial frame.

a) Find the velocity and position of the particle as a function of time in both reference frames

b) Find the work done by the force during a time interval t in both frames

Solution

a) The velocity of the particle in first frame:

$$v = 0 + at = at.$$

The position of the particle in first frame:

$$s = \int_0^t vdt = \frac{at^2}{2}.$$

The velocity of the particle in second frame:

$$v' = v_0 + at.$$

The position of the particle in second frame:

$$s' = \int_0^t v'dt = v_0 t + \frac{at^2}{2}.$$

b) The work done by the force during a time interval t in the first frame is

$$W = mas = ma\frac{at^2}{2} = \frac{ma^2t^2}{2}.$$

The work done by the force during a time interval t in the second frame is

$$W' = mas' = ma\left(v_0 t + \frac{at^2}{2}\right) = mav_o t + \frac{ma^2t^2}{2}.$$