Answer on Question #40446

Physics – Mechanics | Kinematics | Dynamics

Question:

An object is tracked by a radar station and found to have a position vector by r=(3500-160t)i + 2700j + 300k, with r in m and t in sec. The radar station's x-axis points east, its y-axis north and its z-axis vertically up. If the object is a 250-kg missile warhead, what are (a) its linear momentum (b) its direction of motion (c) its net force on it.

Solution:

The linear momentum is

$$\vec{p} = m\vec{v},$$

where $m = 250\ kg$ is mass of the object and v is its velocity.

$$\vec{v} = \frac{d\vec{r}}{dt} = -160\vec{\imath}.$$

Thus,

$$\vec{p} = -160m\vec{\imath} = -40{,}000\vec{\imath}\ \frac{kg \cdot m}{s}.$$

Because only the X coordinate of the object is changed in time and X axis points East, the object moves to the East.

The net force $F_{net} = ma$ acting on the object is zero, because the acceleration

$$a = \frac{d\vec{v}}{dt} = \frac{d^2\vec{r}}{dt^2} = 0.$$

Answer:

a) $\vec{p} = -40{,}000\vec{\imath}\ \frac{kg \cdot m}{s}$

b) East

c) 0.