

Q- An object moves with a uniform velocity of [4m/s, -1m/s, 3m/s] and is acted on by a force of [-5N, 0, +5N]. What is the power of the energy transfer in this interaction?

Power is the work done per unit time.

As the work done is given by the scalar product of force and displacement

$$W = \vec{F} \bullet \Delta\vec{r}$$

The power can be expressed as

$$P = \frac{W}{\Delta t} = \frac{\vec{F} \bullet \Delta\vec{r}}{\Delta t} = \vec{F} \bullet \vec{v}$$

Now $\vec{v} = 4\hat{i} - 1\hat{j} + 3\hat{k}$

And the force is

$$\vec{F} = -5\hat{i} + 0\hat{j} + 5\hat{k}$$

Here \hat{i} , \hat{j} and \hat{k} are unit vectors in x, y, and z directions respectively.

Hence

$$P = \vec{F} \bullet \vec{v} = (-5\hat{i} + 0\hat{j} + 5\hat{k}) \bullet (4\hat{i} - 1\hat{j} + 3\hat{k})$$

Or $P = (-5)*4 + 0*(-1) + 5*3 = -5 \text{ W}$

(The power is negative means that the work is done against the force. The energy of the system is reducing.)