A constant force with vector representation

$$\mathbf{F} = 10\mathbf{i} + 18\mathbf{j} - 6\mathbf{k}$$

moves an object along a straight line from the point $P(2, 3, 0)$ to the point $Q(4, 9, 15)$. Assuming force to be measured in Newtons and distance to be measured in meters, explain why the work done by this force is 38 Joules. (Write in complete sentences, include all relevant calculations, use correct notation, etc.)

**Solution:** The work done by this force is $W = \mathbf{PQ} \cdot \mathbf{F}$. Since

$$\mathbf{PQ} = (4 - 2)\mathbf{i} + (9 - 3)\mathbf{j} + (15 - 0)\mathbf{k} = 2\mathbf{i} + 6\mathbf{j} + 15\mathbf{k}$$

we see that the work done is

$$W = \mathbf{PQ} \cdot \mathbf{F}$$

$$= (2)(10) + (6)(18) + (15)(-6)$$

$$= 38 \text{ Joules.}$$