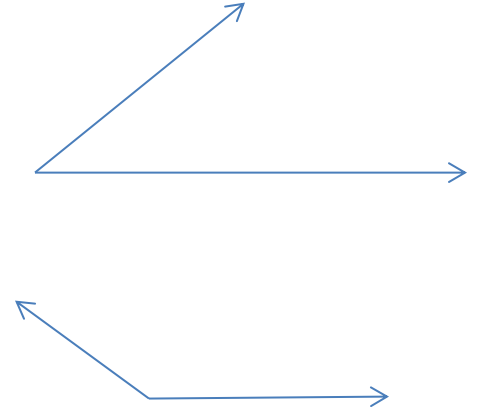


Applications of Dot and Cross Products

Mathematically, a projection is formed by drawing perpendicular lines from each of the points on one object onto a line or plane.

The projection of one vector onto another can be pictured as follows.



Example Find the projection of vector $\vec{a} = (2, 0, -4)$ onto vector $\vec{b} = (1, 3, 8)$.

Example Find the projection of the vector $\vec{v} = (4, -8)$ on the basis vectors \hat{i} and \hat{j} .

WORK

In physics, work is done whenever a force acting on an object causes displacement of that object. Work is defined as the following:

$W = \vec{F} \cdot \vec{d}$ where \vec{F} is the force acting on an object and \vec{d} is the displacement (movement) of that object.

The unit for work is the Joule (J). Note that $J = N \times m = \frac{kg \times m^2}{s^2}$

Example

A 25-kg box is located 8 m up a ramp inclined at 18° to the horizontal. Determine the work done by the force of gravity as the box slides to the bottom of the ramp.

Torque

A force that causes an object to turn is called torque. (Consider using a wrench).

Torque can be calculated using the cross product:

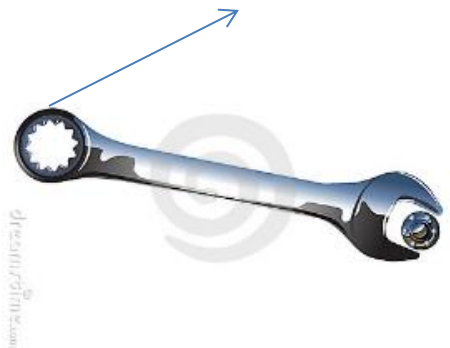
$$\vec{T} = \vec{r} \times \vec{F}$$

$$|\vec{T}| = |\vec{r}| |\vec{F}| \sin \theta$$

where: \vec{F} is the applied force, \vec{r} is the vector determined from the lever arm acting from axis of rotation

θ is the angle between \vec{r} and \vec{F} .

Example: A force of 50 N acting at an angle of 40° at the end of a 19 cm wrench as shown in the diagram below. Calculate the torque on the bolt.



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