Work and Energy Notes

Note Taking Guide - Episode 603, Part 1

Energy - the ability to do work

Work involves:

1. exertion of a force
2. movement of something by that force

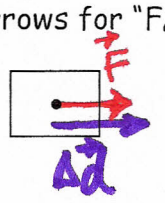
$W = \underbrace{F \times d}$ — force in the same direction as displacement

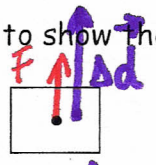
Is work being done on the box? Answer yes or no.

1) Student pushes box horizontally across the lab table. yes
2) Student picks the box up vertically ~~No~~ yes
3) Student holds the box still. No
4) Student holds box still as he walks across room. No

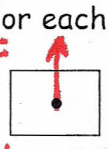
Draw arrows for "F_a" and "d" to show the reason for each above answer.

$W = F \cdot \Delta d$

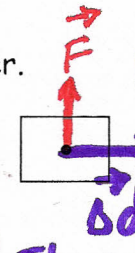
1) 

2) 

$W = F \cdot \Delta d$

3) 

$\Delta d = 0\,m$
$W = 0\,J$ (Joule)

4) 

$W = 0N \cdot \Delta d$
$W = 0J$

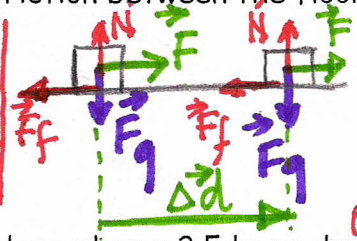
The component of the applied force on the horizontal direction is equal with zero.

MKS unit for work is the Joule = 1 N = 1 X 1 m

Ex. Problems:

What work is done when a refrigerator is pushed uniformly 12 m across the floor. The force of friction between the floor and refrigerator is 480 N.

$\Delta d = 12\,m$
$F_f = 480N$
$W = ?$

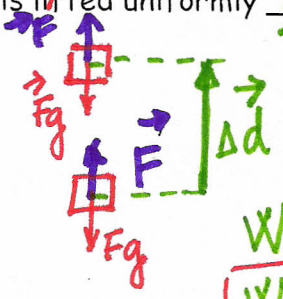


$W = F \cdot \Delta d$
The object is pushed uniformly → the object is at balance
$N = F_g \quad F = F_f$
$W = 480N \cdot 12m = 5760J \simeq 5800J$

What work is done when a 2.5 kg package is lifted uniformly 2.2 m?

$m = 2.5kg$
$\Delta d = 2.2m$
$W = ?$

$W = F \cdot \Delta d$
The object is at balance: $F = F_g$



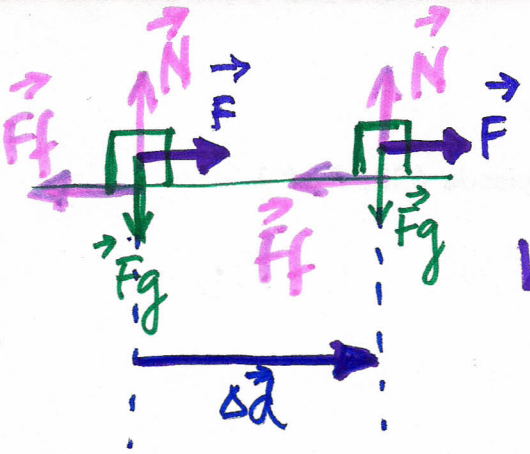
$F = F_g = m \cdot g = 2.5kg \cdot 9.8 m/s^2$
$F = 24.5\,N$
$W = 24.5N \cdot 2.2m$
$W = 53.9J \simeq 54J$

Problem Set #1: (1-3) Solve on back.

① $W = 550\,J$

$\Delta d = 4.6\,m$

$F_f = ?$



$W = F \cdot \Delta d$

The object is at balance on horizontal direction : $F_f = F$

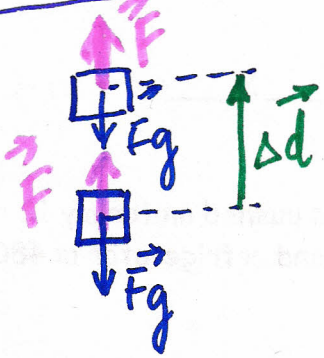
$$W = F \cdot d \Rightarrow F = \frac{W}{d} = \frac{550\,J}{4.6\,m}$$

$$F = 119.56\,N \simeq 120\,N$$

② $W = 75\,J$

$\Delta d = 6\,m$

$F_g = ?$



The object is moving uniformly $\Rightarrow$ the object is at equilibrium

$F = F_g$

$W = F \cdot \Delta d$

$$F_g = F = \frac{W}{\Delta d} = \frac{75\,J}{6\,m} = 12.5\,N \simeq 13\,N$$