Phys 2110-3 10/6/10

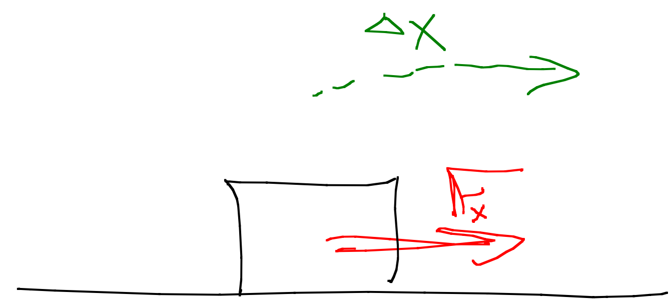
Collisions

Energy, Momentum

Chap 6 Definitions

work done by force F_x
(F_x is constant, straight line)

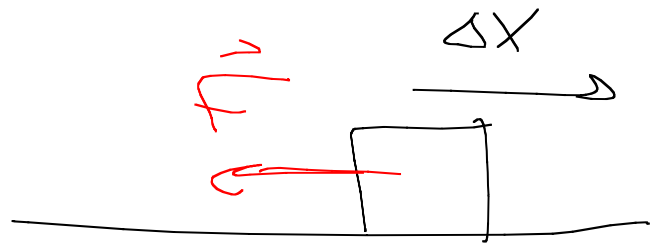
$$\boxed{W = F_x \Delta x}$$



$W = F_x \Delta x$

Number

Positive or negative



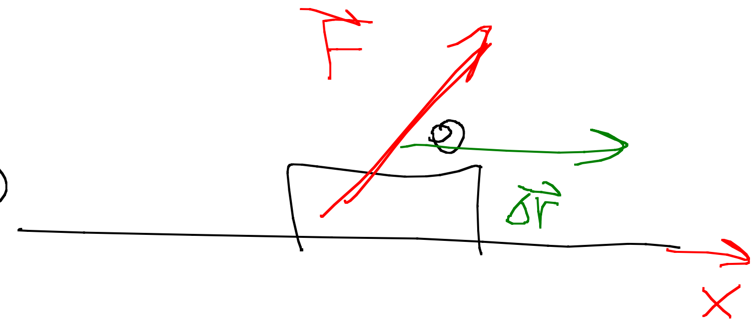
Units $= N \cdot m = \frac{kg\,m}{s^2} \cdot m = \frac{kg\,m^2}{s^2} = 1$ joule $= 1\,J$

Unit of energy. Other units

$1\,\text{erg} = \frac{g\,cm^2}{s^2} = 10^{-7}\,J$ $1\,eV = 1.602 \times 10^{-19}\,J$

$1\,\text{calorie} = 4.184\,J$ $1\,Btu = 1.054\,kJ$

$$W = F_x \Delta x = (F)(\Delta r)\cos\theta$$

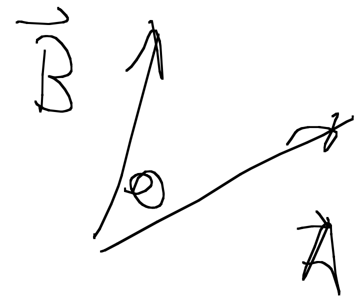


If $\theta > 90°$ work is negative

If $\theta = 90°$ no work done.

$$AB\cos\theta = \vec{A}\cdot\vec{B}$$

$$= A_x B_x + A_y B_y$$

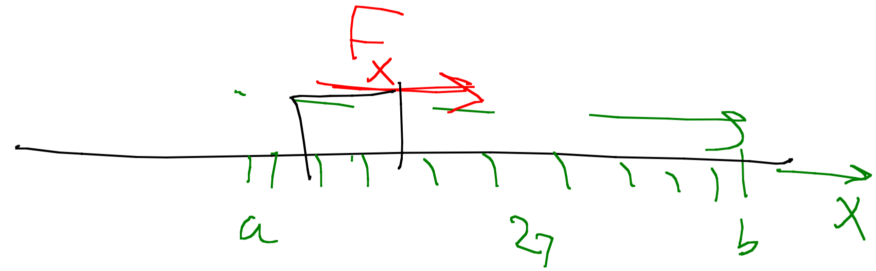


Force non-constant:

$$W = \sum_i F_{x,i} \Delta x_i$$

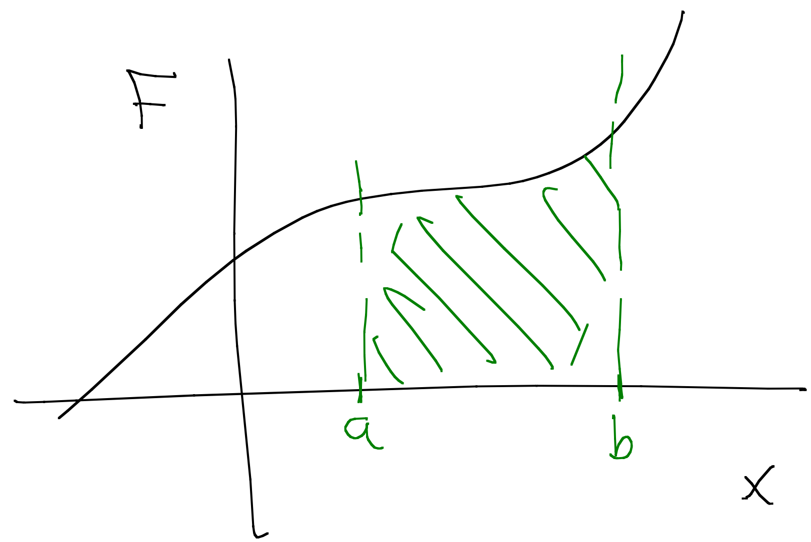
$$= \int_a^b F_x \, dx$$

$$= \int_a^b F_x(x) \, dx$$

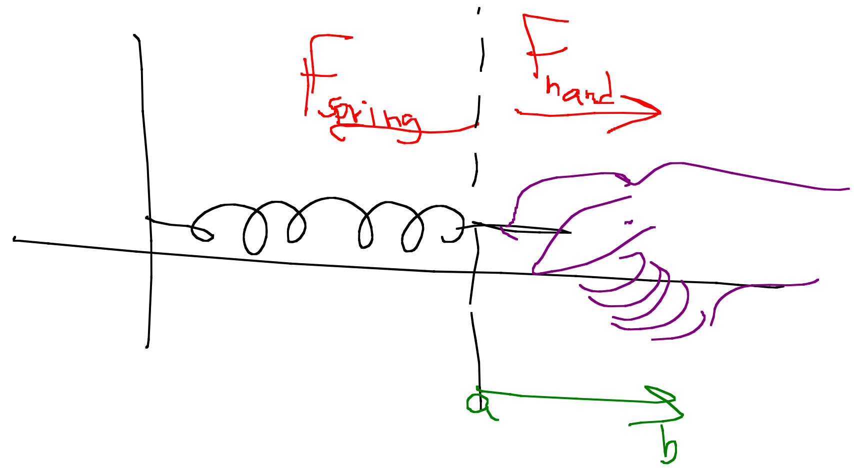


Interpretation:

Work in "area under curve" for F(x)



Work done by hand on spring from a to b



$$W = \int_a^b F(x)\,dx$$

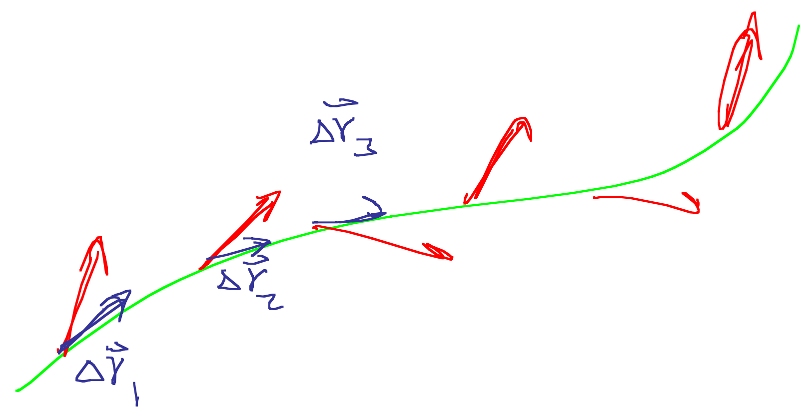
$$= \int_a^b kx\,dx = k\frac{x^2}{2}\Big|_a^b$$

$$= k\left(\frac{b^2}{2} - \frac{a^2}{2}\right) = \frac{k}{2}\left(b^2 - a^2\right)$$

Most general expression

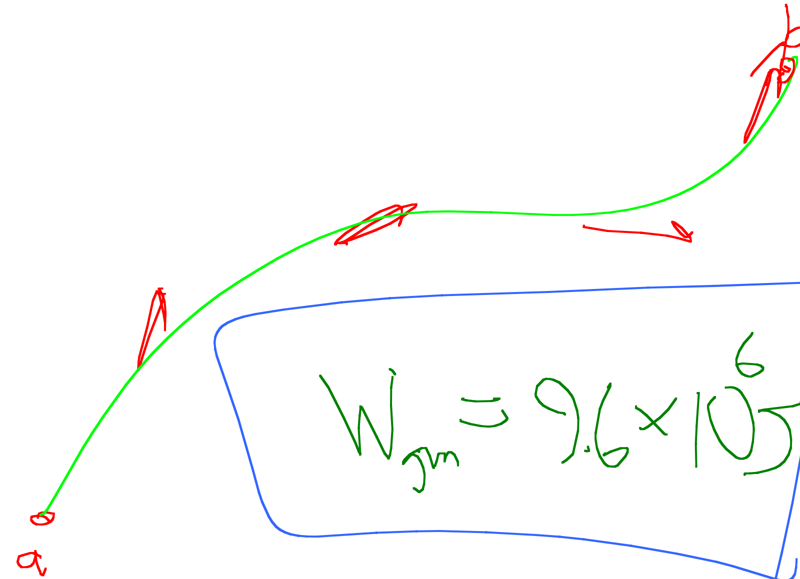
$$\sum_i \vec{F}_i \cdot \Delta\vec{r}$$

limit when $\Delta\vec{r}$'s get small



$$W = \int_a^b \vec{F} \cdot d\vec{r}$$

line integral

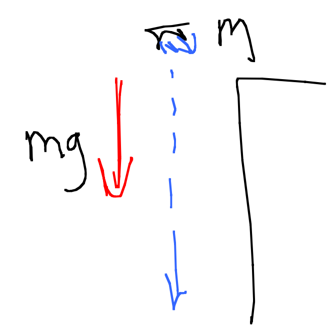


$$\boxed{W_{gm} = 9.6 \times 10^6}$$

6.15 World's highest waterfall Cherun-Meru total drop of 980 m. How much work does gravity do on cubic meter of water down the Ch.-M.

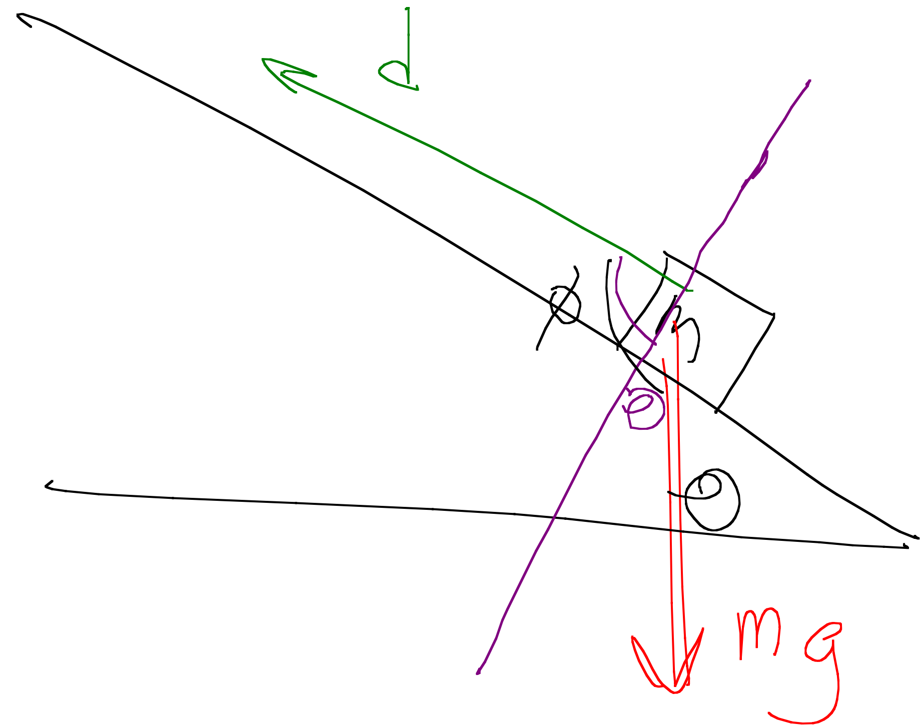
$$W = F \cdot \Delta x \cdot \underbrace{\cos\theta}_{1} = mgd$$

$m = 10^3\,kg$ $\qquad g = 9.8\,\frac{m}{s^2}$ $\qquad d = 980\,m$



Mass goes distance d up inclined plane.

Work done by gravity

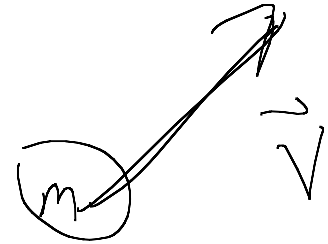


$$W = mg \cdot d \cdot \cos\phi$$

$$= -mgd\sin\theta$$

$$\phi = \theta + 90^\circ$$

Kinetic Energy



$$K = \frac{1}{2} m v^2$$

v = speed

Number, positive

Units $\quad kg \cdot \left(\frac{m}{s}\right)^2 = \frac{kg\, m^2}{s^2} = 1$ joule
$= 1\ J$

6.26 $\quad 2.4\times10^5$ kg airplane
cruises at 900 km/h.
What is KE rel. to ground:

$$\frac{1}{2}\left(2.4\times10^5\ kg\right)\left(250\ \frac{m}{s}\right)^2$$
$$= 7.50\times10^9\ J$$
$$= 7.5\ GJ$$

Theorem

Connection between the two

W_{Total}

Change in Kin E, ΔK

$$W_{Total} = \Delta K$$