

-h7 Kinetic Energy and Work

• Constant Force

$$W = \vec{F} \cdot \vec{d} = F \cos \theta d \quad \text{Joul (N.m)}$$

↳ to use it F should be cste in Mag and direction + object like particle

- Work can be
 - Positive: Force adds energy to the system ($0 < \theta < 90^\circ$)
 - Zero: $\Rightarrow (\theta = 90^\circ) \Rightarrow$ Force does not add ~~or~~ energy
 - negative: $\Rightarrow$ Force decreases the Energy of the system ($\theta > 90^\circ$)

• Variable Force

$$W = \int_{r_i}^{r_f} \vec{F} \cdot d\vec{r} = \int_{r_i}^{r_f} F \cos \theta dr = \int_{x_i}^{x_f} F_x dx + \int_{y_i}^{y_f} F_y dy + \int_{z_i}^{z_f} F_z dz$$

• Remark! the Area under the curve F_x vs x is (=) W

$$\hookrightarrow W = \int_{x_i}^{x_f} F_x dx$$

• Work-Energy Theorem

$$W_{\text{net}} = \Delta K \rightarrow \text{Kinetic Energy} \quad \text{Units} \rightarrow \text{Joul}$$

$\hookrightarrow$ Work done by $\vec{F}_{\text{net}}$

$1 \text{ kW.h} = \text{Kilowatt} \cdot \text{hour} = 3.6 \text{ MJ}$
 $\hookrightarrow$ used by Electrical companies

• Work Done by Gravity

$$W_g = (\vec{mg}) \cdot \vec{d} \quad (\text{Constant Force})$$
$$= mg \cos \theta d$$

• In Circular Motion $W = 0$
Because θ between v and F is 90°
 $\Rightarrow \cos 90^\circ = 0$

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Work Done by a spring force (variable force)

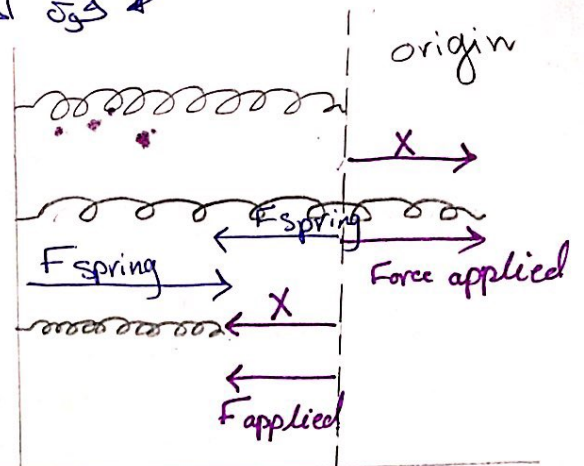
قوة المرونة في النابض (قانون هوك)

$$* F_s = -Kx \quad (\text{Hook's law})$$

↪ elastic constant

which measures the stiffness of the spring so:

$K \uparrow \rightarrow$ the material is stiffer
 $\rightarrow$ spring is stronger



$x^+ \Rightarrow$ stretched to the right

$x^- \Rightarrow$ ~ ~ ~ left

$$\rightarrow W_s = \int_{x_i}^{x_f} F_x dx = \int_{x_i}^{x_f} -Kx dx = -K \int_{x_i}^{x_f} x dx$$

$$\rightarrow W_s = -\frac{K}{2} (x_f^2 - x_i^2) \quad \text{if } x_i = 0 \Rightarrow W = -\frac{K}{2} x_f^2$$

Power القد scalar [Watt]

$$P_{avg} = \frac{\Delta W}{\Delta t} \quad \frac{J}{s} = \text{Watt}$$

$$P_{instantaneous} = \vec{F} \cdot \vec{V}$$



1hp : horse power = 746 watt $\therefore$ قدوة الحصان

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