Shaimaa Hjijah

chapter 7

Kinetic energy & work

$K = \frac{1}{2} m v^2$ ⇒ Joule = $kg.m^2/s^2$

work ⇒ طاقة تأخذ أو تعطى للجسم من خلال قوة F

دفع الجسم → $w +$

قوة عكس اتجاه حركته → $w -$

work done by Force:

$W = \vec{F} . \vec{d}$

$= F\cos\theta \, d$

$\theta = 90$ لا تبذل شغل على الجسم F_y & $= F_x d$ → مع اتجاه حركة الجسم

$W = 0$ $\vec{F} \perp \vec{d}$ $\theta = 90$

$W > 0$ $\theta < 90$

$W < 0$ $\theta > 90$

] حسب الأرباع

W: scaller quantity

work - energy theorm.

$v_f^2 = v_i^2 + 2ad$

$(v_f^2 - v_i^2 = 2ad) \frac{m}{2}$

$\frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2 = m a_x d$

$\Delta K = F_x d$

$\boxed{\Delta K = W_{net}}$

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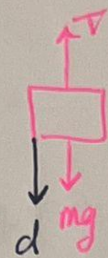
Work done by gravitational Force

Case 1:

$$W_g = F_g \cdot d$$
$$= mg\,d\cos 0$$
$$= mg\,d$$



$a = 0$

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

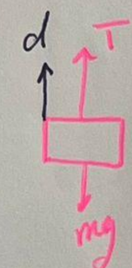
$a = 0$
$\hookrightarrow v_f = v_i$

$$W_g + W_T = K_f - K_i$$

$$W_g + W_T = 0$$

$$\boxed{W_T = -W_g}$$

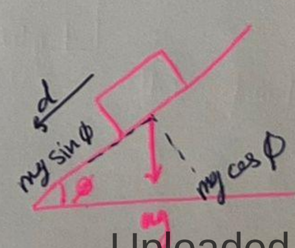
Case 2:



$$W_g = mg \cdot d$$
$$= mg\cos 180\; d$$
$$W_g = -mg\,d$$
$$W_T = mg\,d$$

Case 3:

$$W_g = mg\sin\phi \cdot d$$
$$= mg\sin\phi\; d\cos 0$$
$$= mg\sin\phi\; d$$



if $d \nearrow \Rightarrow W_g = -mg\sin\phi\, d$

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work done by Variables $\vec{F}$

$$W = \int_{r_i}^{r_f} \vec{F} \cdot \vec{dr}$$

$$= \int_{r_f}^{r_i} (F_x \hat{i} + F_y \hat{j} + F_z \hat{k}) \cdot (dx \hat{i} + dy \hat{j} + dz \hat{k})$$

$$= \int_{x_i}^{x_f} F_x \, dx + \int_{y_i}^{y_f} F_y \, dy + \int_{z_i}^{z_f} F_z \, dz$$

remark: $\vec{r_i} = 2\hat{i} + 3\hat{j} \longrightarrow x_i = 2 \quad y_i = 3$

$\vec{r_f} = 3\hat{i} \longrightarrow x_f = 3 \quad y_f = 0$

work done by a spring Force

$F_s = -Kx \rightarrow$ Hook's Law

قوة ارجاع

↳ قوة ارجاع بعكس الازاحة

$$W_s = \int_{x_i}^{x_f} F_x \, dx$$

$$= \int_{x_i}^{x_f} -Kx \, dx$$

$$= -\frac{Kx^2}{2} \Big|_{x_i}^{x_f}$$

$$\boxed{W_s = \frac{1}{2} K x_i^2 - \frac{1}{2} K x_f^2}$$

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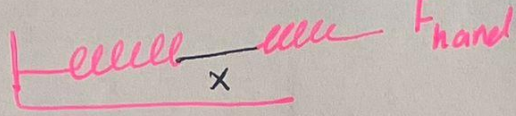
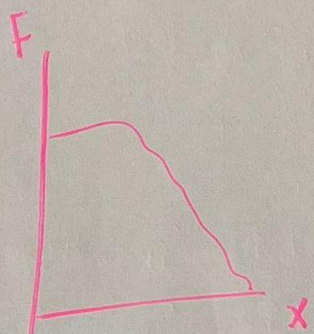


* الشغل المبذول من اليد
نفس قوة النابض
لكن عكس الاتجاه

$$U_f = U_i$$

$$W_{net} = \Delta K \quad \rightarrow \quad W_{hand} = -W_s$$

$$W_s + W_h = 0$$



W : area under the curve.

Average Power

The time rate of doing work

$$P_{avg} = \frac{\text{work}}{\text{time}} = \frac{W}{\Delta t} \qquad J/s = \text{watt}$$

$$P_{inst} = \lim_{\Delta t \to 0} \frac{W}{\Delta t} = \frac{dW}{dt}$$

$$= \frac{d}{dt}(\vec{F} \cdot \vec{d})$$

$$= \vec{F} \cdot \vec{v}$$

$$\boxed{P_{inst} = \vec{F} \cdot \vec{v}}$$