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Potential Energy:

gravitational: $\boxed{V_g = mgh \;\&\; \Delta V_g = mg\,\Delta h}$

elastic: $\boxed{\begin{aligned} V_e &= \int_0^x kx\,dx = \tfrac{1}{2}kx^2 \\ \Delta V_e &= \tfrac{1}{2}k\left(x_2^2 - x_1^2\right) \end{aligned}}$

k = spring const.
x = extension of spring

Work energy equation:

$$\boxed{U'_{1\to 2} = \Delta T + \Delta V_g + \Delta V_e}$$

U' denotes work done by all forces EXCEPT weight (gravity) and elastic forces.

these are accounted for in ΔV_e & ΔV_g

Power

work done per unit time

Force $\quad P = \dfrac{dU}{dt} = \dfrac{\vec{F}\cdot d\vec{r}}{dt} = \underbrace{\vec{F}\cdot\dfrac{d\vec{r}}{dt}} = \vec{F}\cdot\vec{v}$

velocity of point of application of $\vec{F}$

– at any instant.

assumed that $\vec{F}$ is not varying w.r.t time

Couple $\quad P = \dfrac{dU}{dt} = M\dfrac{d\theta}{dt} = M\omega$

Total $\quad \boxed{P = M\omega + \vec{F}\cdot\vec{v}}$

SCALAR QUANTITY

SCALAR CALCULATION Because we're working in 2D