PRAYAS

JEE 2025

Lecture - 01

Physics

Work, Energy & Power

By- Saleem Ahmed Sir

Topics *to be covered*

1. (WD) by const force
2.
3.
4.

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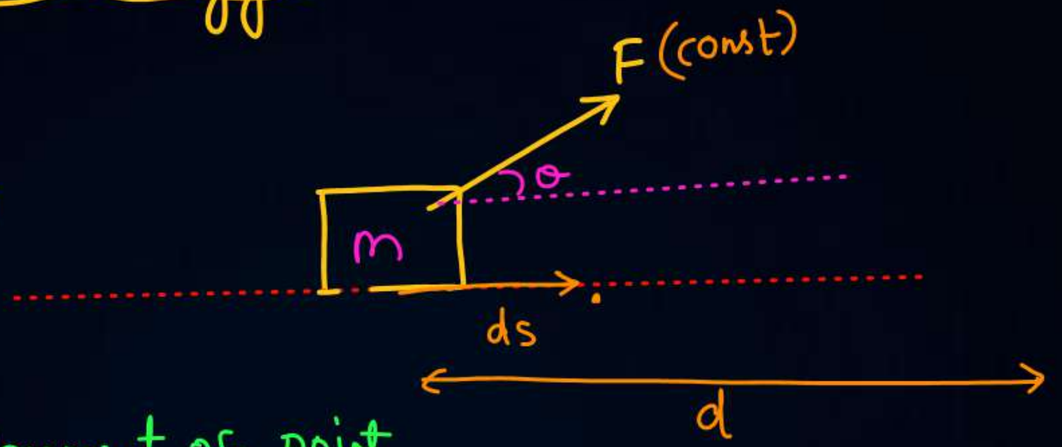
Work Power Energy

F → constant force (let)

$(WD)_{\text{by force } F} = dF = \vec{F}\cdot d\vec{s}$



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

displacement of point of application of force

$\int dw = \int \vec{F}\cdot d\vec{s}$

$(WD) = \vec{F}\cdot\int d\vec{s} \Rightarrow (WD)_{\text{by const force F}} = \vec{F}\cdot\vec{d} = F\,d\cos\theta = F\cos\theta\cdot d =$

θ → angle b/w force & displacement

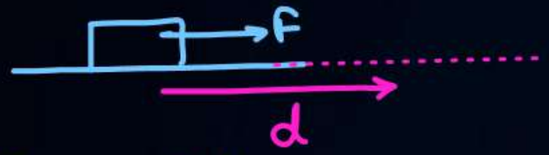
(magnitude) = (force) × (component of displacement in the dirⁿ of force)

$(F\cos\theta)\,d =$ (magnitude of component of force in the dirⁿ of displacement) × Displacement

$(WD)_{\text{by const force}} = \vec{F}\cdot\vec{d} = Fd\cos\theta$

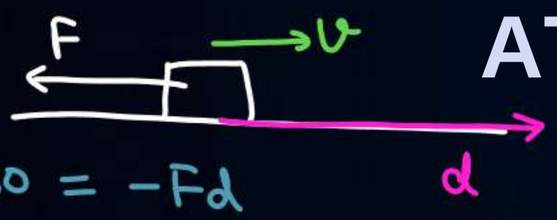
$\vec{d}$ → Displacement of point of application of force

① if $\theta = 0$



$(WD)_F = Fd\cos 0 = +Fd$

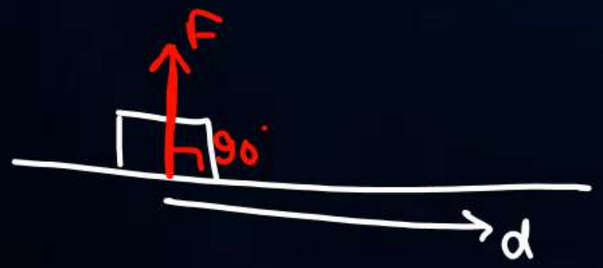
② If $\theta = 180^\circ$



$(WD)_F = Fd\cos 180 = -Fd$

③ $\theta = 90^\circ$

$(WD)_F = 0$



if force is variable

$dw = \vec{F}\cdot d\vec{s}$

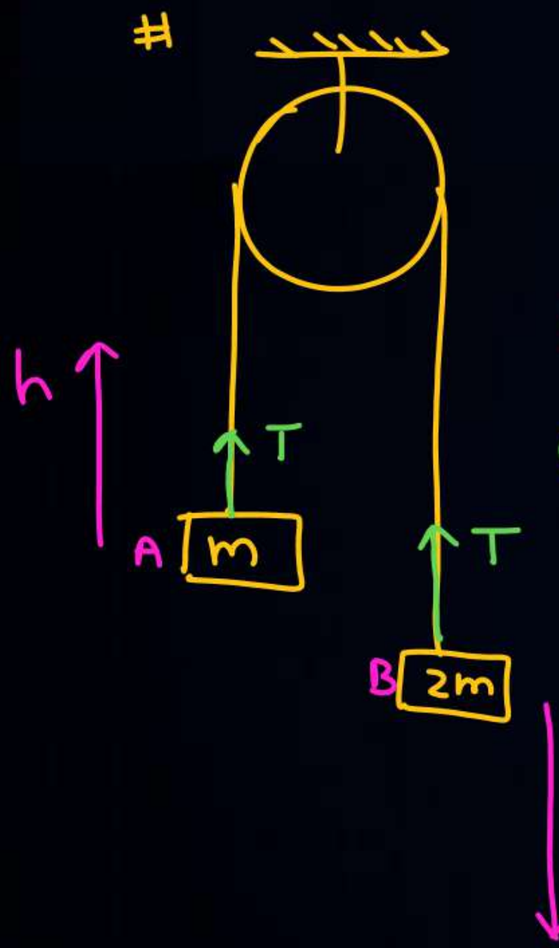
$\int dw = (WD) = \int \vec{F}\cdot d\vec{s}$

$(WD)_{\text{by const force}} = Fd\cos\theta$

$\theta < 90 \Rightarrow (WD)_F > 0$

$\theta = 90 \Rightarrow (WD)_F = 0$

$180 > \theta > 90 \Rightarrow (WD)_F < 0$

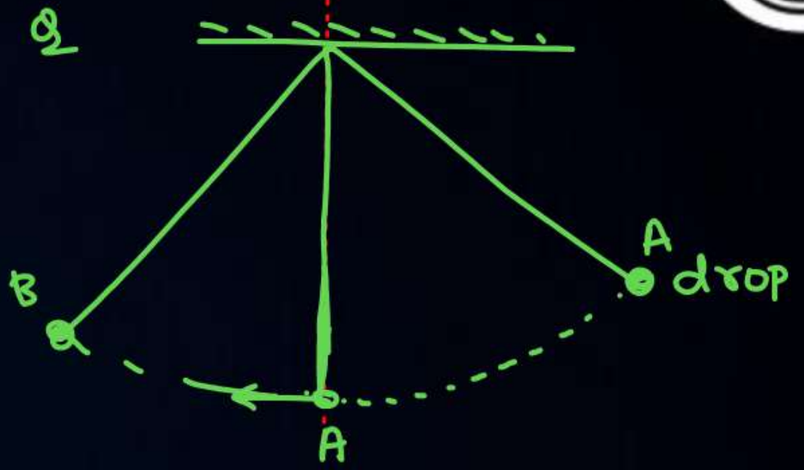


$(WD)_{T \text{ on } A} \longrightarrow +ve$

$(WD)_{T \text{ on } B} \longrightarrow -ve$

$(WD)_{\text{gravity on A}} \longrightarrow -ve$

$(WD)_{\text{by gravity on B}} \longrightarrow +ve.$



$(O \to A) \Rightarrow (WD)_{\text{by air resistance}} \equiv -ve$

$(A \to B) \Rightarrow$ " " $-ve$

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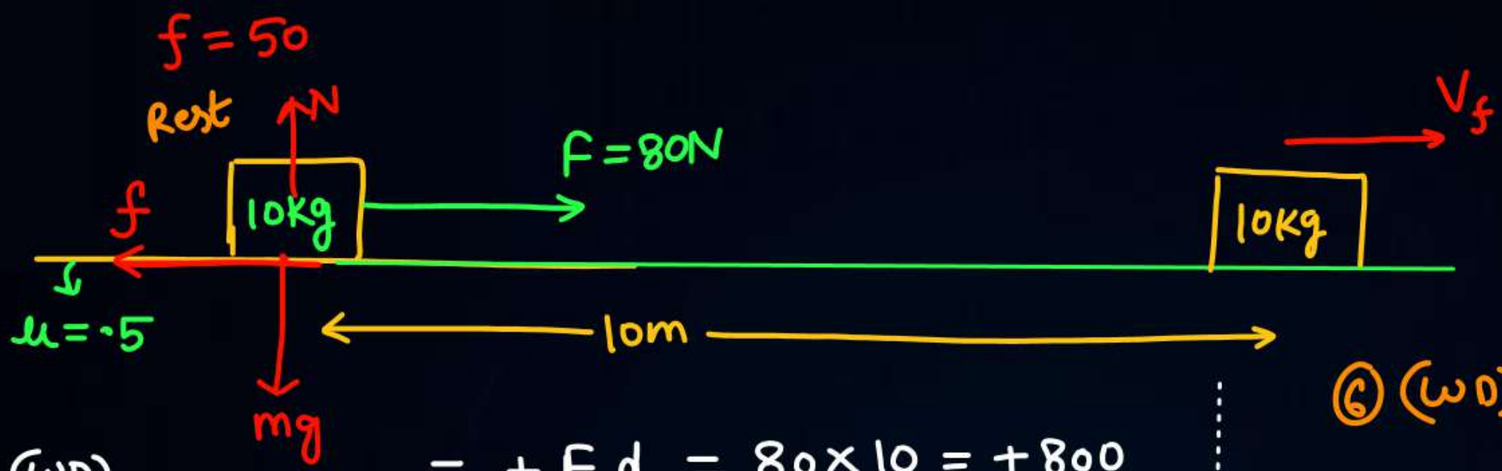
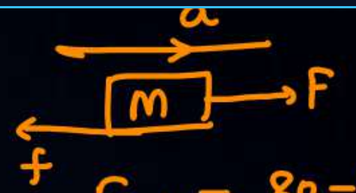




$F_{net} = 80 - 50 = 30$

① $(WD)_{\text{by force } F} = +F.d = 80 \times 10 = +800$

② $(WD)_{\text{by friction}} = -fd = -50 \times 10 = -500$

③ $(WD)_{\text{gravity}} = (WD)_{mg} = 0 \quad (\theta = 90^\circ)$

④ $(WD)_{\text{normal}} = 0$

⑤ $(WD)_{\text{by all the force}} = W_g + W_N + W_F + W_f$

$= 0 + 0 + 800 - 500$

$= 300$

⑥ $(WD)_{\text{by net force}} = +30 \times 10 = 300$

work energy theorem $= (WD)_{\text{by all force}} = \Delta K.E.$

$K_f = 300 = \frac{1}{2}mV^2$

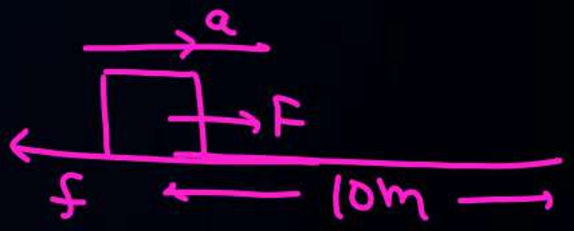
$300 = K_f - K_i$ ($K_i = 0$)

$300 = \frac{1}{2} \times 10 \times V^2$

$V = \sqrt{60}$

$a = \frac{F-f}{m} = \frac{80-50}{10}$

$a = 3$



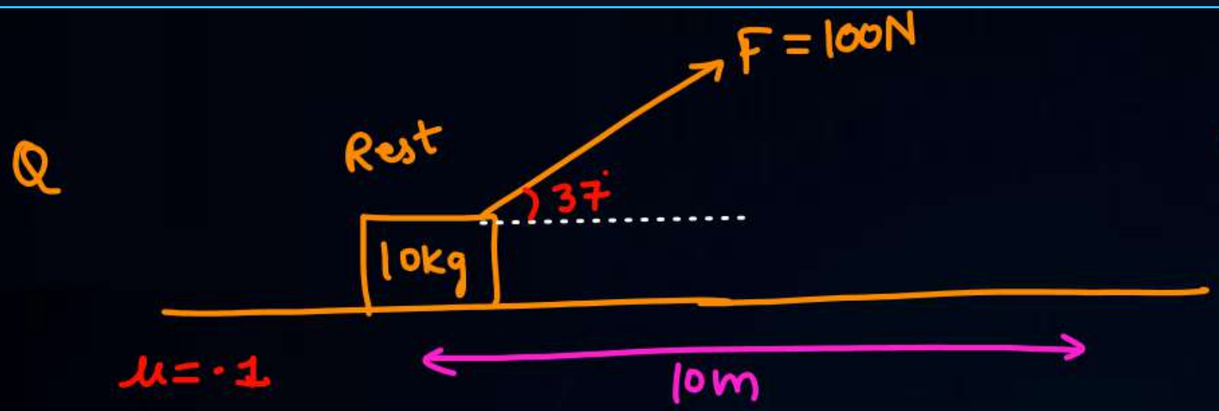
$V_f^2 = u^2 + 2as = 0 + 2 \times 3 \times 10$

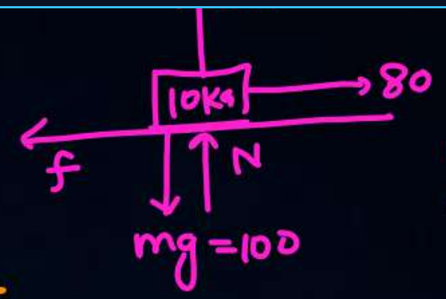
$V_f = \sqrt{60}$

* Work Energy theorem

$(WD)_{\text{by all the force}} = \text{Change in K.E.}$

$= K_f - K_i$





$N = 40$

$f_k = \mu N = \cdot 1 \times 40 = 4$

① $(WD)_F = Fd\cos 37^\circ = 100 \times 10 \times \frac{4}{5} = 800$

$= +80 \times 10$

② $(WD)_f = -4 \times 10 = -40$

③ $(WD)_N = 0$

④ $(WD)_g = 0$

⑤ $(WD)_{\text{by all the force}} = 800 - 40 + 0 + 0$

$= 760 = \frac{1}{2} m v_f^2$

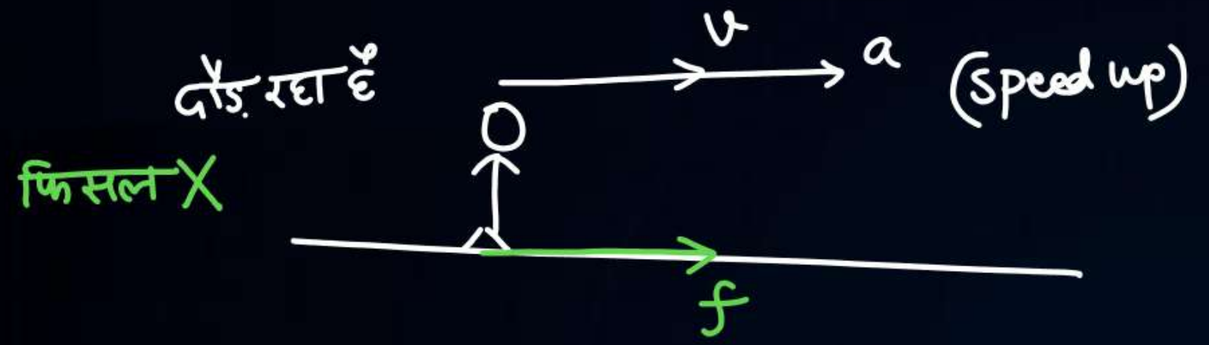
$760 = \frac{1}{2} \times 10 \times v_f^2$

$v_f = \sqrt{152}$

$a = \frac{80 - 4}{10} = 7.6$

$v^2 = 0^2 + 2 \times 7.6 \times 10$

$v = \sqrt{152}$



$f \longrightarrow a$ दिया

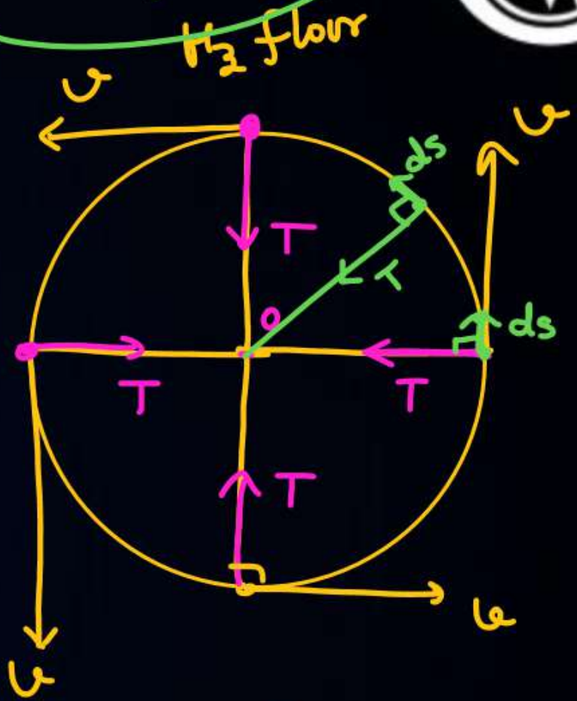
$(WD)_f = 0$

$(WD)_{internal} + (WD)_g + (WD)_N + (WD)_f = \Delta K.E.$

$(WD)_{intenl} + 0 + 0 + 0 = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

$T = \frac{mv^2}{R} = ma_c$

Q



$WD = \int \vec{F} \cdot d\vec{s}$ $\quad \vec{v} = \frac{d\vec{s}}{dt}$

$= \int \vec{F} \cdot \vec{v}\, dt$

$\vec{F} \perp \vec{v} \Rightarrow WD = 0$

SKC

* internal forces (WD) तो कर सकते हैं but acc. नहीं दे सकते
* ऐसा भी possible है ⇒ कोई force acc तो दे रहा है But उसका WD = 0 है
* ∴ acc हमेशा External force देंगे।

Home Work

— Complete your Backlog if any.

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