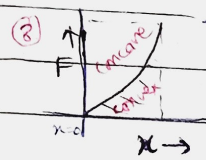
Work, Power. Energy

① $W = \vec{F}.\vec{s} \Rightarrow F.S.\cos\theta$

② $\vec{F}$ = (magnitude) (unit vector)

- Sum of w.d. of all the forces $= \Delta K$

- max. speed तिथपर्यंत असते जिथपर्यंत area वाढत असतो.

③ 

$A_{convex} = \frac{x_0 y_0}{3}$ | $A_{concave} = \frac{2 x_0 y_0}{3}$

④ $a = F(v)$

$\frac{v\,dv}{dx} = f(v)$

⑤ Conservative force.

$W_{cons} = -\Delta U$

⑥ spring force ; $W_{sp} = -\frac{1}{2} k x^2$

⑦ 3 dimensional formula for P.E.

$$\vec{F} = -\frac{\partial U}{\partial x}\hat{i} - \frac{\partial U}{\partial y}\hat{j} - \frac{\partial U}{\partial z}\hat{k}$$

$$F = -\frac{dU}{dx}$$

⑧ Types of eqm.

stable — (PE min)

unstable — (PE max)

neutral. — F always zero

⑨ Relⁿ of K.E with linear momentum

$K = \frac{1}{2}mv^2 = \frac{p^2}{2m}$

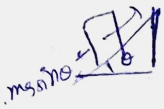
⑩ % change in K.E. $\left(\frac{K_f - K_i}{K_i}\right) \times 100$

$\Rightarrow \left(\frac{P_f^2 - P_i^2}{P_i^2}\right) \times 100.$

⑪ % change in momentum $\Rightarrow \left(\frac{P_f - P_i}{P_i}\right) \times 100$

$\Rightarrow \left(\frac{\sqrt{K_f} - \sqrt{K_i}}{\sqrt{K_i}}\right) \times 100.$

$-\Delta U = W_{conservative}$



⑫ % change in K.E = 2 % change in momentum

$\frac{\Delta K}{K} = \frac{2\Delta P}{P}$

⑬ Work - Energy theorem.

$\Sigma W = \Delta K$

work done = change in K.E.

⑭ mechanical Energy conservation.

$W_{eq} + W_{nc} = \Delta K + \Delta U$

$W_{eq} + W_{nc} = \Delta E$

$K_i + U_i = K_f + U_f$

⑮ Horizontal spring mass system.

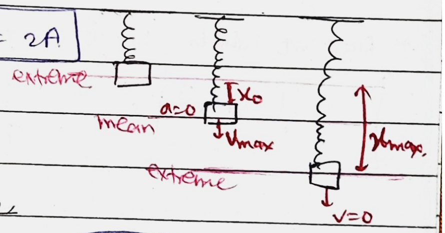
→ when mass 'm' detaches then $U_f = 0$

→ when gets attached with spring $U_f \neq 0$

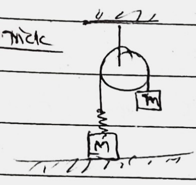
⇒ Trick for solving attached 'm' block to the spring in vertical & horizontal dirⁿ

$V_{max} = A\omega$ $\omega = \sqrt{\frac{k}{m}}$

$X_{max} = 2A$



⇒ Trick

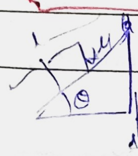


$m = \frac{M}{2}$ then block will lift up from ground surface

⑯ chain problems.

$U_{horizontal} = 0$

$U_{vertical} = -\frac{M}{x} \times \frac{L}{2x} \times g$



$W_{nc} = \Delta K + \Delta U$

$-\mu mgl\cos\theta = (0+0) + (0 + mgl\sin\theta)$

Power

$$\text{av. Power} = \frac{\Delta K}{\Delta t}$$, $$P_{inst} = \frac{dW}{dt} = \frac{dK}{dt} = \vec{F} \cdot \vec{v}$$

Power (when force is const):

$$P_{av} = \frac{P_{inst}}{2}$$

$$P_{av} = \frac{(P_{inst})_{initial} + (P_{inst})_{final}}{2}$$

Engine pump.

$$\text{Power} = F \cdot v$$

$$\frac{m}{\Delta t} \text{ (mass of liq. flowing/time)} = \rho A V.$$

$$\text{Power of engine pump} = \rho A V^3$$

AV = vol. of liq flowing/time

(i) ↳ Rate of flow (R).

* Rate at which K.E is imparted to liquid.

$$P = \frac{1}{2} \rho A V^3 \qquad \eta = \frac{P_{output}}{P_{input}}.$$

(Q). How to ↑es rate of flow.

a) Rate is ↑es keeping pipe same (A = same)

$$P_2 = n^3 P_1$$

b) Rate is ↑es by (n) time by keeping 'speed' same.

$$P_2 = n P_1$$

car problems (with const power).

↳ Refer notebook

$x \propto t^{3/2}$ → differentiation
$v \propto t^{1/2}$
$a \propto t^{-1/2}$