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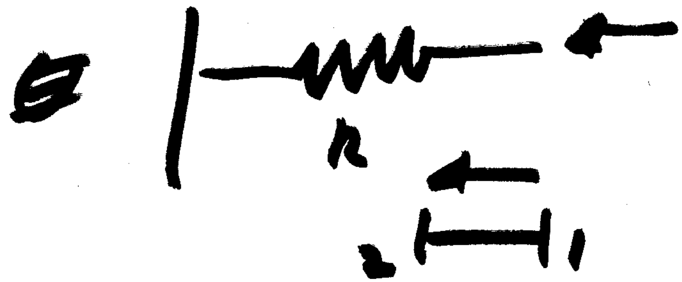
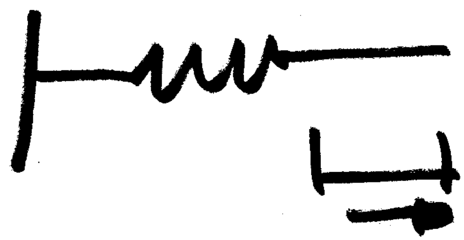
Work - Energy.

Work $dU = \vec{F} \cdot d\vec{r}$.



work done on a spring.

$U_{1-2} = \frac{1}{2} k s_1^2 - \frac{1}{2} k s_2^2$



work done by the spring

$U_{1-2} = -(\frac{1}{2} k s_1^2 - \frac{1}{2} k s_2^2)$

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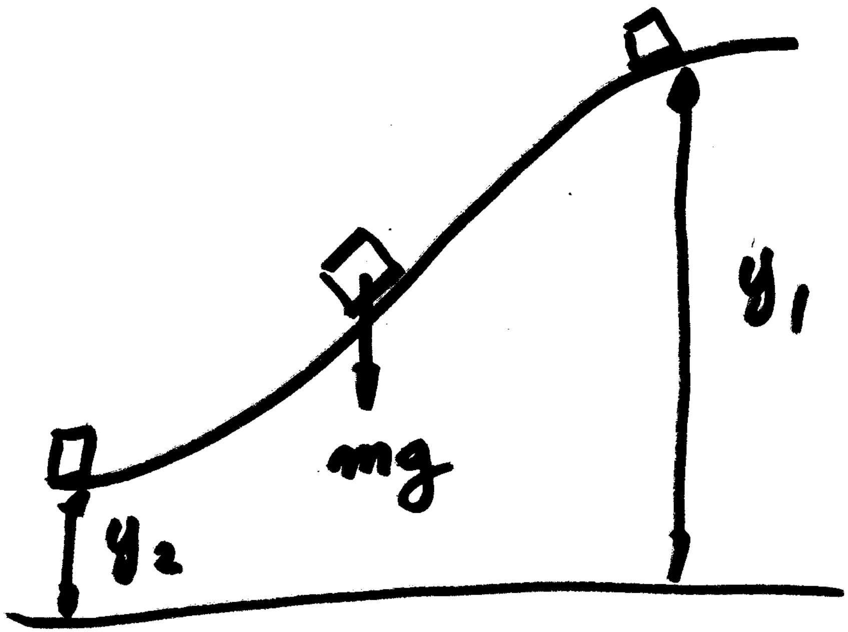
Work done by the gravity



$$dU = \vec{F} \cdot d\vec{y}$$

$$\vec{F} = -mg\hat{j}$$

$$U = \int_{y_1}^{y_2} -mg\, dy$$

$$U = -mg(y_2 - y_1)$$

$$U_g = -mg\Delta y$$

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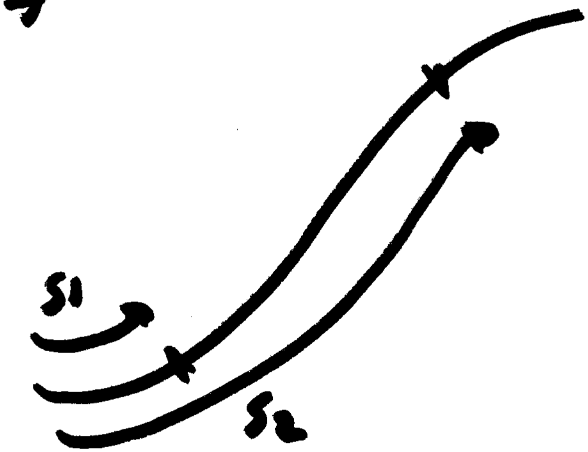
$\vec{F} = m\vec{a}$ Eq. mot.



$F_t = m a_t$

$dU = F_t \cdot ds$

$= m a_t ds$

$\int dU = \int_{v_1}^{v_2} m v \, dv$

$U = \frac{1}{2} m (v_2^2 - v_1^2)$

$T = \frac{1}{2} m v^2$ → Kinetic Energy

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- $\underline{U = \Delta T}$ → Eq. of motion

  $\vec{F} = m\vec{a}$

- ado. - no acceleration
  - scalar eq.

- disado. - F → tan
  - v → tan → a_t
  - Solution → $a_n = \frac{v^2}{R}$ R → radius of curv.
  - $\underline{\Sigma F_n = m a_n}$

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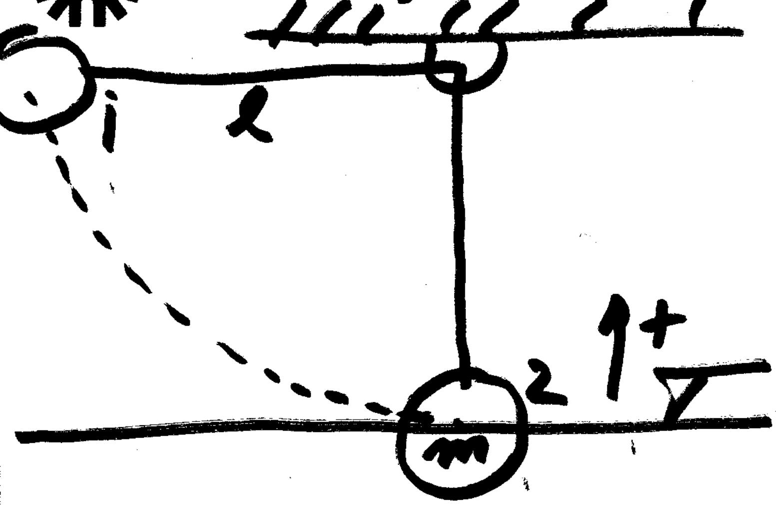
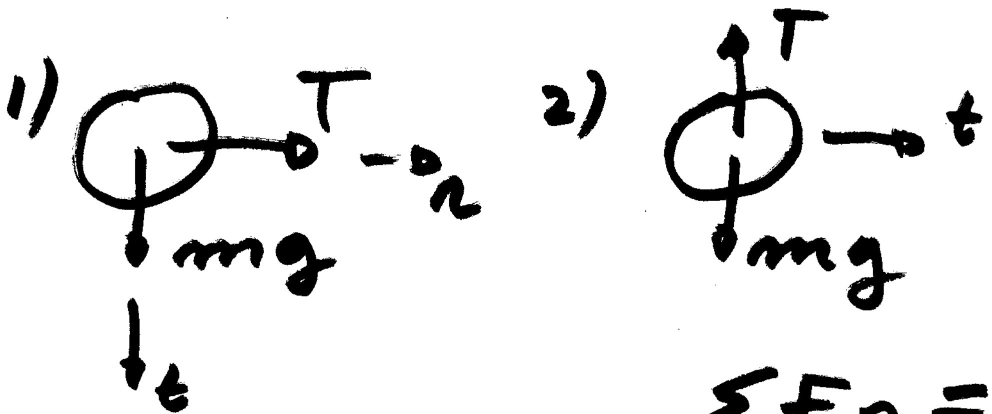


G) start from rest.

mass = m.

F) . T_2 of cord.

I) n



$$\Sigma F_n = m a_n$$

$$T - mg = m \frac{v_2^2}{l}$$

$$U = \Delta T$$

$$-mg\,\Delta y = \frac{1}{2}m(v_2^2 - \cancel{v_1^2}) \to 0$$

$$-mg(y_2 - y_1) = \frac{1}{2}m v_2^2$$

$$+\cancel{m}g(0 + l) = \frac{1}{2}\cancel{m}v_2^2$$

$$v_2^2 = 2gl$$

$$T = m\frac{v_2^2}{l} + mg$$

$$= m \cdot \frac{2gl}{l} + mg$$

$$T = 3mg$$

Power.

$$P_{av.} = \frac{\Delta U}{\Delta t}$$

$$P = \frac{dU}{dt} = \vec{F} \cdot \frac{d\vec{r}}{dt} \rightarrow v.$$

$$P = \vec{F} \cdot \vec{v} \quad [W] \; [J/s]$$

← scalar.

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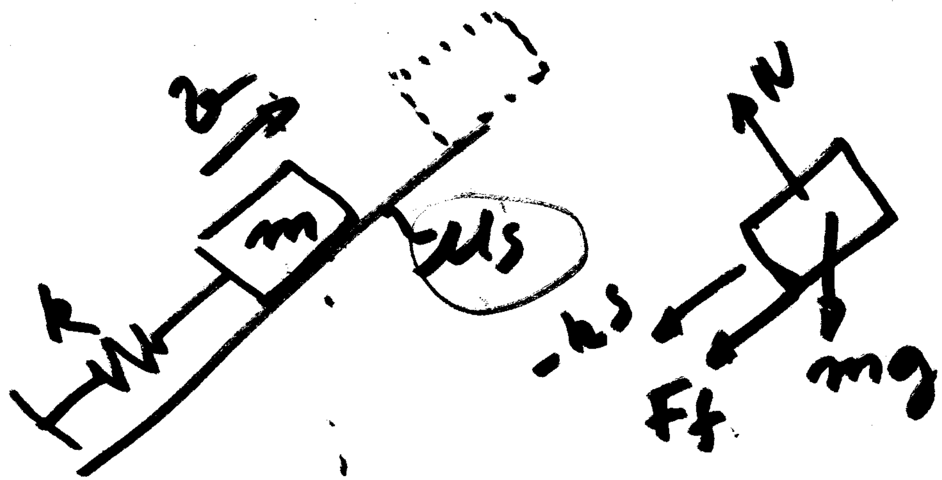
$U = \Delta E$ Eq. of mot.

$U = \int \vec{F} \cdot dr$

$U_g = -mg\,\Delta y$

$U_s = -\frac{1}{2}k(s_2^2 - s_1^2)$



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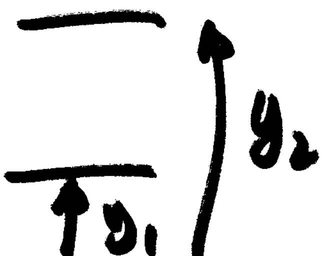
$$U = \Delta T$$

$$\int_{s_1}^{s_2} F_t \, ds - mg\,\Delta y - \frac{1}{2}k(s_2^2 - s_1^2) = \Delta T$$

$$\int_{s_1}^{s_2} F_t \, ds = \Delta T + \underbrace{mg\,\Delta y}_{\Delta V_g} + \underbrace{\frac{1}{2}k(s_2^2 - s_1^2)}_{\Delta V_s}.$$

$\Delta V_g \rightarrow$ Work done against gravity to move an object from $y_1 \rightarrow y_2$



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$$U = \underbrace{\Delta T + \Delta V_g + \Delta V_s}$$

$$U = \Delta E_m$$

↓ Total mechanical E.

Conservation of Energy:

$$\underbrace{0 = \Delta E_m}$$

↳ Conservative.

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⇒ g, k are conservative

if $\Delta E_m = 0$.

Nonconservative.

- friction
- tension.