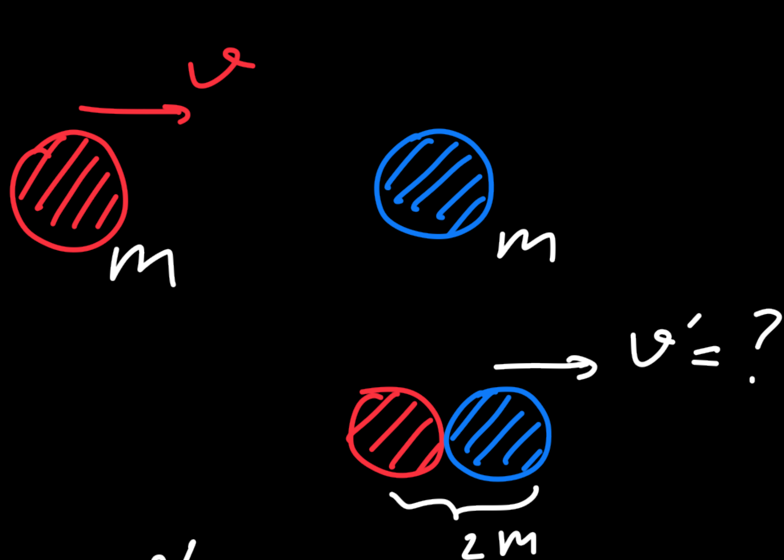
Homework 15.

N1



$$mv = 2m\cdot v'$$

$$\Rightarrow \boxed{v' = v/2 = 2.5\ m/s}$$

Before: $E_{kin,1} = \frac{mv^2}{2}$

After: $E_{kin,2} = \frac{2m\,(v/2)^2}{2} = \frac{1}{2}\cdot\frac{mv^2}{2}$

$$\Rightarrow \boxed{E_{kin,2} = \frac{1}{2}\cdot E_{kin,1}}$$

N2. $E_{kin} = 4.5\ kJ$

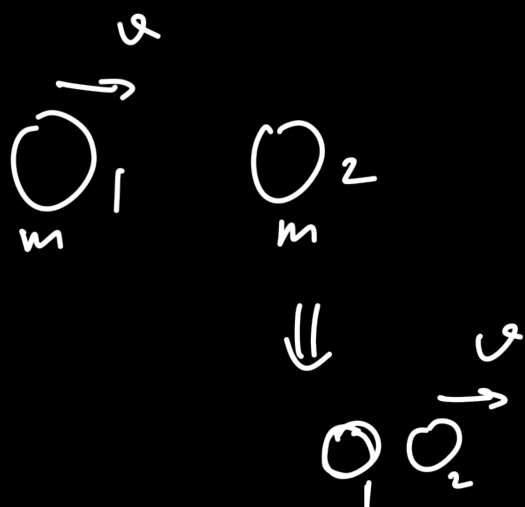
$v = g\cdot t = 30\ \frac{m}{s}$

№3.

$E_{kin} = 500\,\text{J}$

$$E_{kin} = \frac{mv^2}{2} = \frac{mv \cdot v}{2} = \frac{p \cdot v}{2}$$

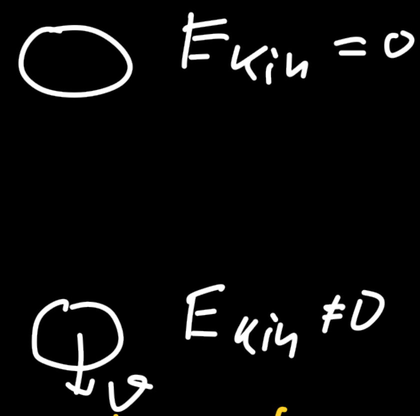
№4.*



Classwork Potential energy

$$\boxed{E_{kin} = \frac{m v^2}{2}}$$

Falling object:



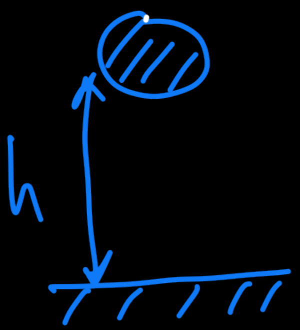
There has to be another form of energy that is transformed into kinetic energy.

$\Rightarrow$ Potential energy.

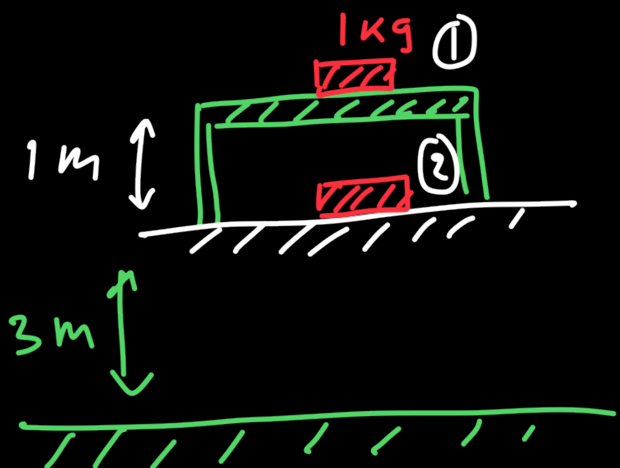
should increase with height!

$$\boxed{E_{pot} = m \cdot g \cdot h}$$

$$[E_{pot}] = 1\,kg \cdot \frac{m}{s^2} \cdot m = 1\,kg \cdot \frac{m^2}{s^2} = 1\,J$$



E_{pot} → depends on the reference point!



$$\begin{cases} E_{pot,1} = mgh = 10\,J \\ E_{pot,2} = 0 \end{cases}$$

$$\Rightarrow \Delta E_{pot} = E_{pot,2} - E_{pot,1}$$

$$\Delta E_{pot} = -10\,J$$

Let's say the table is on the second floor, so it is 3 m. above ground level.

w.r.t. the ground level:

$$\begin{cases} E_{pot,1} = 1\,kg \cdot 10\,\frac{m}{s^2} \cdot 4\,m = 40\,J \\ E_{pot,2} = 1 \cdot 10 \cdot 3\,J = 30\,J \end{cases}$$

$$\boxed{\Delta E_{pot} = 30\,J - 40\,J = -10\,J}$$

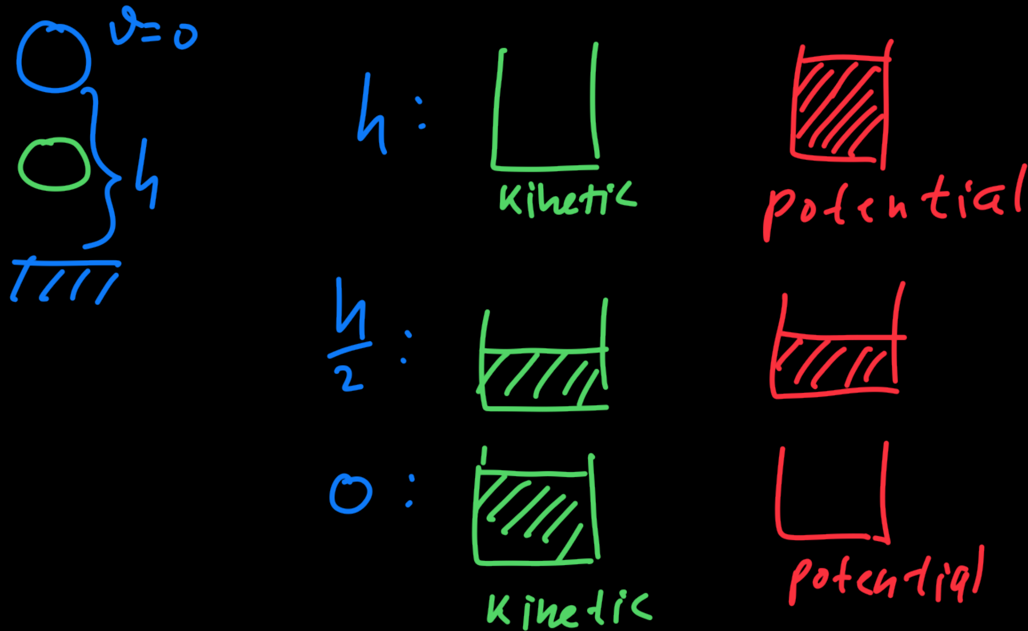
The change in the potential energy is independent of the reference point.

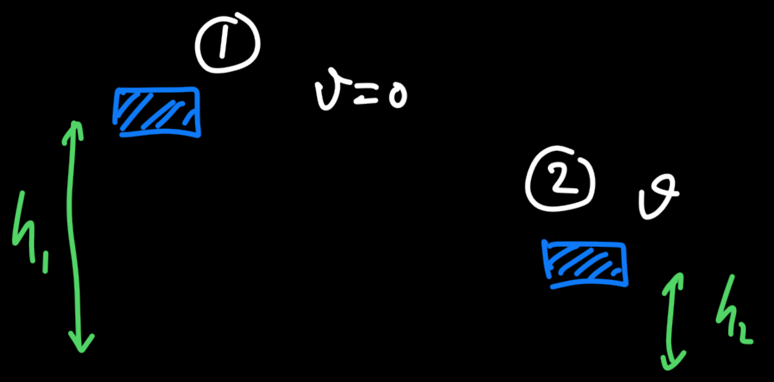
Total mechanical energy

$$\boxed{E_{mech.} = E_{kin} + E_{pot} = \frac{mv^2}{2} + mgh}$$

Conservation of total mechanical energy, when the object moves only under the influence of gravity (no friction ...):

$$\boxed{E_{mech} = const.}$$





$h_2 < h_1$

$$E_{mech,1} = mgh_1 + 0$$

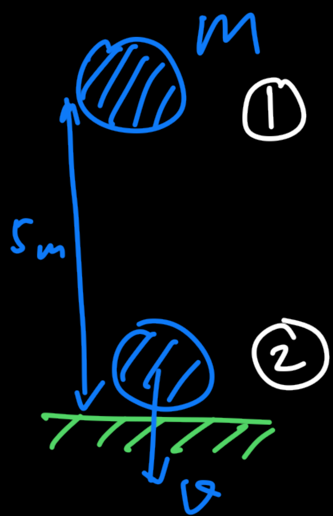
$$E_{mech,2} = mgh_2 + \frac{mv^2}{2}$$

$$E_{mech} = \text{const} \Rightarrow E_{mech,1} = E_{mech,2}.$$

$$\boxed{mgh_1 = mgh_2 + \frac{mv^2}{2}}$$

$$\boxed{\begin{gathered}\frac{mv^2}{2} = mgh_1 - mgh_2 = -\Delta E_{pot.} \\ \Delta E_{pot} = mgh_2 - mgh_1\end{gathered}}$$

$E_{pot.}$ only depends on the current position in space (no matter the previous trajectory)



$$\begin{cases} E_{mech,1} = mgh + 0 \\ E_{mech,2} = 0 + \frac{mv^2}{2} \end{cases}$$

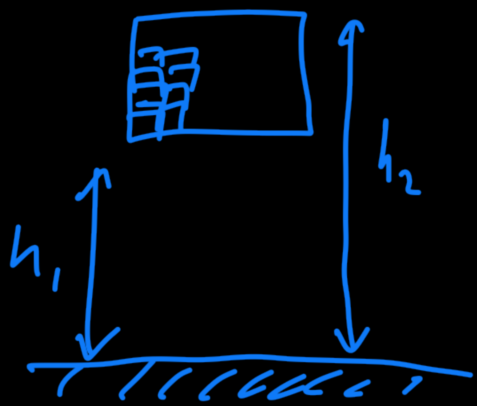
$$\Downarrow \quad \frac{\cancel{m} v^2}{2} = \cancel{m} g h$$

$$v^2 = 2gh$$

$$\boxed{v = \sqrt{2gh}}$$

$$v = \sqrt{2 \cdot 10 \frac{m}{s^2} \cdot 5 m} = \sqrt{100 \frac{m^2}{s^2}}$$

$$\boxed{v = 10 \frac{m}{s}}$$



$h_2 > h_1$

$$\boxed{E_{pot} = \sum_i m_i \cdot h_i \cdot g}$$

Guess: h_1, $\frac{h_1 + h_2}{2}$