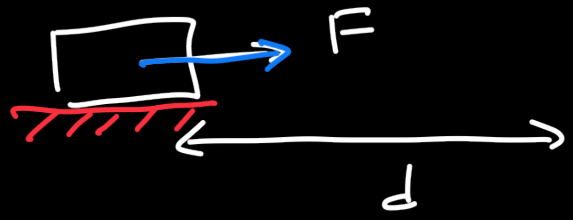
Homework 17

Recap:

Work:



$W = F \cdot d \ (\pm)$

$\Delta E_{kin} = W_{all\ forces}$

$\Delta E_{mech.} = W_{except\ grav.}$

① $\Delta E_{mech} = \Delta E_{kin} + \Delta E_{pot.}$

$\Delta E_{kin} = W_{all\ forces.}$

$\Delta E_{pot} = - W_{grav.}$

$\Delta E_{mech.} = W_{all\ forces} - W_{grav.}$

$= W_{except\ grav.}$

HW17.

4. $W_{fr.} = \Delta E_{kin} = 0 - \frac{Mv^2}{2} = -200\,kJ$

$v = 72 \frac{km}{h} = 72 \frac{10^3 m}{60 \cdot 60 s.}$

$v = 72 \frac{km}{h} = \frac{72}{3.6} \frac{m}{s} = 20\, m/s$

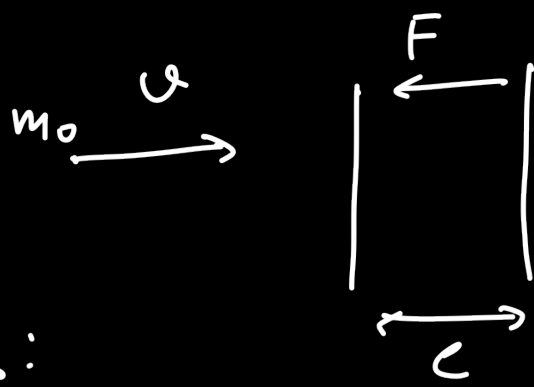
$W_{fr} = -d \cdot F_{fr.}$; $F_{fr} = \mu \cdot N = \mu \cdot m \cdot g$

$F_{fr.} = 4 \cdot 10^3 N$

$\Rightarrow \quad d = -\frac{W_{fr}}{F_{fr.}} = \frac{200 \cdot 10^3 J}{4 \cdot 10^3 N}$

$\frac{J}{N} = \frac{N \cdot m}{N} = m \Rightarrow \boxed{d = 50\, m}$

5*



$m_0 = ?$

David:

$l = \frac{1}{2} v \cdot t$

$t = 2l / v$

$m_0 = \frac{2 l \cdot F}{v^2}$

for m_0:

$$\Delta E_{kin} = - F \cdot l$$

$$0 - \frac{m_0 v^2}{2} = - F \cdot l$$

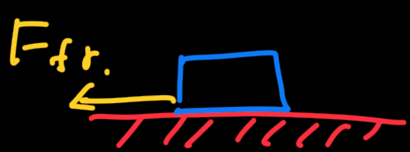
$$m_0 = \frac{-2 F l}{v^2}$$

$|\vec{d}| = l$

Thermal energy and temperature.

Mechanical energy: KE + PE

It can change if the force is applied.



KE is decreasing due to $W_{fr.}$

⇒ Mech. energy also ↓ in a closed system!

But! total energy of a closed system is never lost or gained!

It can only change forms.

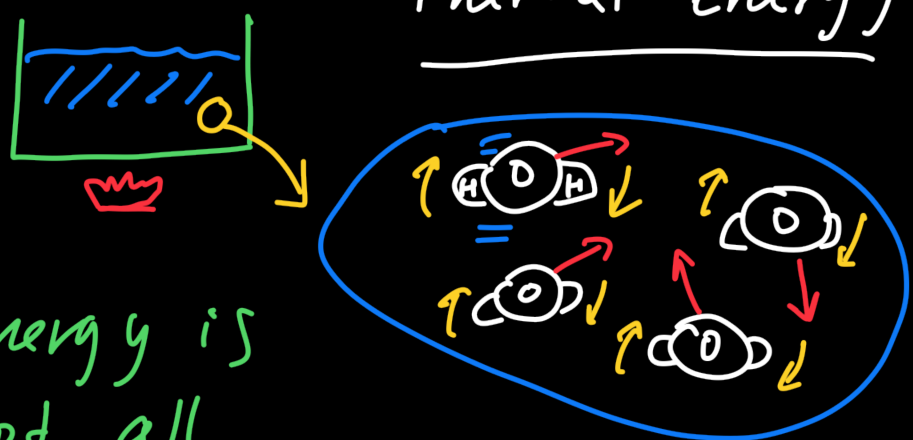
In this case → some kinetic energy of an object turned into Thermal energy

Thermal energy ⟷ Temperature

Temperature is the measure of thermal energy.

Example: boiling pot od water.

Thermel energy



Thermel energy is the sum od all KE of all molecules.

All types od KE:

1. Translational → most important in gases.
2. Rotational
3. Vibrations.

When do we feel that an obj. has higher temp?

→ when molecules and atoms „move faster" (higher KE)

⇒ How exactly is temp. related to kinetic energy?

$$T \sim KE_{avg.}$$

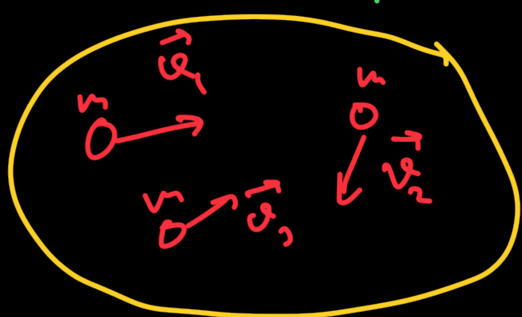
it measures the average KE

Ex. small volume of gas.

→ it has N identical molecules.

$$T \sim KE_{avg} = \frac{KE_1 + KE_2 + \dots KE_N}{N}$$

$$KE_1 = \frac{m v_1^2}{2}, \quad KE_2 = \frac{m v_2^2}{2}$$



Temp. scales

	Fahrenheit	Celsius
Boiling water	$212^\circ F$	$100^\circ C$
freezing water	$32^\circ F$	$0^\circ C$

Conversion formula:

$$t_F = 32 + \frac{9}{5} t_C$$ ✓

KE is always positive, but temp. in t_F, t_C can be negative!

Thus, we need an absolute temp. scale, where $T = 0$ corresponds to $KE = 0$

This is <u>Kelvin scale</u>

$$\boxed{T_K = 0}$$ absolute zero temp.

it corresponds to $$\boxed{KE_{avg.} = 0}$$

$$T_K = t_c + 273.15$$

$$\boxed{T_K = 0} \rightarrow \boxed{t_c = -273.15°C}$$

<u>For most gases:</u>

$$\boxed{KE_{avg} = 3/2 \, k \, T}$$

$$\boxed{k = 1.38 \cdot 10^{-23} \; J/K}$$ Boltzmann constant.