L'ÉNERGIE

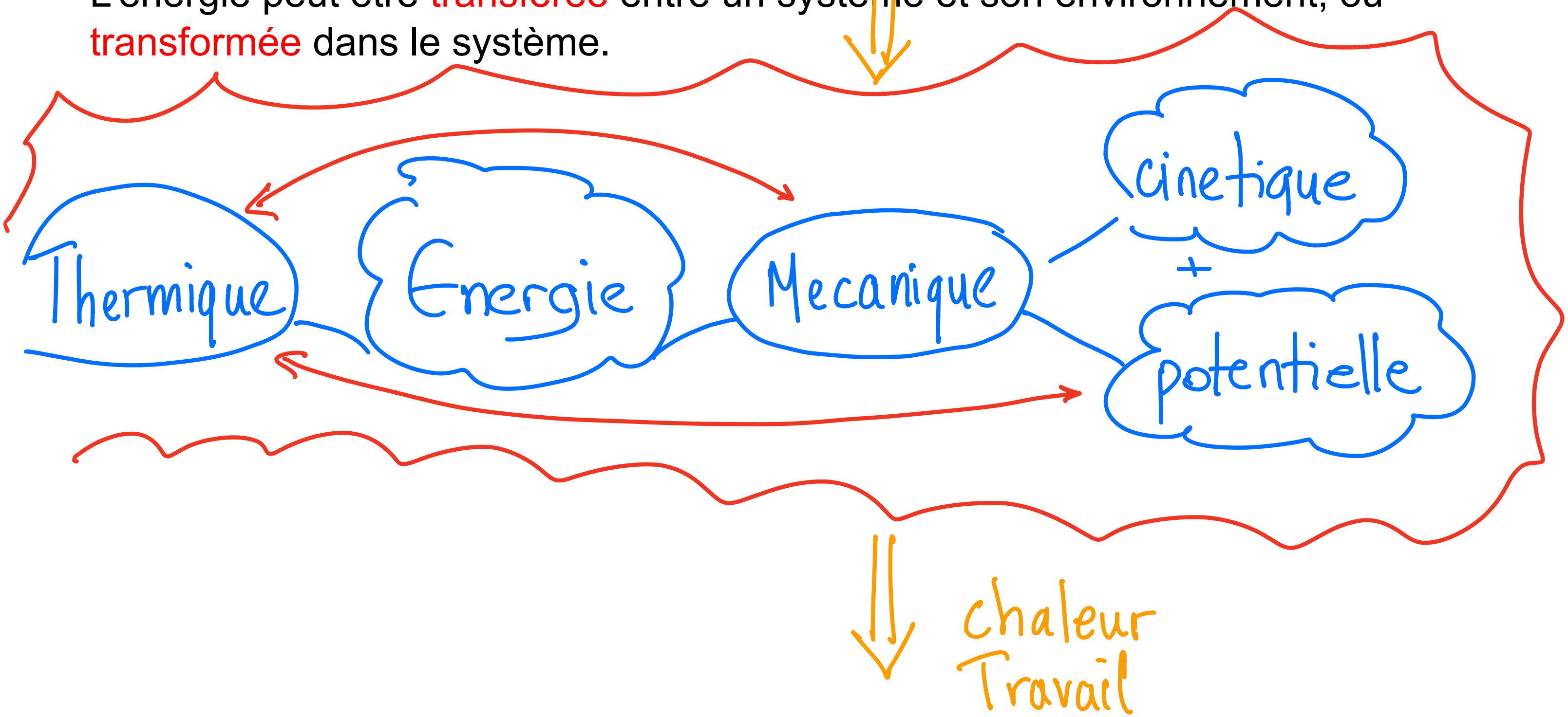
CONSERVATION D'ÉNERGIE MÉCANIQUE ET APPLICATIONS

PGC-05

L'ÉNERGIE

Une mesure de l'état d'un système.

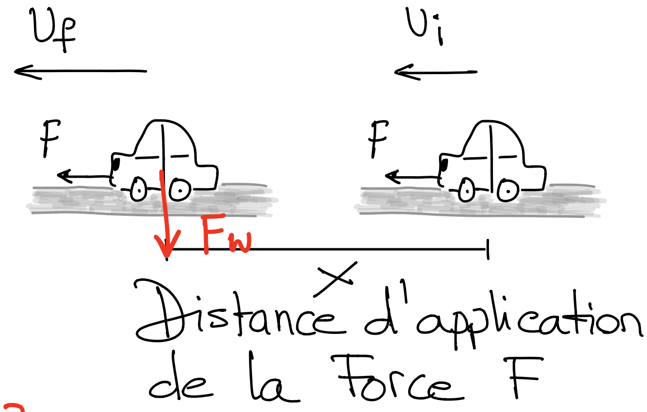
L'énergie peut être transferée entre un système et son environnement, ou transformée dans le système.



TRAVAIL ET ÉNERGIE CINÉTIQUE

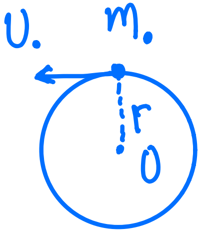
$$W = \vec{F} \cdot \vec{x}$$

$$= F \cdot x \cdot \cos\theta$$



$$W = \Delta E_c = \frac{1}{2} m v_F^2 - \frac{1}{2} m v_i^2$$

ÉNERGIE CINÉTIQUE DE ROTATION



$$E.c = \frac{1}{2} m . v.^2$$

$$E_c = \sum_{\bullet} \frac{1}{2} m. v.^2$$

$$v. = r\omega$$

$$\Rightarrow E_c = \sum \frac{1}{2} m r^2 \omega^2 \Rightarrow$$

$$\Rightarrow E_c = \frac{1}{2} \omega^2 \underbrace{\sum m r^2}_{I} \Rightarrow$$

$$\Rightarrow \boxed{E_c = \frac{1}{2} I \omega^2}$$

$$\left(E_c = \frac{1}{2} m v^2\right)$$

Transl	RotaT.
$\vec{F} = m\vec{a}$	$\vec{\tau} = I . \vec{a}_{ang}$
$\vec{p} = m\vec{v}$	$\vec{L} = I\vec{\omega}$
$\frac{d\vec{p}}{dt} = \vec{F}$	$\frac{d\vec{L}}{dt} = \vec{\tau}$
$E_c = \frac{1}{2} m v^2$	$E_c = \frac{1}{2} I \omega^2$

ÉNERGIE POTENTIELLE GRAVITATIONNELLE

$$h = y_i - y_f$$

$$W = \Delta E_c$$

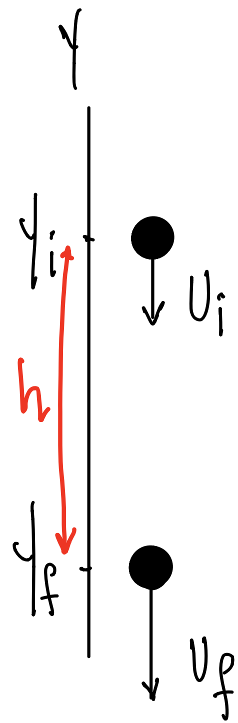
$$F \cdot h = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2 \Rightarrow$$

$$F(y_i - y_f) = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2 \Rightarrow$$

$$F \cdot y_i + \frac{1}{2} m v_i^2 = F \cdot y_f + \frac{1}{2} m v_f^2 \Rightarrow$$

$$\underbrace{mg y_i + \frac{1}{2} m v_i^2}_{f(y_i, v_i)} = \underbrace{mg y_f + \frac{1}{2} m v_f^2}_{f(y_f, v_f)} \Rightarrow$$

$$E_{pot}^{i} + E_{cin}^{i} = E_{pot}^{f} + E_{cin}^{f}.$$



ÉNERGIE MÉCANIQUE ET SA CONSERVATION

$$E_{MEC} = E_{POT} + E_{CIN}$$

$$W = \Delta E_c$$

pas de force gravitation

$$W_{EXT} = \Delta E_M = \Delta E_c + \Delta E_p = E_M^f - E_M^i$$

$$W_{EXT} = 0 \Rightarrow \Delta E_M = 0 \Rightarrow \boxed{E_M^f = E_M^i}$$

CONSERVATION D' ÉNERGIE MÉCANIQUE

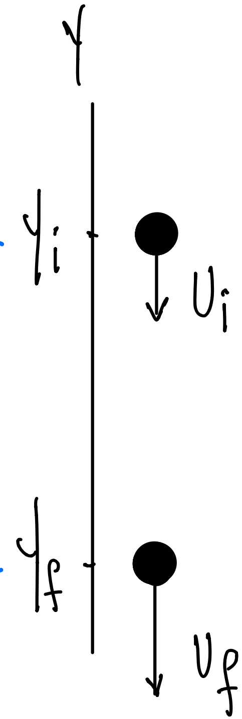
$$W_{F_W} = \Delta E_c$$

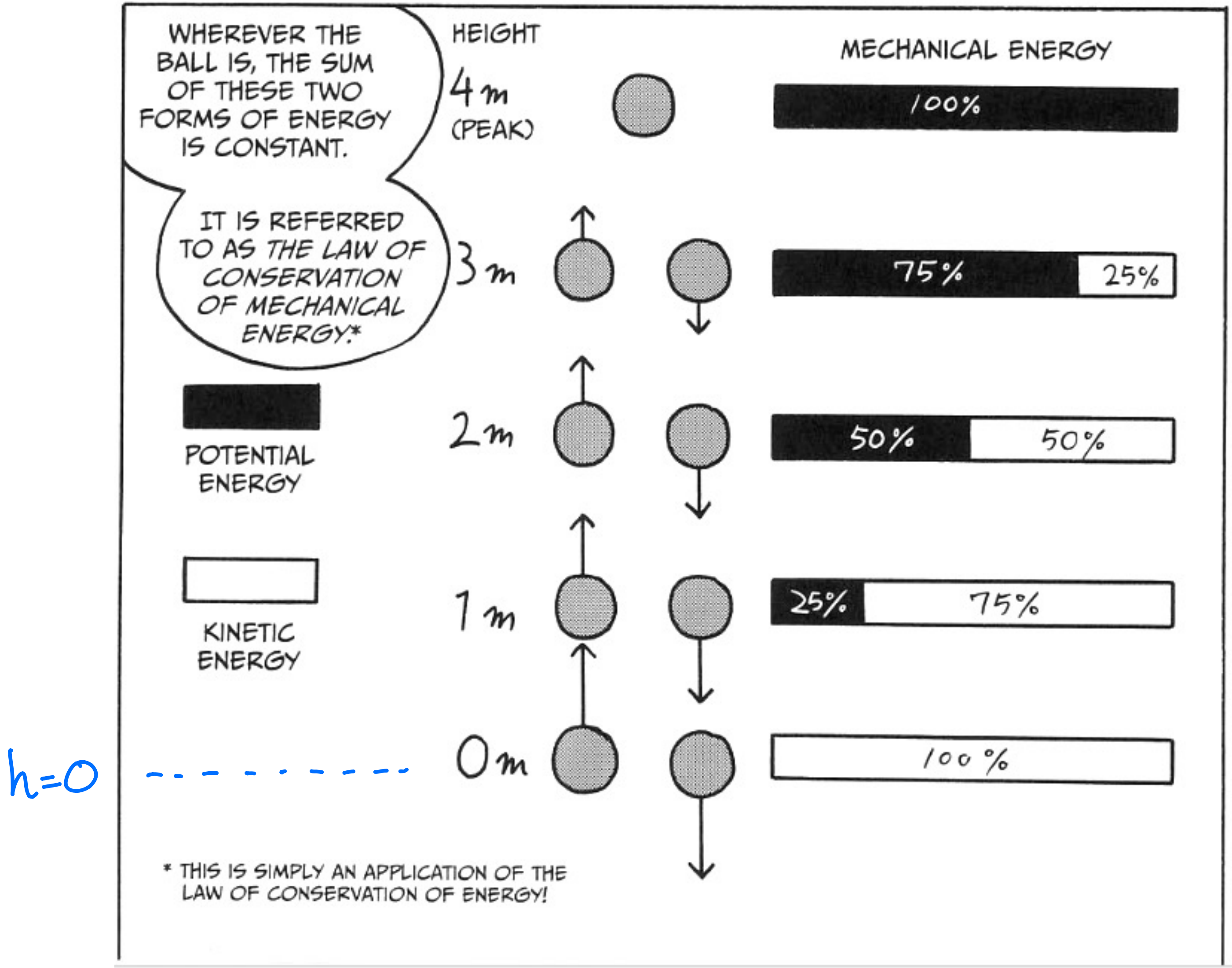
$$W_{EXT} = \Delta E_M$$

$$W_{Ex} = 0 \Rightarrow E_M^i = E_M^f$$

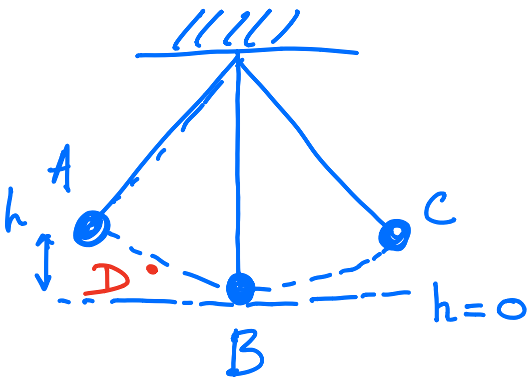
$$E_M^i = E_c^i + E_p^i$$

$$E_M^f = E_c^f + E_p^f$$




WHEREVER THE BALL IS, THE SUM OF THESE TWO FORMS OF ENERGY IS CONSTANT.
IT IS REFERRED TO AS *THE LAW OF CONSERVATION OF MECHANICAL ENERGY*.*
HEIGHT
4 m (PEAK)
3 m
2 m
1 m
0 m
MECHANICAL ENERGY
100%
75%
25%
50%
50%
25%
75%
100 %
POTENTIAL ENERGY
KINETIC ENERGY
h=0
* THIS IS SIMPLY AN APPLICATION OF THE LAW OF CONSERVATION OF ENERGY!

APPLICATIONS – PENDULE



$$E_M^A = E_M^B = E_M^C$$

$$E_M^A = E_p = mgh$$

$$E_M^C = E_p = mgh$$

$$E_M^B = E_{CIN} = \frac{1}{2} m v^2$$

$$E_M^D = E_p^D + E_{CIN}^D = mgh_D + \frac{1}{2} m v_D^2$$

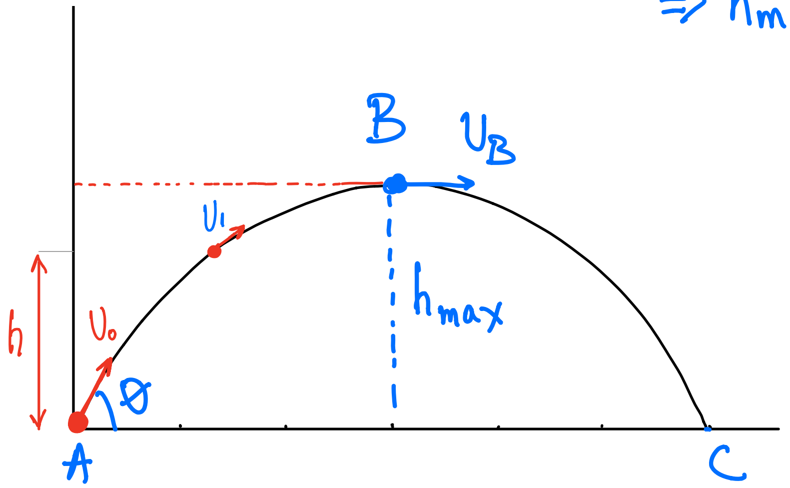
APPLICATIONS – MOUVEMENT BALISTIQUE

$$E_M^A = E_M^B \Rightarrow$$

$$\frac{1}{2} m v_0^2 = m g h_{max} + \frac{1}{2} m v_B^2 \Rightarrow$$

$$\Rightarrow h_{max} = \frac{1}{2g}\left(v_0^2 - v_B^2\right)$$

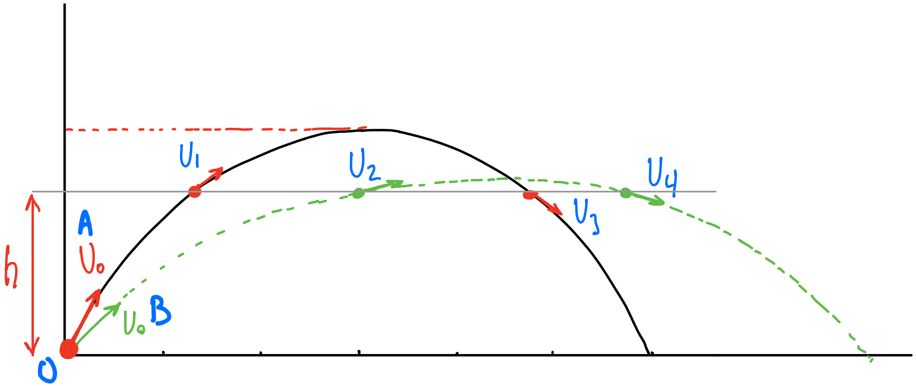
(MRUA)



QUESTION

$$E_M^0 = \frac{1}{2} m v_0^2$$

$$E_M^h = \frac{1}{2} m v_h^2 + mgh$$



$v_1 > v_2 \quad v_3 > v_4$ (a)

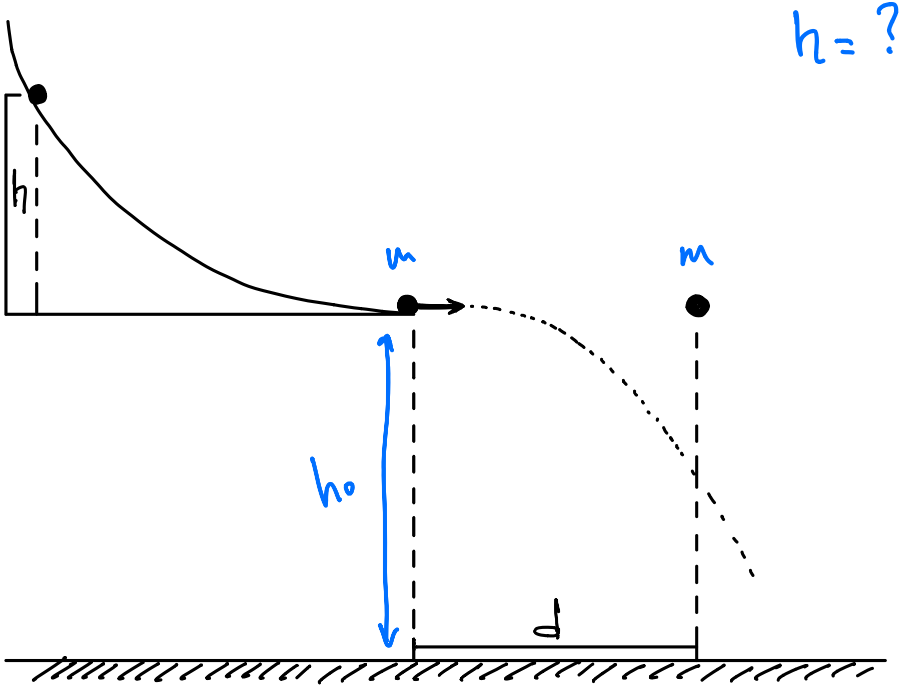
$v_1 = v_3 > v_2 = v_4$ (b)

$v_1 = v_2 = v_3 = v_4$ (c)

APPLICATIONS – MOUVEMENT BALISTIQUE

h_0 , d , m

$h = ?$



COLLISIONS
ET LA CONSERVATION DE LA QUANTITÉ DE MOUVEMENT

PGC-05

LA QUANTITÉ DE MOUVEMENT

$$\vec{F} = \frac{d\vec{P}}{dt}$$

$$\vec{F}_m = \frac{\Delta\vec{P}}{\Delta t}$$

$$(\vec{P} = m\vec{v})$$

$$\Delta\vec{P} \Leftrightarrow \vec{F}$$

Si $\vec{F}_m = 0 \Rightarrow \Delta\vec{P} = 0 \Rightarrow \vec{P}_i = \vec{P}_f$

CONVERVATION DE LA QUANTITÉ DE MOUVEMENT

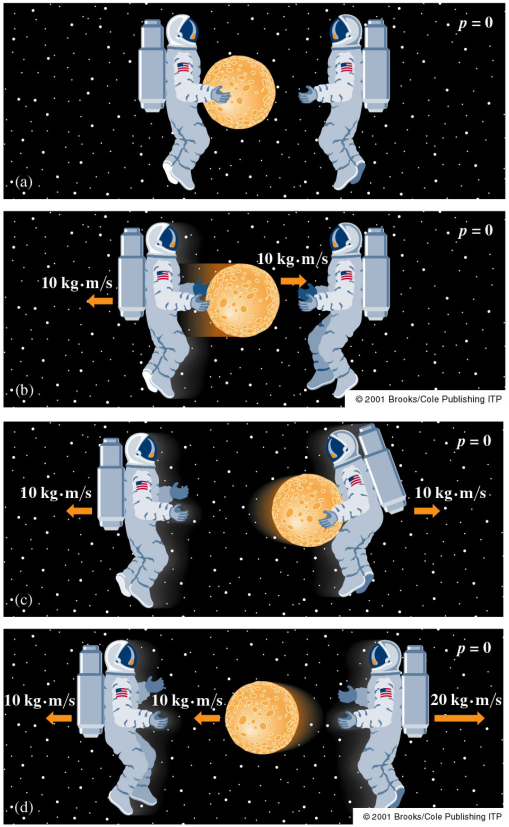
$F_{m\to M}$ $\quad v \quad M \quad m \quad u \quad$ $F_{M\to m}$

$$F_{m\to M} = -F_{M\to m} \Rightarrow M\frac{d\vec{v}}{dt} = -m\frac{d\vec{u}}{dt}$$

$$\Rightarrow \frac{d}{dt}\left(M\vec{v} + m\vec{u}\right) = 0 \Rightarrow \underline{\underline{M\vec{v} + m\vec{u} \Rightarrow \text{cons.}}}$$

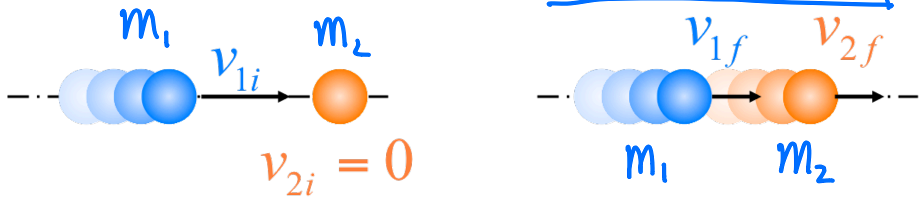
$$\vec{P}_i = \vec{P}_f \Rightarrow \underbrace{m_1\vec{v}_1^{\,i} + m_2\vec{v}_2^{\,i} = m_1\vec{v}_1^{\,f} + m_2\vec{v}_2^{\,f}}$$

$$\vec{F} = m\frac{d\vec{v}}{dt} + \vec{v}\cancel{\frac{dm}{dt}}$$



COLLISIONS ÉLASTIQUES EN 1-D

$$\boxed{\begin{array}{ll} P_i = P_f & (1) \\ E_{Mi} = E_{Mf} & (2) \end{array}}$$



$$P_i = m_1 v_{1i}$$

$$E_{Mi} = \frac{1}{2} m_1 v_{1i}^2$$

$$P_f = m_1 v_{1f} + m_2 v_{2f}$$

$$E_{Mf} = \frac{1}{2} m_1 v_{1f}^2 + \frac{1}{2} m_2 v_{2f}^2$$

$$\left.\begin{array}{l} (1):\ m_1 v_{1i} = m_1 v_{1f} + m_2 v_{2f} \\ (2):\ \frac{1}{2} m_1 v_{1i}^2 = \frac{1}{2} m_1 v_{1f}^2 + \frac{1}{2} m_2 v_{2f}^2 \end{array}\right\} \Rightarrow$$

$$v_{1f} = \frac{m_1 - m_2}{m_1 + m_2} v_{1i}$$

$$v_{2f} = \frac{2 m_1}{m_1 + m_2} v_{1i}$$

COLLISIONS ÉLASTIQUES EN 1-D

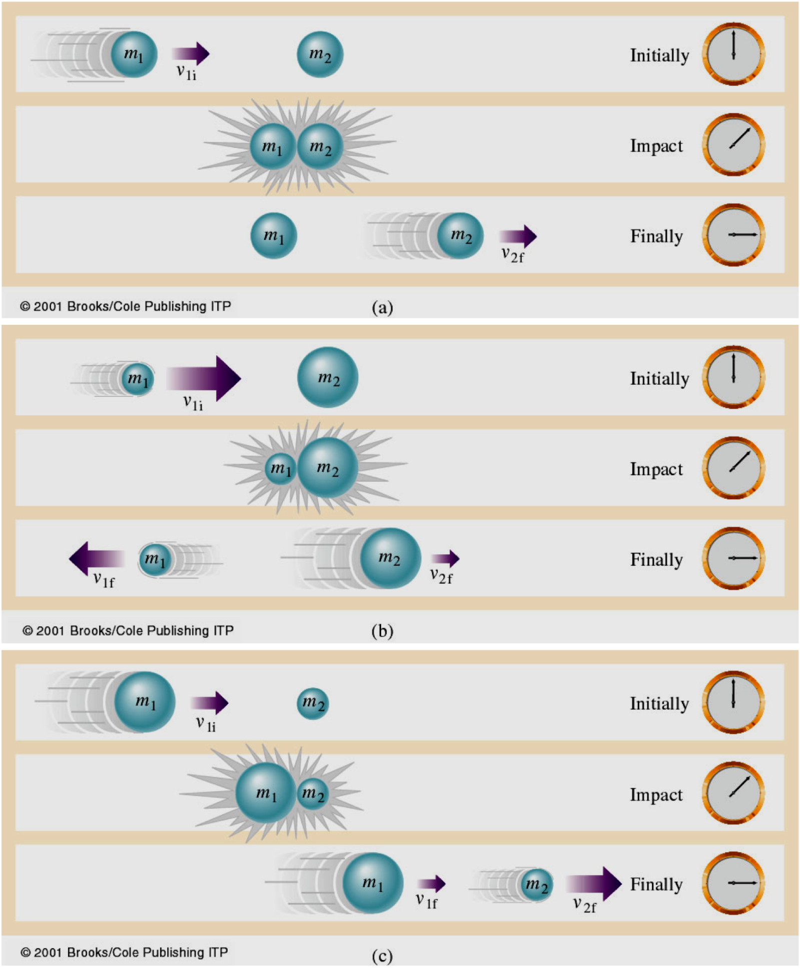
$$v_{1f} = \frac{m_1 - m_2}{m_1 + m_2} v_{1i}$$

$$v_{2f} = \frac{2m_1}{m_1 + m_2} v_{1i}$$

a) $m_1 = m_2$

b) $m_1 > m_2$

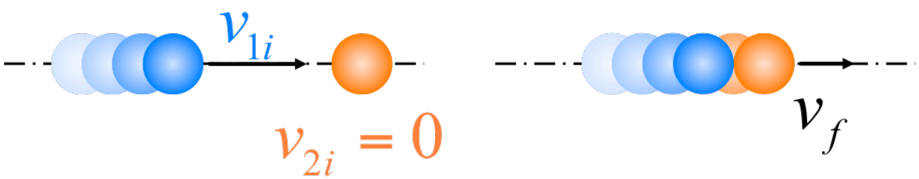
c) $m_1 < m_2$



COLLISIONS INÉLASTIQUES EN 1-D

$$E_M^i \neq E_M^f$$

$$p^i = p^f$$



$$p_i = m_1 v_{1i}$$

$$p_f = (m_1 + m_2) v_f$$

$$m_1 v_{1i} = (m_1 + m_2) v_f \Rightarrow \boxed{v_f = \frac{m_1}{m_1 + m_2} v_{1i}}$$

$$E_c^f = \frac{m_1}{m_1 + m_2} E_c^i$$