KEEP CALM AND STUDY PHYSICS

Sistemas mecanicamente isolados

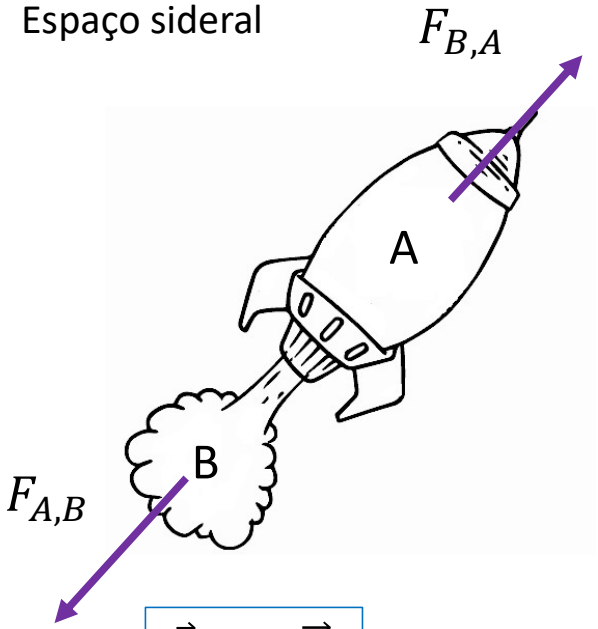
- Aula 40 / Caderno 5 / Página 257

Apresentação e demais documentos: **fisicasp.com.br**

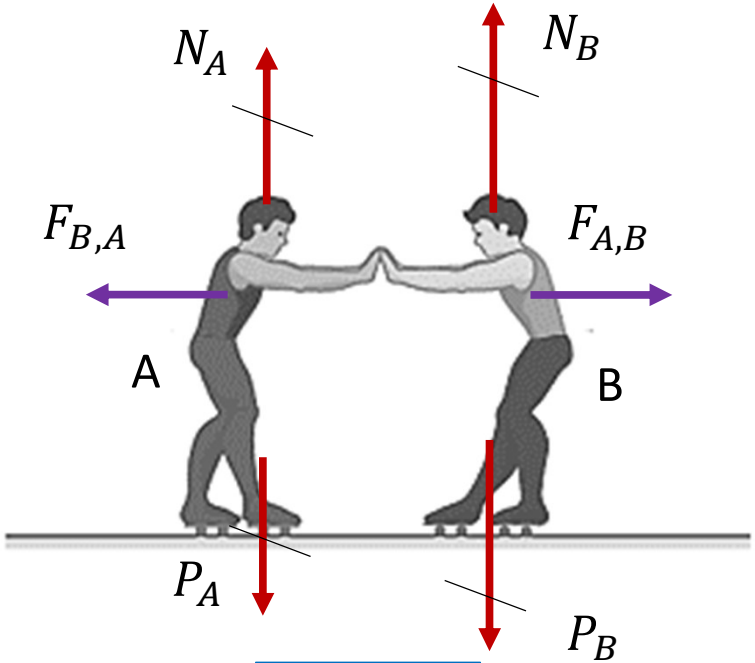
Professor Caio – Física / Setor A

1. Sistemas mecanicamente isolados (de forças externas)

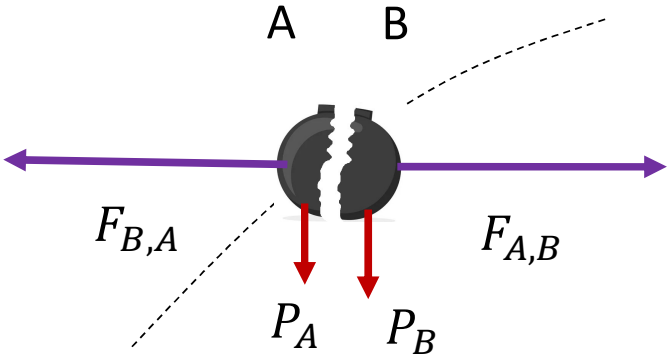
Espaço sideral



$\vec{F}_{ext} = \vec{0}$



$\vec{R}_{ext} = \vec{0}$



$F_{int} >> F_{ext}$

$$\vec{I}_{sistema} = \vec{I}_{ext} + \vec{I}_{int} = \Delta\vec{Q}_{sistema}$$

($\vec{I}_{ext} = \vec{0}$; $\vec{I}_{int} = 0$ (sempre))

$$\Delta\vec{Q}_{sistema} = \vec{0}$$

$$\vec{Q'}_{sistema} = \vec{Q}_{sistema}$$

$$\vec{Q'}_A + \vec{Q'}_B = \vec{Q}_A + \vec{Q}_B$$

Exemplos

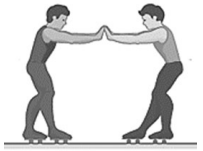
$$\vec{I}_{sistema} = \vec{I}_{ext} + \vec{I}_{int} = \Delta\vec{Q}_{sistema}$$

($\vec{I}_{ext} = \vec{0}$; $\vec{I}_{int} = \vec{0}$ (sempre))

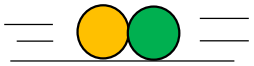
Sistemas mecanicamente isolados

$$\Delta\vec{Q}_{sistema} = \vec{0}$$

$$\vec{Q'}_{sistema} = \vec{Q}_{sistema}$$

- Patinadores 

  $\vec{R}_{ext} = \vec{0}$

- Colisões  

  $F_{int} >> F_{ext}$

- Explosões 

  $F_{int} >> F_{ext}$

- Decaimentos $^{6}_{2}He \longrightarrow {}^{6}_{3}Li + e^{-} + \bar{\nu}$

  $F_{int} >> F_{ext}$

- Disparos 

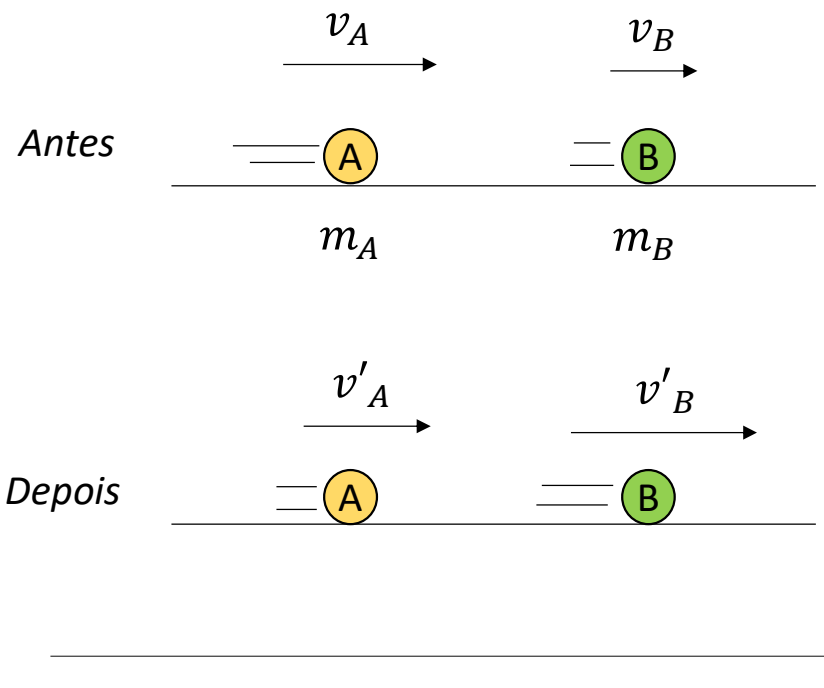
  $F_{int} >> F_{ext}$

- Espaço sideral 

  $\vec{F}_{ext} = \vec{0}$

Casos unidimensionais

Fazer o tratamento algébrico



Sistema mecanicamente isolado

$$\overrightarrow{Q'}_{sistema} = \vec{Q}_{sistema}$$

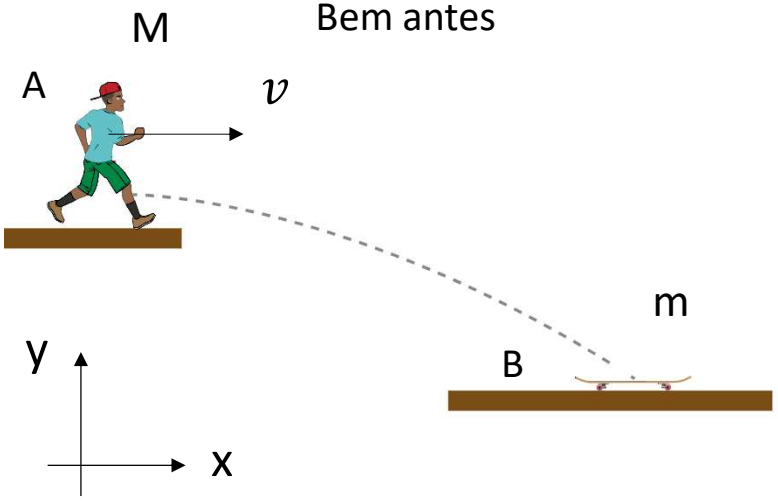
$$\overrightarrow{Q'}_A + \overrightarrow{Q'}_B = \vec{Q}_A + \vec{Q}_B$$

$$Q'_A + Q'_B = Q_A + Q_B$$

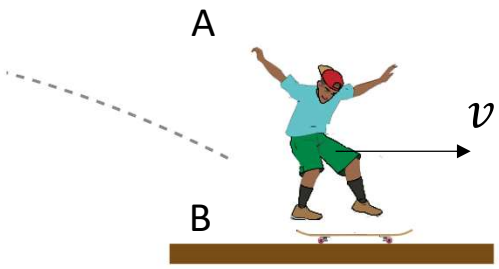
$$m_A.v'_A + m_B.v'_B = m_A.v_A + m_B.v_B$$

2. Sistemas mecanicamente isolados em uma única direção

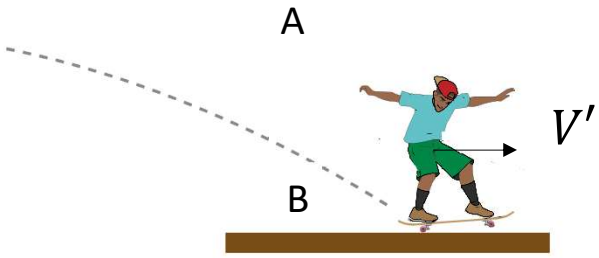
Bem antes

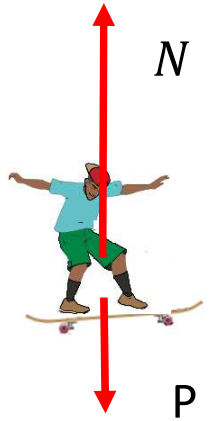


Imediatamente antes



Imediatamente depois





Eixo y

Existem forças externas não equilibradas

Eixo x:

$\vec{F}_{ext} = \vec{0}$ $\vec{R}_{ext} = \vec{0}$ $F_{int} >> F_{ext}$

$Q'_{sist\,(x)} = Q_{sist\,(x)}$

(m + M).V' = 0 + M.v

KEEP CALM AND STUDY PHYSICS

3. Sistemas mecanicamente isolados e sistemas conservativos

Sistema	Causa	Consequência
Isolado	$\vec{F}_{ext} = \vec{0}$ ou $\vec{R}_{ext} = \vec{0}$ ou $F_{int} >> F_{ext}$	$\vec{Q}_{sist.} = \vec{Q}'_{sist.}$
Conservativo	$\tau = 0$ Forças não conservativas	$E_m = E'_m$

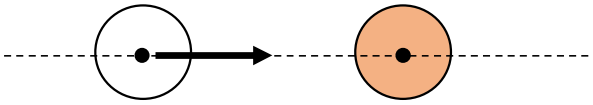
KEEP CALM AND STUDY PHYSICS

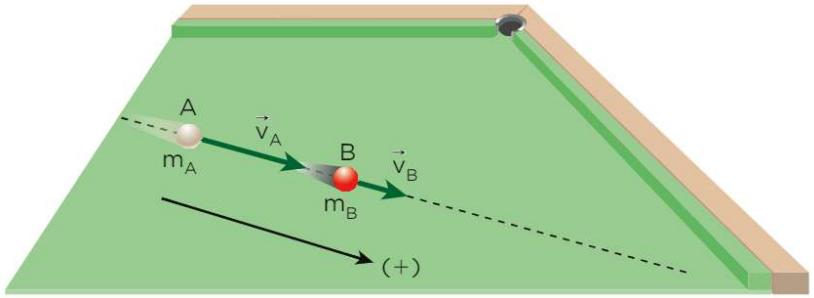
Colisões frontais

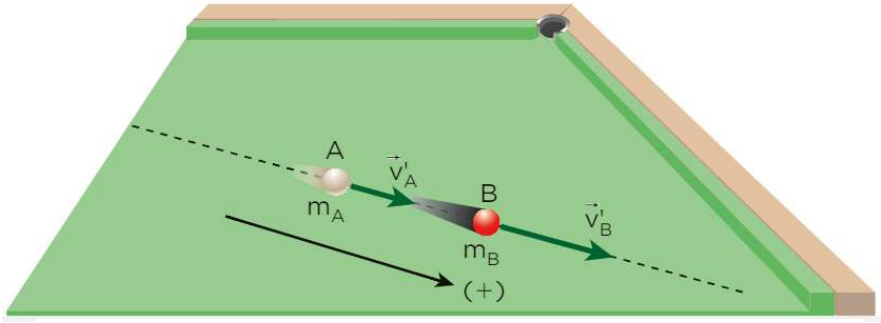
- Aula 43 / Caderno 6 / Página 255

1. Colisão frontal

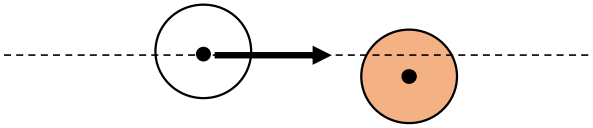
Colisão frontal

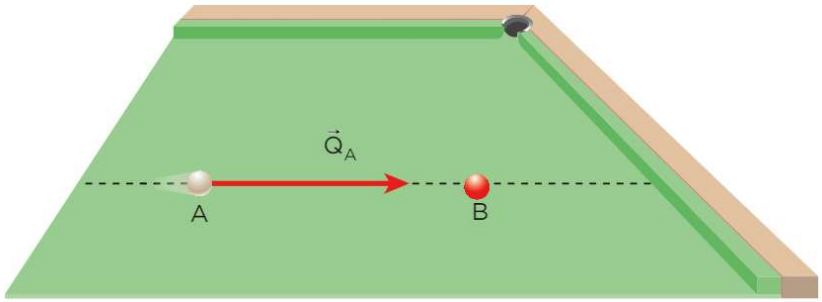


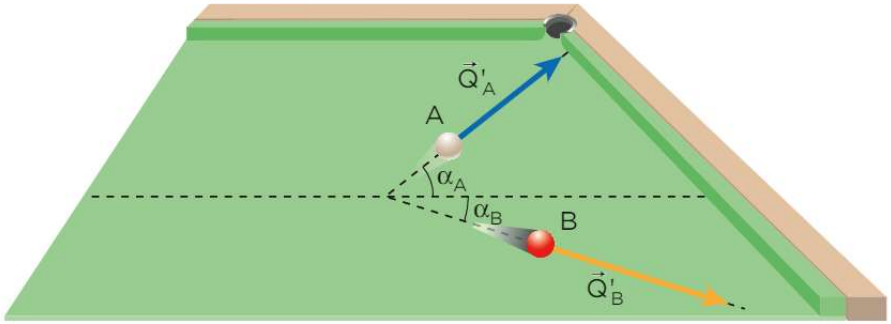




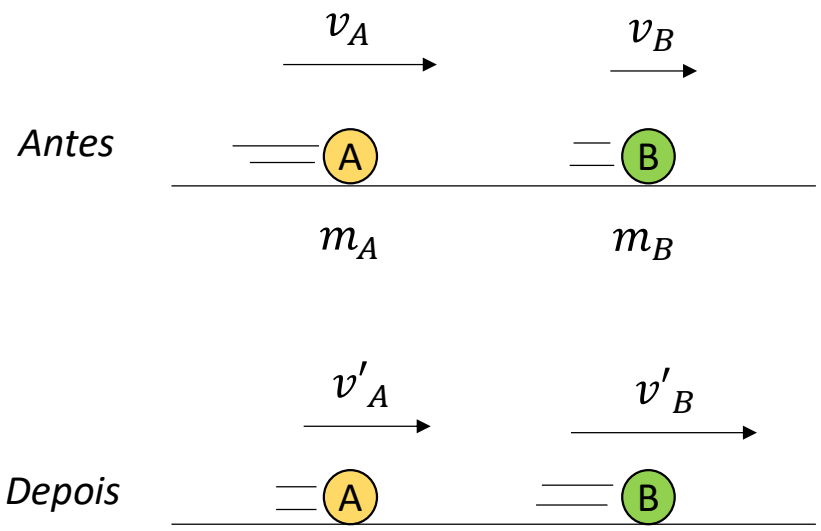
Colisão oblíqua







Colisão frontal



Sistema mecanicamente isolado

$$Q'_A + Q'_B = Q_A + Q_B$$

$$m_A.v'_A + m_B.v'_B = m_A.v_A + m_B.v_B$$

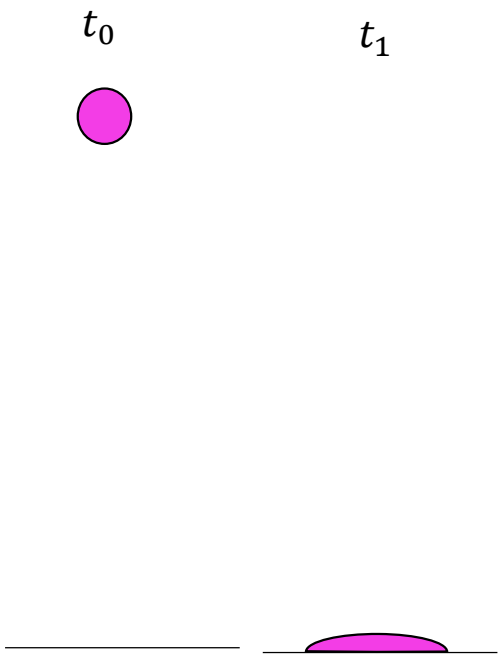
Coeficiente de restituição (e)

$$e = \frac{v_{afastamento}}{v_{aproximação}} = \frac{v_B' - v_A'}{v_A - v_B}$$

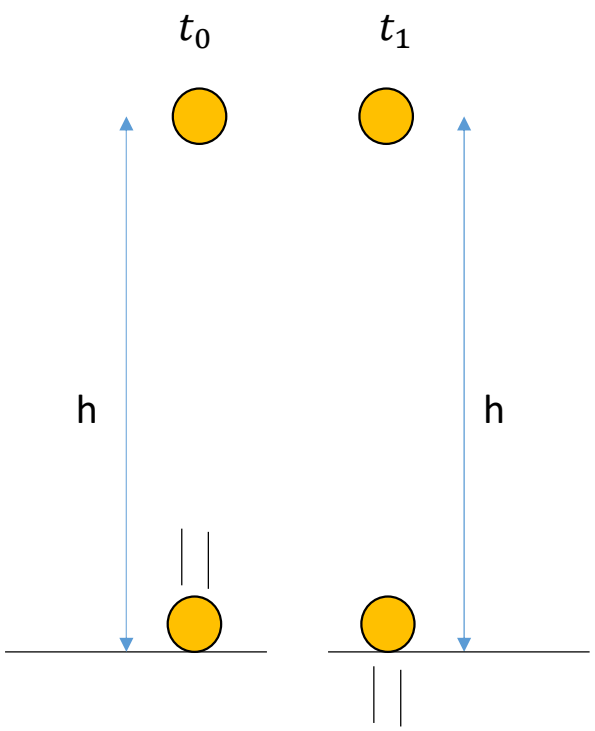
- e = 1 → perfeitamente elástica / elástica → sem perda de E_c → $E_{c\,(f)} = E_{c\,(i)}$
- 0 < e < 1 → parcialmente elástica
- e = 0 → inelástica / anelástica / plástica → máxima perda $E_{cinética}$ (corpos grudados no final)

KEEP CALM AND STUDY PHYSICS

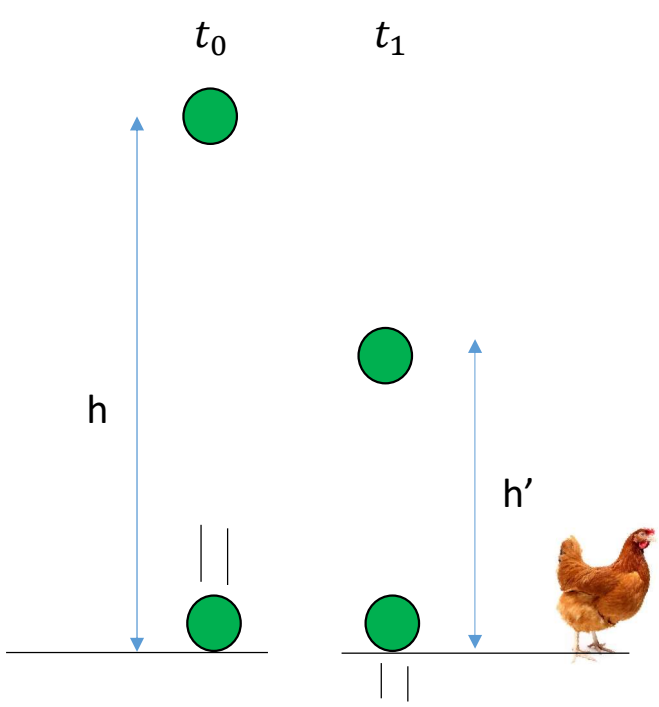
Colisão contra o chão ou uma parede



$$e = \frac{v_{afastamento}}{v_{aproximação}} = 0$$



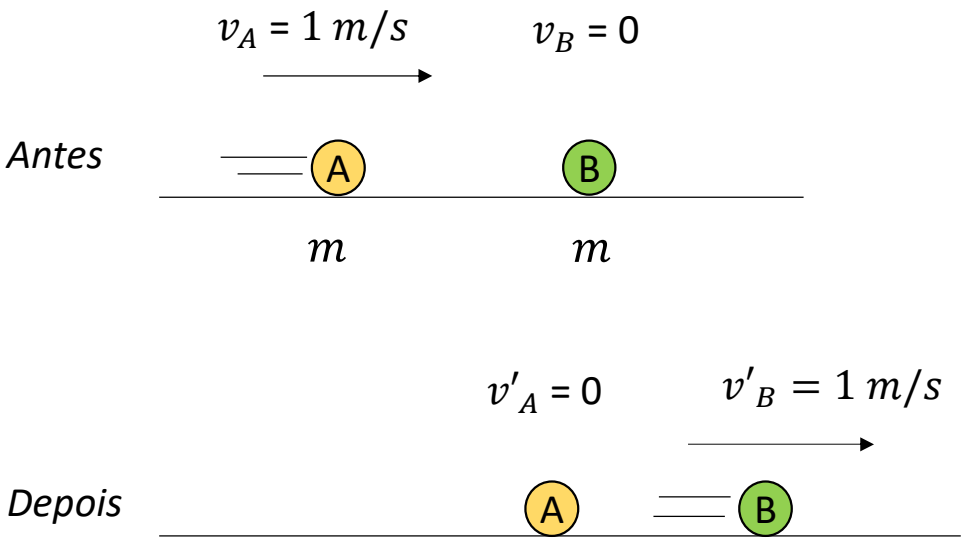
$$e = \frac{v_{afastamento}}{v_{aproximação}} = 1$$



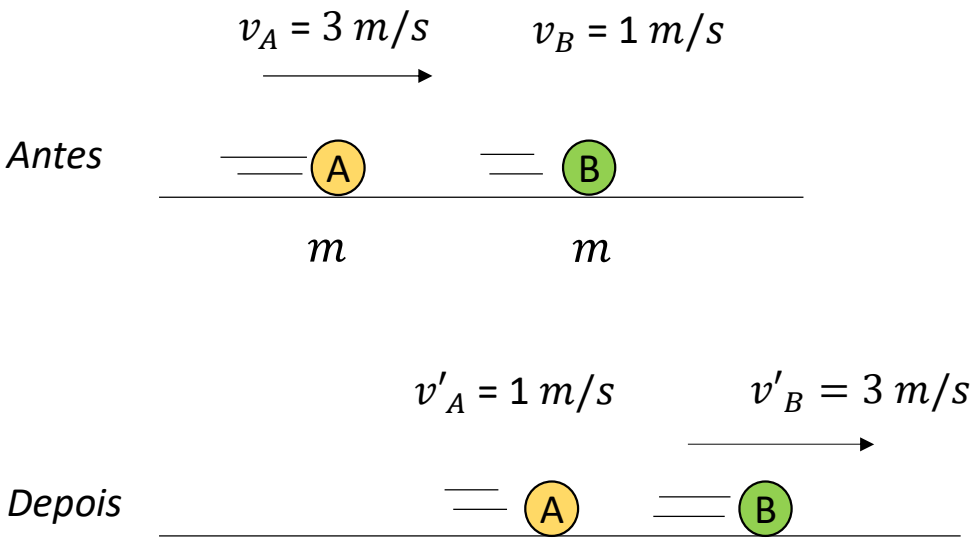
$$e = \frac{v_{afastamento}}{v_{aproximação}} = 0{,}5$$

Caso particular: colisão perfeitamente elástica entre corpos de mesma massa

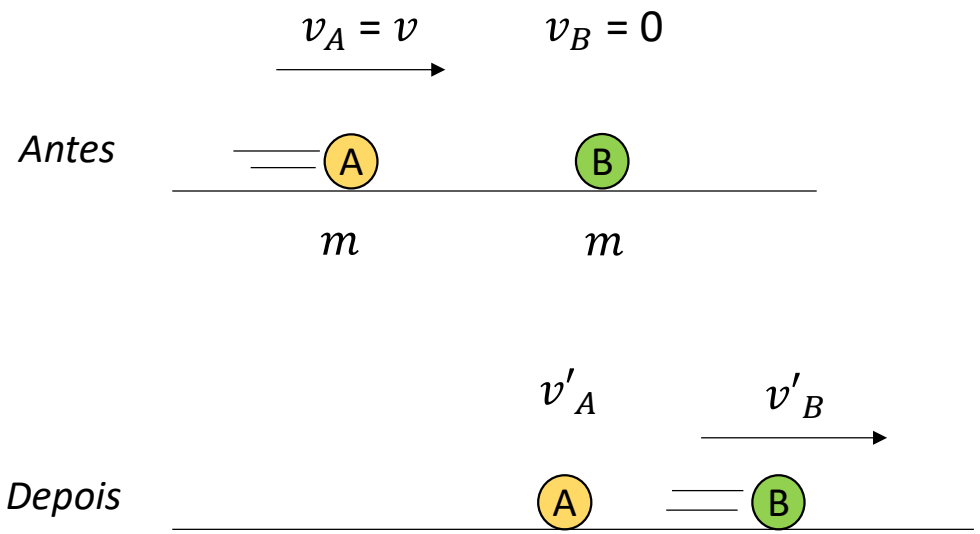
Exemplo 1



Exemplo 2



Caso particular: colisão perfeitamente elástica entre corpos de mesma massa



$$m_A.v'_A + m_B.v'_B = m_A.v_A + m_B.v_B$$

$$m.v'_A + m.v'_B = m.v + m.0$$

$$\boxed{v'_A + v'_B = v}$$

$$e = \frac{v_{afastamento}}{v_{aproximação}} = \frac{v_{B'} - v_{A'}}{v_A - v_B}$$

$$1 = \frac{v_{B'} - v_{A'}}{v - 0}$$

$$\boxed{v'_B - v'_A = v}$$

$$\begin{cases} v'_A + v'_B = v \\ v'_B - v'_A = v \end{cases} +$$

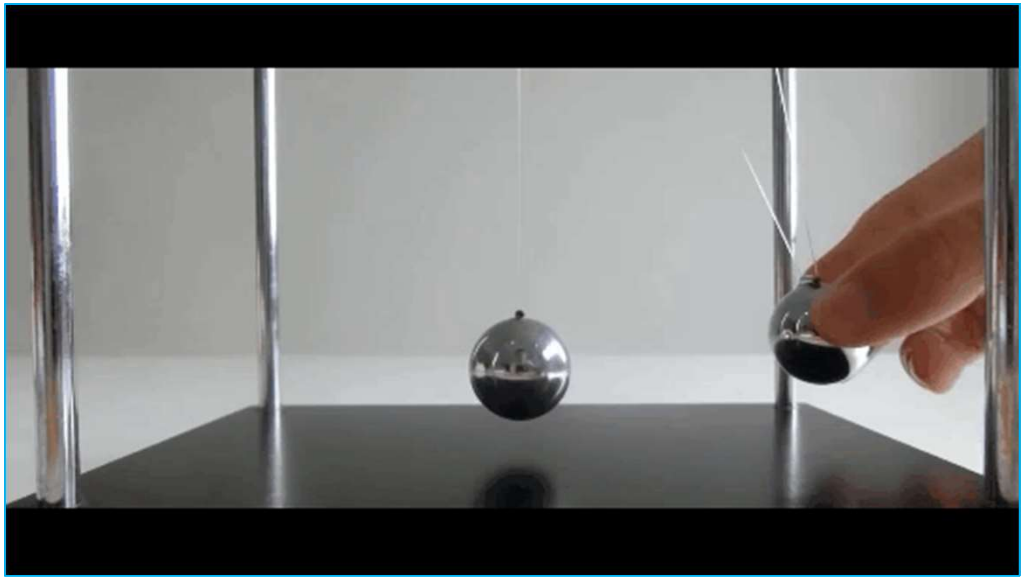
$$2v'_B = 2v$$

$$\boxed{v'_B = v}$$

$$\boxed{v'_A = 0}$$

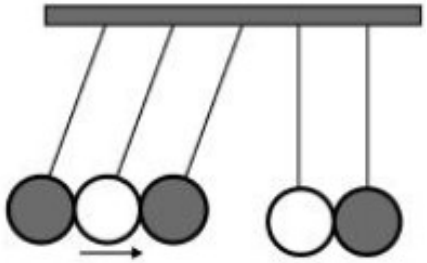
KEEP CALM AND STUDY PHYSICS

Caso particular: colisão perfeitamente elástica entre corpos de mesma massa



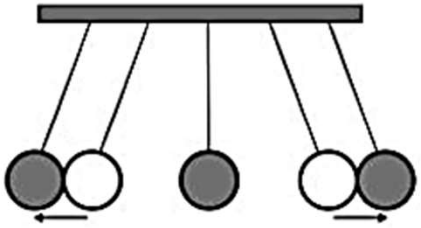
Exercícios

8. (Enem) O pêndulo de Newton pode ser constituído por cinco pêndulos idênticos suspensos em um mesmo suporte. Em um dado instante, as esferas de três pêndulos são deslocadas para a esquerda e liberadas, deslocando-se para a direita e colidindo elasticamente com as outras duas esferas, que inicialmente estavam paradas.

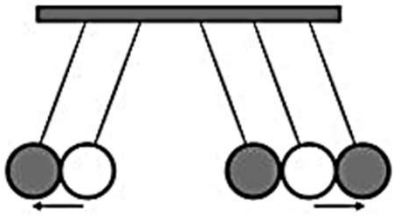


O movimento dos pêndulos após a primeira colisão está representado em:

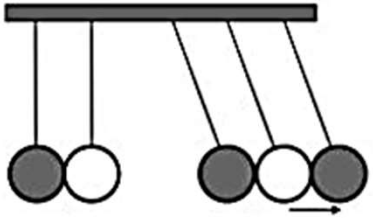
a)



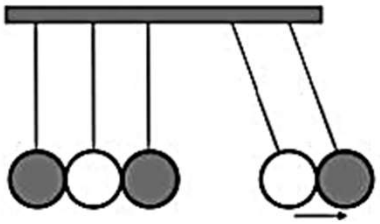
b)



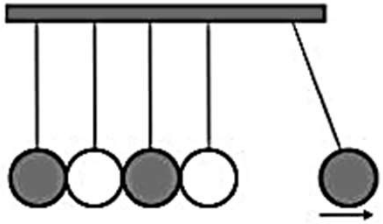
c)

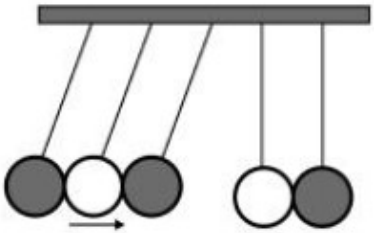


d)

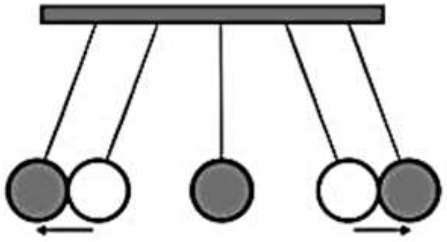


e)

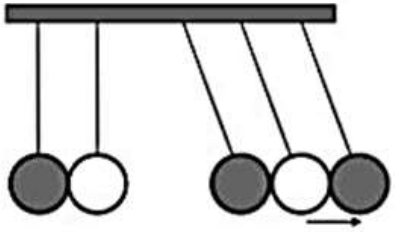




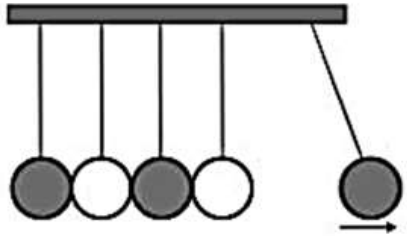
a)



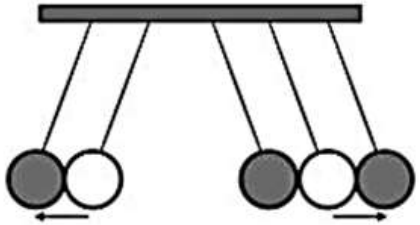
c)



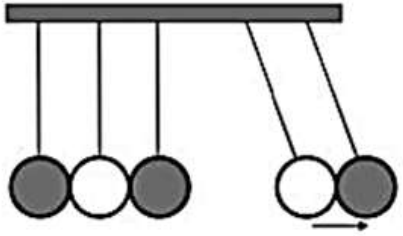
e)



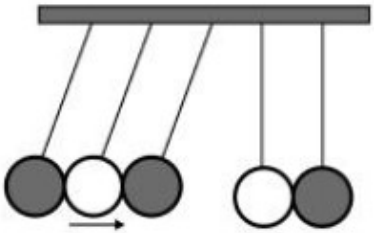
b)



d)

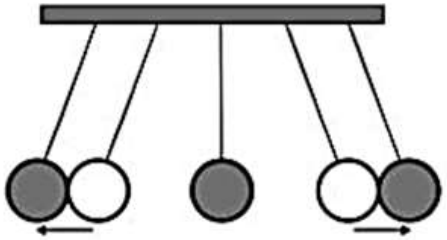


$Q_{antes} = 3mv$



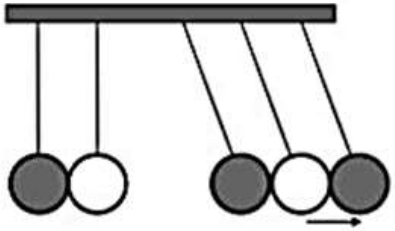
+

a)



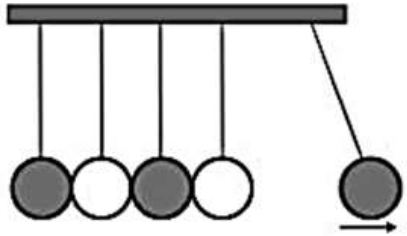
$Q_{depois} = -2mv + 2mv = 0$

c)



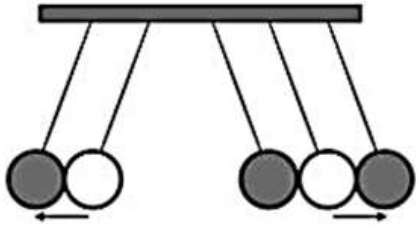
$Q_{depois} = 3mv$

e)



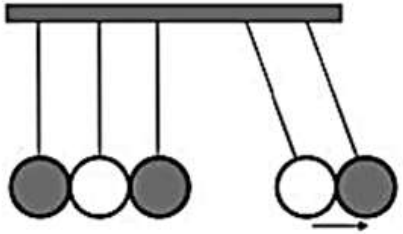
$Q_{depois} = mv$

b)



$Q_{depois} = -2mv + 3mv = mv$

d)



$Q_{depois} = 2mv$