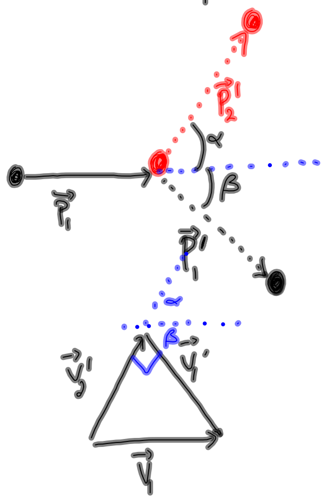
Elastic Collisions

Both conservation of momentum + KE

A special case:

Consider a 2D collision involving 2 identical masses with one mass initially at rest. It is an elastic collision.



According to the Law of Conservation of momentum (if we neglect friction)

$$\vec{p}_{total} = \vec{p}\,'_{total}$$

$$\vec{p}_1 = \vec{p}_1\,' + \vec{p}_2\,'$$

$$\cancel{m}\vec{v}_1 = \cancel{m}\vec{v}_1\,' + \cancel{m}\vec{v}_2\,'$$

$$\vec{v}_1 = \vec{v}_1\,' + \vec{v}_2\,'$$

Since the collision is elastic:

$$E_{k\,total} = E'_{k\,total}$$

$$E_{k_1} = E'_{k_1} + E'_{k_2}$$

$$\cancel{\tfrac{1}{2}m}v_1^2 = \cancel{\tfrac{1}{2}m}v_1'^2 + \cancel{\tfrac{1}{2}m}v_2'^2$$

$$v_1^2 = v_1'^2 + v_2'^2$$

$$(c^2 = a^2 + b^2)$$

The vector addition diagram must make a right Δ with the hypotenuse being v_1

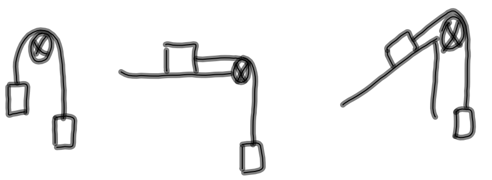
The paths of the balls after the collision must be at right angles to one another

ie: $\alpha + \beta = 90^0$

TEST (§10-2, 10-3, 10-4)

10-2 Connected Masses

- elevator problems
- connected masses



- draw a FBD for each mass and write an F_{net} expression (2 unknowns T and a)
- towing problem

$$\xrightarrow{a}$$

$$F_{g_1} \leftarrow \boxed{m_1+m_2} \rightarrow F_{g_2}$$

- find the acceleration (using F_{net})
- draw a FBD for either m_1 or m_2 to find tension.

10-3 Static Equilibrium

① $F_{net} = 0$ (horizontally + vertically)

② $\tau_{net} = 0$ $\left(\Sigma\tau_{ccw} = \Sigma\tau_{cw} \right)$ ← use torque when forces don't act through a common point

DRAW A FBD !!!!!

$$\tau = r_{\perp} F$$

$$\tau = rF\sin\theta$$

10-4 2D Collision

- Conservation of Momentum: $\vec{P}_{total} = \vec{P}'_{total}$

EVERY COLLISION

① momentum vector addition diagram

② x-y chart (before/after)

- Elastic Collisions: $E_{k\,total} = E'_{k\,total}$

SOME COLLISIONS

$$\left(E_k = \frac{1}{2}mv^2 \right)$$