Lecture 15 - Phys 203

Chapter 7 - Momentum $\vec{p}$.

a particle $\vec{p} = m\vec{v}$

two particles → $\vec{P} = \vec{p}_1 + \vec{p}_2 = m_1\vec{v}_1 + m_2\vec{v}_2$

when $\Sigma \vec{F}_{ext} = 0$ → collision of two particles.

↓

total momentum conservation.

before = after collision

$\vec{P}_o = \vec{P}_f$

$\underbrace{m_1\vec{v}_{1o} + m_2\vec{v}_{2o}}_{\vec{P}_o} = \underbrace{m_1\vec{v}_{1f} + m_2\vec{v}_{2f}}_{\vec{P}_f}$

1D-collisions

2D-collisions

Section 7.4 Collisions in 2D

Fig 7.14

Ex 9 $m_1 = 0.15\,kg$, $v_{0_1} = 0.9\,m/s$, $m_2 = 0.26\,kg$, $v_{0_2} = 0.54\,m/s$, $50°$, $35°$, $v_{2f} = 0.70\,m/s$.

Find v_{1f} and θ? billiard balls. pool table. frictionless table.

$\vec{P}_0$, $\vec{P}_f$, $v_{1f} = ?$, $\vec{v}_{1f} = (v_{f_{1x}}, v_{f_{1y}})$, $\theta \rightarrow ?$

$\vec{P}_0 = \vec{P}_f$ → momentum conservation

$\hat{x}$: $P_{0_x} = P_{f_x}$ → get $v_{f_{1x}}$

$\hat{y}$: $P_{0_y} = P_{f_y}$ → get $v_{f_{1y}}$

$$m_1 v_{0_{1y}} + m_2 v_{0_{2y}} = m_1 v_{f_{1y}} + m_2 v_{f_{2y}}$$

before collision in y-direction

after collision in y-direction

ok ✓

$\sum \vec{F}_{ext} = 0$ ✓

every ball

$\vec{W}_1 + \vec{F}_{N_1} = 0$ ✓

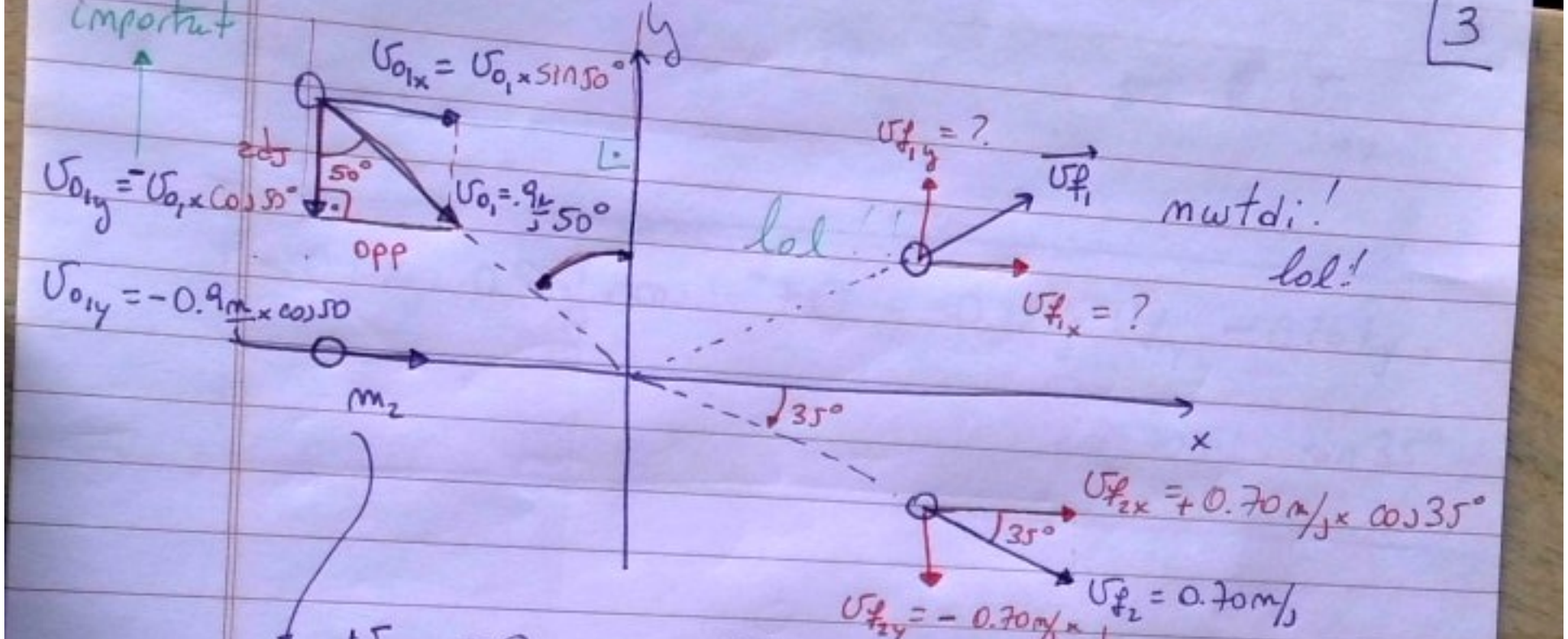
$\vec{W}_2 + \vec{F}_{N_2} = 0$ ✓

$\vec{W}_1 = -\vec{F}_{N_1}$ ✓

tii! lol!

important

3



$\hat{x}$: $\quad P_{0_x} = P_{f_x}$ $\quad \overset{?}{=}$

$m_1 v_{0_1} \times \sin 50° + m_2 \times 0.54 m/s = m_1 v_{f_{1x}} + m_2 \, 0.7 m/s \times \cos 35°$

$0.15 kg \times 0.9 \frac{m}{s} \times \sin 50° + 0.26 kg \times 0.54 \frac{m}{s} =$

$= 0.15 kg \times v_{f_{1x}} + 0.26 kg \times 0.7 m/s \times \cos 35°$

$[P] = kg \frac{m}{s} = N \times s$

$v_{f_{1x}} = 0.63 m/s$ ✓

$\hat{y}$:

$P_{oy} = P_{fy}$ → get $v_{f_{1y}}$

$-0.15kg \times 0.9 m/s \times \cos 50° + 0 = 0.15kg\, v_{f_{1y}} - 0.26kg \times$
$\times 0.70 m/s \times \sin 35°$

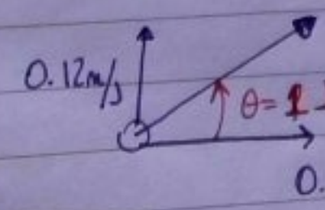
$$\frac{-0.15kg \times 0.9 m/s \times \cos 50° + 0.26kg \times 0.70 m/s \times \sin 35°}{0.15kg} = v_{f_{1y}}$$

$$\boxed{v_{f_{1y}} = 0.12 m/s}$$ ✓

$$\vec{v}_{f_1} = (0.63 m/s, 0.12 m/s)$$

calculate final speed (magnitude $v_{f_1} = ?$) and direction.

$v_{f_1} = 0.64 m/s$ $v_{f_1} = \sqrt{\left(0.63 \frac{m}{s}\right)^2 + \left(0.12 \frac{m}{s}\right)^2} =$
$= 0.64 m/s$



$\tan\theta = \frac{0.12}{0.63}$

$\theta = \tan^{-1}\left(\frac{0.12}{0.63}\right) = 11°$ ✓