Assignment No.2

Valli Devi Bolla

Download all python codes from

https://github.com/Vallidevibolla/Assignment−2/blob/main/main.tex

and latex-tikz codes from

https://github.com/Vallidevibolla/Assignment−2/blob/main/main.tex

Question taken from

https://github.com/gadepall/ncert/blob/main/linalg/vectors/gvv_ncert_vectors.pdf− Q.no.2.18

1 Question No.2.18

Consider the collision depicted in Fig. 2.18 to be between two billiard balls with equal masses m1=m2. The first ball is called the cue while the second ball is called the target. The billiard player wants to 'sink' the target ball in a corner pocket, which is at angle $\Phi = 37°$. Assume that the collision is elastic and that friction and rotational motion are not important. Obtain θ.

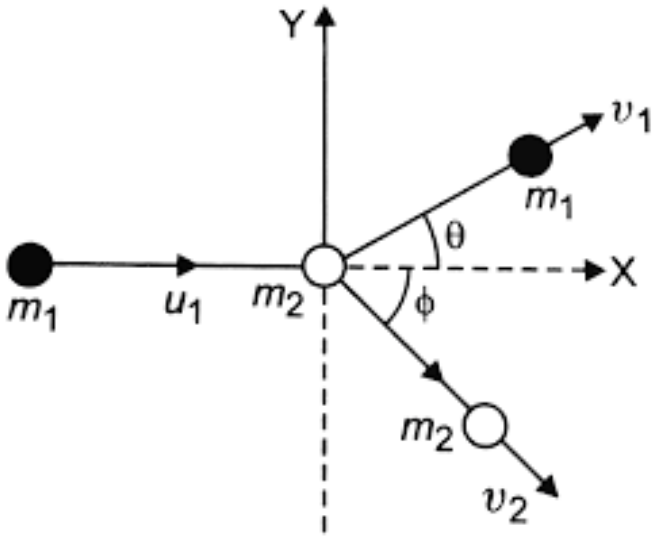

Fig. 1.1: Fig. 2.18

2 Solution

Given, two billiard balls with equal masses m1=m2

$\therefore$ m1=m2=m

The first ball is called the **cue** while the second ball is called the **target**.

Figure shows that the cue is moving with initial velocity u1 towards target

$\therefore$ The initial velocity of cue = u1

The initial velocity of target (Static) u2=0

The cue moving with velocity collide the target thereby both balls get collide and travel in two directions with some velocity.

$\therefore$ The final velocity of cue = v1

The final velocity of target = v2

3 Formula

Momentum of the ball is given as P=mv

$$\boxed{m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2} \tag{3.0.1}$$

$$since(u_2 = 0), also(m_1 = m_2 = m) \tag{3.0.2}$$

$$\boxed{u_1 = v_1 + v_2} \tag{3.0.3}$$

The energy of two balls after collision is given by Kinetic energy. **K.E** $=\frac{1}{2}mv^2$

$$\frac{1}{2}mu_1^2 = \frac{1}{2}mv_1^2 + \frac{1}{2}mv_2^2$$

$$\boxed{u_1^2 = v_1^2 + v_2^2} \tag{3.0.4}$$

$$\implies (v_1 + v_2)^2 = v_1^2 + v_2^2 \tag{3.0.5}$$

$$\implies v_1^2 + v_2^2 + 2v_1v_2 = v_1^2 + v_2^2 \tag{3.0.6}$$

$$\implies 2v_1v_2 = 0 \tag{3.0.7}$$

$$\implies v_1.v_2 = 0 \tag{3.0.8}$$

since $\cos 90°$=0

$\implies v_1.v_2(\cos\theta + \Phi) = \cos 90°$

$Given, \Phi = 37° \implies \cos(\theta + 37°) = \cos 90°$

$\implies \theta + 37° = 90°$

$\boxed{\theta = 53°}$

$\therefore$ The angle of target was found to be θ=53°