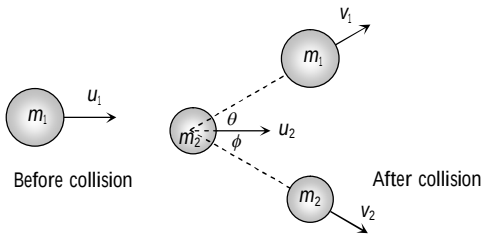
Perfectly Elastic Oblique Collision

Let two bodies moving as shown in figure.

By law of conservation of momentum



Along *x*-axis, $m_1u_1 + m_2u_2 = m_1v_1\cos\theta + m_2v_2\cos\phi$

Along *y*-axis, $0 = m_1v_1\sin\theta - m_2v_2\sin\phi$

By law of conservation of kinetic energy

$$\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2$$

In case of oblique collision it becomes difficult to solve problem unless some experimental data is provided, as in these situations more unknown variables are involved than equations formed.

Special condition : If $m_1 = m_2$ and $u_2 = 0$ then, we get

$u_1 = v_1\cos\theta + v_2\cos\phi$

$0 = v_1\sin\theta - v_2\sin\phi$

and $u_1^2 = v_1^2 + v_2^2$

Also we get

$u_1^2 = v_1^2 + v_2^2 + 2v_1v_2\cos(\theta+\phi)$

And $\cos(\theta+\phi) = 0$

$\therefore \qquad \theta + \phi = \pi/2$

After perfectly elastic oblique collision of two bodies of equal masses (if the second body is at rest), the scattering angle $\theta+\phi$ would be 90°.