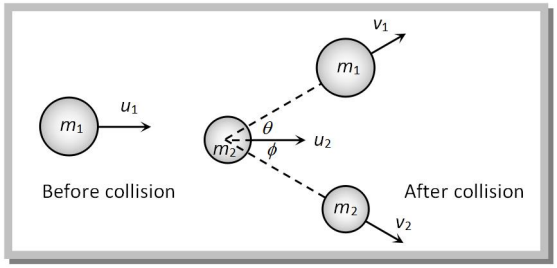
Perfectly Elastic Oblique Collision.

Let two bodies moving as shown in figure.



By law of conservation of momentum

Along x-axis, $m_1u_1 + m_2u_2 = m_1v_1\cos\theta + m_2v_2\cos\phi$ .....(i)

Along y-axis, $0 = m_1v_1\sin\theta - m_2v_2\sin\phi$ .....(ii)

By law of conservation of kinetic energy

$$\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2 \quad \text{.....(iii)}$$

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

Special condition: If $m_1 = m_2$ and $u_2 = 0$ substituting these values in equation (i), (ii) and (iii) we get

$u_1 = v_1\cos\theta + v_2\cos\phi$ .....(iv)

$0 = v_1\sin\theta - v_2\sin\phi$ .....(v)

and $u_1^2 = v_1^2 + v_2^2$ .....(vi)

Squaring (iv) and (v) and adding we get

$u_1^2 = v_1^2 + v_2^2 + 2v_1u_2\cos(\theta + \phi)$ .....(vii)

Using (vi) and (vii) we get $\cos(\theta + \phi) = 0$

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

i.e. 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 $90°$.