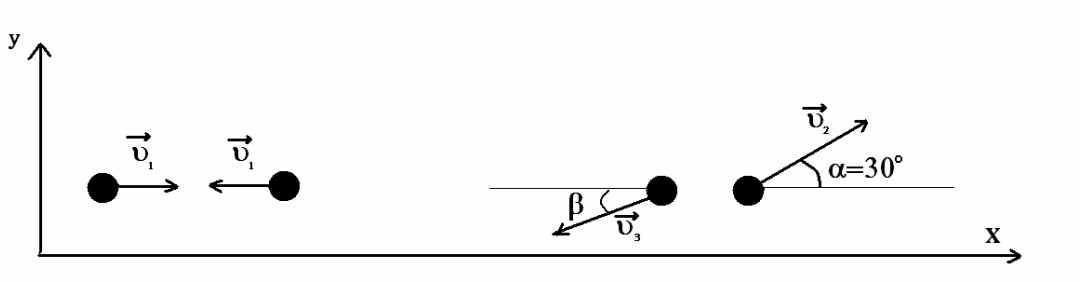
QUESTION:

Two identical balls traveling parallel to the x-axis have speed of 30cm/s and are oppositely directed.they collide perfectly elastically. after the collision, one ball is moving at an angle of 30 degrees above the x-axis.find its speed and the velocity of the other balls

SOLUTION:



According to the energy and momentum conservation laws:

$$\begin{cases} m\cdot\upsilon_1 - m\upsilon_1 = 0 \\ m\cdot\upsilon_2\cos\alpha - m\cdot\upsilon_3\cos\beta = 0 \quad \text{(projection on x axis)} \\ m\cdot\upsilon_2\sin\alpha - m\cdot\upsilon_3\sin\beta = 0 \quad \text{(projection on y axis)} \\ \frac{m\cdot\upsilon_1^2}{2} + \frac{m\cdot\upsilon_1^2}{2} = \frac{m\cdot\upsilon_2^2}{2} + \frac{m\cdot\upsilon_3^2}{2} \end{cases}$$

$$\begin{cases} \upsilon_2\cos\alpha = \upsilon_3\cos\beta \\ \upsilon_2\sin\alpha = \upsilon_3\sin\beta \\ 2\upsilon_1^2 = \upsilon_2^2 + \upsilon_3^2 \end{cases} \Rightarrow \begin{cases} \frac{\upsilon_2\cos\alpha}{\upsilon_2\sin\alpha} = \frac{\upsilon_3\cos\beta}{\upsilon_3\sin\beta} \\ \upsilon_2\sin\alpha = \upsilon_3\sin\beta \\ 2\upsilon_1^2 = \upsilon_2^2 + \upsilon_3^2 \end{cases} \Rightarrow \begin{cases} \text{ctg}\alpha = \text{ctg}\beta \\ \upsilon_2\sin\alpha = \upsilon_3\sin\beta \Rightarrow \\ 2\upsilon_1^2 = \upsilon_2^2 + \upsilon_3^2 \end{cases}$$

$$\Rightarrow \begin{cases} \alpha = \beta \\ \upsilon_2 = \upsilon_3 \\ 2\upsilon_1^2 = \upsilon_2^2 + \upsilon_3^2 \end{cases} \Rightarrow \begin{cases} \alpha = \beta \\ \upsilon_2 = \upsilon_3 \\ 2\upsilon_1^2 = \upsilon_2^2 + \upsilon_2^2 \end{cases} \Rightarrow \begin{cases} \alpha = \beta \\ \upsilon_2 = \upsilon_3 \\ 2\upsilon_1^2 = 2\upsilon_2^2 \end{cases} \Rightarrow \begin{cases} \alpha = \beta \\ \upsilon_2 = \upsilon_3 \\ \upsilon_2 = \upsilon_1 \end{cases} \Rightarrow \begin{cases} \beta = 30^o \\ \upsilon_2 = 30\ \text{cm/s} \\ \upsilon_3 = 30\ \text{cm/s} \end{cases}$$

ANSWER:

$$\begin{cases} \beta = 30^o \\ \upsilon_2 = 30\ \text{cm/s} \\ \upsilon_3 = 30\ \text{cm/s} \end{cases}$$

The second ball moves at angle β=30° below the -*x*-axis (opposite to the first ball)