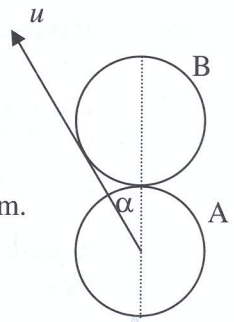
5 **(b)** A smooth sphere A, of mass m kg, moving with speed u, collides with a stationary identical smooth sphere B.
The direction of motion of A, before impact, makes an angle α with the line of centres at impact and just touches sphere B, as shown in the diagram.



The coefficient of restitution between the spheres is $\frac{4}{5}$.

(i) Show that $\alpha = 30°$.

(ii) Find the direction in which each sphere travels after the collision.

(iii) Find the percentage loss in kinetic energy due to the col lision.

(i) $\sin\alpha = \frac{r}{2r} \Rightarrow \alpha = 30°$ — 5

(ii) PCM $m\left(\frac{u\sqrt{3}}{2}\right) + m(0) = mv_1 + mv_2$

NEL $v_1 - v_2 = -\frac{4}{5}\left(\frac{u\sqrt{3}}{2} - 0\right)$ — 5

$\Rightarrow v_1 = \frac{u\sqrt{3}}{20}$ and $v_2 = \frac{9u\sqrt{3}}{20}$

velocity of A $= -\frac{u}{2}\vec{i} + \frac{u\sqrt{3}}{20}\vec{j}$

direction of A $= \tan^{-1}\left(\frac{\sqrt{3}}{10}\right)$

velocity of B $= 0\,\vec{i} + \frac{9u\sqrt{3}}{20}\vec{j}$

direction of B = along line of centres — 5

(iii) KE before $= \frac{1}{2}mu^2$

KE after $= \frac{1}{2}m\left\{\frac{u^2}{4} + \frac{3u^2}{400} + \frac{243u^2}{400}\right\}$

KE lost $= \frac{27}{400}mu^2$

% KE lost $= \frac{\frac{27}{400}mu^2}{\frac{1}{2}mu^2} \times 100 = 13.5\%$ — 5

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