5 **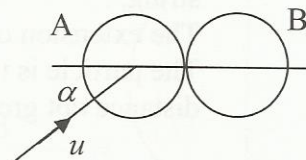(b)** A smooth sphere A, of mass 4 kg, moving with speed u, collides with a stationary smooth sphere B of mass 8 kg. The direction of motion of A, before impact, makes an angle α with the line of centres at impact.

The coefficient of restitution between the spheres is $\frac{1}{2}$.

Find in terms of u and α

- **(i)** the speed of each sphere after the collision
- **(ii)** the angle through which the 4 kg sphere is deflected as a result of the collision
- **(iii)** the loss in kinetic energy due to the collision.

(i) PCM $4(u\cos\alpha) + 8(0) = 4v_1 + 8v_2$ 5

NEL $v_1 - v_2 = -\frac{1}{2}(u\cos\alpha - 0)$ 5

$$\Rightarrow \quad v_1 = 0 \quad \text{and} \quad v_2 = \frac{1}{2}u\cos\alpha$$

Speed of A $= u\sin\alpha$

Speed of B $= \frac{1}{2}u\cos\alpha$ 5

(ii) Angle $= 90 - \alpha$ 5

(iii) KE before $= \frac{1}{2}(4)u^2 = 2u^2$

$$\text{KE after} = \frac{1}{2}(4)\{u\sin\alpha\}^2 + \frac{1}{2}(8)\left\{\frac{1}{2}u\cos\alpha\right\}^2$$

$$= 2u^2\sin^2\alpha + u^2\cos^2\alpha$$

Loss in KE $= 2u^2 - 2u^2\sin^2\alpha - u^2\cos^2\alpha$ 5

$$= 2u^2(1-\sin^2\alpha) - u^2\cos^2\alpha$$

$$= u^2\cos^2\alpha$$ 5

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