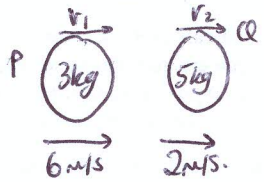
2006 HL

5. **(a)** A smooth sphere P, of mass 3 kg, moving with speed 6 m/s, collides directly with a smooth sphere Q, of mass 5 kg, which is moving in the same direction with speed 2 m/s. The coefficient of restitution for the collision is e.

(i) Find, in terms of e, the speed of each sphere after the collision.

(ii) If the loss of kinetic energy due to the collision is $k(1-e^2)$, find the value of k.



(*i*) PCM $\quad 3(6) + 5(2) = 3v_1 + 5v_2$ ① 5

NEL $\quad v_1 - v_2 = -e(6-2)$ ② 5

$$v_1 = \frac{7-5e}{2}$$

$$v_2 = \frac{7+3e}{2}$$ 5

(*ii*) KE before $= \frac{1}{2}(3)(6)^2 + \frac{1}{2}(5)(2)^2 = 64$

KE after $= \frac{1}{2}(3)(v_1)^2 + \frac{1}{2}(5)(v_2)^2$

Loss in KE $= 64 - \frac{3}{2}\left(\frac{7-5e}{2}\right)^2 - \frac{5}{2}\left(\frac{7+3e}{2}\right)^2$ 5

$= 15(1-e^2)$

$\Rightarrow \quad k = 15$ 5

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