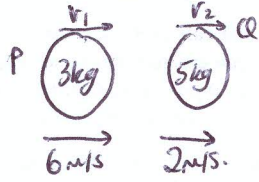


5. (a) A smooth sphere P, of mass 3 kg, moving with speed 6 m/s, collides directly with a smooth sphere Q, of mass 5 kg, which is moving in the same direction with speed 2 m/s. The coefficient of restitution for the collision is e .

- (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 $3(6) + 5(2) = 3v_1 + 5v_2$ ①

① $3v_1 + 5v_2 = 28$

② NEL $5v_1 - 5v_2 = -20e$ $v_1 - v_2 = -e(6-2)$ ②

$8v_1 = 28 - 20e$

$v_1 = \frac{28 - 20e}{8}$

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

sub into ②

$\frac{7 - 5e}{2} + 4e = v_2$

$\frac{7 - 5e + 8e}{2} = v_2$

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

(ii)

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

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

$\frac{1}{2}M_1u_1^2 + \frac{1}{2}M_2u_2^2$

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

$\frac{1}{2}M_1v_1^2 + \frac{1}{2}M_2v_2^2$

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

$\frac{1}{2}(3)\left(\frac{7-5e}{2}\right)^2 + \frac{1}{2}(5)\left(\frac{7+3e}{2}\right)^2$

$\frac{3(49 - 70e + 25e^2)}{8} + \frac{5(49 + 42e + 9e^2)}{8}$

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

= $15(1 - e^2)$

$\Rightarrow k = 15$

$\frac{120e^2 + 392}{8}$

$15e^2 + 49$

Loss = $64 - (15e^2 + 49)$

= $-15e^2 + 15$

= $15(1 - e^2)$

5
5
5
5
5
5

25
