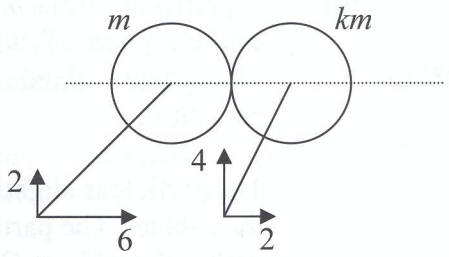
(b) 2010

A smooth sphere, of mass m, moving with velocity $6\vec{i}+2\vec{j}$ collides with a smooth sphere, of mass km, moving with velocity $2\vec{i}+4\vec{j}$ on a smooth horizontal table.



After the collision the spheres move in parallel directions.

The coefficient of restitution between the spheres is e.

(i) Find e in terms of k.

(ii) Prove that $k \geq \frac{1}{3}$.

(i) PCM $\quad m(6) + km(2) = mv_1 + kmv_2$ — 5

NEL $\quad v_1 - v_2 = -e(6-2)$ — 5

$$v_1 = \frac{6+2k-4ek}{k+1}$$

$$v_2 = \frac{6+4e+2k}{k+1}$$

parallel directions $\Rightarrow$ slopes are equal

$$\frac{2}{v_1} = \frac{4}{v_2}$$

$$v_2 = 2v_1$$

$$\frac{6+4e+2k}{k+1} = \frac{2(6+2k-4ek)}{k+1}$$

$$3+2e+k = 6+2k-4ek$$

$$e = \frac{3+k}{2+4k}$$ — 5

(ii) $e \leq 1$

$$\frac{3+k}{2+4k} \leq 1$$ — 5

$$3+k \leq 2+4k$$

$$k \geq \frac{1}{3}$$ — 5

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