1986 (ctd)

Q5 (B)

$\vec{v}_1 = c\vec{i} + b\vec{j}$ $\quad \vec{v}_2 = 0\vec{i} + 0\vec{j}$.

(4) (2) $\quad e = \frac{1}{2}$

$\vec{u}_1 = a\vec{i} + b\vec{j}$ $\quad \vec{u}_2 = x\vec{i} + 0\vec{j}$

Smoothness $\Rightarrow$ $\vec{j}$ cpts unchanged before and after

PCM: ($\vec{i}$ dirⁿ) $\quad 4a + 2x = 4c + 2(0)$ ——— (1)

$\Rightarrow \quad 2a + x = 2c$

NLR ($\vec{i}$ dirⁿ) $\quad v_2 - v_1 = -e(u_2 - u_1)$

$0 - c = -\frac{1}{2}(x - a)$

$\Rightarrow \quad -2c = -x + a$ ——— (2)

$\Rightarrow \quad -a + x = 2c$

(i) Equations (1) and (2) are inconsistent unless $a = 0$

$\therefore \quad a = 0 \Rightarrow \vec{u}_1 = 0\vec{i} + b\vec{j}$ and $\vec{u}_2 = x\vec{i} + 0\vec{j}$.

$\Rightarrow \vec{u}_1 \cdot \vec{u}_2 = 0(x) + b(0) = 0$.

$\Rightarrow \vec{u}_1 \perp \vec{u}_2$.

(ii) If $a = 0$ (as proven!) $\quad (1) \Rightarrow x = 2c$

KE Loss for 2kg mass ($\vec{i}$ cpts only) $= \frac{1}{2}(0)^2 - \frac{1}{2}2(x)^2$

$= 0 - x^2$

$= 0 - (2c)^2$

$= -4c^2$

KE GAIN. for 4kg mass ($\vec{i}$ cpts only) $= \frac{1}{2}4c^2 - \frac{1}{2}4(0)^2$

$= 2c^2 - 0$

$= 2c^2$

$= \frac{1}{2}$ loss of 2kg mass.