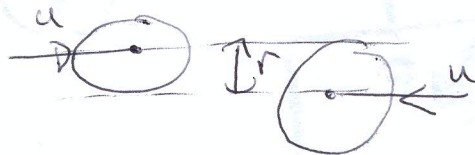
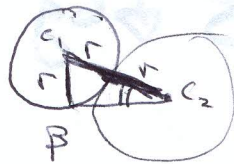


19a2 Q5 =



$$e = \frac{1}{3}$$

(i) At contact =

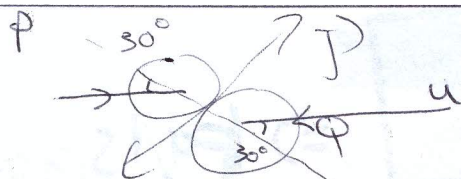


line of centres C_1C_2

$$\sin \beta = \frac{r}{2r} = \frac{1}{2}$$

$$\Rightarrow \beta = 30^\circ$$

(ii)



After

$$a\vec{i} + u\sin 30\vec{j}$$

$$b\vec{i} - u\sin 30\vec{j}$$

Before

$$u\cos 30\vec{i} + u\sin 30\vec{j}$$

$$-u\cos 30\vec{i} - u\sin 30\vec{j}$$

(\vec{j} cpts unchanged because of smoothness)

PEM (along C_1C_2): $m u \cos 30 + m(-u \cos 30) = ma + mb$

$$\Rightarrow a + b = 0 \quad (1)$$

NLR (along C_1C_2): $b - a = e(-u \cos 30 - u \cos 30)$

$$b - a = +\frac{1}{3} \frac{2u\sqrt{3}}{2}$$

$$b - a = +\frac{1}{3} u\sqrt{3} \quad (2)$$

$$(1) + (2) \Rightarrow 2b = \frac{1}{3} u\sqrt{3} \Rightarrow b = \frac{u\sqrt{3}}{6} = \frac{u}{2\sqrt{3}}$$

$$\therefore (1) \Rightarrow a = -\frac{u}{2\sqrt{3}}$$

Answer to (ii) Velocity P = $-\frac{u}{2\sqrt{3}}\vec{i} + \frac{u}{2}\vec{j}$ Velocity Q = $\frac{u}{2\sqrt{3}}\vec{i} + \frac{u}{2}\vec{j}$

(iii) Original KE (Total) = $\frac{1}{2}mu^2 + \frac{1}{2}mu^2 = mu^2$

ΔKE (cpts along centres only) = KE before = $\frac{1}{2}m(u\cos 30)^2 + \frac{1}{2}m(-u\cos 30)^2$

$$= \frac{m u^3}{4}$$

$$= KE \text{ after} = \frac{1}{2}m\left(\frac{u}{2\sqrt{3}}\right)^2 + \frac{1}{2}m\left(\frac{u}{2\sqrt{3}}\right)^2$$

$$= m\left(\frac{u}{2\sqrt{3}}\right)^2$$

$$= \frac{m u^2}{12}$$

$$\Rightarrow \Delta KE = \frac{3mu^2}{4} - \frac{mu^2}{12} = \frac{9mu^2}{12} - \frac{mu^2}{12} = \frac{8mu^2}{12} = \frac{2}{3}mu^2$$

FRAC KE LOST = $\frac{\Delta KE}{\text{original KE}} = \frac{\frac{2}{3}mu^2}{mu^2} = \frac{2}{3}$