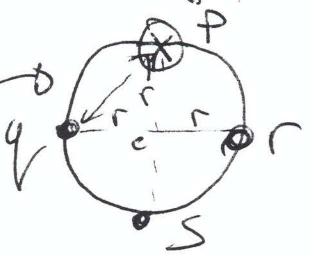
4) 1992 Q8(a)

Proof of (·A) $I_A = \frac{1}{2}mr^2$ (Text)

(b)

$|pq|^2 = r^2 + r^2$
$|pq| = 2r^2$



masses m at q, r, s
disk radius r of mass 8m.
Calculate T for small oscillations.

$$\boxed{T = 2\pi\sqrt{\frac{I_p}{\text{mass } g\,|p \text{ to c of } G|}}}$$

i) Total mass = m+m+m+8m = 11m.

(ii) $I_p(\text{system}) = I_p(\cdot q) + I_p(\cdot r) + I_p(\cdot s) + I_p(\text{disk})$

$I_p(\cdot q) = m|pq|^2 = m(\sqrt{2}r)^2 = 2mr^2$

$I_p(\cdot r) = m|pr|^2 = m(\sqrt{2}r)^2 = 2mr^2$

$I_p(\cdot s) = m|ps|^2 = m(2r)^2 = 4mr^2.$

$I_p(O) = I_c(O) + 8m|pc|^2$ (|| axis theorem)

$= \frac{1}{2}(8m)r^2 + 8mr^2$

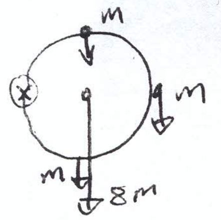
$= 12mr^2$

$\Rightarrow I_p(\text{system}) = 2mr^2 + 2mr^2 + 4mr^2 + 12mr^2$

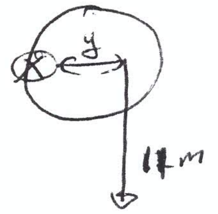
$= 20mr^2$

(iii) |p to c of G|

Bits



whole.



Principle of moments $m(r) + m(r) + 8mr + m(2r) = 11my$

$12mr = 11my$

$$\boxed{\frac{12}{11}r = y}$$

$$\therefore T = 2\pi\sqrt{\frac{20mr^2}{(11m)\,g\,\frac{12}{11}r}} = 2\pi\sqrt{\frac{20r}{12g}} = 2\pi\sqrt{\frac{5r}{3g}}$$

seconds.