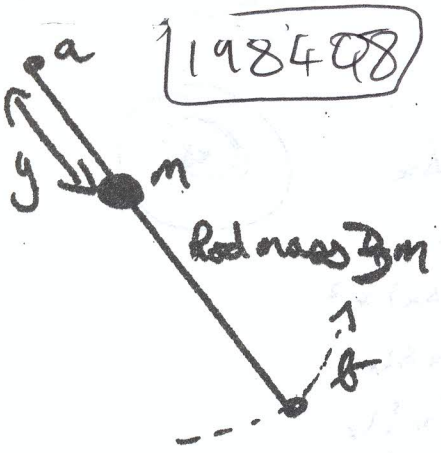

1984Q8

$I_a(\text{Rod}) = \frac{1}{3}3mp^2 = 4mp^2$

$I_a(\text{mass}) = my^2$

$I_a(\text{syst}) = my^2 + 4mp^2$.

Find T of Compound pendulum:

$$T = 2\pi\sqrt{\frac{I}{\text{mass} \times g \times h}}$$

$I_{syst} = my^2 + 4mp^2$

Mass $= m + 3m = 4m$

Find h.: mg $\quad my + 3mp = 4mh$

$$\Rightarrow \quad \frac{y+3p}{4} = h$$

$$\therefore \quad T = 2\pi\sqrt{\frac{my^2+4mp^2}{4m \cdot g \cdot \left(\frac{y+3p}{4}\right)}}$$

$$= 2\pi\sqrt{\frac{y^2+4p^2}{g(y+3p)}} \quad *$$

Equivalent Simple pendulum length $\frac{40}{33}p \Rightarrow$

$$T = 2\pi\sqrt{\frac{l}{g}} = 2\pi\sqrt{\frac{40p}{33g}} \quad (**)$$

Comparing (*) and (**)

$$\Rightarrow \frac{40p}{33} = \frac{y^2+4p^2}{y+3p}$$

$$\Rightarrow 40p(y+3p) = 33(y^2+4p^2)$$

$$\Rightarrow 40py + 120p^2 = 33y^2 + 132p^2$$

$$\Rightarrow 33y^2 - 40py + 12p^2 = 0$$

$$\Rightarrow (3y-2p)(11y-6p) = 0$$

$$\Rightarrow y = \frac{2p}{3} \text{ or } y = \frac{6p}{11} \quad \text{qed.}$$

(Factors got by looking at answer and working backwards)