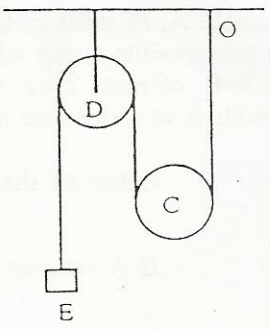
(b) 1997 no. 4 (b)

(b) The diagram shows a light inextensible string having one end fixed at O, passing under a smooth movable pulley C of mass km kg and then over a fixed smooth light pulley D. The other end of the string is attached to a particle E of mass m kg.

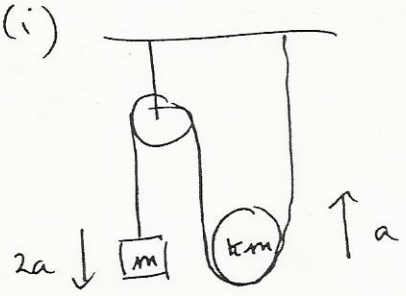


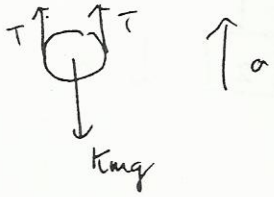
(i) Show on separate diagrams the forces acting on each mass when the system is released from rest.

(ii) Show that the upward acceleration of C is $\frac{(2-k)g}{4+k}$.

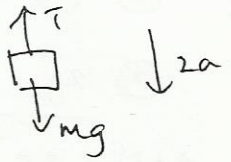
(iii) If $k = 0.5$, find the tension in the string.

(i)





$2T - kmg = (km)a$ (C)



$mg - T = m(2a)$ (E)

C: $2T - kmg = kma$

2E: $-2T + 2mg = 4ma$

$(2-k)mg = (4+k)ma$

$a = \left(\frac{2-k}{4+k}\right)g$

If $k = \frac{1}{2}$ $\quad a = \left(\frac{2-\frac{1}{2}}{4+\frac{1}{2}}\right)g = \left(\frac{1\frac{1}{2}}{4\frac{1}{2}}\right)g = \frac{1}{3}g$

$\therefore$ E $\Rightarrow \quad mg - T = 2ma$

$\Rightarrow \quad mg - T = 2m\left(\frac{1}{3}g\right)$

$\Rightarrow \quad \frac{1}{3}mg = T$

$\boxed{T = \frac{1}{3}mg}$