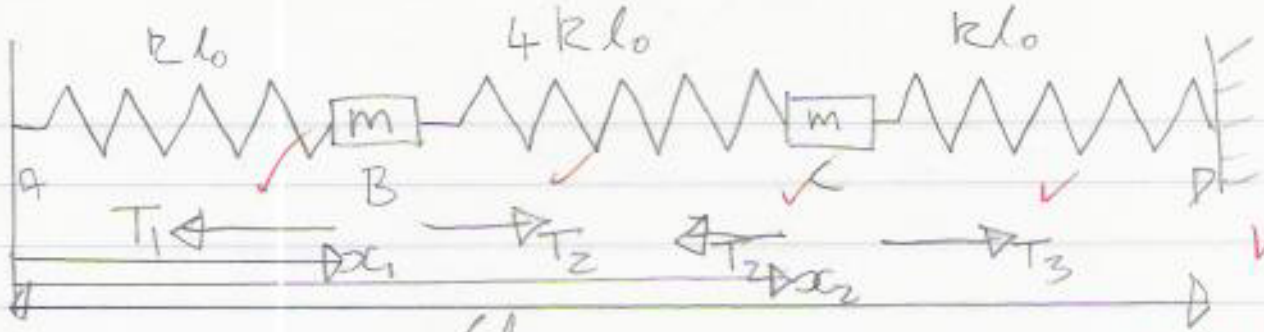
5)



i) Applying F=ma to each of B and C in turn

$m\ddot{x}_1 = T_2 - T_1$

$= 4k(x_2 - x_1 - l_0) - k(x_1 - l_0)$ ①

$m\ddot{x}_2 = T_3 - T_2$

$= k(6l_0 - x_2 - l_0) - 4k(x_2 - x_1 - l_0)$ ②

In equilibrium $\ddot{x}_1 = \ddot{x} = 0$

so $0 = 4k(x_2 - x_1 - l_0) - k(x_1 - l_0)$

$0 = 4kx_2 - 4kx_1 - 4kl_0 - kx_1 + kl_0$

$0 = 4kx_2 - 5kx_1 - 3kl_0$

$0 = 4x_2 - 5x_1 - 3l_0$ ③

$0 = k(6l_0 - x_2 - l_0) - 4k(x_2 - x_1 - l_0)$

$0 = 6kl_0 - kx_2 - kl_0 - 4kx_2 + 4kx_1 + 4kl_0$

$0 = 9l_0 - 5x_2 + 4x_1$ ④

③ & ④ are simultaneous equations

$5 \times ③ + 4 \times ④$

$21l_0 - 9x_1 = 0$

$x_1 = 7l_0/3$

Sub into ③ for x_1

$0 = 4x_2 - 5(7l_0/3) - 3l_0$

$x_2 = \frac{1}{4}\left(\frac{35l_0}{3} + 3l_0\right) = \frac{1}{4}\left(\frac{44l_0}{3}\right) = \frac{11l_0}{3}$

The equilibrium positions are: $x_1 = 7l_0/3$ = length of AB

$x_2 = 11l_0/3$ = length AB+BC

ii) Sub for $X_1 = x_1 - \frac{7l_0}{3}$ and $X_2 = x_2 - \frac{11l_0}{3}$ into ① and ②

$m\ddot{x}_1 = 4k(x_2 - x_1 - l_0) - k(x_1 - l_0)$

$\ddot{X}_1 = \ddot{x}_1$

$\therefore m\ddot{X}_1 = 4k(X_2 + \frac{11l_0}{3} - X_1 - \frac{7l_0}{3} - l_0) - k(X_1 + \frac{7l_0}{3} - l_0)$

Clearly state what x_1, x_2 stand for! You are also expected to be clear as to the nature of the forces: tension or thrusts. 1/2

What about the length of the third string? 1/2

∴ BC = ?

State clearly what X_1, X_2 are