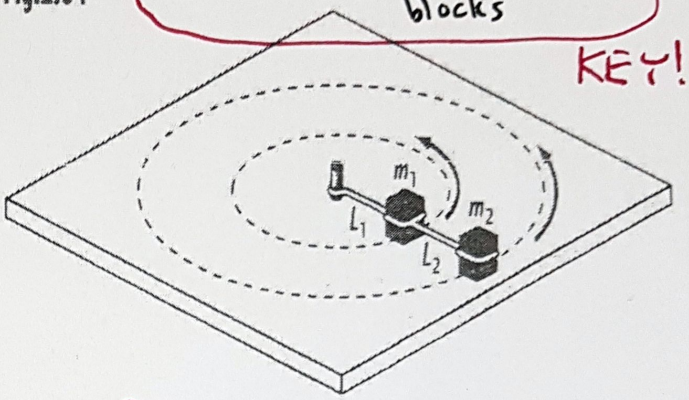
Circular Motion Problem

Name: _____ Date: _____

A block of mass m_1=3kg is attached to a rope of length L_1=8cm, which is fixed at one end to a table. The mass moves in a horizontal circle supported by a frictionless table. A second block of mass m_2=6kg is attached to the first mass by a rope of length L_2=10cm. The mass also moves in a circle, as shown in *Figure 2.64*. If the masses take 5 seconds to make 2 revolutions, calculate the tension in each rope (try and get a general solution before putting in the numbers, also assume all ropes are massless).

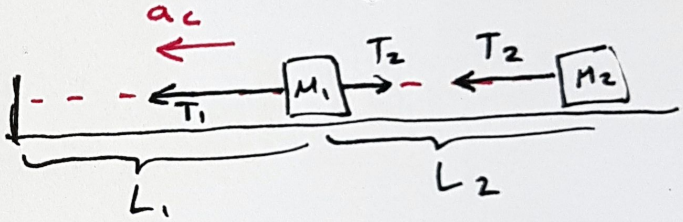
[*ANS*: $T_1 = 8.33N$, $T_2 = 6.81N$]

Fig.2.64



* f is the same for both blocks

KEY!!



solution:

It is likely $T_1 > T_2$.

for M_1

$$\Sigma F = M_1 a_c = M_1 4\pi^2 L_1 f^2$$

$$T_1 - T_2 = M_1 4\pi^2 L_1 f^2$$

$$T_1 - M_2 4\pi^2 (L_1+L_2) f^2 = M_1 4\pi^2 L_1 f^2$$

$$T_1 = M_1 4\pi^2 L_1 f^2 + M_2 4\pi^2 (L_1+L_2) f^2$$

$$T_1 = 4\pi^2 f^2 \left(M_1 L_1 + M_2 (L_1+L_2) \right)$$

$$= 4\pi^2 \left(\tfrac{2}{5}\right)^2 \left(3(0.08) + 6(0.08+0.1) \right)$$

$$\boxed{T_1 = 8.33N}$$

$T_1 > T_2$ ✓

for M_2

$$\Sigma F = M_2 a_c = M_2 4\pi^2 (L_1+L_2) f^2$$

$$T_2 = M_2 4\pi^2 (L_1+L_2) f^2$$

↳ so,

$$T_2 = (6)(4)\pi^2 (0.08+0.1)\left(\tfrac{2}{5}\right)^2$$

$$\boxed{T_2 = 6.81N}$$