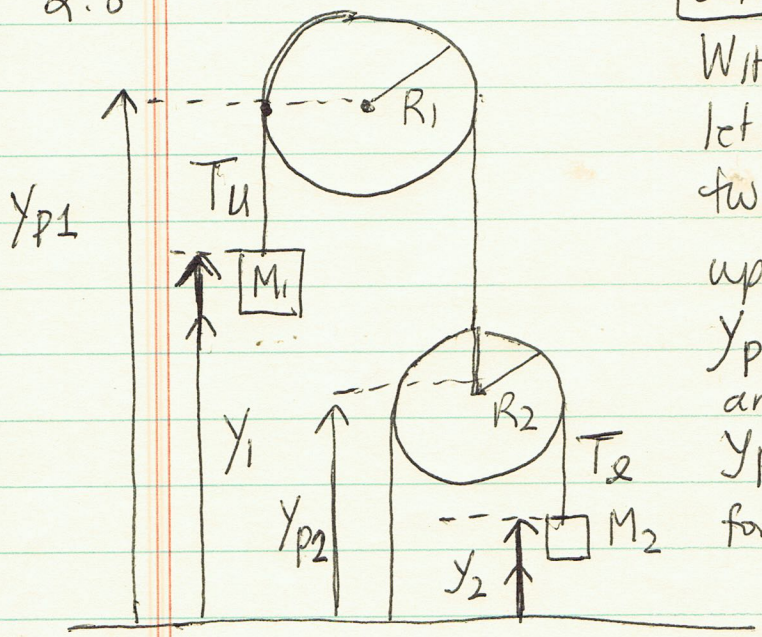
2.8




**Constraints**

With this choice of coordinates, let's write the expressions for the two string lengths

upper string $L$, lower string $\ell$

$$y_{p1} - y_1 + y_{p1} - y_{p2} + \pi R = L$$

and

$$y_{p2} + y_{p2} - y_2 + \pi R = \ell$$

for the acceleration, differentiate:

$$-a_1 - a_{p2} = 0$$

$$a_{p2} + a_{p2} - a_2 = 0 = 2a_{p2} - a_2$$

eliminate $a_{p2}$ to get constraint connecting $a_1$ and $a_2$

$$-a_1 - a_2/2 = 0$$

$$\Rightarrow \boxed{a_2 = -2a_1}$$

Force diagrams

$M_1$: $T_u - M_1 g = M_1 a_1$

$M_2$: $T_\ell - M_2 g = M_2 a_2$

'Lower pulley' $T_u = 2T_\ell$

$$2T - M_1 g = M_1 a_1$$

$$T - M_2 g = -2M_2 a_1$$

eliminate $T$

$$(-M_1 + 2M_2) g = (M_1 + 4M_2) a_1$$

$$a_1 = \frac{(-M_1 + 2M_2)}{M_1 + 4M_2} g$$