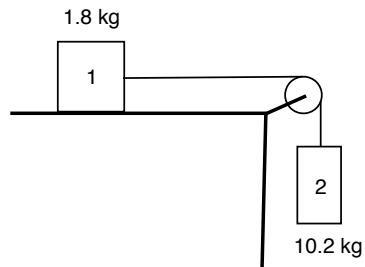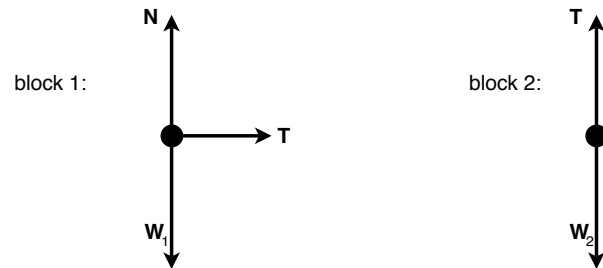# Problem: Pulley with weights

1.8 kg

10.2 kg

Two weights are attached to a frictionless, massless pulley.
(a) Find the magnitude of acceleration of the blocks
(b) Find the tension in the string.

Draw free-body diagrams for the two blocks:

block 1:

block 2:

Because the blocks are linked by the string, the tension is the same for both blocks, and the acceleration is the same for both blocks.

Because block 2 is heavier, we predict it will accelerate downwards, in which case block 1 will accelerate to the right. So take the positive direction to be *down* for block 2 and *right* for block 1.

Equation of motion for block 1:
  - forces in vertical direction sum to zero (no acceleration in vertical direction)
  - in horizontal direction
    $$F_1 = T = m_1 a$$

Equation of motion for block 2:
  - no horizontal forces
  - in vertical direction
    $$F_2 = W_2 - T = m_2 a$$

Hence
  $$m_1 a + m_2 a = T + W_2 - T$$
so
  $$(m_1 + m_2)a = W_2 = m_2 g$$
Hence
  $$a = m_2 g / (m_1 + m_2)$$
  $$= 10.2 \times 9.8 / (1.8 + 10.2)$$
  $$= 8.33 \text{ ms}^{-2} \qquad (= 0.85g)$$

$T = m_1 a = 1.8 \times 8.33 = 15$ N