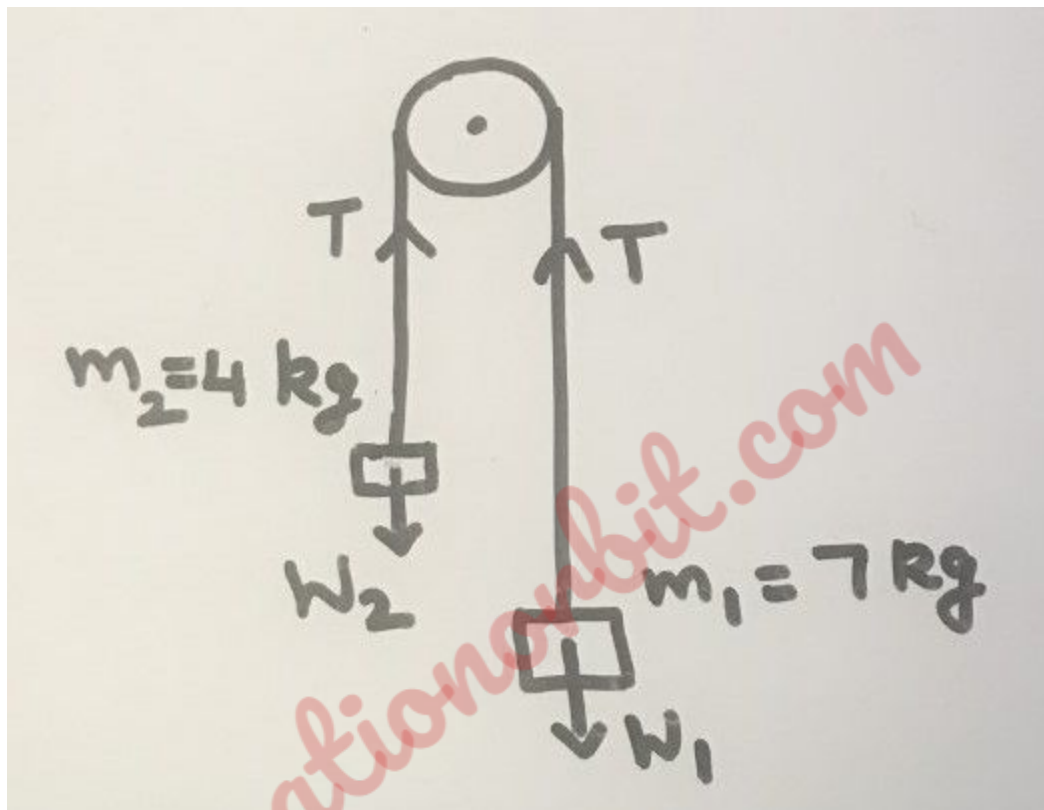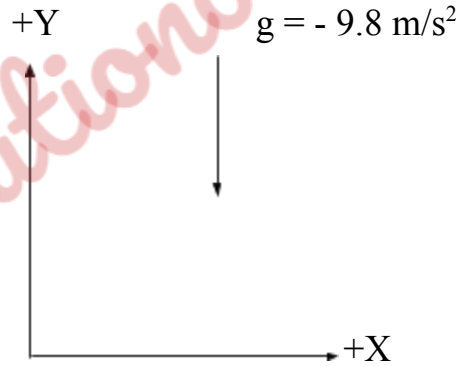A mass of 7 kg and a mass of 4 kg are connected by a massless string. The string is stretched over a frictionless pulley. Assume the mass of the pulley is negligible.

a) Determine the acceleration of the masses.

+Y $g = -9.8$ m/s^2

+X

Given:

Mass $m_1 = 7$ kg
Mass $m_2 = 4$ kg

Forces acting on mass m_1:

Weight W_1 of the mass m_1 acting vertically downwards
Tension T on the string acting vertically upwards

Net force on mass m_1:
$F_{y1} = W_1 - T = m_1g - T = m_1a$ ---------------(1)

Rearranging (1):
$T = m_1g - m_1a$ ----------------(2)

Forces acting on mass m_2:
Weight W_2 of the mass m_2 acting vertically downwards
Tension T on the string acting vertically upwards

Net force on mass m_2:
$F_{y2} = T - W_2 = T - m_2g = m_2a$ ---------------(3)

Rearranging (3):
$T = m_2a + m_2g$ -------------------------(4)

Combining (2) and (4):
$m_1g - m_1a = m_2a + m_2g$ ---------------(5)

Rearranging (5):

$$(m_1 + m_2)a = (m_1 - m_2) g$$

Then:

$$a = [(m_1 - m_2) \ g \ ] / (m_1 + m_2)$$

$$\mathbf{a = \ [\ 3 \times | - 9.8 | \ ] / 11 = 2.7 \ m/s^2}$$

b) Find the tension in the string.

Use equation (2)

$$\mathbf{T = \ m_1 g \ - m_1 a = (\ 7 \times | - 9.8 | \ ) - (\ 7 \times 2.7) = 68.6 - 18.9 = 50 \ N}$$

N is Newtons, the unit of force.
1 N = 1 kg m / s².