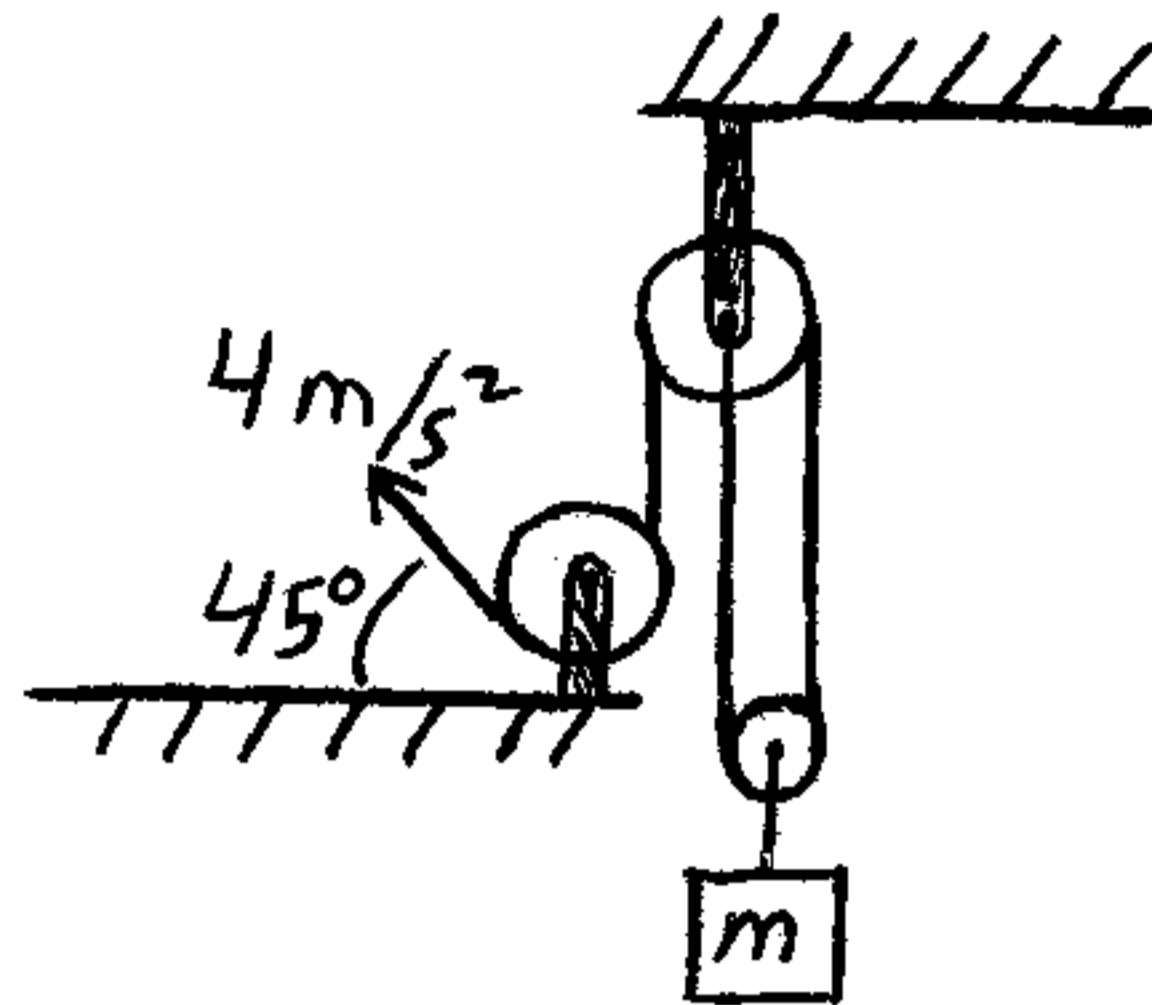


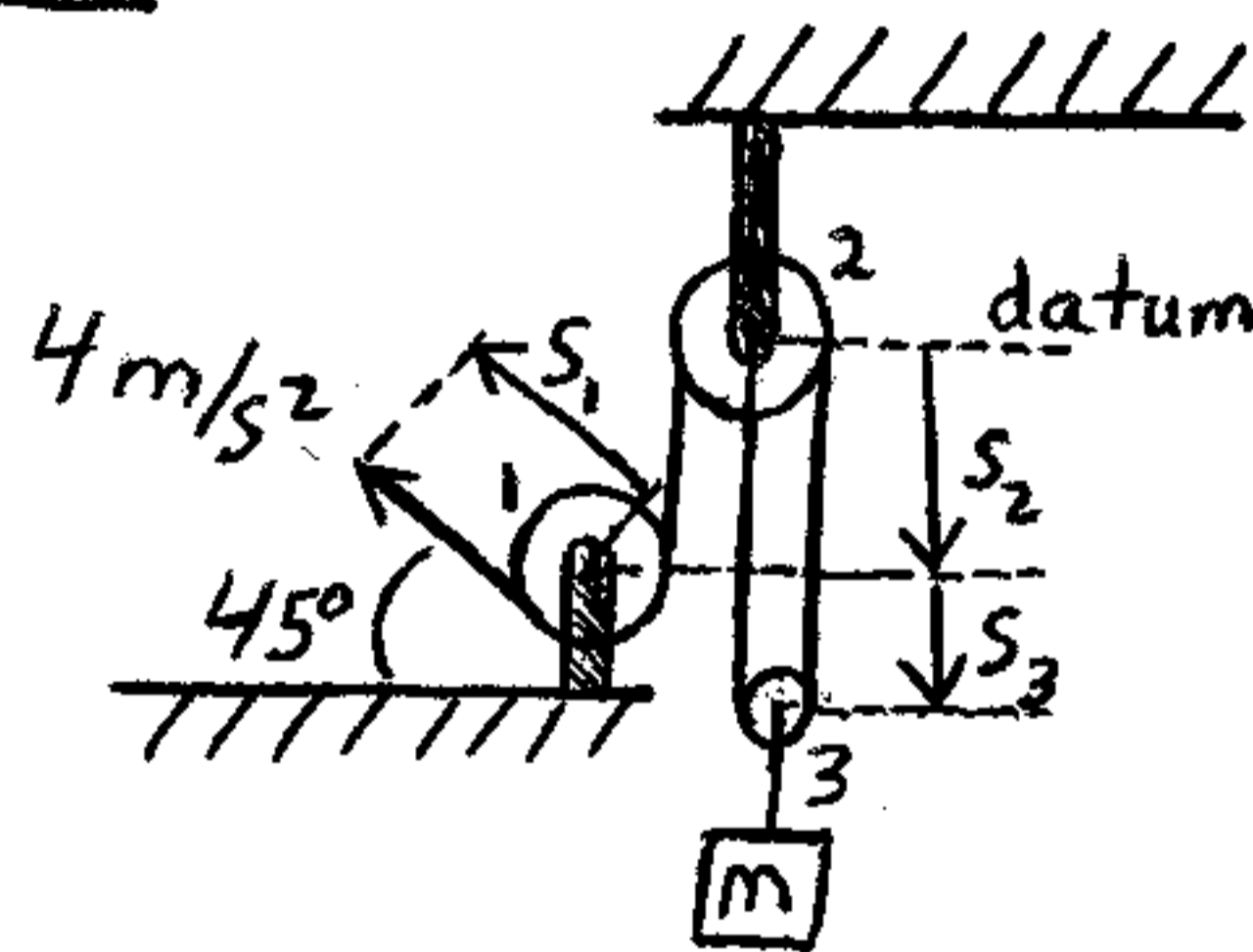
This is a force and motion problem involving pulleys.



In the pulley system shown, block  $m$  has a mass of 120 kg. If one end of the rope is being pulled at an acceleration of  $4 \text{ m/s}^2$ , what is the rope tension?

Neglect the mass of the pulleys and rope.

Solution:



$$s_1 + 3s_2 + 2s_3 = L \text{ (constant length)}$$

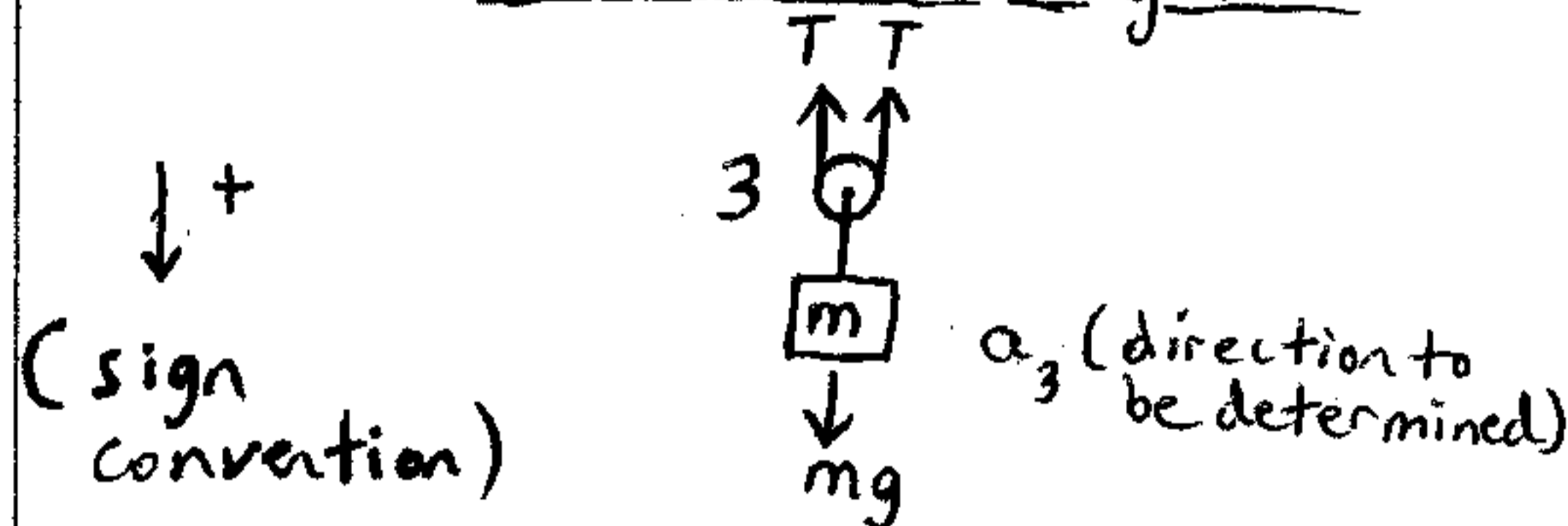
differentiate twice with respect to time:

$$\rightarrow a_1 + 3a_2 + 2a_3 = 0$$

↓ since  $s_2$  is constant

$$\rightarrow a_1 + 2a_3 = 0 \quad (1)$$

Free-body diagram



Apply Newton's second law:

$$-2T + mg = ma_3 \quad (2)$$

$a_3$  is upward (negative), so  $a_1$  must be positive, to satisfy equation (1)  $\frac{2}{2}$

It's given that  $a_1 = 4 \text{ m/s}^2$ . Substitute this into (1) and solve for  $a_3$ :

$$\rightarrow 4 + 2a_3 = 0$$

$$a_3 = -2 \text{ m/s}^2$$

Substitute into equation (2) and solve for  $T$ :

$$2T = mg - ma_3$$

$$2T = m(g - a_3)$$

$$T = \frac{m(g - a_3)}{2}$$

$$T = \frac{120(9.8 - (-2))}{2} = 708 \text{ N} \quad (\text{answer})$$