55 kg student stands on a bathroom scale in 3000 N elevator cabin that is supported by a cable as the cabin starts moving the scale read the mass of student as 45 kg.

a) What is the acceleration vector of cabin?

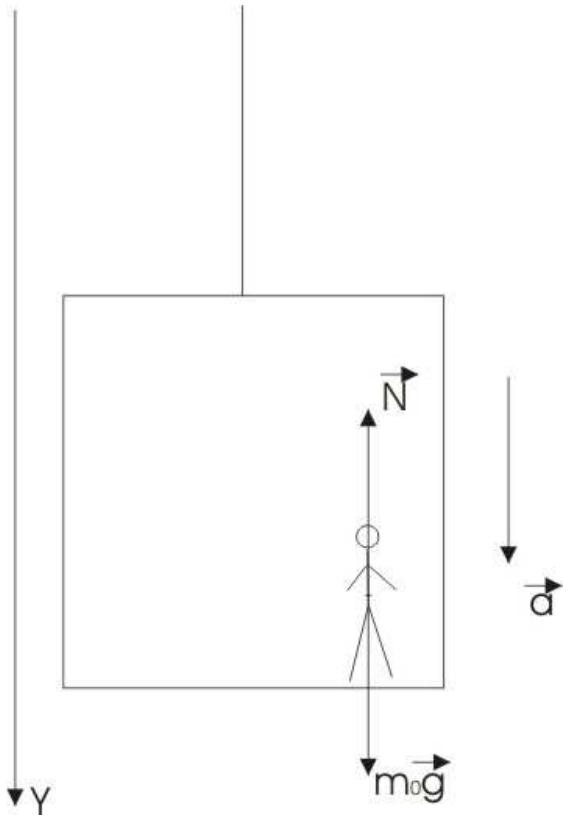
b) What is tension in cable?

**Solution.**

$$m_0 = 55kg, G = 3000N, m = 45kg;$$

$$a - ? \; F_t - ?$$

**a)**




Newton's second law for the student in vector form:

$$m_0\vec{a} = m_0\vec{g} + \vec{N};$$

$m_0$ - the mass of the student.

Projection on Y:

$$m_0 a = m_0 g - N;$$

The scale read the mass of student $m$.

$$N = mg;$$

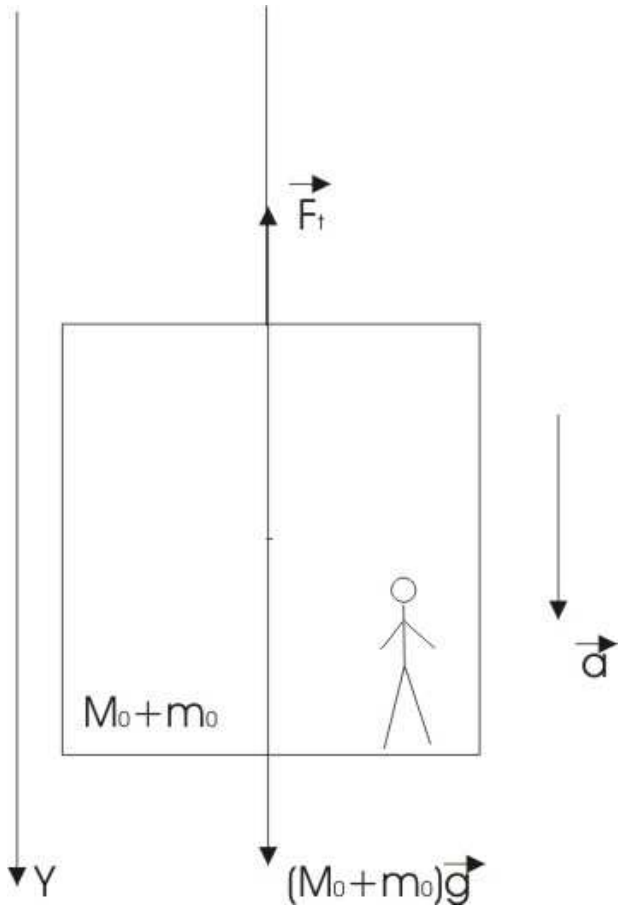
$$m_0 a = m_0 g - mg;$$

$$a = g - \frac{m}{m_0} g;$$

$$a = \left(1 - \frac{m}{m_0}\right) g.$$

$$a = \left(1 - \frac{45}{55}\right) 9.8 = 1.78 \left(\frac{m}{s^2}\right).$$

**b)**




The weight of the elevator cabin at rest:

$$G = M_0 g.$$

The mass of the cabin:

$$M_0 = \frac{G}{g}.$$

Newton's second law for the student and the elevator cabin in vector form:

$$(M_0 + m_0)\vec{a} = (M_0 + m_0)\vec{g} + \overrightarrow{F_t};$$

Projection on Y:

$$(M_0 + m_0)a = (M_0 + m_0)g - F_t;$$

$$F_t = (M_0 + m_0)(g - a);$$

$$F_t = \left(\frac{G}{g} + m_0\right)(g - a);$$

$$F_t = \left(\frac{3000}{9.8} + 55\right)(9.8 - 1.78) = 2896(N).$$

**Answer:** $a = 1.78\frac{m}{s^2}$; $F_t = 2896N$.