

Physics

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(Chapter 4) (Laws of Motion) (Exercises)

(Class 11)

Question 4.15:

Two bodies of masses 10 kg and 20 kg respectively kept on a smooth, horizontal surface are tied to the ends of a light string. A horizontal force $F = 600 \text{ N}$ is applied to (i) A, (ii) B along the direction of string. What is the tension in the string in each case?

Answer 4.15:

Horizontal force, $F = 600 \text{ N}$

Mass of body A, $m_1 = 10 \text{ kg}$ and Mass of body B, $m_2 = 20 \text{ kg}$

Total mass of the system, $m = m_1 + m_2 = 30 \text{ kg}$

Using Newton's second law of motion, the acceleration (a) produced in the system can be calculated as: $F = ma$

$$\therefore a = \frac{F}{m} = \frac{600}{30} = 20 \text{ m/s}^2$$

When force F is applied on body A:



The equation of motion can be written as: $F - T = m_1 a$

$$\therefore T = F - m_1 a = 600 - 10 \times 20 = 400 \text{ N} \quad \dots (i)$$

When force F is applied on body B:



The equation of motion can be written as: $F - T = m_2 a$

$$\therefore T = F - m_2 a = 600 - 20 \times 20 = 200 \text{ N} \quad \dots (ii)$$

Question 4.16:

Two masses 8 kg and 12 kg are connected at the two ends of a light inextensible string that goes over a frictionless pulley. Find the acceleration of the masses, and the tension in the string when the masses are released.

Answer 4.16:

The given system of two masses and a pulley can be represented as shown in the following figure:

Smaller mass, $m_1 = 8 \text{ kg}$

Larger mass, $m_2 = 12 \text{ kg}$

Tension in the string = T

Mass m_2 , owing to its weight, moves downward with acceleration a , and mass m_1 moves upward.

Applying Newton's second law of motion to the system of each mass:

For mass m_1 : The equation of motion can be written as:

$$T - m_1 g = m_1 a \quad \dots (i)$$

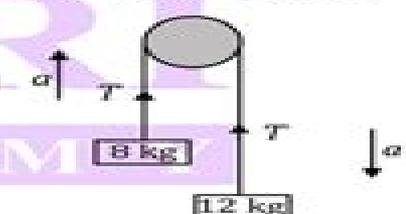
For mass m_2 : The equation of motion can be written as:

$$m_2 g - T = m_2 a \quad \dots (ii)$$

Adding equations (i) and (ii), we get: $(m_2 - m_1)g = (m_2 + m_1)a$

$$\therefore a = \left(\frac{m_2 - m_1}{m_2 + m_1} \right) g \quad \dots (iii)$$

$$= \left(\frac{12 - 8}{12 + 8} \right) \times 10 = \frac{4}{20} \times 10 = 2 \text{ m/s}^2$$



Mastering Physics Chapter 4 Solutions

Michael Hoelscher



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