

Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

6 Connected particles

Exercise A, Question 12

Question:

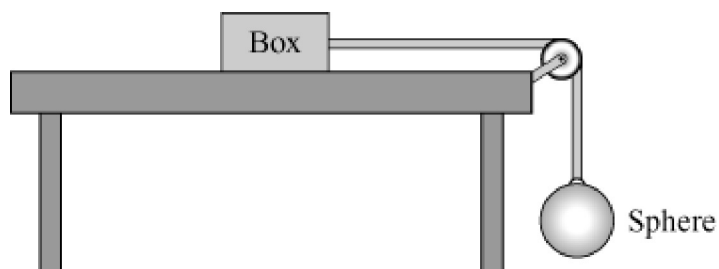
A box, of mass 6 kg, is at rest on a rough horizontal table. A light, inextensible string is attached to the box. This string passes over a smooth, light pulley and the other end is attached to a sphere of mass 4 kg, as shown in the diagram. Assume that the string is horizontal between the box and the pulley. The coefficient of friction between the box and the table is 0.5.

The sphere is released from rest, with the string taut, and the box slides along the table.

(a) Calculate the magnitude of the friction force acting on the box.

(b) Show that the acceleration of the system is 0.98 m s^{-2} .

(c) Calculate the tension in the string. [A]

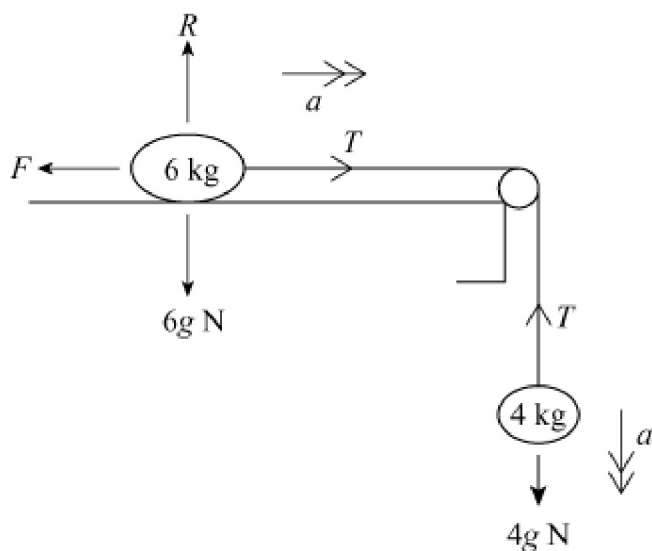


Solution:

(a) At the box;

$$\begin{aligned}
 \text{resolve vertically } R &= 6g \\
 \text{using } F &= \mu R, \\
 F &= 0.5 \times 6g \\
 &= 3g
 \end{aligned}$$

Friction is 29.4 N



$$\text{Using } F = ma \text{ at 4 kg sphere; } 4g - T = 4a$$

$$\text{at 6 kg box (in the direction of movement); } T - F = 6a \quad [1]$$

$$\text{Adding } 4g - F = 10a$$

$$(b) \quad \begin{aligned} 10a &= 4g - 29.4 \\ a &= 0.98 \end{aligned}$$

$$\therefore \text{Acceleration is } 0.98 \text{ m s}^{-2}$$

$$\text{From [1], } T = F + 6a$$

$$(c) \quad \begin{aligned} &= 29.4 + 6 \times 0.98 \\ &= 35.28 \end{aligned}$$

\therefore Tension is 35.3 N.