Connected Particles Review Homework

1

Boxes A and B slide on a smooth, horizontal plane. Box A has a mass of 4 kg and box B a mass of 5 kg. They are connected by a light, inextensible, horizontal wire. Horizontal forces of 9 N and 135 N act on A and B in the directions shown in Fig. 5.

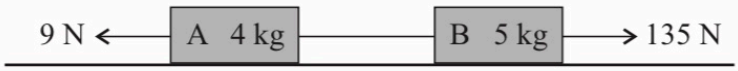

Fig. 5

Calculate the tension in the wire joining the boxes. [4]

2

A block of mass 4 kg slides on a horizontal plane against a constant resistance of 14.8 N. A light, inextensible string is attached to the block and, after passing over a smooth pulley, is attached to a freely hanging sphere of mass 2 kg. The part of the string between the block and the pulley is horizontal. This situation is shown in Fig. 5.

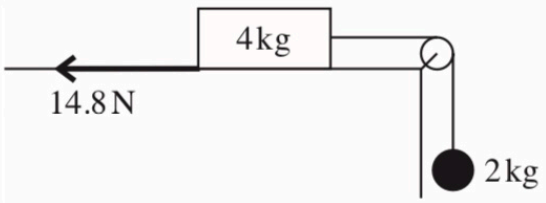

Fig. 5

The tension in the string is T N and the acceleration of the block and of the sphere is a m s^{-2}.

(i) Write down the equation of motion of the block and also the equation of motion of the sphere, each in terms of T and a. [3]

(ii) Find the values of T and a. [3]

3 Particles of mass 2 kg and 4 kg are attached to the ends X and Y of a light, inextensible string. The string passes round fixed, smooth pulleys at P, Q and R, as shown in Fig. 2. The system is released from rest with the string taut.

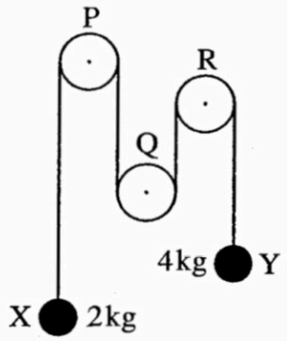

Fig. 2

(i) State what information in the question tells you that

(*A*) the tension is the same throughout the string,

(*B*) the magnitudes of the accelerations of the particles at X and Y are the same. [2]

The tension in the string is T N and the magnitude of the acceleration of the particles is a m s^{-2}.

(ii) Draw a diagram showing the forces acting at X and a diagram showing the forces acting at Y. [1]

(iii) Write down equations of motion for the particles at X and at Y. Hence calculate the values of T and a. [5]

4 A man of mass 75 kg is standing in a lift. He is holding a parcel of mass 5 kg by means of a light inextensible string, as shown in Fig. 5. The tension in the string is 55 N.

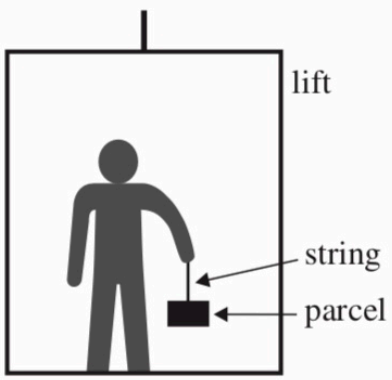

Fig. 5

(i) Find the upward acceleration. **[3]**

(ii) Find the reaction on the man of the lift floor. **[2]**