Godalming College

Mechanics 8 – Connected Particles 2

Please **complete** this homework by _____. Start it early. If you can't do a question you will then have time to ask your teacher for help or go to a drop in session.

Section 1 – Review of previous topics. Please complete all questions.

1. Using the equations of motion for constant acceleration
   (i) Find v when u = 5, a = 3, t = 2.
   (ii) Find v when u = 4, a = -2, t = 3.
   (iii) Find s when v = 10, u = 4, a = 6.
   (iv) Find s when u = 15, a = -5, t = 3.

2.
   (i) Find a when u = 6, s = 4, v = 1.
   (ii) Find a when s = 12, u = 3, t = 4.
   (iii) Find u when v = 0, a = 4, s = -12.
   (iv) Find u when s = 10, t = 2, a = -4.

3.
   (i) If u = 5, a = 2 and t = 3 find v and s.
   (ii) If v = -18, s = -64 and t = 8 find a and u.

Section 2 – Consolidation of this week's topic. Please complete all questions.

1. Two particles of masses 3 kg and 9 kg respectively are connected by a light, inextensible string passed over a smooth pulley. Both masses hang vertically. Find the tension in the string and the acceleration when the system is released from rest.

   (6 marks)

2. A particle of mass 4 kg rests on a smooth horizontal table. It is connected by a light inextensible string which passes over a smooth pulley at the edge of the table to a mass of 1.5 kg which hangs freely. The system is released from rest. Find the acceleration of the particles and the tension in the string.

   (7 marks)

3. A particle of mass m rests on a smooth horizontal table. It is connected by a light inextensible string which passes over a smooth pulley at the edge of the table to a particle of mass m which hangs freely. The system is released from rest. Find the distance travelled by each particle and the speed at the end of the first 0.5 seconds of motion.

   (9 marks)

(continued overleaf)

4.

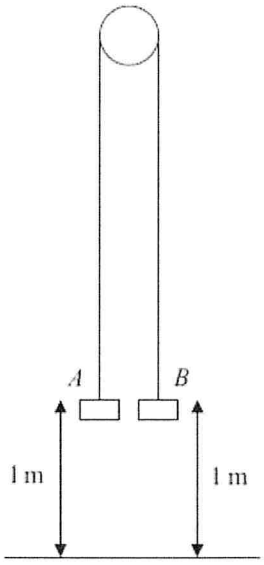

Figure 1

Two particles A and B have mass 0.4 kg and 0.3 kg respectively. The particles are attached to the ends of a light inextensible string. The string passes over a small smooth pulley which is fixed above a horizontal floor. Both particles are held, with the string taut, at a height of 1 m above the floor, as shown in Figure 3. The particles are released from rest and in the subsequent motion B does not reach the pulley.

(a) Find the tension in the string immediately after the particles are released.

(6)

(b) Find the acceleration of A immediately after the particles are released.

(2)

When the particles have been moving for 0.5 s, the string breaks.

(c) Find the further time that elapses until B hits the floor.

(9)

(Total 39 marks)

Section 3 – Extension questions. If you are aiming for a top grade, you should attempt these questions.

Past exam Questions

M1 May 2013

A woman travels in a lift. The mass of the woman is 50 kg and the mass of the lift is 950 kg. The lift is being raised vertically by a vertical cable which is attached to the top of the lift. The lift is moving upwards and has constant deceleration of 2 m s^{-2}. By modelling the cable as being light and inextensible, find

(*a*) the tension in the cable,

(*b*) the magnitude of the force exerted on the woman by the floor of the lift.

M1 May 2012

Figure 1

Two particles P and Q, of mass 0.3 kg and 0.5 kg respectively, are joined by a light horizontal rod. The system of the particles and the rod is at rest on a horizontal plane.

At time $t = 0$, a constant force **F** of magnitude 4 N is applied to Q in the direction PQ, as shown in Figure 1. The system moves under the action of this force until $t = 6$ s. During the motion, the resistance to the motion of P has constant magnitude 1 N and the resistance to the motion of Q has constant magnitude 2 N.

Find

(*a*) the acceleration of the particles as the system moves under the action of **F**,

(*b*) the speed of the particles at $t = 6$ s,

(*c*) the tension in the rod as the system moves under the action of **F**.

At $t = 6$ s, **F** is removed and the system decelerates to rest. The resistances to motion are unchanged. Find

(*d*) the distance moved by P as the system decelerates,

(*e*) the thrust in the rod as the system decelerates.