Introduction to Mechanics (0J2)
Example Sheet 3

This sheet has three recent exam questions on 1D Dynamics, showing the mark scheme. For all questions take the acceleration due to gravity $g = 9.81\text{ms}^{-2}$ where needed.

1. (June 2011) A hot air balloon is at rest at point A on the ground. When the balloon is released, it rises vertically at a constant acceleration to point B at height of 320 m in 80 s.

   (i) Show that the acceleration of the balloon is 0.1 ms^{-2}. (2 marks)
   (ii) Find the speed of the balloon when it reaches a height of 320 m. (1 marks)
   (iii) The mass of the balloon is 450 kg. Show that the magnitude of the vertical lift force is 4459.5 N. (3 marks)

   At B the vertical lift force is reduced so that the balloon rises at a constant speed to point C at a height of 400 m above A.
   (iv) Find the magnitude of the vertical lift force acting between B and C (2 marks)
   (v) the work done by this force from B to C. (2 marks)

   Answers: (ii) 8ms^{-1} quad (iv) 4414.5N (v) 353.16kJ

2. (June 2008) Two particles A and B are connected by a light inextensible string. Particle A has mass 20 kg and rests on a rough horizontal table. The coefficient of friction is 0.15. The string passes over a smooth pulley at the edge of the table. The other end is attached to particle B which has mass 5 kg and hangs vertically as shown.

   The particles are released from rest and begin to move.

(a) Find the magnitude of the friction force acting on A. (3 marks)

(b) Show that the acceleration is 0.785 ms^{-2}. (4 marks)

(c) Find the tension in the string, (1 mark)

(d) Find the distance moved by A in the first 3 seconds (assuming it remains on the table). (2 marks)

Answers: (a) 29.4N (c) 45.1N (d) 3.53m

3. (June2009) A particle A with mass 2 kg moves in a straight line on a smooth horizontal surface at speed 6 ms^{-1}, from left to right. Another particle B with mass 3 kg is at rest. The particles collide.

(a) If after the collision A is at rest and B moves to the right, find the speed of B. (2 marks)

(b) If after the collision A is moving to the left with speed v ms^{-1} and B is moving to the right with speed $4v$ ms^{-1} find the value of v. (3 marks)

(c) Find the total loss in Kinetic Energy in the second case and also the coefficient of restitution e. (5 marks)

Answers: (a) 4ms^{-1} (b) 1.2ms^{-1} (c) 36J, $e = 1$