1 Hanging Freely

Question Paper 3

Level	A Level
Subject	Maths
Exam Board	AQA
Module	Mechanics 1
Topic	Connected Particles
Sub Topic	1 hanging freely
Booklet	Question Paper - 3

Time Allowed: **51 minutes**

Score: **/42**

Percentage: **/100**

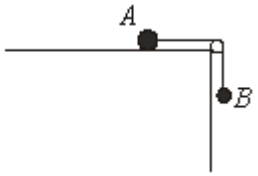
Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

Q1. A particle A of mass 0.2 kg is connected to a particle B of mass 0.3 kg by a light inextensible string.

The particle A is placed on a rough horizontal surface.

The string passes over a smooth fixed peg with B hanging freely, as shown in the diagram.



(a) The system is held in equilibrium by a horizontal force, P newtons, which is applied to the particle A. The coefficient of friction between A and the rough horizontal surface is 0.5.

(i) Draw a diagram showing the forces acting on the particle A.

(2)

(ii) Show that the magnitude of the maximum possible frictional force between A and the rough horizontal surface is 0.98 newtons.

(2)

(iii) Find the tension in the string.

(2)

(iv) Find the least value of P required to hold the system in equilibrium.

(2)

(b) The horizontal force P is removed and the particles start to move from rest.

(i) Find the magnitude of the acceleration of the particles during the subsequent motion.

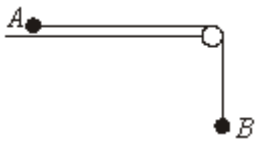
(5)

(ii) After falling 0.1 metres, the particle B hits the ground. Find the time between the system being released and B hitting the ground.

(2)

(Total 15 marks)

Q2. Two particles, A and B, are connected by a light inextensible string which passes over a smooth, fixed peg, as shown in the diagram.



The particle A, of mass 0.6 kg, is in contact with a smooth horizontal surface, and the particle B, of mass 0.1 kg, hangs freely above the ground. The system is released from rest with the string taut and A moves towards the peg.

It can be assumed that, during the subsequent motion, A does **not** reach the peg.

(a) While the particles move freely, the string is taut.

(i) Show that the acceleration of the particles is 1.4 m s^{-2}.

(5)

(ii) Find the tension in the string.

(1)

(iii) Find the magnitude of the resultant force on the peg due to the tension in the string.

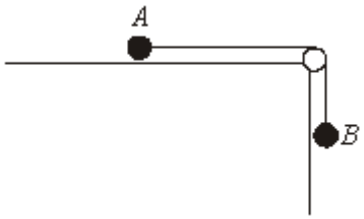
(3)

(b) After q seconds of the motion, the particle B hits the ground and remains there. The string connecting A and B slackens and A continues to move towards the peg. Sketch a velocity–time graph to show the two stages of the motion of A after being released from rest.

(3)
(Total 12 marks)

Q3. Two particles, A and B, are connected by a light, inextensible string which passes

over a smooth, fixed peg, as shown in the diagram.



The particle A is of mass 0.5 kg and the particle B is of mass 0.1 kg. The particle A is in contact with a rough horizontal surface.

(a) The system is at rest and the particle B hangs vertically.

(i) Show that the tension in the string is 0.98 newtons.

(1)

(ii) The particle A rests in limiting equilibrium. Show that the coefficient of friction between A and the surface is 0.2.

(3)

(iii) Draw a diagram to show the forces acting on the peg due to the string.

(1)

(iv) Find the magnitude of the resultant force on the peg due to the string.

(2)

(b) An additional mass of 0.1 kg is attached to the particle B and the system is released from rest. The particle A moves across the surface towards the peg and B moves vertically downwards. The particles move with acceleration a m s^{-2} and the tension in the string is T newtons.

(i) Show that a = 1.4.

(5)

(ii) Find the value of T.

(1)

(iii) After falling a distance of 0.7 metres, B hits the ground. Find the time between the particles being released and B hitting the ground.

(2)

(Total 15 marks)