Based on the 2022 Advanced Information from Edexcel exam board

Predicted A level Mathematics Paper 3B Mechanics June 2022

Information for Candidates

- This predicted paper is based on the 2022 advance information from Edexcel exam board
- There are 5 questions in this question paper
- The total mark for this paper is 56.
- The marks for **each** question are shown in brackets.
- Full marks may be obtained for answers to ALL questions

Advice to candidates:

- You must ensure that your answers to parts of questions are clearly labelled.
- You must show sufficient working to make your methods clear to the Examiner
- Answers without working may not gain full credit

Question 1

A particle, P, moves with constant acceleration $(3\mathbf{i} + 4\mathbf{j})$ m s^{-2}.

At time $t = 0$, the particle is at the point A and is moving with velocity $(-7\mathbf{i} + \mathbf{j})$ m s^{-1}.

At time $t = T$ seconds, P is moving in the direction of vector $(2\mathbf{i} + 3\mathbf{j})$.

(a) Find the value of T. **(4)**

At time $t = 4$ seconds, P is at the point B.

(b) Find the distance AB. **(2)**

(Total for Question 2 is 6 marks)

Question 2

At time t seconds, $t \geq 0$, a particle P has velocity $\boldsymbol{v}$ m s^{-1}, where

$$\boldsymbol{v} = (5t^2 - 12t + 15)\mathbf{i} + (t^2 + 8t - 10)\mathbf{j}$$

When $t = 0$, P is at the origin O.

At time T seconds, P is moving in the direction of $(\mathbf{i} + \mathbf{j})$.

(a) Find the value of T. **(3)**

When $t = 3$, P is at the point A.

(b) Find the magnitude of the acceleration of P as it passes through A. **(4)**

(c) Find the position vector of A. **(4)**

(Total for question = 11 marks)

Question 3

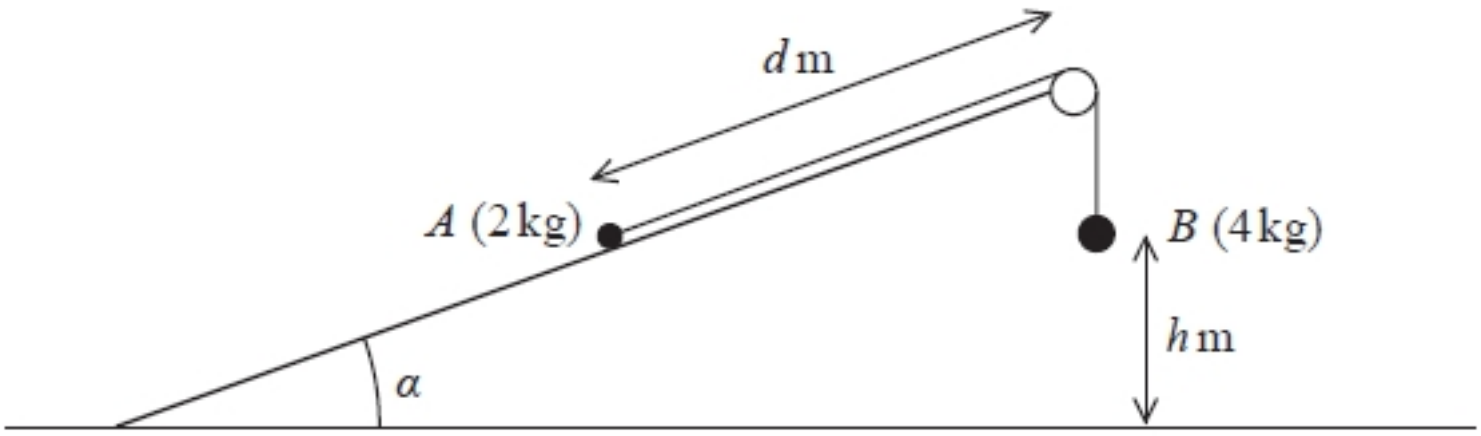

Figure 3

Two particles, *A* and *B*, have masses 2 kg and 4 kg respectively. The particles are connected by a light inextensible string. The string passes over a small smooth pulley which is fixed at the top of a rough plane. The plane is inclined to the horizontal ground at an angle α where $\tan \alpha = \frac{3}{4}$. The particle *A* is held at rest on the plane at a distance *d* metres from the pulley. The particle *B* hangs freely at rest, vertically below the pulley, at a distance *h* metres above the ground, as shown in Figure 3. The part of the string between *A* and the pulley is parallel to a line of greatest slope of the plane. The coefficient of friction between *A* and the plane is $\frac{1}{4}$.

The system is released from rest with the string taut and *B* descends.

(a) Find the tension in the string as *B* descends. **(9)**

On hitting the ground, *B* immediately comes to rest.

Given that *A* comes to rest before reaching the pulley,

(b) find, in terms of *h*, the range of possible values of *d*. **(7)**

(c) State one physical factor, other than air resistance, that could be taken into account to make the model described above more realistic. **(1)**

(Total for question = 17 marks)

Question 4

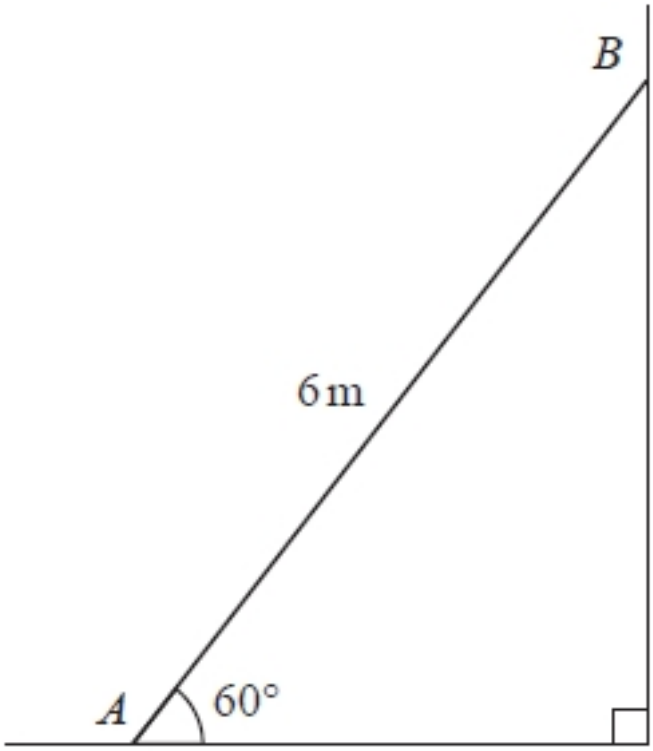

Figure 3

A ladder AB has length 6 m and mass 30 kg. The ladder rests in equilibrium at 60° to the horizontal with the end A on rough horizontal ground and the end B against a smooth vertical wall, as shown in Figure 3.

A man of mass 70 kg stands on the ladder at the point C, where $AC = 2$ m, and the ladder remains in equilibrium. The ladder is modelled as a uniform rod in a vertical plane perpendicular to the wall. The man is modelled as a particle.

(a) Find the magnitude of the force exerted on the ladder by the ground. **(6)**

The man climbs further up the ladder. When he is at the point D on the ladder, the ladder is about to slip.

Given that the coefficient of friction between the ladder and the ground is 0.4

(b) find the distance AD. **(4)**

(c) State how you have used the modelling assumption that the ladder is a rod. **(1)**

(Total for question = 11 marks)

Question 5

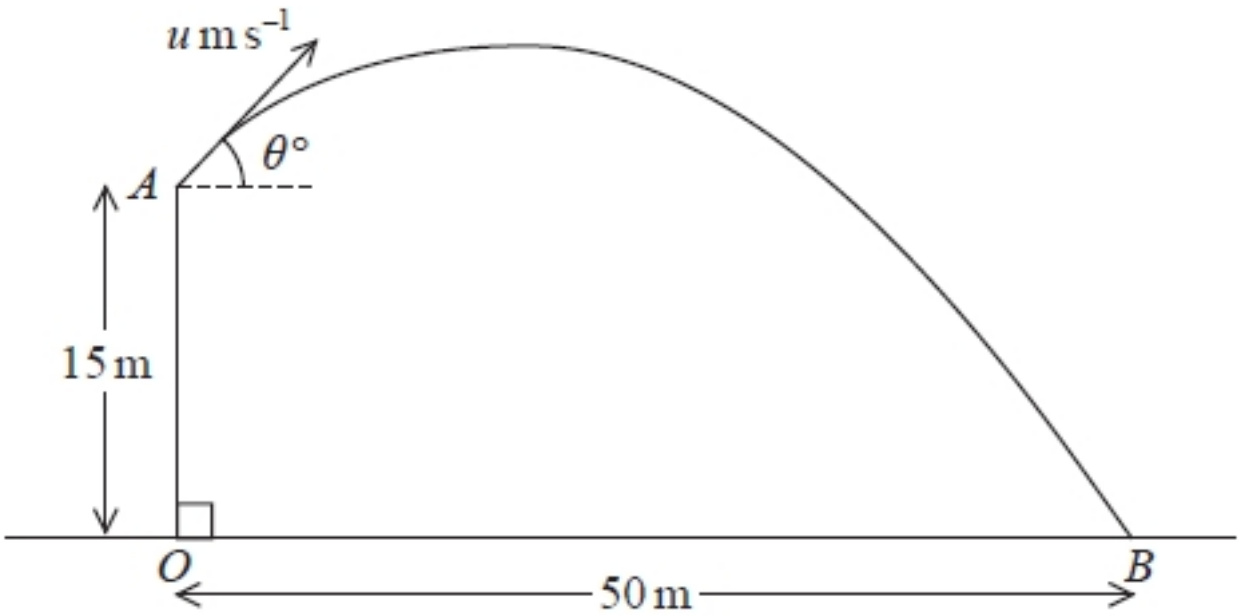

Figure 4

A small ball is thrown from the point A with speed u m s^{-1} at an angle $\theta°$ above the horizontal. The point is vertically above the point O, which is on horizontal ground, such that AO is 15 m.

The ball takes 3 seconds to travel from A to B, where B is on the ground and OB = 50 m, as shown in Figure 4. By modelling the motion of the ball as that of a particle moving freely under gravity,

find

(a) (i) the value of θ,

(ii) the value of u, **(6)**

(b) the speed of the ball as it hits the ground at B, **(3)**

(c) the direction of motion of the ball as it hits the ground at B. **(2)**

(Total for question = 11 marks)

TOTAL FOR PAPER IS 56 MARKS