Write your name here

Surname	Other Names

AS/A Level Mathematics

Connected Particles

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

• Use **black** ink or ball-point pen.
• If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
• **Fill in the boxes** at the top of this page with your name.
• Answer **all** questions and ensure that your answers to parts of questions are clearly labelled..
• Answer the questions in the spaces provided
– there may be more space than you need.
• You should show sufficient working to make your methods clear.
Answers without working may not gain full credit.
• Answers should be given to three significant figures unless otherwise stated.

Information

• The marks for **each** question are shown in brackets
– use this as a guide as to how much time to spend on each question.

Advice

• Read each question carefully before you start to answer it.
• Try to answer every question.
• Check your answers if you have time at the end.

1 Two particles *A* of mass 2 kg and *B* of mass 3 kg are connected by a light inextensible string. The string passes over a smooth pulley fixed at the top of a rough inclined plane. The plane is inclined at an angle of 40° to the horizontal. *A* lies at rest on the plane and *B* hangs freely from the edge of the plane with the string taut.
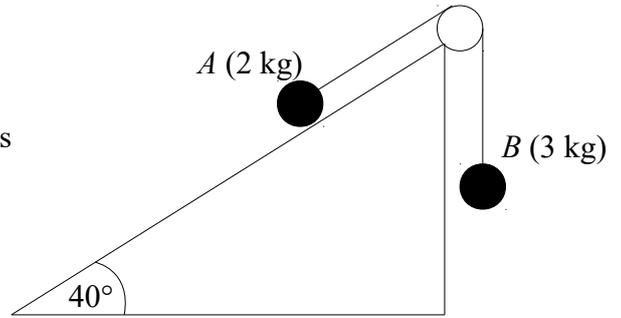
Particle *A* is released from rest and accelerates up the plane at 2 ms⁻².

Find

(a) The tension in the string **(3)**

(b) The coefficient of friction between *A* and the plane **(3)**

(c) The force exerted on the pulley by the string **(3)**

(Total for question 1 is 9 marks)

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2 Two particles *P* of mass 4 kg and *Q* of mass 5 kg are connected by a light inextensible string.
The string passes over a smooth pulley fixed at the top of a rough inclined plane.
The coefficient of friction between the block and the plane is 0.2. The plane is inclined at an angle of $\theta°$ to the horizontal such that $\cos \theta = 0.8$. *P* lies at rest on the plane and *Q* hangs freely from the edge of the plane 2 m above the ground with the string taut.
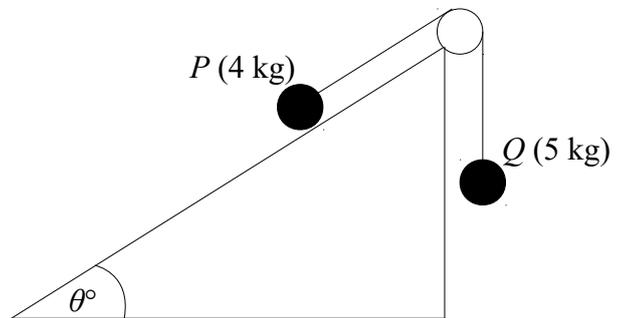
The system is released from rest. Assuming *Q* hits the ground before *P* reaches the pulley.

Find the speed at which *Q* hits the ground.

(Total for question 2 is 9 marks)

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3 Two particles *P* of mass 6 kg and *Q* of mass 2 kg are connected by a light inextensible string. The string passes over a smooth pulley fixed at the top of a wedge.
One face of the wedge is smooth and inclined at an angle of 30° to the horizontal. The other face of the wedge is rough and inclined at an angle of 45° to the horizontal. *P* lies on the smooth face and the string connecting the particles is taut. The coefficient of friction between *Q* and the rough face is 0.3.
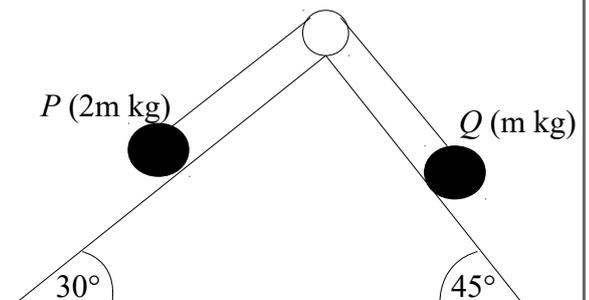
Find

(a) The tension in the string **(7)**

(b) The acceleration of the system and the direction of travel. **(2)**

(Total for question 3 is 9 marks)