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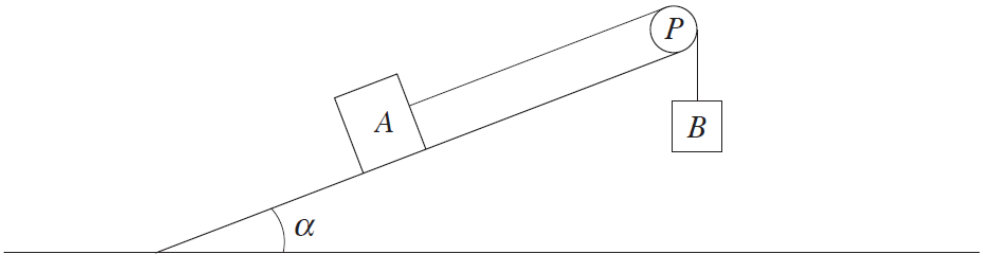
Motion on an Inclined Plane

(Gaeaf 2007)

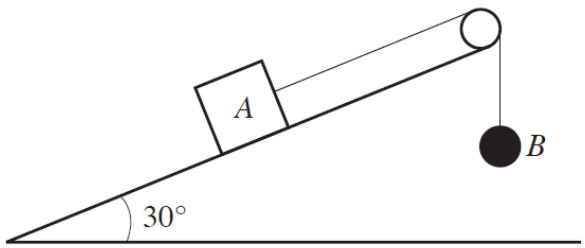
4. The diagram shows a particle A, on a fixed smooth inclined plane, joined by a light inextensible string passing over a smooth fixed pulley P to a particle B, which hangs freely. The plane is inclined at an angle α to the horizontal, where $\sin \alpha = 0{\cdot}21$. The masses of A and B are 5 kg and 9 kg respectively. The string is in the same vertical plane as a line of greatest slope of the plane. Initially, the particles are held at rest with the string taut.



The system is released. Calculate the magnitude of the acceleration of the particle A and the tension in the string. [7]

(Haf 2007)

4. The diagram shows a block A of mass 8 kg on a smooth plane inclined at an angle of 30° to the horizontal. The block is connected to a body B, of mass 6 kg, by means of a light inextensible string passing over a light smooth pulley fixed at the top of the plane.



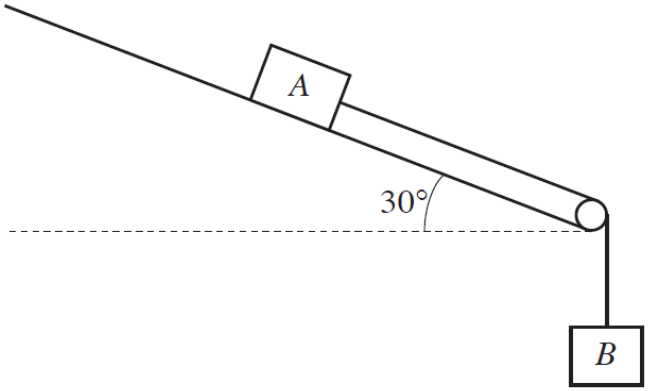
Initially, the system is held at rest with the string taut. The system is then released.

(a) Calculate the magnitude of the acceleration of A and the tension in the string. [7]

(b) What assumption did the word 'inextensible', underlined above, enable you to make in your solution? [1]

(Gaeaf 2008)

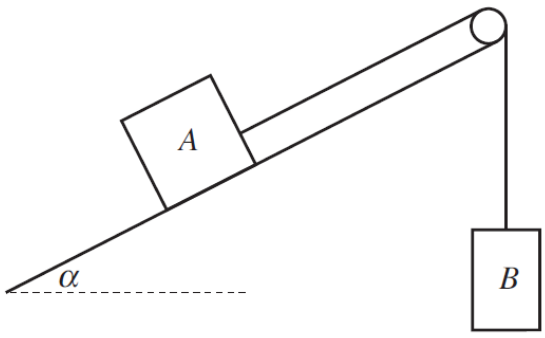
6. A light inextensible string connects object A, of mass 2 kg, to object B, of mass 3 kg. The diagram shows A on a smooth plane, inclined at an angle of 30° to the horizontal with the string passing over a smooth light pulley at the edge of the plane so that B hangs freely. Initially, A is held at rest with the string taut.



The system is released from rest. Find the magnitude of the acceleration of object A and the tension in the string. [7]

(Gaeaf 2010)

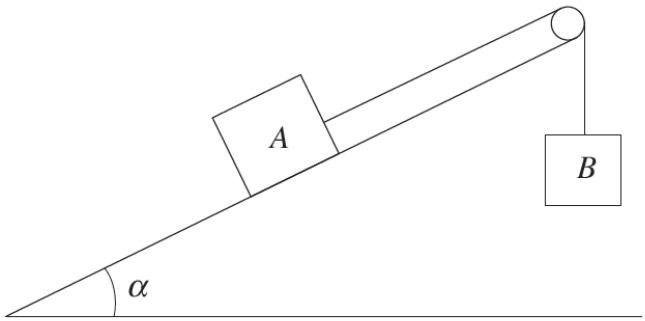
3. The diagram shows an object A, on a fixed smooth inclined plane, joined by a light inextensible string passing over a smooth fixed pulley to an object B, which hangs freely. The plane is inclined at an angle α to the horizontal, where $\sin \alpha = 0{\cdot}4$. The masses of A and B are 11 kg and 9 kg respectively. The string is in the same vertical plane as a line of greatest slope of the plane.



Initially, the objects are held at rest with the string just taut. The system is released. Calculate the tension in the string and the magnitude of the acceleration of A. [7]

(Haf 2011)

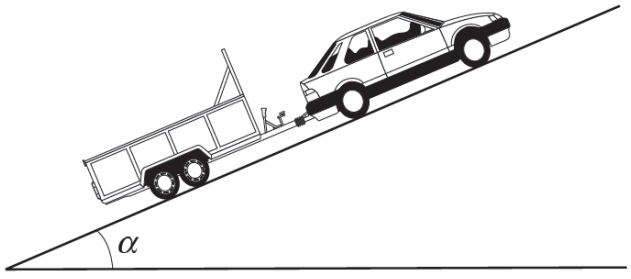
5. The diagram shows a particle A, on a smooth inclined plane, joined by a light inextensible string passing over a smooth pulley to a particle B, which hangs freely. The plane is inclined at an angle α to the horizontal, where $\sin\alpha = \frac{5}{13}$. The masses of A and B are 13 kg and 15 kg respectively. The string is in the same vertical plane as a line of greatest slope of the plane.



Initially, the particles are held at rest with the string taut. The system is released. Calculate the magnitude of the acceleration of the particle A and the tension in the string. [7]

(Gaeaf 2014)

6. The diagram below shows a car of mass 1500 kg connected to a trailer of mass 600 kg by means of a rigid tow bar. The car is moving upwards along a slope inclined at an angle α to the horizontal, where $\sin\alpha = \frac{7}{25}$. A constant resistance of magnitude 400 N acts on the car and a constant resistance of 300 N acts on the trailer. The car's engine produces a constant forward force of 8400 N.

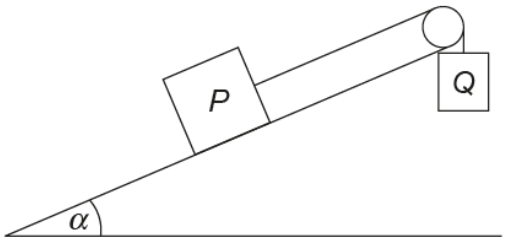


(a) Calculate the acceleration of the car, giving your answer correct to three decimal places. [5]

(b) Determine the tension in the tow bar. [4]

(Haf 2017)

5. Two particles P and Q, of masses 6 kg and 4 kg respectively, are connected by a light inextensible string of length 2 m. The string passes over a light smooth pulley fixed at the top of a smooth plane which is inclined at an angle α to the horizontal where $\sin\alpha = \frac{3}{5}$.



Initially, the particles are held at rest with the string just taut, with particle P lying on the plane and particle Q hanging just over the pulley. The particles are then released.

(a) Find the magnitude of the acceleration of the particles and the tension in the string. [6]

(b) Given that particle Q is initially 1·5 m above the ground, determine the speed with which particle Q hits the ground. [3]

(c) Given that particle P does not reach the top of the plane, calculate the time that elapses between Q reaching the ground and the string becoming taut again. Give your answer correct to 2 decimal places. [4]