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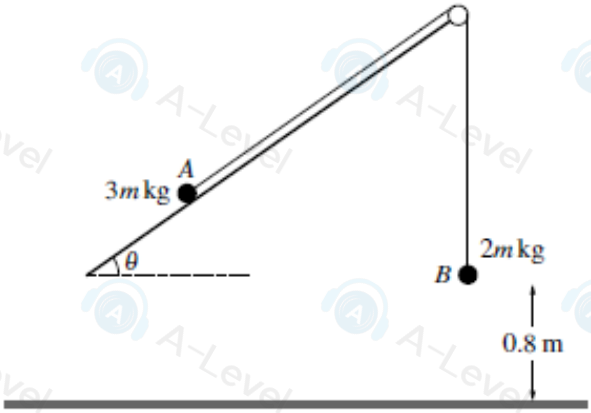

Two particles A and B, of masses $3m$ kg and $2m$ kg respectively, are attached to the ends of a light inextensible string. The string passes over a fixed smooth pulley which is attached to the edge of a plane. The plane is inclined at an angle θ to the horizontal. A lies on the plane and B hangs vertically, 0.8 m above the floor, which is horizontal. The string between A and the pulley is parallel to a line of greatest slope of the plane (see diagram). Initially A and B are at rest.

(a) Given that the plane is smooth, find the value of θ for which A remains at rest. [3]

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It is given instead that the plane is rough, $\theta = 30°$ and the acceleration of A up the plane is $0.1\ \text{m s}^{-2}$.

(b) Show that the coefficient of friction between A and the plane is $\frac{1}{10}\sqrt{3}$. [5]

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(c) When B reaches the floor it comes to rest.

Find the length of time after B reaches the floor for which A is moving up the plane. [You may assume that A does not reach the pulley.] [4]

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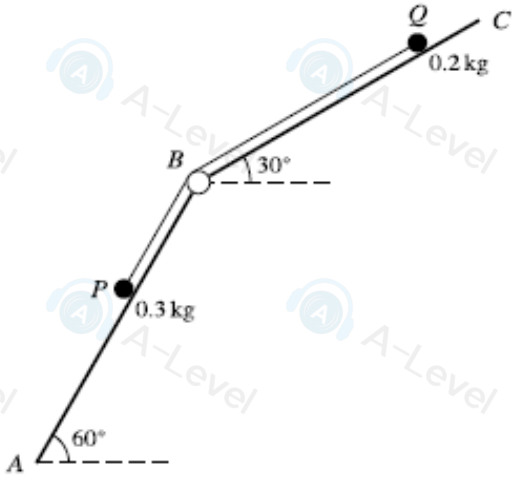

Two particles P and Q, of masses 0.3 kg and 0.2 kg respectively, are attached to the ends of a light inextensible string. The string passes over a fixed smooth pulley at B which is attached to two inclined planes. P lies on a smooth plane AB which is inclined at 60° to the horizontal. Q lies on a plane BC which is inclined at 30° to the horizontal. The string is taut and the particles can move on lines of greatest slope of the two planes (see diagram).

(a) It is given that the plane BC is smooth and that the particles are released from rest.

Find the tension in the string and the magnitude of the acceleration of the particles. [5]

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(b) It is given instead that the plane BC is rough. A force of magnitude 3 N is applied to Q directly up the plane along a line of greatest slope of the plane.

Find the least value of the coefficient of friction between Q and the plane BC for which the particles remain at rest. [5]

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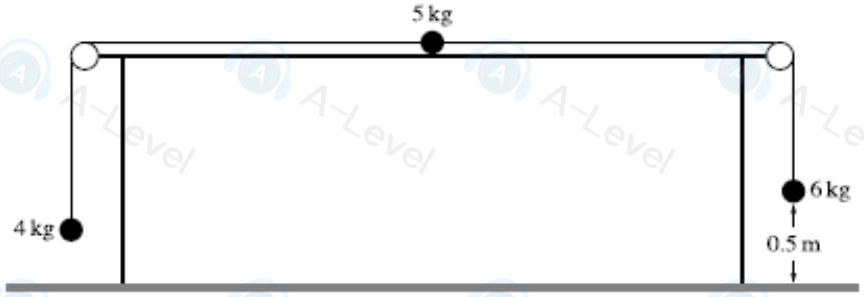

The diagram shows a particle of mass 5 kg on a rough horizontal table, and two light inextensible strings attached to it passing over smooth pulleys fixed at the edges of the table. Particles of masses 4 kg and 6 kg hang freely at the ends of the strings. The particle of mass 6 kg is 0.5 m above the ground. The system is in limiting equilibrium.

(a) Show that the coefficient of friction between the 5 kg particle and the table is 0.4. [2]

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The 6 kg particle is now replaced by a particle of mass 8 kg and the system is released from rest.

(b) Find the acceleration of the 4 kg particle and the tensions in the strings. [5]

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(c) In the subsequent motion the 8 kg particle hits the ground and does not rebound.

Find the time that elapses after the 8 kg particle hits the ground before the other two particles come to instantaneous rest. (You may assume this occurs before either particle reaches a pulley.) [5]

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