Chapter 3 Newton's Law of motion

May/June 2002

2 A basket of mass 5 kg slides down a slope inclined at 12° to the horizontal. The coefficient of friction between the basket and the slope is 0.2.

(i) Find the frictional force acting on the basket. [2]

(ii) Determine whether the speed of the basket is increasing or decreasing. [3]

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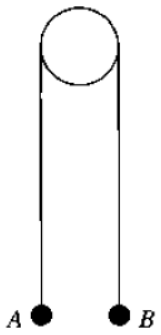

Particles A and B, of masses 0.15 kg and 0.25 kg respectively, are attached to the ends of a light inextensible string which passes over a smooth fixed pulley. The system is held at rest with the string taut and with A and B at the same horizontal level, as shown in the diagram. The system is then released.

(i) Find the downward acceleration of B. [4]

After 2 s B hits the floor and comes to rest without rebounding. The string becomes slack and A moves freely under gravity.

(ii) Find the time that elapses until the string becomes taut again. [4]

(iii) Sketch on a single diagram the velocity-time graphs for both particles, for the period from their release until the instant that B starts to move upwards. [3]

May/June 2003

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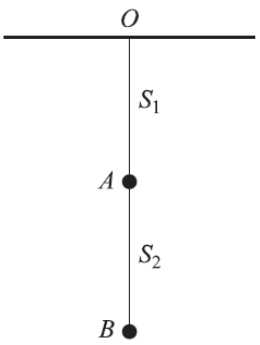

S_1 and S_2 are light inextensible strings, and A and B are particles each of mass 0.2 kg. Particle A is suspended from a fixed point O by the string S_1, and particle B is suspended from A by the string S_2. The particles hang in equilibrium as shown in the diagram.

(i) Find the tensions in S_1 and S_2. [3]

The string S_1 is cut and the particles fall. The air resistance acting on A is 0.4 N and the air resistance acting on B is 0.2 N.

([5]

May/June 2004

May/June 2005

3 A and B are points on the same line of greatest slope of a rough plane inclined at 30° to the horizontal. A is higher up the plane than B and the distance AB is 2.25 m. A particle P, of mass m kg, is released from rest at A and reaches B 1.5 s later. Find the coefficient of friction between P and the plane. [6]

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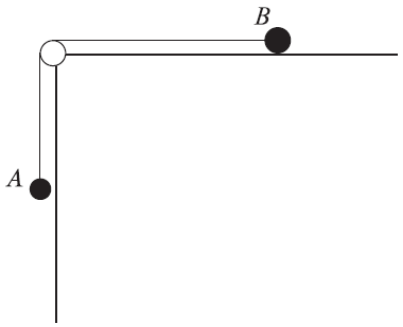

Particles A and B, of masses 0.2 kg and 0.3 kg respectively, are connected by a light inextensible string. The string passes over a smooth pulley at the edge of a rough horizontal table. Particle A hangs freely and particle B is in contact with the table (see diagram).

(i) The system is in limiting equilibrium with the string taut and A about to move downwards. Find the coefficient of friction between B and the table. [4]

A force now acts on particle B. This force has a vertical component of 1.8 N upwards and a horizontal component of X N directed away from the pulley.

(ii) The system is now in limiting equilibrium with the string taut and A about to move **upwards**. Find X. [3]

May/June 2006

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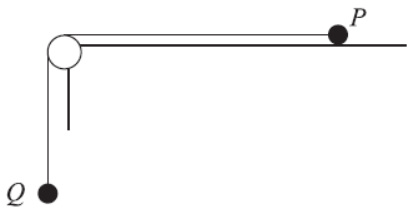

Particles P and Q are attached to opposite ends of a light inextensible string. P is at rest on a rough horizontal table. The string passes over a small smooth pulley which is fixed at the edge of the table. Q hangs vertically below the pulley (see diagram). The force exerted on the string by the pulley has magnitude $4\sqrt{2}$ N. The coefficient of friction between P and the table is 0.8.

(i) Show that the tension in the string is 4 N and state the mass of Q. [2]

(ii) Given that P is on the point of slipping, find its mass. [2]

A particle of mass 0.1 kg is now attached to Q and the system starts to move.

(iii) Find the tension in the string while the particles are in motion. [4]

May/June 2007

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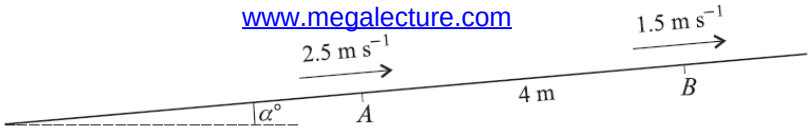

A particle slides up a line of greatest slope of a smooth plane inclined at an angle $\alpha°$ to the horizontal. The particle passes through the points A and B with speeds 2.5 m s^{-1} and 1.5 m s^{-1} respectively. The distance AB is 4 m (see diagram). Find

(i) the deceleration of the particle, [2]

(ii) the value of α. [2]

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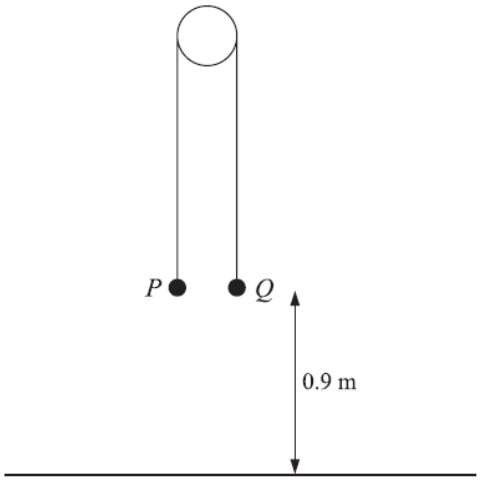

Particles P and Q, of masses 0.6 kg and 0.2 kg respectively, are attached to the ends of a light inextensible string which passes over a smooth fixed peg. The particles are held at rest with the string taut. Both particles are at a height of 0.9 m above the ground (see diagram). The system is released and each of the particles moves vertically. Find

(i) the acceleration of P and the tension in the string before P reaches the ground, [5]

(ii) the time taken for P to reach the ground. [2]

May/June 2008

1 A particle slides down a smooth plane inclined at an angle of $\alpha°$ to the horizontal. The particle passes through the point A with speed 1.5 m s^{-1}, and 1.2 s later it passes through the point B with speed 4.5 m s^{-1}. Find

(i) the acceleration of the particle, [2]

(ii) the value of α. [2]

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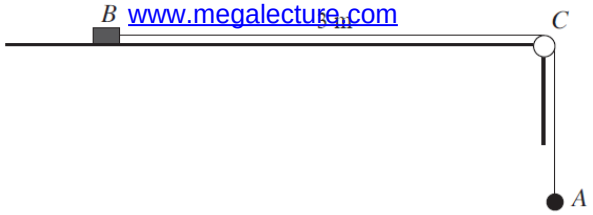

A block B of mass 0.6 kg and a particle A of mass 0.4 kg are attached to opposite ends of a light inextensible string. The block is held at rest on a rough horizontal table, and the coefficient of friction between the block and the table is 0.5. The string passes over a small smooth pulley C at the edge of the table and A hangs in equilibrium vertically below C. The part of the string between B and C is horizontal and the distance BC is 3 m (see diagram). B is released and the system starts to move.

(i) Find the acceleration of B and the tension in the string. [6]

(ii) Find the time taken for B to reach the pulley. [2]

May/June 2009

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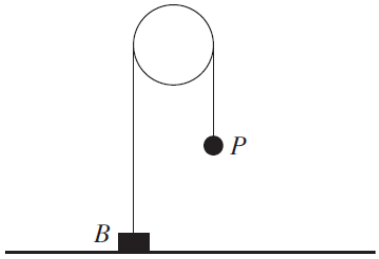

A block B of mass 5 kg is attached to one end of a light inextensible string. A particle P of mass 4 kg is attached to other end of the string. The string passes over a smooth pulley. The system is in equilibrium with the string taut and its straight parts vertical. B is at rest on the ground (see diagram). State the tension in the string and find the force exerted on B by the ground. [3]

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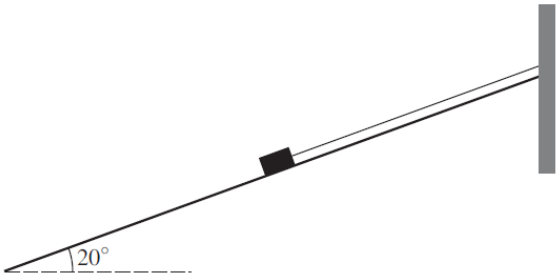

A block of mass 8 kg is at rest on a plane inclined at 20° to the horizontal. The block is connected to a vertical wall at the top of the plane by a string. The string is taut and parallel to a line of greatest slope of the plane (see diagram).

(i) Given that the tension in the string is 13 N, find the frictional and normal components of the force exerted on the block by the plane. [4]

The string is cut; the block remains at rest, but is on the point of slipping down the plane.

(ii) Find the coefficient of friction between the block and the plane. [2]

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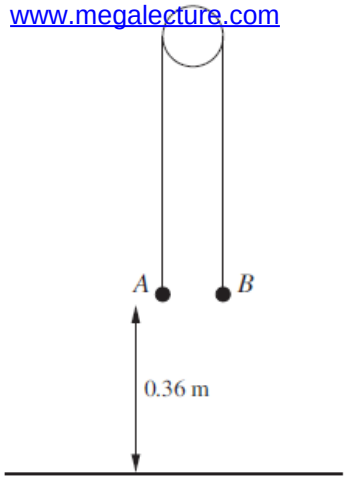

Particles A and B are attached to the ends of a light inextensible string which passes over a smooth pulley. The system is held at rest with the string taut and its straight parts vertical. Both particles are at a height of 0.36 m above the floor (see diagram). The system is released and A begins to fall, reaching the floor after 0.6 s.

(i) Find the acceleration of A as it falls. [2]

The mass of A is 0.45 kg. Find

(ii) the tension in the string while A is falling, [2]

(iii) the mass of B, [3]

(iv) the maximum height above the floor reached by B. [3]