

Edexcel (U.K.) Pre 2017

Questions By Topic

M1 Chap03 Dynamics

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Last updated: February 10, 2026

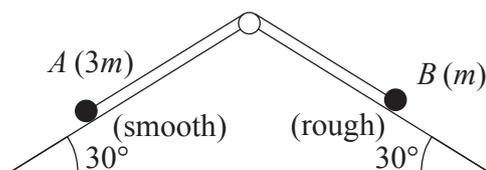


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Figure 3



A fixed wedge has two plane faces, each inclined at 30° to the horizontal. Two particles A and B , of mass $3m$ and m respectively, are attached to the ends of a light inextensible string. Each particle moves on one of the plane faces of the wedge. The string passes over a small smooth light pulley fixed at the top of the wedge. The face on which A moves is smooth. The face on which B moves is rough. The coefficient of friction between B and this face is μ . Particle A is held at rest with the string taut. The string lies in the same vertical plane as lines of greatest slope on each plane face of the wedge, as shown in Figure 3.

The particles are released from rest and start to move. Particle A moves downwards and B moves upwards. The accelerations of A and B each have magnitude $\frac{1}{10}g$.

- (a) By considering the motion of A , find, in terms of m and g , the tension in the string. (3)
- (b) By considering the motion of B , find the value of μ . (8)
- (c) Find the resultant force exerted by the string on the pulley, giving its magnitude and direction. (3)

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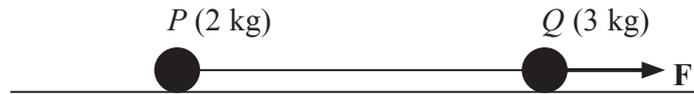


Figure 4

Two particles P and Q , of mass 2 kg and 3 kg respectively, are joined by a light inextensible string. Initially the particles are at rest on a rough horizontal plane with the string taut. A constant force \mathbf{F} of magnitude 30 N is applied to Q in the direction PQ , as shown in Figure 4. The force is applied for 3 s and during this time Q travels a distance of 6 m. The coefficient of friction between each particle and the plane is μ . Find

- (a) the acceleration of Q , (2)
- (b) the value of μ , (4)
- (c) the tension in the string. (4)
- (d) State how in your calculation you have used the information that the string is inextensible. (1)

When the particles have moved for 3 s, the force \mathbf{F} is removed.

- (e) Find the time between the instant that the force is removed and the instant that Q comes to rest. (4)

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Figure 3

Two particles P and Q , of mass 0.3 kg and 0.5 kg respectively, are joined by a light horizontal rod. The system of the particles and the rod is at rest on a horizontal plane.

At time $t = 0$, a constant force \mathbf{F} of magnitude 4 N is applied to Q in the direction PQ , as shown in Figure 3. The system moves under the action of this force until $t = 6\text{ s}$. During the motion, the resistance to the motion of P has constant magnitude 1 N and the resistance to the motion of Q has constant magnitude 2 N .

Find

- (a) the acceleration of the particles as the system moves under the action of \mathbf{F} , (3)
- (b) the speed of the particles at $t = 6\text{ s}$, (2)
- (c) the tension in the rod as the system moves under the action of \mathbf{F} . (3)

At $t = 6\text{ s}$, \mathbf{F} is removed and the system decelerates to rest. The resistances to motion are unchanged. Find

- (d) the distance moved by P as the system decelerates, (4)
- (e) the thrust in the rod as the system decelerates. (3)

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Figure 3

Two particles A and B , of mass m and $2m$ respectively, are attached to the ends of a light inextensible string. The particle A lies on a rough horizontal table. The string passes over a small smooth pulley P fixed on the edge of the table. The particle B hangs freely below the pulley, as shown in Figure 3. The coefficient of friction between A and the table is μ . The particles are released from rest with the string taut. Immediately after release, the magnitude of the acceleration of A and B is $\frac{4}{9}g$. By writing down separate equations of motion for A and B ,

(a) find the tension in the string immediately after the particles begin to move, (3)

(b) show that $\mu = \frac{2}{3}$. (5)

When B has fallen a distance h , it hits the ground and does not rebound. Particle A is then a distance $\frac{1}{3}h$ from P .

(c) Find the speed of A as it reaches P . (6)

(d) State how you have used the information that the string is light. (1)

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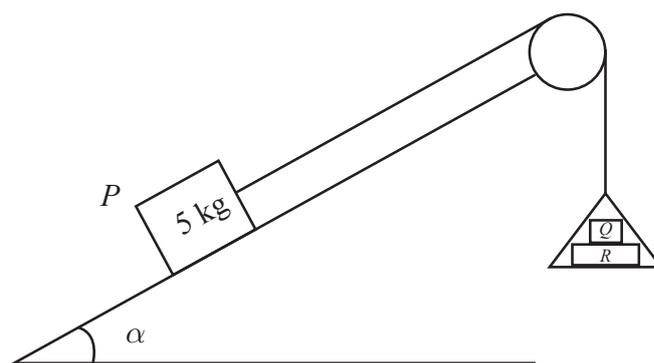


Figure 3

One end of a light inextensible string is attached to a block P of mass 5 kg . The block P is held at rest on a smooth fixed plane which is inclined to the horizontal at an angle α , where $\sin \alpha = \frac{3}{5}$. The string lies along a line of greatest slope of the plane and passes over a smooth light pulley which is fixed at the top of the plane. The other end of the string is attached to a light scale pan which carries two blocks Q and R , with block Q on top of block R , as shown in Figure 3. The mass of block Q is 5 kg and the mass of block R is 10 kg . The scale pan hangs at rest and the system is released from rest. By modelling the blocks as particles, ignoring air resistance and assuming the motion is uninterrupted, find

- (a) (i) the acceleration of the scale pan, (8)
 (ii) the tension in the string, (8)
- (b) the magnitude of the force exerted on block Q by block R , (3)
- (c) the magnitude of the force exerted on the pulley by the string. (5)

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Figure 4

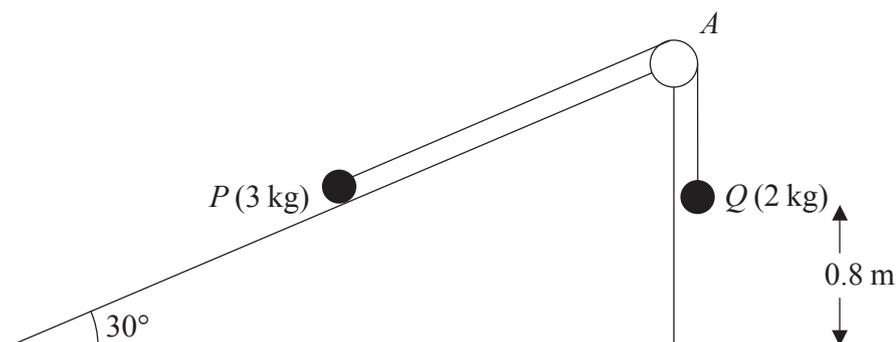


Figure 4 shows two particles P and Q , of mass 3 kg and 2 kg respectively, connected by a light inextensible string. Initially P is held at rest on a fixed smooth plane inclined at 30° to the horizontal. The string passes over a small smooth light pulley A fixed at the top of the plane. The part of the string from P to A is parallel to a line of greatest slope of the plane. The particle Q hangs freely below A . The system is released from rest with the string taut.

- (a) Write down an equation of motion for P and an equation of motion for Q . (4)
- (b) Hence show that the acceleration of Q is 0.98 m s^{-2} . (2)
- (c) Find the tension in the string. (2)
- (d) State where in your calculations you have used the information that the string is inextensible. (1)

On release, Q is at a height of 0.8 m above the ground. When Q reaches the ground, it is brought to rest immediately by the impact with the ground and does not rebound. The initial distance of P from A is such that in the subsequent motion P does not reach A . Find

- (e) the speed of Q as it reaches the ground, (2)
- (f) the time between the instant when Q reaches the ground and the instant when the string becomes taut again. (5)

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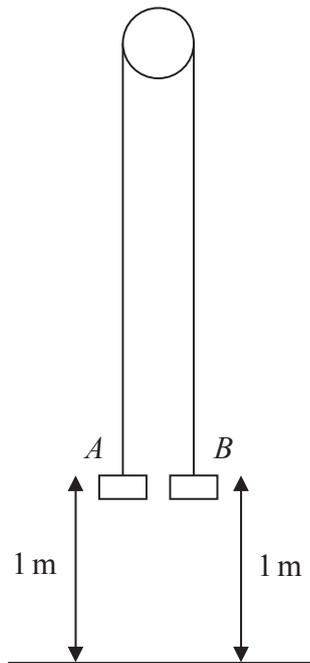


Figure 3

Two particles A and B have mass 0.4 kg and 0.3 kg respectively. The particles are attached to the ends of a light inextensible string. The string passes over a small smooth pulley which is fixed above a horizontal floor. Both particles are held, with the string taut, at a height of 1 m above the floor, as shown in Figure 3. The particles are released from rest and in the subsequent motion B does not reach the pulley.

- (a) Find the tension in the string immediately after the particles are released. (6)
- (b) Find the acceleration of A immediately after the particles are released. (2)

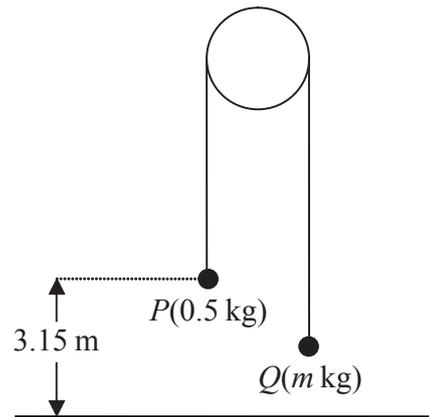
When the particles have been moving for 0.5 s , the string breaks.

- (c) Find the further time that elapses until B hits the floor. (9)

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Figure 4



Two particles P and Q have mass 0.5 kg and $m \text{ kg}$ respectively, where $m < 0.5$. The particles are connected by a light inextensible string which passes over a smooth, fixed pulley. Initially P is 3.15 m above horizontal ground. The particles are released from rest with the string taut and the hanging parts of the string vertical, as shown in Figure 4. After P has been descending for 1.5 s , it strikes the ground. Particle P reaches the ground before Q has reached the pulley.

(a) Show that the acceleration of P as it descends is 2.8 m s^{-2} . (3)

(b) Find the tension in the string as P descends. (3)

(c) Show that $m = \frac{5}{18}$. (4)

(d) State how you have used the information that the string is inextensible. (1)

When P strikes the ground, P does not rebound and the string becomes slack. Particle Q then moves freely under gravity, without reaching the pulley, until the string becomes taut again.

(e) Find the time between the instant when P strikes the ground and the instant when the string becomes taut again. (6)
