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Edexcel AS Mechanics M1

TOPIC-Pulleys

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I Care Your Dream

physics is fun
chemistry is juicy
mathematics is spicy

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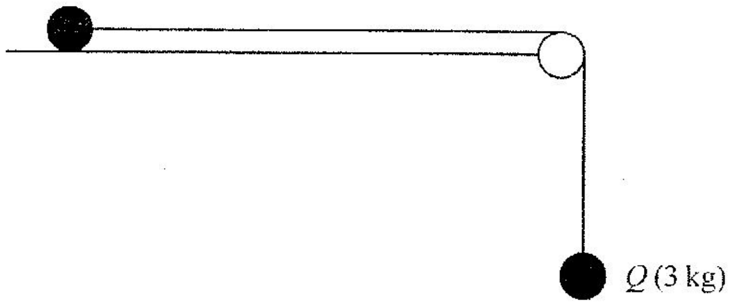

Figure 3

Two particles P and Q have masses 1.5 kg and 3 kg respectively. The particles are attached to the ends of a light inextensible string. Particle P is held at rest on a fixed rough horizontal table. The coefficient of friction between P and the table is $\frac{1}{5}$. The string is parallel to the table and passes over a small smooth light pulley which is fixed at the edge of the table. Particle Q hangs freely at rest vertically below the pulley, as shown in Figure 3. Particle P is released from rest with the string taut and slides along the table.

Assuming that P has not reached the pulley, find

(a) the tension in the string during the motion,
(8)

(b) the magnitude and direction of the resultant force exerted on the pulley by the string.
(4)

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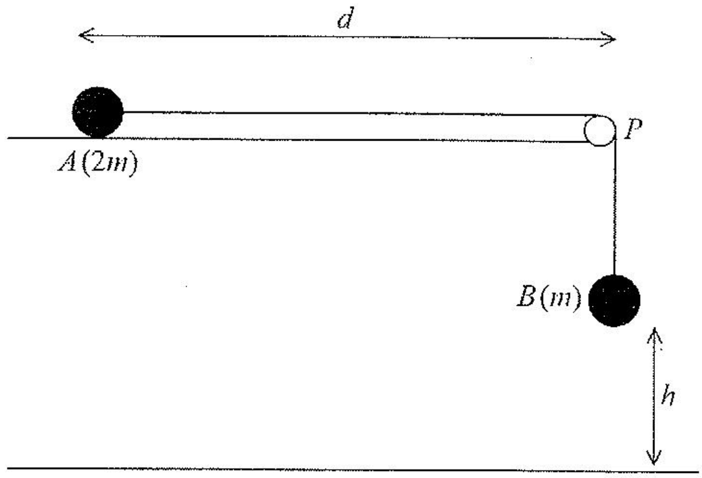

Figure 3

Two particles, A and B, have masses $2m$ and m respectively. The particles are attached to the ends of a light inextensible string. Particle A is held at rest on a fixed rough horizontal table at a distance d from a small smooth light pulley which is fixed at the edge of the table at the point P. The coefficient of friction between A and the table is μ, where $\mu < \frac{1}{2}$. The string is parallel to the table from A to P and passes over the pulley. Particle B hangs freely at rest vertically below P with the string taut and at a height h, $(h < d)$, above a horizontal floor, as shown in Figure 3. Particle A is released from rest with the string taut and slides along the table.

(a) (i) Write down an equation of motion for A.

(ii) Write down an equation of motion for B.

(4)

(b) Hence show that, until B hits the floor, the acceleration of A is $\frac{g}{3}(1 - 2\mu)$.

(3)

(c) Find, in terms of g, h and μ, the speed of A at the instant when B hits the floor.

(2)

After B hits the floor, A continues to slide along the table. Given that $\mu = \frac{1}{3}$ and that A comes to rest at P,

(d) find d in terms of h.

(5)

(e) Describe what would happen if $\mu = \frac{1}{2}$

(1)

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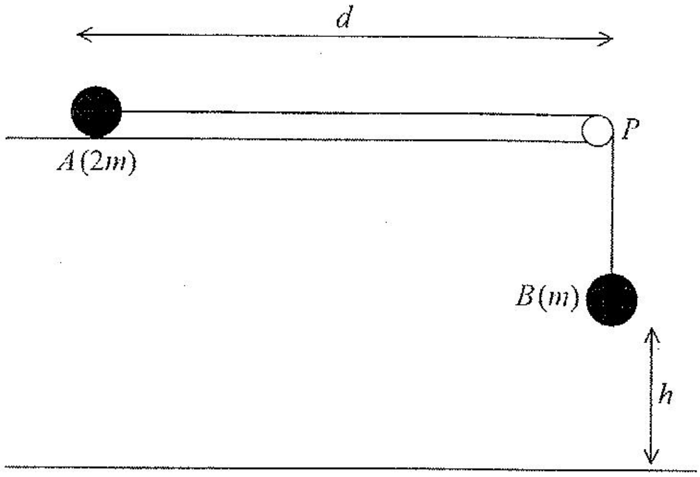

Figure 3

Two particles, A and B, have masses $2m$ and m respectively. The particles are attached to the ends of a light inextensible string. Particle A is held at rest on a fixed rough horizontal table at a distance d from a small smooth light pulley which is fixed at the edge of the table at the point P. The coefficient of friction between A and the table is μ, where $\mu < \frac{1}{2}$. The string is parallel to the table from A to P and passes over the pulley. Particle B hangs freely at rest vertically below P with the string taut and at a height h, ($h < d$), above a horizontal floor, as shown in Figure 3. Particle A is released from rest with the string taut and slides along the table.

(a) (i) Write down an equation of motion for A.

(ii) Write down an equation of motion for B.

(4)

(b) Hence show that, until B hits the floor, the acceleration of A is $\frac{g}{3}(1 - 2\mu)$.

(3)

(c) Find, in terms of g, h and μ, the speed of A at the instant when B hits the floor.

(2)

After B hits the floor, A continues to slide along the table. Given that $\mu = \frac{1}{3}$ and that A comes to rest at P,

(d) find d in terms of h.

(5)

(e) Describe what would happen if $\mu = \frac{1}{2}$.

(1)

6-17 Dy pully

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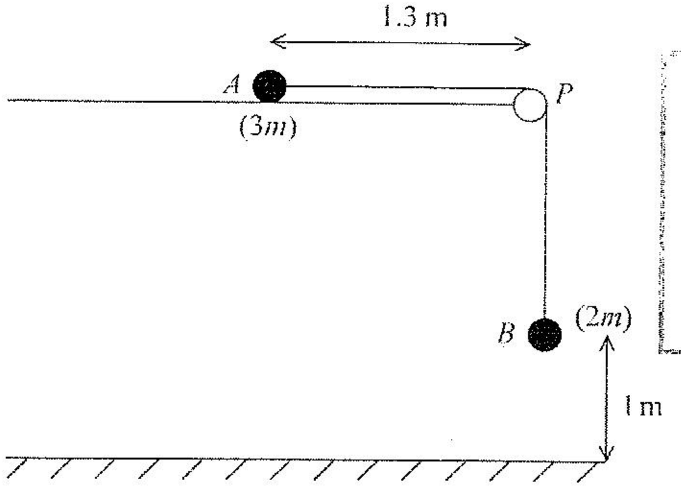

Figure 3

A particle A of mass $3m$ is held at rest on a rough horizontal table. The particle is attached to one end of a light inextensible string. The string passes over a small smooth pulley P which is fixed at the edge of the table. The other end of the string is attached to a particle B of mass $2m$, which hangs freely, vertically below P. The system is released from rest, with the string taut, when A is 1.3 m from P and B is 1 m above the horizontal floor, as shown in Figure 3.

Given that B hits the floor 2 s after release and does not rebound,

(a) find the acceleration of A during the first two seconds.

(2)

(b) find the coefficient of friction between A and the table,

(8)

(c) determine whether A reaches the pulley.

(6)

W-1-15 Dy- pully

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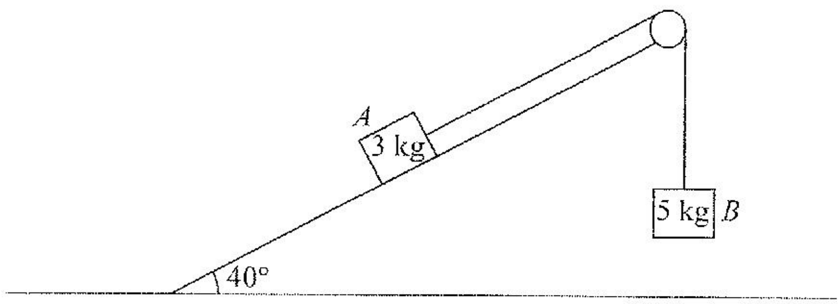

Figure 4

One end of a light inextensible string is attached to a block A of mass 3 kg. Block A is held at rest on a smooth fixed plane. The plane is inclined at 40° to the horizontal ground. The string lies along a line of greatest slope of the plane and passes over a small smooth pulley which is fixed at the top of the plane. The other end of the string is attached to a block B of mass 5 kg. Block B hangs freely at rest below the pulley, as shown in Figure 4. The system is released from rest with the string taut.

By modelling the two blocks as particles,

(a) find the tension in the string as B descends.

(6)

After falling for 1.5 s, block B hits the ground and is immediately brought to rest. In its subsequent motion, A does not reach the pulley.

(b) Find the speed of B at the instant it hits the ground.

(3)

(c) Find the total distance moved up the plane by A before it comes to instantaneous rest.

(5)

W-1-18 Dy pully

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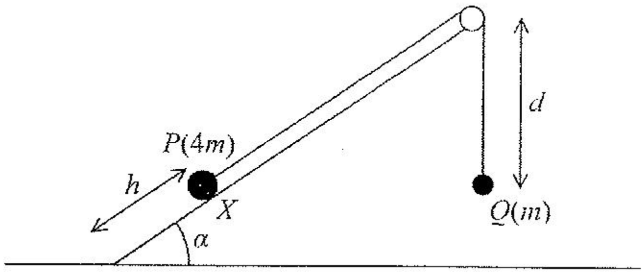

Figure 4

A particle P of mass $4m$ is held at rest at the point X on the surface of a rough inclined plane which is fixed to horizontal ground. The point X is a distance h from the bottom of the inclined plane. The plane is inclined to the horizontal at an angle α where $\tan \alpha = \frac{3}{4}$. The coefficient of friction between P and the plane is $\frac{1}{4}$. The particle P is attached to one end of a light inextensible string. The string passes over a small smooth pulley which is fixed at the top of the plane. The other end of the string is attached to a particle Q of mass m which hangs freely at a distance d, where $d > h$, below the pulley, as shown in Figure 4.

The string lies in a vertical plane through a line of greatest slope of the inclined plane. The system is released from rest with the string taut and P moves down the plane.

For the motion of the particles before P hits the ground,

(a) state which of the information given above implies that the magnitudes of the accelerations of the two particles are the same,
(1)

(b) write down an equation of motion for each particle,
(5)

(c) find the acceleration of each particle.
(5)

When P hits the ground, it immediately comes to rest. Given that Q comes to instantaneous rest before reaching the pulley,

(d) show that $d > \frac{28h}{25}$.
(5)

W-18 puly 5

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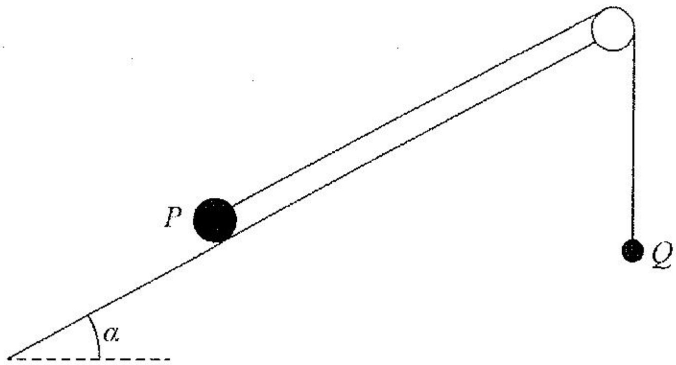

Figure 4

Two particles P and Q have mass 4 kg and 0.5 kg respectively. The particles are attached to the ends of a light inextensible string. Particle P is held at rest on a fixed rough plane, which is inclined to the horizontal at an angle α where $\tan \alpha = \frac{4}{3}$. The coefficient of friction between P and the plane is 0.5. The string lies along the plane and passes over a small smooth light pulley which is fixed at the top of the plane. Particle Q hangs freely at rest vertically below the pulley. The string lies in the vertical plane which contains the pulley and a line of greatest slope of the inclined plane, as shown in Figure 4. Particle P is released from rest with the string taut and slides down the plane.

Given that Q has not hit the pulley, find

(a) the tension in the string during the motion,

(11)

(b) the magnitude of the resultant force exerted by the string on the pulley.

(4)

6-15 Dy – pully

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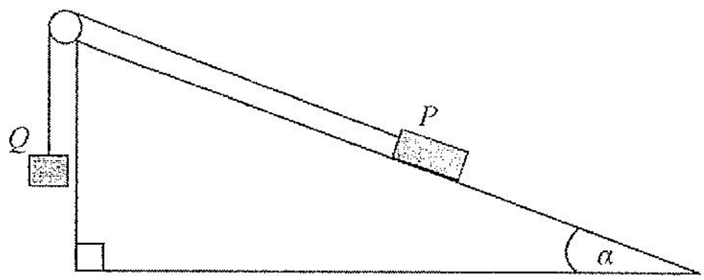

Figure 2

Two particles P and Q have masses 0.3 kg and m 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 at the top of a fixed rough plane. The plane is inclined to the horizontal at an angle α, where $\tan \alpha = \frac{3}{4}$. The coefficient of friction between P and the plane is $\frac{1}{2}$.

The string lies in a vertical plane through a line of greatest slope of the inclined plane. The particle P is held at rest on the inclined plane and the particle Q hangs freely below the pulley with the string taut, as shown in Figure 2.

The system is released from rest and Q accelerates vertically downwards at 1.4 m s^{-2}. Find

(a) the magnitude of the normal reaction of the inclined plane on P,

(2)

(b) the value of m.

(8)

When the particles have been moving for 0.5 s, the string breaks. Assuming that P does not reach the pulley,

(c) find the further time that elapses until P comes to instantaneous rest.

(6)

1-11 pulley 7

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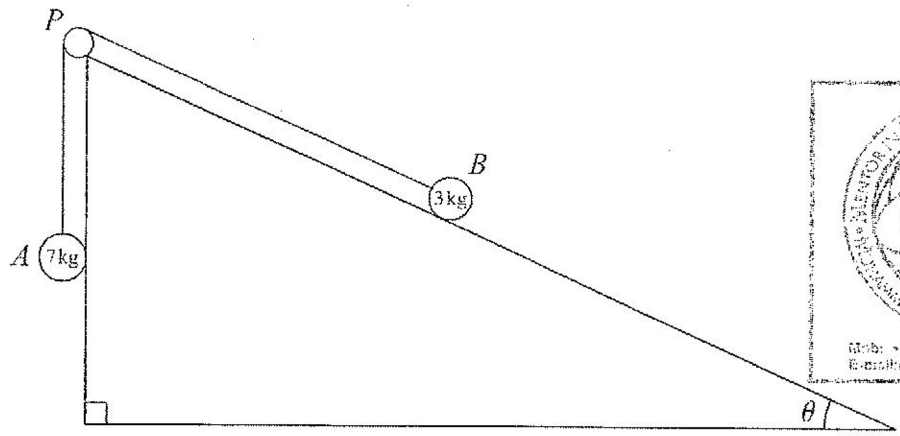

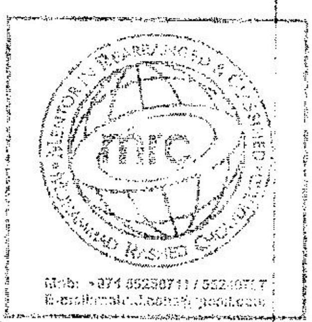

Figure 4

Two particles A and B, of mass 7 kg and 3 kg respectively, are attached to the ends of a light inextensible string. Initially B is held at rest on a rough fixed plane inclined at angle θ to the horizontal, where $\tan\theta = \frac{5}{12}$. The part of the string from B to P is parallel to a line of greatest slope of the plane. The string passes over a small smooth pulley, P, fixed at the top of the plane. The particle A hangs freely below P, as shown in Figure 4. The coefficient of friction between B and the plane is $\frac{2}{3}$. The particles are released from rest with the string taut and B moves up the plane.

(a) Find the magnitude of the acceleration of B immediately after release.

(10)

(b) Find the speed of B when it has moved 1 m up the plane.

(2)

When B has moved 1 m up the plane the string breaks. Given that in the subsequent motion B does not reach P,

(c) find the time between the instants when the string breaks and when B comes to instantaneous rest.

(4)

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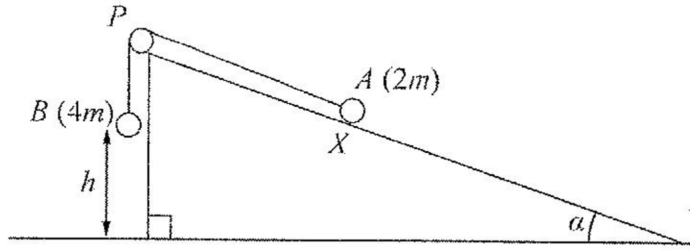

Figure 5

Figure 5 shows two particles A and B, of mass $2m$ and $4m$ respectively, connected by a light inextensible string. Initially A is held at rest on a rough inclined plane which is fixed to horizontal ground. The plane is inclined to the horizontal at an angle α, where $\tan\alpha = \frac{3}{4}$. The coefficient of friction between A and the plane is $\frac{1}{4}$. The string passes over a small smooth pulley P which is fixed at the top of the plane. The part of the string from A to P is parallel to a line of greatest slope of the plane and B hangs vertically below P. The system is released from rest with the string taut, with A at the point X and with B at a height h above the ground.

For the motion until B hits the ground,

(a) give a reason why the magnitudes of the accelerations of the two particles are the same,

(1)

(b) write down an equation of motion for each particle,

(4)

(c) find the acceleration of each particle.

(5)

Particle B does not rebound when it hits the ground and A continues moving up the plane towards P. Given that A comes to rest at the point Y, without reaching P,

(d) find the distance XY in terms of h.

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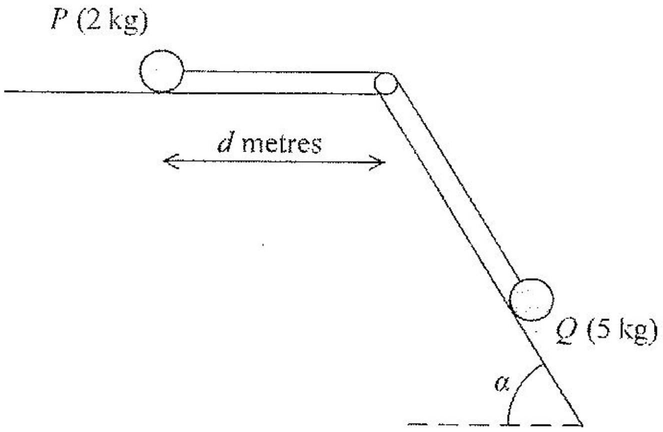

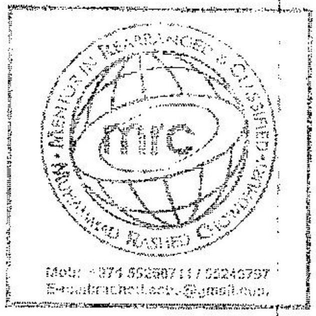

Figure 3

A particle P of mass 2 kg is attached to one end of a light inextensible string. A particle Q of mass 5 kg is attached to the other end of the string. The string passes over a small smooth light pulley. The pulley is fixed at a point on the intersection of a rough horizontal table and a fixed smooth inclined plane. The string lies along the table and also lies in a vertical plane which contains a line of greatest slope of the inclined plane. This plane is inclined to the horizontal at an angle α, where $\tan \alpha = \frac{3}{4}$. Particle P is at rest on the table, a distance d metres from the pulley. Particle Q is on the inclined plane with the string taut, as shown in Figure 3. The coefficient of friction between P and the table is $\frac{1}{4}$.

The system is released from rest and P slides along the table towards the pulley.

Assuming that P has not reached the pulley and that Q remains on the inclined plane,

(a) write down an equation of motion for P,

(2)

(b) write down an equation of motion for Q,

(2)

(c) (i) find the acceleration of P,

(ii) find the tension in the string.

(5)

When P has moved a distance 0.5 m from its initial position, the string breaks. Given that P comes to rest just as it reaches the pulley,

(d) find the value of d.

(7)

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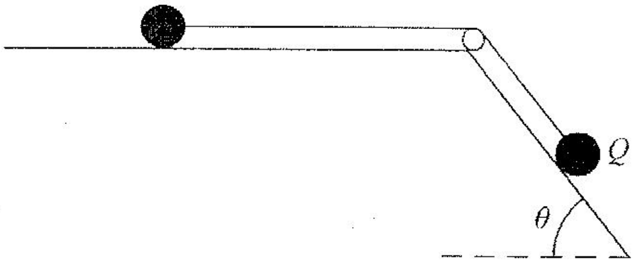

Figure 2

Two particles P and Q have masses 0.1 kg and 0.5 kg respectively. The particles are attached to the ends of a light inextensible string. Particle P is held at rest on a rough horizontal table. The string lies along the table and passes over a small smooth pulley which is fixed to the edge of the table. Particle Q is at rest on a smooth plane which is inclined to the horizontal at an angle θ, where $\tan\theta = \frac{4}{3}$

The string lies in the vertical plane which contains the pulley and a line of greatest slope of the inclined plane, as shown in Figure 2. Particle P is released from rest with the string taut. During the first 0.5 s of the motion P does not reach the pulley and Q moves 0.75 m down the plane.

(a) Find the tension in the string during the first 0.5 s of the motion.

(6)

(b) Find the coefficient of friction between P and the table.

(5)

W-1-14 Dy- Pulley

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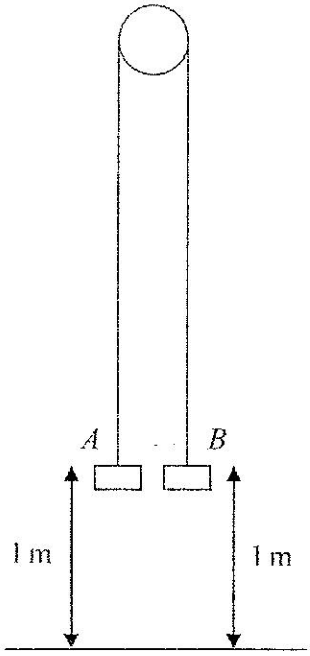

Figure 3

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)

6–10 pulley

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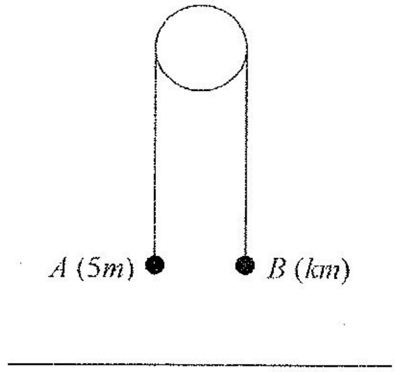

Figure 4

Two particles A and B have masses $5m$ and km respectively, where $k < 5$. The particles are connected by a light inextensible string which passes over a smooth light fixed pulley. The system is held at rest with the string taut, the hanging parts of the string vertical and with A and B at the same height above a horizontal plane, as shown in Figure 4. The system is released from rest. After release, A descends with acceleration $\frac{1}{4}g$.

(a) Show that the tension in the string as A descends is $\frac{15}{4}mg$.

(3)

(b) Find the value of k.

(3)

(c) State how you have used the information that the pulley is smooth.

(1)

After descending for 1.2 s, the particle A reaches the plane. It is immediately brought to rest by the impact with the plane. The initial distance between B and the pulley is such that, in the subsequent motion, B does not reach the pulley.

(d) Find the greatest height reached by B above the plane.

(7)

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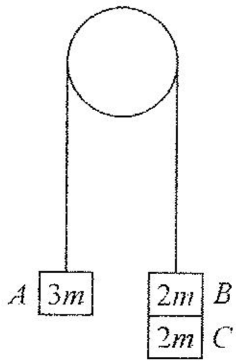

Figure 5

Three particles A, B and C have masses $3m$, $2m$ and $2m$ respectively. Particle C is attached to particle B. Particles A and B are connected by a light inextensible string which passes over a smooth light fixed pulley. The system is held at rest with the string taut and the hanging parts of the string vertical, as shown in Figure 5. The system is released from rest and A moves upwards.

(a) (i) Show that the acceleration of A is $\frac{g}{7}$

(ii) Find the tension in the string as A ascends.

(7)

At the instant when A is 0.7 m above its original position, C separates from B and falls away. In the subsequent motion, A does not reach the pulley.

(b) Find the speed of A at the instant when it is 0.7 m above its original position.

(2)

(c) Find the acceleration of A at the instant after C separates from B.

(4)

(d) Find the greatest height reached by A above its original position.

(3)

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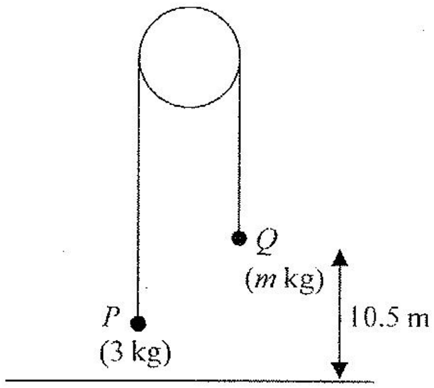

Figure 5

Two particles P and Q have masses 3 kg and m kg respectively ($m > 3$). The particles are connected by a light inextensible string which passes over a smooth light fixed pulley. The system is held at rest with the string taut and the hanging parts of the string vertical. The particle Q is at a height of 10.5 m above the horizontal ground, as shown in Figure 5. The system is released from rest and Q moves downwards. In the subsequent motion P does not reach the pulley. After the system is released, the tension in the string is 33.6 N.

(a) Show that the magnitude of the acceleration of P is 1.4 m s^{-2}.

(3)

(b) Find the value of m.

(3)

The system is released from rest at time $t = 0$. At time T_1 seconds after release, Q strikes the ground and does not rebound. The string goes slack and P continues to move upwards.

(c) Find the value of T_1

(3)

At time T_2 seconds after release, P comes to instantaneous rest.

(d) Find the value of T_2

(3)

At time T_3 seconds after release ($T_3 > T_1$) the string becomes taut again.

(e) Sketch a velocity-time graph for the motion of P in the interval $0 \leqslant t \leqslant T_3$

(2)

W-1-17 Dy- Pully

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Edexcel AS Mechanics M1

TOPIC-Pulleys

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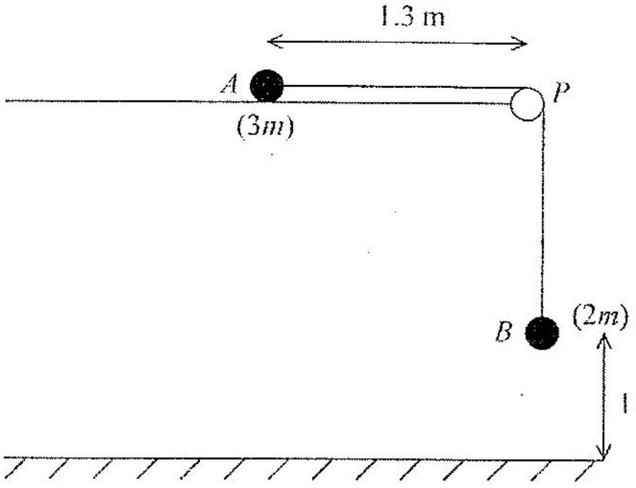

Figure 3

A particle A of mass $3m$ is held at rest on a rough horizontal table. The particle is attached to one end of a light inextensible string. The string passes over a small smooth pulley P which is fixed at the edge of the table. The other end of the string is attached to a particle B of mass $2m$, which hangs freely, vertically below P. The system is released from rest, with the string taut, when A is 1.3 m from P and B is 1 m above the horizontal floor, as shown in Figure 3.

Given that B hits the floor 2 s after release and does not rebound,

(a) find the acceleration of A during the first two seconds,

(2)

(b) find the coefficient of friction between A and the table,

(8)

(c) determine whether A reaches the pulley.

(6)

W-1-15 Dy- pully

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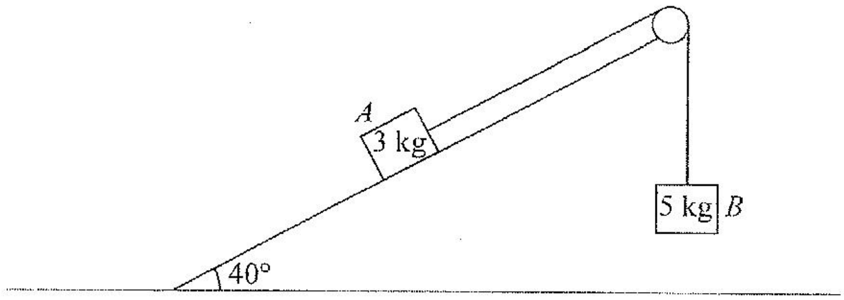

Figure 4

One end of a light inextensible string is attached to a block A of mass 3 kg. Block A is held at rest on a smooth fixed plane. The plane is inclined at 40° to the horizontal ground. The string lies along a line of greatest slope of the plane and passes over a small smooth pulley which is fixed at the top of the plane. The other end of the string is attached to a block B of mass 5 kg. Block B hangs freely at rest below the pulley, as shown in Figure 4. The system is released from rest with the string taut.

By modelling the two blocks as particles,

(a) find the tension in the string as B descends.
(6)

After falling for 1.5 s, block B hits the ground and is immediately brought to rest. In its subsequent motion, A does not reach the pulley.

(b) Find the speed of B at the instant it hits the ground.
(3)

(c) Find the total distance moved up the plane by A before it comes to instantaneous rest.
(5)

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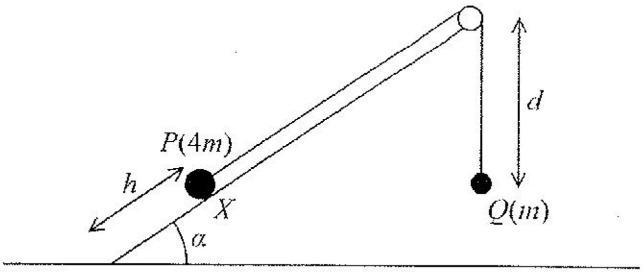

Figure 4

A particle P of mass $4m$ is held at rest at the point X on the surface of a rough inclined plane which is fixed to horizontal ground. The point X is a distance h from the bottom of the inclined plane. The plane is inclined to the horizontal at an angle α where $\tan \alpha = \frac{3}{4}$. The coefficient of friction between P and the plane is $\frac{1}{4}$. The particle P is attached to one end of a light inextensible string. The string passes over a small smooth pulley which is fixed at the top of the plane. The other end of the string is attached to a particle Q of mass m which hangs freely at a distance d, where $d > h$, below the pulley, as shown in Figure 4.

The string lies in a vertical plane through a line of greatest slope of the inclined plane. The system is released from rest with the string taut and P moves down the plane.

For the motion of the particles before P hits the ground,

(a) state which of the information given above implies that the magnitudes of the accelerations of the two particles are the same,
(1)

(b) write down an equation of motion for each particle,
(5)

(c) find the acceleration of each particle.
(5)

When P hits the ground, it immediately comes to rest. Given that Q comes to instantaneous rest before reaching the pulley,

(d) show that $d > \frac{28h}{25}$.
(5)

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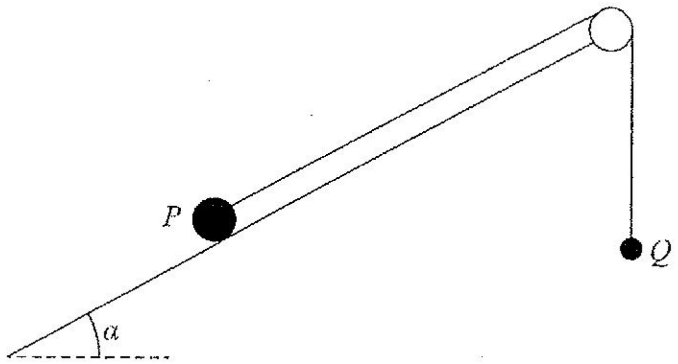

Figure 4

Two particles P and Q have mass 4 kg and 0.5 kg respectively. The particles are attached to the ends of a light inextensible string. Particle P is held at rest on a fixed rough plane, which is inclined to the horizontal at an angle α where $\tan \alpha = \frac{4}{3}$. The coefficient of friction between P and the plane is 0.5. The string lies along the plane and passes over a small smooth light pulley which is fixed at the top of the plane. Particle Q hangs freely at rest vertically below the pulley. The string lies in the vertical plane which contains the pulley and a line of greatest slope of the inclined plane, as shown in Figure 4. Particle P is released from rest with the string taut and slides down the plane.

Given that Q has not hit the pulley, find

(a) the tension in the string during the motion,

(11)

(b) the magnitude of the resultant force exerted by the string on the pulley.

(4)

6-15 Dy - pully

6

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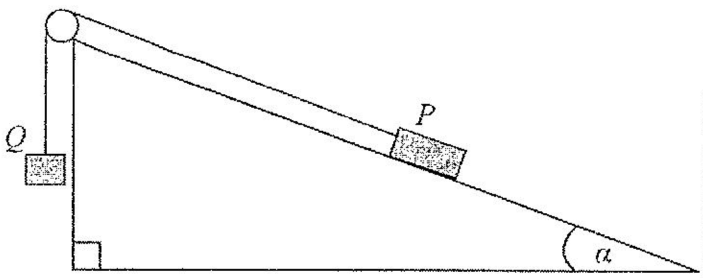

Figure 2

Two particles P and Q have masses 0.3 kg and m 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 at the top of a fixed rough plane. The plane is inclined to the horizontal at an angle α, where $\tan \alpha = \frac{3}{4}$. The coefficient of friction between P and the plane is $\frac{1}{2}$.

The string lies in a vertical plane through a line of greatest slope of the inclined plane. The particle P is held at rest on the inclined plane and the particle Q hangs freely below the pulley with the string taut, as shown in Figure 2.

The system is released from rest and Q accelerates vertically downwards at 1.4 m s^{-2}. Find

(a) the magnitude of the normal reaction of the inclined plane on P,

(2)

(b) the value of m.

(8)

When the particles have been moving for 0.5 s, the string breaks. Assuming that P does not reach the pulley,

(c) find the further time that elapses until P comes to instantaneous rest.

(6)

6-11 pulley

7

P 3 8 1 6 1 R R A 0 1 8 2 4

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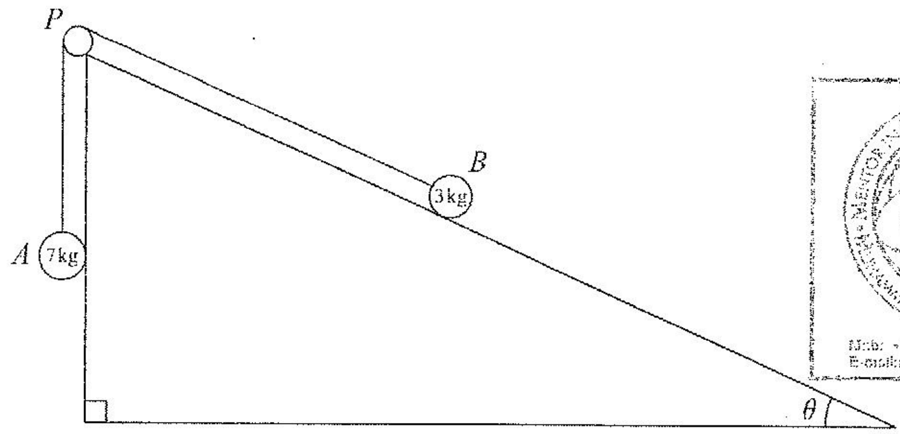

Figure 4

Two particles A and B, of mass 7 kg and 3 kg respectively, are attached to the ends of a light inextensible string. Initially B is held at rest on a rough fixed plane inclined at angle θ to the horizontal, where $\tan\theta = \frac{5}{12}$. The part of the string from B to P is parallel to a line of greatest slope of the plane. The string passes over a small smooth pulley, P, fixed at the top of the plane. The particle A hangs freely below P, as shown in Figure 4. The coefficient of friction between B and the plane is $\frac{2}{3}$. The particles are released from rest with the string taut and B moves up the plane.

(a) Find the magnitude of the acceleration of B immediately after release.

(10)

(b) Find the speed of B when it has moved 1 m up the plane.

(2)

When B has moved 1 m up the plane the string breaks. Given that in the subsequent motion B does not reach P,

(c) find the time between the instants when the string breaks and when B comes to instantaneous rest.

(4)

1–11 pulley

8

N 3 5 4 0 7 A 0 2 0 2 4

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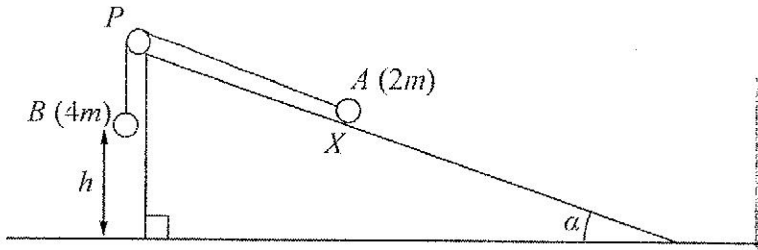

Figure 5

Figure 5 shows two particles A and B, of mass $2m$ and $4m$ respectively, connected by a light inextensible string. Initially A is held at rest on a rough inclined plane which is fixed to horizontal ground. The plane is inclined to the horizontal at an angle α, where $\tan\alpha = \frac{3}{4}$. The coefficient of friction between A and the plane is $\frac{1}{4}$. The string passes over a small smooth pulley P which is fixed at the top of the plane. The part of the string from A to P is parallel to a line of greatest slope of the plane and B hangs vertically below P. The system is released from rest with the string taut, with A at the point X and with B at a height h above the ground.

For the motion until B hits the ground,

(a) give a reason why the magnitudes of the accelerations of the two particles are the same,

(1)

(b) write down an equation of motion for each particle,

(4)

(c) find the acceleration of each particle.

(5)

Particle B does not rebound when it hits the ground and A continues moving up the plane towards P. Given that A comes to rest at the point Y, without reaching P,

(d) find the distance XY in terms of h.

(6)

P 4 1 4 8 1 A 0 2 4 2 8

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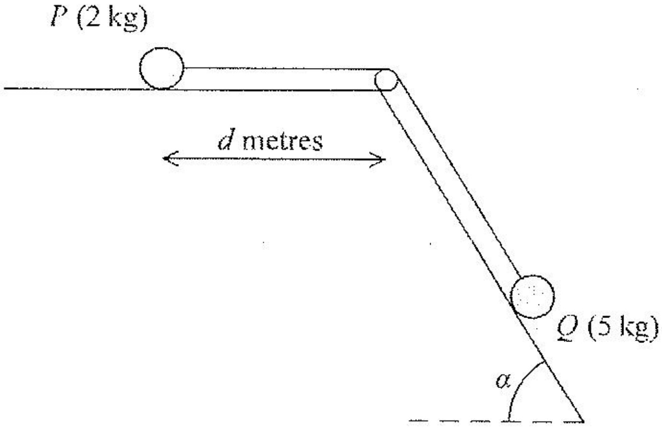

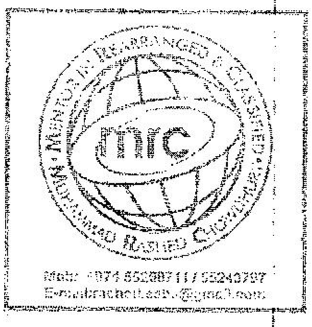

Figure 3

A particle P of mass 2 kg is attached to one end of a light inextensible string. A particle Q of mass 5 kg is attached to the other end of the string. The string passes over a small smooth light pulley. The pulley is fixed at a point on the intersection of a rough horizontal table and a fixed smooth inclined plane. The string lies along the table and also lies in a vertical plane which contains a line of greatest slope of the inclined plane. This plane is inclined to the horizontal at an angle α, where $\tan\alpha = \frac{3}{4}$. Particle P is at rest on the table, a distance d metres from the pulley. Particle Q is on the inclined plane with the string taut, as shown in Figure 3. The coefficient of friction between P and the table is $\frac{1}{4}$.

The system is released from rest and P slides along the table towards the pulley.

Assuming that P has not reached the pulley and that Q remains on the inclined plane,

(a) write down an equation of motion for P,

(2)

(b) write down an equation of motion for Q,

(2)

(c) (i) find the acceleration of P,

(ii) find the tension in the string.

(5)

When P has moved a distance 0.5 m from its initial position, the string breaks. Given that P comes to rest just as it reaches the pulley,

(d) find the value of d.

(7)

W-1-16 Dy- pully

10

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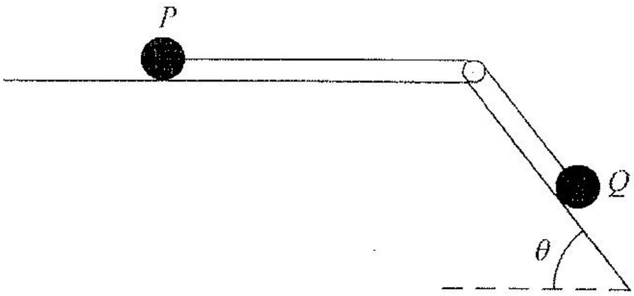

Figure 2

Two particles P and Q have masses 0.1 kg and 0.5 kg respectively. The particles are attached to the ends of a light inextensible string. Particle P is held at rest on a rough horizontal table. The string lies along the table and passes over a small smooth pulley which is fixed to the edge of the table. Particle Q is at rest on a smooth plane which is inclined to the horizontal at an angle θ, where $\tan\theta = \frac{4}{3}$

The string lies in the vertical plane which contains the pulley and a line of greatest slope of the inclined plane, as shown in Figure 2. Particle P is released from rest with the string taut. During the first 0.5 s of the motion P does not reach the pulley and Q moves 0.75 m down the plane.

(a) Find the tension in the string during the first 0.5 s of the motion.

(6)

(b) Find the coefficient of friction between P and the table.

(5)

W-1-14 Dy- Pulley

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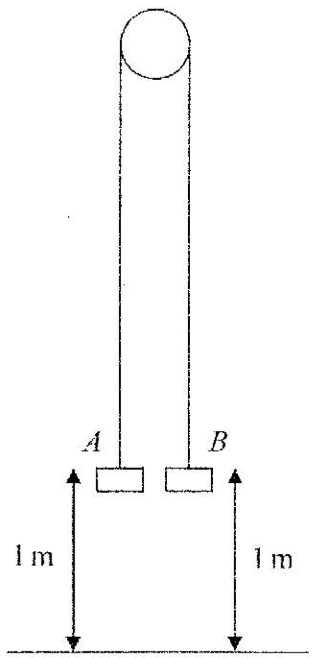

Figure 3

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)

6–10 pulley

12

N 3 5 3 9 0 A 0 2 4 2 8

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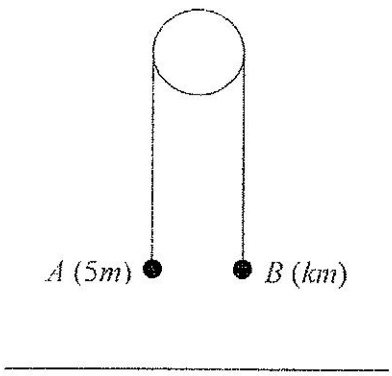

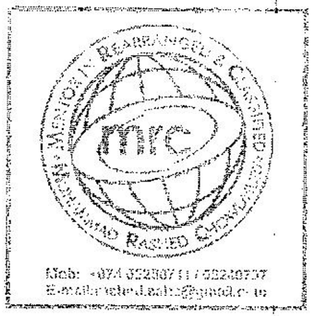

Figure 4

Two particles A and B have masses $5m$ and km respectively, where $k < 5$. The particles are connected by a light inextensible string which passes over a smooth light fixed pulley. The system is held at rest with the string taut, the hanging parts of the string vertical and with A and B at the same height above a horizontal plane, as shown in Figure 4. The system is released from rest. After release, A descends with acceleration $\frac{1}{4}g$.

(a) Show that the tension in the string as A descends is $\frac{15}{4}mg$.

(3)

(b) Find the value of k.

(3)

(c) State how you have used the information that the pulley is smooth.

(1)

After descending for 1.2 s, the particle A reaches the plane. It is immediately brought to rest by the impact with the plane. The initial distance between B and the pulley is such that, in the subsequent motion, B does not reach the pulley.

(d) Find the greatest height reached by B above the plane.

(7)

1–10 pulley 13

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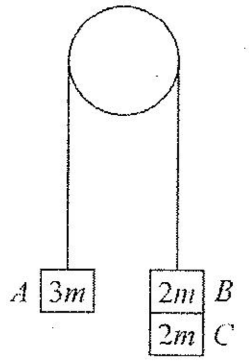

Figure 5

Three particles A, B and C have masses $3m$, $2m$ and $2m$ respectively. Particle C is attached to particle B. Particles A and B are connected by a light inextensible string which passes over a smooth light fixed pulley. The system is held at rest with the string taut and the hanging parts of the string vertical, as shown in Figure 5. The system is released from rest and A moves upwards.

(a) (i) Show that the acceleration of A is $\frac{g}{7}$

(ii) Find the tension in the string as A ascends.

(7)

At the instant when A is 0.7 m above its original position, C separates from B and falls away. In the subsequent motion, A does not reach the pulley.

(b) Find the speed of A at the instant when it is 0.7 m above its original position.

(2)

(c) Find the acceleration of A at the instant after C separates from B.

(4)

(d) Find the greatest height reached by A above its original position.

(3)

6-14 Dy- pulley 14

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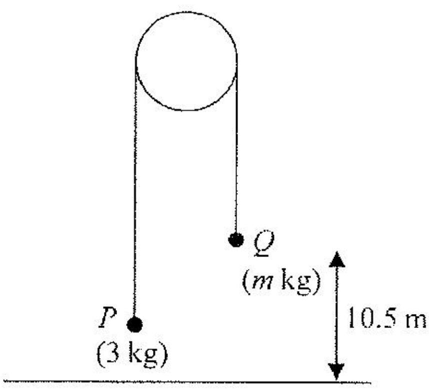

Figure 5

Two particles P and Q have masses 3 kg and m kg respectively ($m > 3$). The particles are connected by a light inextensible string which passes over a smooth light fixed pulley. The system is held at rest with the string taut and the hanging parts of the string vertical. The particle Q is at a height of 10.5 m above the horizontal ground, as shown in Figure 5. The system is released from rest and Q moves downwards. In the subsequent motion P does not reach the pulley. After the system is released, the tension in the string is 33.6 N.

(a) Show that the magnitude of the acceleration of P is 1.4 m s^{-2}.

(3)

(b) Find the value of m.

(3)

The system is released from rest at time $t = 0$. At time T_1 seconds after release, Q strikes the ground and does not rebound. The string goes slack and P continues to move upwards.

(c) Find the value of T_1

(3)

At time T_2 seconds after release, P comes to instantaneous rest.

(d) Find the value of T_2

(3)

At time T_3 seconds after release ($T_3 > T_1$) the string becomes taut again.

(e) Sketch a velocity-time graph for the motion of P in the interval $0 \leqslant t \leqslant T_3$

(2)

W-1-17 Dy- Pully 15

P 4 8 3 2 6 A 0 2 4 2 8