

Dynamics

Questions B

1 A hockey ball of mass 0.125kg , is moving horizontally at 22ms^{-1} when it hits a vertical kick board at right angles. The ball rebounds horizontally at 12ms^{-1} .

a) Find, in Ns, the impulse of the force exerted by the ball on the kick board.

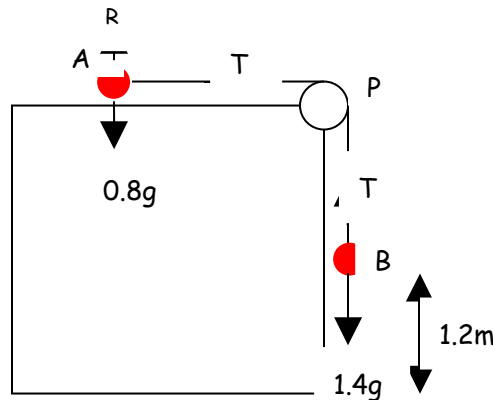
Given that the ball is in contact with the kick board for 0.15s :

b) Find, in N, the force, assumed constant exerted by the ball on the kick board.

2 Two particles of mass 5kg and 10kg are connected by a light inextensible string which passes over a smooth fixed pulley. The system is released from rest with the string taut. Find the acceleration of the system and the tension in the string.

3 A particle of mass 0.8kg rests on rough horizontal table and is attached to one end of a light inextensible string. The string passes over a smooth pulley P fixed at the edge of the table. The other end of the string is attached to a particle P of mass 1.4kg which hangs freely below the pulley. The coefficient of friction between the particle and the table is 0.45 . The system is released from rest with the string taut and B at a height of 1.2m above the ground. At the point of release A is 1.8m from P. Find:

- the acceleration of the particles;
- the time taken by B to reach the ground.
- the speed with which A hits P.

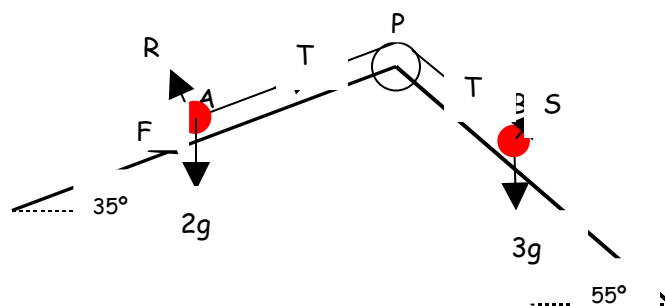


- 4 Thomas the tank engine has a mass of 12000Kg and is moving along horizontal rails at 1.2ms^{-1} , strikes buffers and is brought to rest in 0.45s .
- Calculate the impulse, in Ns , of the force exerted by the buffers on Thomas in bringing him to rest.
 - Calculate the magnitude of this force assuming it to be constant.
- 5 Two particles A and B, of masses $4m$ and $2m$ respectively are moving towards each other on a smooth horizontal surface with speeds $9v$ and $3v$ respectively. The particles collide directly and after the collision A continues to move in the same direction but its speed is halved. Find:
- the speed of B after the impact.
 - the magnitude of the impulse exerted by A on B.
- 6 A bullet is fired horizontally with a speed of 450ms^{-1} into a block of wood of mass 0.15kg that is placed on a smooth horizontal surface. Given that the block begins to move with a velocity of 9ms^{-1} , find, in kg the mass of the bullet.

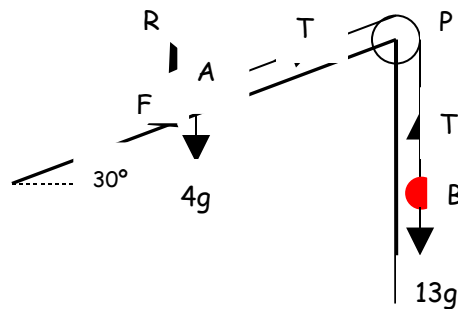
7 Two particles P and Q of masses have masses 8kg and m , they are connected by a light inextensible string which passes over a smooth fixed pulley. The system is released from rest with the string taut and the hanging parts of the string vertical. After 1.5 seconds P has fallen 2.5m . Assuming that Q does not reach the pulley, calculate the tension in the string and the value of m .

8 Two particles A and B of masses 2kg and 3kg are connected by a light inextensible string which passes over a smooth fixed pulley, as outlined in the diagram below. The system is released from rest with the string taut. Find the acceleration of the system and the tension in the string if:

- both planes are smooth;
- both planes are rough and the coefficient of friction between the particles and the plane is 0.1 .



- 9 A particle, A of mass 4kg, rests on a rough plane inclined at an angle of 30° to the horizontal. The particle is attached to one end of a light inextensible string which lies in a line of greatest slope of the plane and passes over a light smooth pulley P fixed at the top of the plane. The other end of the string is attached to a particle B of mass 13kg. The particles are released from rest with the string taut. Given that the coefficient of friction between the particle A and the inclined plane is 0.35 calculate:
- the tension in the string and the acceleration of the system.
 - the angle of inclination required to increase the acceleration by 50%.



- 10 A body of mass 6kg is moving with velocity $(4\mathbf{i} + 7\mathbf{j})\text{ms}^{-1}$ when an impulse is applied. The impulse causes its velocity to change to $(-3\mathbf{i} - 5\mathbf{j})\text{ms}^{-1}$. Find the impulse.
- 11 A body of mass 7.5kg is initially at rest on a smooth horizontal surface, experiences a force $(8\mathbf{i} - 13\mathbf{j})\text{N}$ for 3 seconds. Find the final velocity of the body and its speed.

12 A pile driver of mass 250 Kg strikes a pile of mass 450kg and drives it into the ground. The pile driver strikes the pile directly with a velocity of 8.5ms^{-1} . The driver does not rebound and in the subsequent motion the pile and the driver move as one.

- a) Calculate the common speed of the pile and driver immediately after impact.
- b) Calculate the impulse exerted by the driver on the pile.
- c) The pile and the driver penetrate 0.55m into the ground before coming to rest. Assuming that the ground exerts a constant resistive force on the pile and driver, calculate the magnitude of the force.