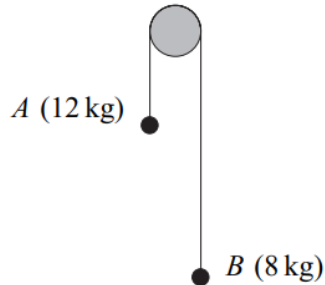


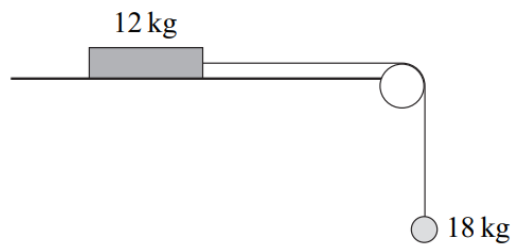
Mechanics 1 Connected Particles

Two particles, A and B , have masses 12 kg and 8 kg respectively. They are connected by a light inextensible string that passes over a smooth fixed peg, as shown in the diagram.



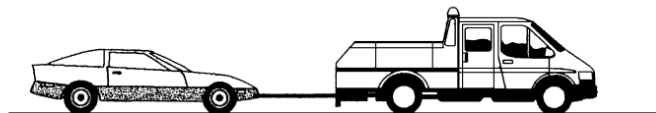
The particles are released from rest and move vertically. Assume that there is no air resistance.

A block, of mass 12 kg , lies on a horizontal surface. The block is attached to a particle, of mass 18 kg , by a light inextensible string which passes over a smooth fixed peg. Initially, the block is held at rest so that the string supports the particle, as shown in the diagram.



The block is then released.

A car, of mass 1200 kg , is connected by a tow rope to a truck, of mass 2800 kg . The truck tows the car in a straight line along a horizontal road. Assume that the tow rope is horizontal. A horizontal driving force of magnitude 3000 N acts on the truck. A horizontal resistance force of magnitude 800 N acts on the car. The car and truck accelerate at 0.4 m s^{-2} .



- (a) By forming two equations of motion, show that the magnitude of the acceleration of each particle is 1.96 m s^{-2} . *(5 marks)*
- (b) Find the tension in the string. *(2 marks)*
- (c) After the particles have been moving for 2 seconds, both particles are at a height of 4 metres above a horizontal surface. When the particles are in this position, the string breaks.
- (i) Find the speed of particle *A* when the string breaks. *(2 marks)*
- (ii) Find the speed of particle *A* when it hits the surface. *(3 marks)*
- (iii) Find the time that it takes for particle *B* to reach the surface after the string breaks. Assume that particle *B* does not hit the peg. *(5 marks)*

- (a) Assuming that the surface is smooth, use two equations of motion to find the magnitude of the acceleration of the block and particle. *(4 marks)*
- (b) In reality, the surface is rough and the acceleration of the block is 3 m s^{-2} .
- (i) Find the tension in the string. *(3 marks)*
- (ii) Calculate the magnitude of the normal reaction force acting on the block. *(1 mark)*
- (iii) Find the coefficient of friction between the block and the surface. *(5 marks)*
- (c) State two modelling assumptions, other than those given, that you have made in answering this question. *(2 marks)*

- (a) Find the tension in the tow rope. *(3 marks)*
- (b) Show that the magnitude of the horizontal resistance force acting on the truck is 600 N. *(4 marks)*
- (c) In fact, the tow rope is **not** horizontal. Assume that the resistance forces and the driving force are unchanged.
- Is the tension in the tow rope greater or less than in part (a)?
- Explain why. *(2 marks)*

Qu Refs...

- AQA M1, June 2010, Question 6
- AQA M1, June 2012, Question 5
- AQA M1, June 2007, Question 4