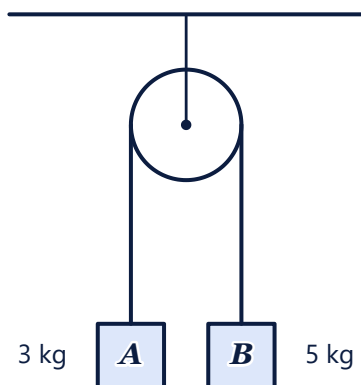




Name: _____ **Date:** _____ **Score:** _____ / 90

1 Two particles A and B , of mass 3 kg and 5 kg respectively, are attached to the ends of a light inextensible string. The string passes over a small smooth pulley which is fixed to a ceiling. The particles hang with the string taut and the hanging parts of the string vertical, as shown in the diagram. The system is released from rest.

- Find the acceleration of A .
- Find the tension in the string.
- Find the magnitude of the force exerted on the pulley by the string.



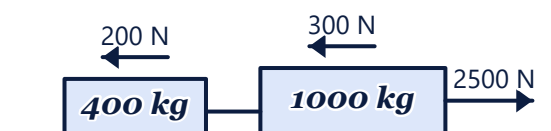
(6 marks)

Answer _____

2

A car of mass 1000 kg tows a trailer of mass 400 kg along a straight horizontal road using a light horizontal tow bar. The engine of the car produces a driving force of 2500 N. The resistances to motion are constant forces of 300 N on the car and 200 N on the trailer, as shown in the diagram.

- Find the acceleration of the car and trailer.
- Find the tension in the tow bar.
- State how you have used the modelling assumption that the tow bar is light.



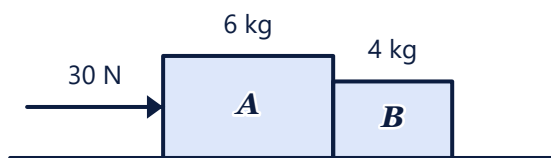
(6 marks)

Answer

3

Two boxes A and B , of mass 6 kg and 4 kg respectively, rest side by side in contact on a smooth horizontal floor. A horizontal force of magnitude 30 N is applied to A , pushing it into B , as shown in the diagram. The boxes move together.

- Find the acceleration of the boxes.
- Find the magnitude of the force exerted on B by A .



(4 marks)

Answer _____

4

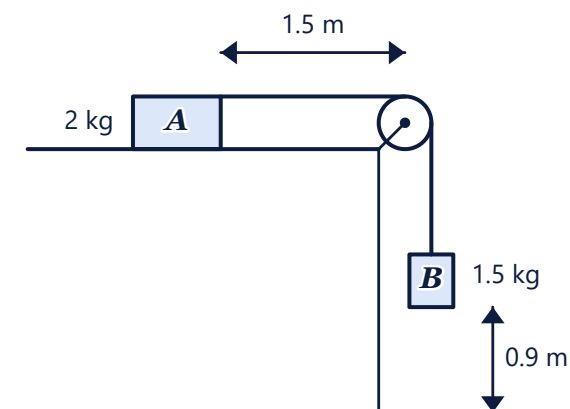
A particle A of mass 2 kg rests on a smooth horizontal table. It is attached to one end of a light inextensible string. The string passes over a small smooth pulley fixed at the edge of the table, and its other end is attached to a particle B of mass 1.5 kg which hangs freely. A is 1.5 m from the pulley and B is 0.9 m above the floor, as shown in the diagram.

The system is released from rest with the string taut.

- Find the acceleration of A and the tension in the string.
- Find the speed of B as it hits the floor.

B does not rebound.

- Find the time from the moment B hits the floor until A reaches the pulley.



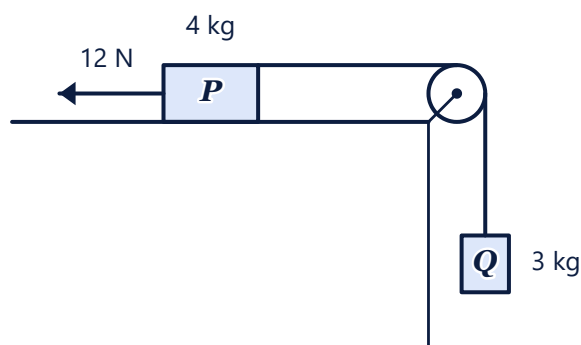
(9 marks)

Answer _____

5

A particle P of mass 4 kg lies on a rough horizontal table. P is attached to one end of a light inextensible string which passes over a small smooth pulley fixed at the edge of the table. The other end of the string is attached to a particle Q of mass 3 kg which hangs freely below the pulley. The part of the string between P and the pulley is horizontal. The system is released from rest with the string taut. As P moves, the table exerts a constant resistance of magnitude 12 N on P , as shown in the diagram.

- Find the acceleration of P .
- Find the tension in the string.
- Find the magnitude and direction of the resultant force exerted on the pulley by the string.



(8 marks)

Answer

6

Two particles P and Q have masses 1.2 kg and $m\text{ kg}$ respectively. They are attached to the ends of a light inextensible string which passes over a small smooth peg. The particles hang freely with the string taut and the hanging parts of the string vertical.

The system is released from rest and Q moves downwards with acceleration 2.8 m s^{-2} .

- Find the tension in the string.
- Show that $m = 2.16$
- Find the magnitude of the force exerted on the peg by the string.
- State where in your working you have used the fact that the peg is smooth.

(7 marks)

Answer _____

7

A car of mass 1200 kg is towing a trailer of mass 600 kg along a straight horizontal road. The car and trailer are joined by a light rigid horizontal tow bar. The resistances to motion are constant forces of 400 N on the car and 200 N on the trailer.

The car and trailer are moving at 20 m s^{-1} when the driver applies the brakes. The brakes produce a constant braking force of $F \text{ N}$ on the car only. The car and trailer come to rest in a distance of 80 m.

- Find the deceleration of the car and trailer.
- Find the value of F .
- Find the magnitude of the force in the tow bar and state whether it is a tension or a thrust.
- Explain why the trailer could not have been towed with a rope during the braking.

(8 marks)

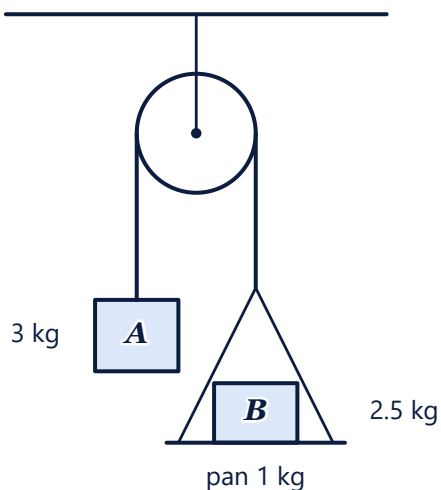
Answer

8

A particle A of mass 3 kg is attached to one end of a light inextensible string. The string passes over a small smooth fixed pulley and its other end is attached to a scale pan of mass 1 kg . A block B of mass 2.5 kg rests in the scale pan, as shown in the diagram. The hanging parts of the string are vertical.

The system is released from rest.

- Find the acceleration of A .
- Find the tension in the string.
- Find the magnitude of the force exerted on the scale pan by B .



(8 marks)

Answer

9

A lift of mass 400 kg is raised and lowered by a vertical cable. A parcel of mass 8 kg rests on the floor of the lift. At one moment the normal reaction of the floor on the parcel has magnitude 70 N.

- Find the magnitude and direction of the acceleration of the lift at this moment.
- Find the tension in the cable at this moment.
- Ella says the lift must be moving downwards. Explain why she may be wrong.

(7 marks)

Answer _____

10

A car of mass 900 kg tows a boat trailer of mass 600 kg along a straight horizontal road using a light inextensible horizontal tow rope. The resistances to motion are constant forces of 250 N on the car and 350 N on the trailer. The car and trailer start from rest and accelerate at 0.8 m s^{-2} .

- Find the driving force produced by the engine of the car.
- Find the tension in the tow rope.

After 10 seconds the tow rope breaks. The driving force and the resistances do not change.

- Find the distance travelled by the trailer from the moment the rope breaks until it comes to rest.
- Find the distance travelled by the car in the same time.

(9 marks)

Answer _____

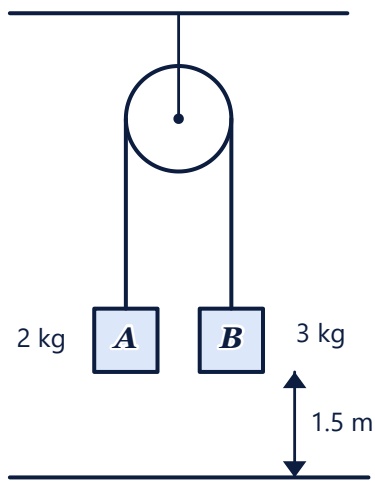
11

Particles A and B , of mass 2 kg and 3 kg respectively, are attached to the ends of a light inextensible string which passes over a small smooth fixed pulley. The particles hang with the string taut and the hanging parts vertical. B is 1.5 m above the ground, as shown in the diagram. The system is released from rest.

- Find the tension in the string while both particles are moving.
- Find the speed of B as it reaches the ground.

B does not rebound. A does not reach the pulley.

- Find the greatest height of A above its starting position.
- Find the time from release until A reaches its greatest height.



(9 marks)

Answer _____

12

Amara, of mass 60 kg, stands on a set of bathroom scales on the floor of a lift. The scales measure the normal reaction on Amara, in newtons. The lift has mass 640 kg, including the scales, and is moved by a vertical cable.

The lift starts from rest and moves upwards. It accelerates uniformly to a speed of 3 m s^{-1} in 2 seconds, travels at 3 m s^{-1} for 5 seconds, then decelerates uniformly to rest in 3 seconds.

- Find the reading on the scales during each of the three stages.
- Find the greatest tension in the cable during the journey.
- Find the total distance travelled by the lift.

(9 marks)

Answer

End of questions | Total 90 marks