Pulleys

A pulley is a wheel on which a rope/string/cable passes.

What modelling assumptions are made?

Example

Particles of mass 4kg and 2kg are connected by a light string passing over a smooth, fixed pulley. The particles hang freely and are released from rest.

i) Find the acceleration of the two particles and the tension in the string. Let the acceleration be a and the tension in the string be T

ii) Find the force exerted on the pulley by the string

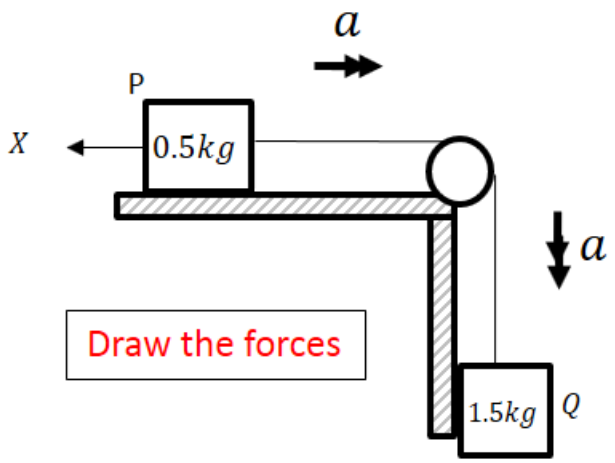
Example – Horizontal and Vertical String

(Take g = 10ms^{-2} in this question)

The diagram shows a particle, P, of mass 0.5kg on a smooth horizontal table. P is connected to another particle, Q, of mass 1.5kg, by a taut, light, inextensible string which passes over a small, fixed, smooth pulley at the edge of the table, Q hanging vertically below the pulley. A horizontal force of magnitude *X*N acts on P as shown.

a) Given the system is in equilibrium, find *X*

b) Given that *X* = 12, find the distance travelled by Q in the first two seconds of its motion, following the release of the system from rest. You may assume that P does not reach the pulley in this time.



Test Your Understanding *(EdExcel M1 Jan 2010 Q6)*

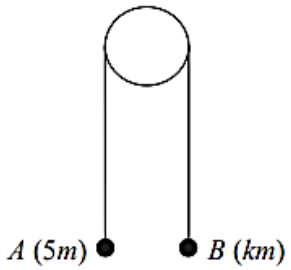


Figure 4

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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