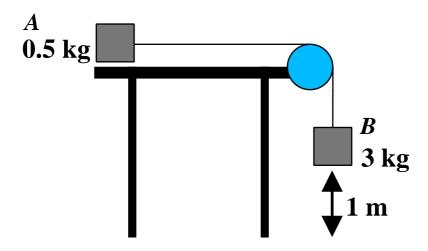
Mechanics: Dynamics I: Year 1

6.1 Over The Edge

Example

Particles A and B of mass 0.5 kg and 3 kg respectively are connected by a light inextensible string over a smooth pulley. A rests on a rough horizontal table. Both particles are initially at rest. Particle B is held 1 metre above the ground and is then released. It takes 0.8 seconds for B to hit the ground. Assuming there is at least 1 metre between particle A and the pulley, find the magnitude of the friction force F_r



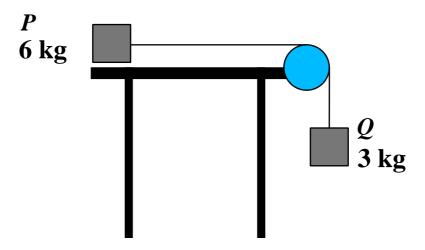
Solution:

6.2 Exercise

Question 1

A particle P of mass 6 kg rests on a rough horizontal plane. P is connected by a light inextensible string passing over a smooth fixed pulley at the edge of the plane to a second particle Q of mass 3 kg which hangs freely. The resistance to motion between P and the horizontal plane is 25 Newtons.

The system is released from rest.



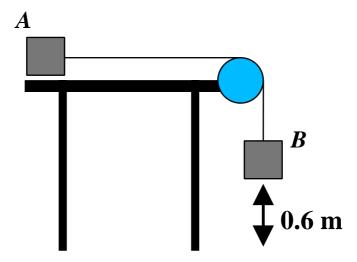
Let the tension in the string be T N and the acceleration of the particles be a m s⁻²

- (i) Write down an equation of motion for P
- (ii) Write down an equation of motion for Q
- (iii) By solving the two equations of motion simultaneously determine the tension in the string, T, and the acceleration, a

(iv)	Find the distance moved by each of the particles in the first 3 seconds of the subsequent motion given that <i>P</i> does not reach the pulley.
(v)	After 3 seconds Q hits the ground and the string then goes slack. With what speed did Q hit the ground ?
(vi)	P now continues to slide, until it stops, 7 cm before it would otherwise have reached the pulley. When the system was released from rest, how far was P from the pulley?

Question 2

Using this model, find,



A particle A of mass 0.8 kg rests on a horizontal table and is attached to one end of a light inextensible string. The string passes over a small smooth pulley P fixed at the edge of the table. The other end of the string is attached to a particle B of mass 1.2 kg which hangs freely below the pulley. The system is released from rest with the string taut and with B at a height of 0.6 m above the ground. In subsequent motion A does not reach P before B reaches the ground. In an initial model of the situation the table is assumed to be smooth.

(\mathbf{a}) the tension in the string before B reaches the ground

[5 marks]

(\mathbf{b}) the time taken by B to reach the ground

In a refinement of the model, it is assumed that the table is rough and that the resistance to motion between A and the table is 5.6 N Using this refined model,

(\mathbf{c}) find the time taken by B to reach the ground

Question 3

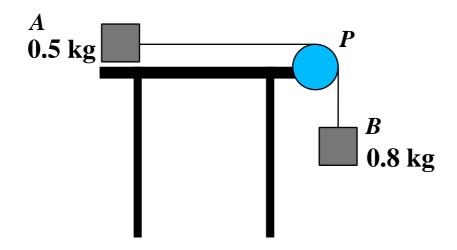
Two particles A and B of masses 0.4 kg and 0.8 kg respectively are connected by a light inextensible string. Particle A lies on a rough horizontal table 4.5 metres from a small smooth pulley which is fixed at the edge of the table. The string passes over the pulley and B hangs freely, with the string taut, 0.5 m above horizontal ground. The resistance to motion between A and the table is 0.8 N. The system is released from rest.

(i) Determine the acceleration of the system

(ii) What is the time taken for B to reach the ground?

(iii) Calculate the total distance travelled by \boldsymbol{A} before it first comes to rest.

Question 4Examination Question from January 2005, M1, Q5



A block of wood A of mass 0.5 kg rests on a rough horizontal table and is attached to one end of a light inextensible string. The string passes over a small smooth pulley P fixed at the edge of the table. The other end of the string is attached to a ball B of mass 0.8 kg which hangs freely below the pulley. The resistance to motion of A from the rough table has a constant magnitude F_r N The system is released from rest with the string taut. After release, B descends a distance of 0.4 metres in 0.5 seconds. A and B are to be modelled as particles.

(i) Determine the acceleration of B

(ii)	Find the tension in the string
	[4 marks]
(iii)	Calculate the value of F_r
	[2 montes]
	[3 marks]
(iv)	State how in your calculations you have used the information that the
	string is inextensible
TPL.	[1 mark]
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