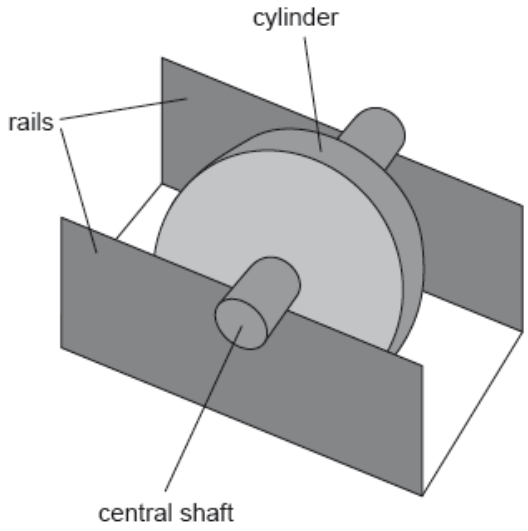
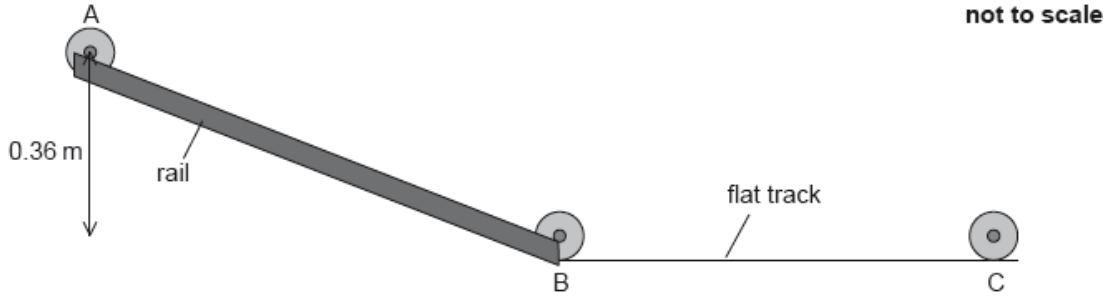
SL Paper 3

A wheel of mass 0.25 kg consists of a cylinder mounted on a central shaft. The shaft has a radius of 1.2 cm and the cylinder has a radius of 4.0 cm.

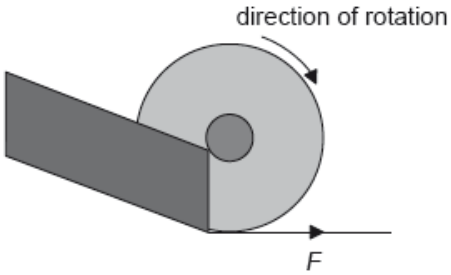
The shaft rests on two rails with the cylinder able to spin freely between the rails.



The stationary wheel is released from rest and rolls down a slope with the shaft rolling on the rails without slipping from point A to point B.



The wheel leaves the rails at point B and travels along the flat track to point C. For a short time the wheel slips and a frictional force *F* exists on the edge of the wheel as shown.



a.i. The moment of inertia of the wheel is 1.3×10^{-4} kg m^2. Outline what is meant by the moment of inertia. [1]

a.ii. In moving from point A to point B, the centre of mass of the wheel falls through a vertical distance of 0.36 m. Show that the translational speed of the wheel is about 1 m s^{-1} after its displacement. [3]

a.iii Determine the angular velocity of the wheel at B. [1]

b.i. Describe the effect of F on the linear speed of the wheel. [2]

b.ii. Describe the effect of F on the angular speed of the wheel. [2]