2 A ball of mass 0.030 kg moves along a curved track, as shown in Fig. 2.1.

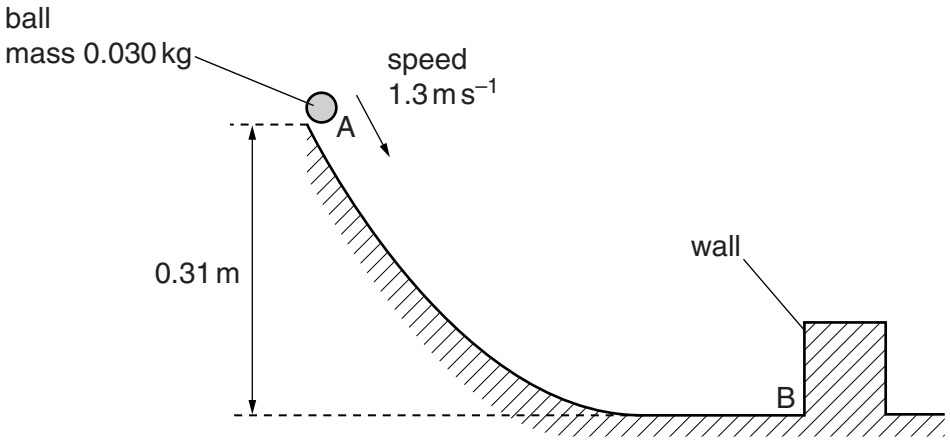

Fig. 2.1

The speed of the ball is 1.3 m s^{-1} when it is at point A at a height of 0.31 m.
The ball moves down the track and collides with a vertical wall at point B. The ball then rebounds back up the track. It may be assumed that frictional forces are negligible.

(a) Calculate the change in gravitational potential energy of the ball in moving from point A to point B.

change in gravitational potential energy = ... J [2]

(b) Show that the ball hits the wall at B with a speed of 2.8 m s^{-1}.

[3]

(c) The change in momentum of the ball due to the collision with the wall is $0.096\,\text{kg}\,\text{m}\,\text{s}^{-1}$. The ball is in contact with the wall for a time of 20 ms.

Determine, for the ball colliding with the wall,

(i) the speed immediately after the collision,

speed = ... $\text{m}\,\text{s}^{-1}$ [2]

(ii) the magnitude of the average force on the ball.

force = ... N [2]

(d) State and explain whether the collision is elastic or inelastic.

.....

.....[1]

(e) In practice, frictional effects are significant so that the actual increase in kinetic energy of the ball in moving from A to B is 76 mJ. The length of the track between A and B is 0.60 m.

Use your answer in **(a)** to determine the average frictional force acting on the ball as it moves from A to B.

frictional force = ... N [2]

[Total: 12]