

- 3 A ball is thrown vertically upwards towards a ceiling and then rebounds, as illustrated in Fig. 3.1.

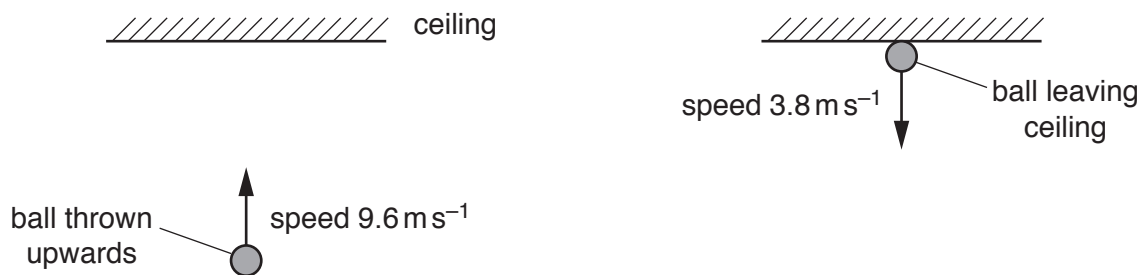


Fig. 3.1

The ball is thrown with speed 9.6 m s^{-1} and takes a time of 0.37 s to reach the ceiling. The ball is then in contact with the ceiling for a further time of 0.085 s until leaving it with a speed of 3.8 m s^{-1} . The mass of the ball is 0.056 kg . Assume that air resistance is negligible.

- (a) Show that the ball reaches the ceiling with a speed of 6.0 m s^{-1} .

[1]

- (b) Calculate the height of the ceiling above the point from which the ball was thrown.

height = m [2]

- (c) Calculate

- (i) the increase in gravitational potential energy of the ball for its movement from its initial position to the ceiling,

increase in gravitational potential energy = J [2]

- (ii) the decrease in kinetic energy of the ball while it is in contact with the ceiling.

decrease in kinetic energy = J [2]

- (d) State how Newton's third law applies to the collision between the ball and the ceiling.

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.....[2]

- (e) Calculate the change in momentum of the ball during the collision.

change in momentum = N s [2]

- (f) Determine the magnitude of the average force exerted by the ceiling on the ball during the collision.

average force = N [2]

[Total: 13]