1 **(a)** State what is meant by *parabolic motion*.

……

…… [2]

(b) A spring is used to launch a metal ball of mass 4.5×10^{-2} kg up a ramp. The spring is compressed by 8.0×10^{-2} m and held in equilibrium, as shown in Fig. 1.1.

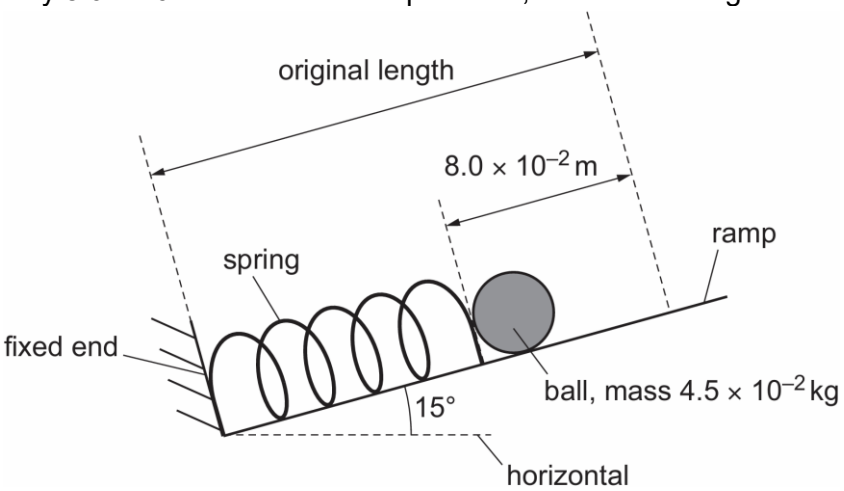

Fig. 1.1

The elastic potential energy stored in the spring at this compression is 0.24 J.
The ramp is at an angle of 15° to the horizontal.
The spring is released and expands quickly back to its original length.

(i) Calculate the average force the spring exerts on the ball during the expansion back to its original length.

average force = …… N [1]

(ii) The ball leaves the spring when the spring reaches its original length. Assume that all the elastic potential energy of the spring is transferred to the ball.

Calculate the speed of the ball as it leaves the spring.

speed = …… m s^{-1} [2]

(iii) The ball travels up the slope as shown in Fig.1.2.

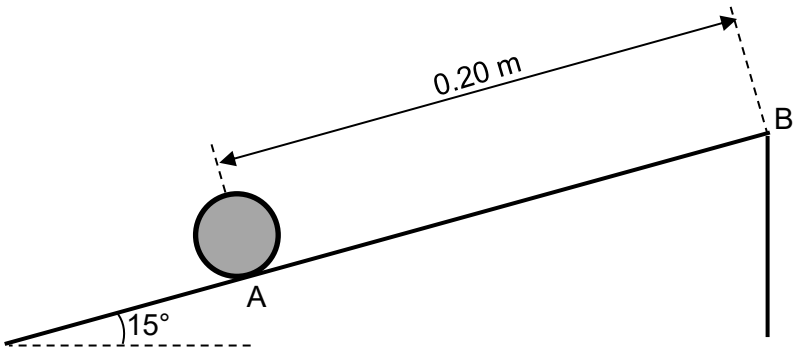

Fig. 1.2

At point A, the ball has a speed of 2.4 m s^{-1}. The ball will travel 0.20 m along the slope to reach point B, which is the end of the slope.

Show that the speed of the ball at point B is 2.2 m s^{-1}.

[1]

(c) The ball will leave the slope at point B. The height of the slope at B from the ground is 0.40 m, as shown in Fig. 1.3.

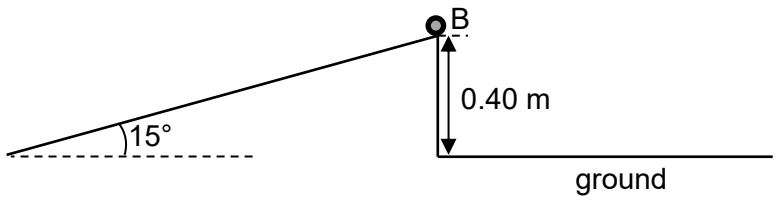

Fig. 1.3

(i) Determine the speed of the ball when it is at the maximum height.

speed = …… m s^{-1} [1]

(ii) Determine the time just before the ball hits the ground.

time = …… s [2]

(iii) Determine the horizontal displacement travelled by the ball from B to the point just before hitting the ground.

horizontal displacement = …… m [1]