Section A
Answer **all** questions in the spaces provided.

1 A ball of mass 0.059 kg is thrown vertically downwards to the ground, as illustrated in Fig. 1.1.
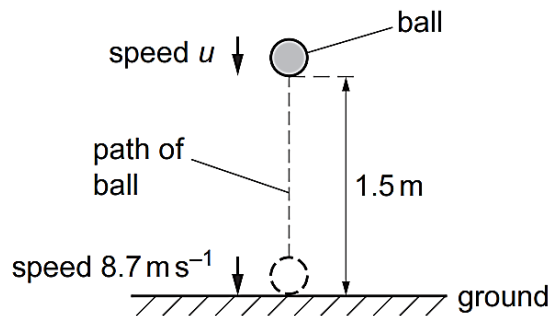

ball

speed u ↓

path of ball

1.5 m

speed 8.7 m s^{-1} ↓

ground

Fig. 1.1

The ball is thrown with speed u from a height of 1.5 m. The ball then hits the ground with speed 8.7 m s^{-1}. Assume that air resistance is negligible.

(a) Calculate speed u.

$u =$ …………………….. m s^{-1} [2]

(b) The ball was thrown downwards at time $t = 0$ and hits the ground at time $t = T$.

On Fig. 1.2, sketch a graph to show the variation of the speed of the ball with time t, from time $t = 0$ to when it hits the ground at time $t = T$. Numerical values are not required.
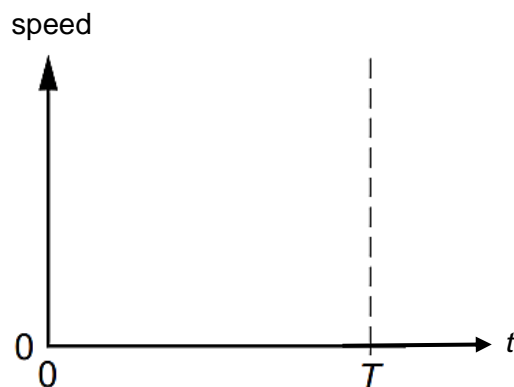

speed

0

0   T   t

Fig. 1.2

[1]

[Turn over

(c) State how Newton's third law applies to the forces between the ball and the ground during the collision.

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…………………………………………………………………………...................... [2]

(d) The ball is in contact with the ground for a time of 0.091 s. The ball rebounds vertically and leaves the ground with speed 5.4 m s^{-1}.

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

change in momentum = ……………………… N s   [2]

(ii) Calculate the magnitude of the average force exerted by the ground on the ball during collision.

average force = ………………………… N   [3]

(e) In practice, air resistance is not negligible.

State and explain the variation, if any, with time t of the gradient of the graph in **(b)**.

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[Total: 12]