

- 2 (a) Fig. 2.1 shows the velocity–time graph for an object moving in a straight line.

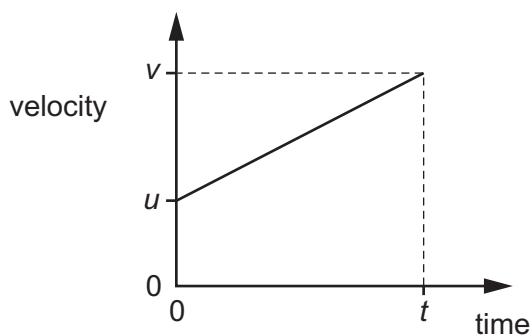


Fig. 2.1

- (i) Determine an expression, in terms of  $u$ ,  $v$  and  $t$ , for the area under the graph.

$$\text{area} = \dots\dots\dots\dots\dots [1]$$

- (ii) State the name of the quantity represented by the area under the graph.

..... [1]

- (b) A ball is kicked with a velocity of  $15\text{ m s}^{-1}$  at an angle of  $60^\circ$  to horizontal ground. The ball then strikes a vertical wall at the instant when the path of the ball becomes horizontal, as shown in Fig. 2.2.

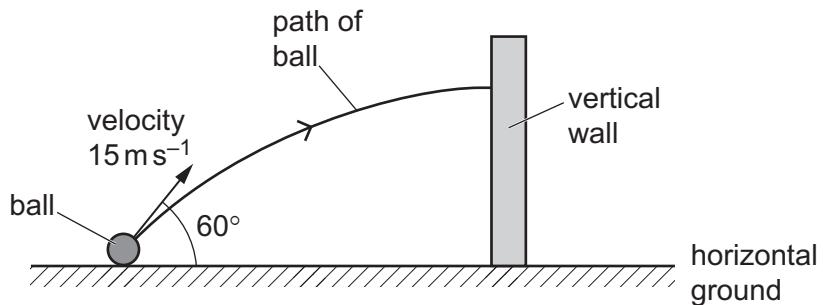


Fig. 2.2 (not to scale)

Assume that air resistance is negligible.

- (i) By considering the vertical motion of the ball, calculate the time it takes to reach the wall.

time = ..... s [3]

- (ii) Explain why the horizontal component of the velocity of the ball remains constant as it moves to the wall.

..... [1]

- (iii) Show that the ball strikes the wall with a horizontal velocity of  $7.5 \text{ ms}^{-1}$ .

[1]

- (c) The mass of the ball in (b) is  $0.40 \text{ kg}$ . It is in contact with the wall for a time of  $0.12 \text{ s}$  and rebounds horizontally with a speed of  $4.3 \text{ ms}^{-1}$ .

- (i) Use the information from (b)(iii) to calculate the change in momentum of the ball due to the collision.

change in momentum = .....  $\text{kg ms}^{-1}$  [2]

- (ii) Calculate the magnitude of the average force exerted on the ball by the wall.

average force = ..... N [1]