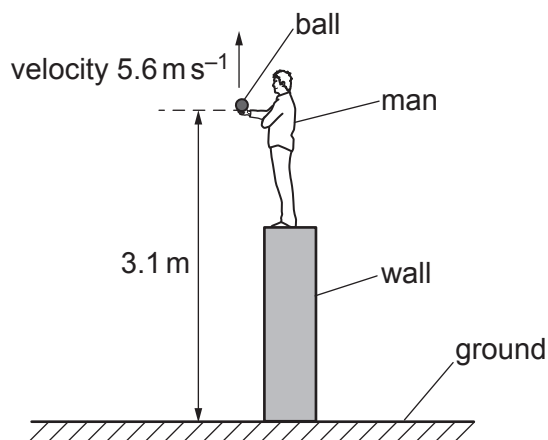**3** A man standing on a wall throws a small ball vertically upwards with a velocity of $5.6\,\mathrm{m\,s^{-1}}$. The ball leaves his hand when it is at a height of $3.1\,\mathrm{m}$ above the ground, as shown in Fig. 3.1.

Fig. 3.1 (not to scale)

Assume that air resistance is negligible.

(a) Show that the ball reaches a maximum height above the ground of $4.7\,\mathrm{m}$.

[2]

(b) The man does not catch the ball as it falls.

Calculate the time taken for the ball to fall from its maximum height to the ground.

time taken = ... s [2]

(c) The ball leaves the man's hand at time $t = 0$ and hits the ground at time $t = T$.

On Fig. 3.2, sketch a graph to show the variation of the velocity v of the ball with time t from $t = 0$ to $t = T$. Numerical values of v and t are not required. Assume that v is positive in the upward direction.
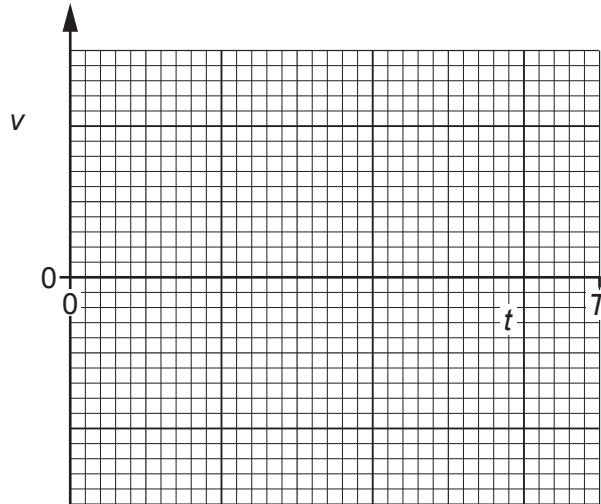
Fig. 3.2

[3]

(d) State what is represented by the gradient of the graph in **(c)**.

.... [1]

(e) The man now throws a second ball with the same velocity and from the same height as the first ball. The mass of the second ball is greater than that of the first ball. Assume that air resistance is still negligible.

For the first and second balls, compare:

(i) the magnitudes of their accelerations

.... [1]

(ii) the speeds with which they hit the ground.

.... [1]