3 A steel ball falls from a platform on a tower to the ground below, as shown in Fig. 3.1.

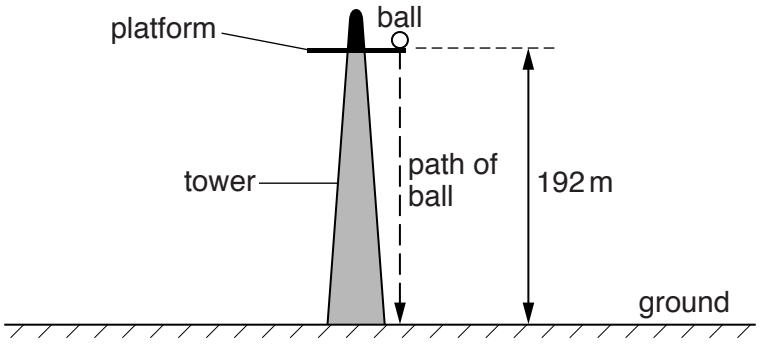

Fig. 3.1

The ball falls from rest through a vertical distance of 192 m. The mass of the ball is 270 g.

(a) Assume air resistance is negligible.

(i) Calculate

1. the time taken for the ball to fall to the ground,

time taken = ...s [2]

2. the maximum kinetic energy of the ball.

maximum kinetic energy = ...J [2]

(ii) State and explain the variation of the velocity of the ball with time as the ball falls to the ground.

.....

.....[1]

(iii) Show that the velocity of the ball on reaching the ground is approximately 60 m s^{-1}.

[1]

(b) In practice, air resistance is not negligible. The variation of the air resistance R with the velocity v of the ball is shown in Fig. 3.2.

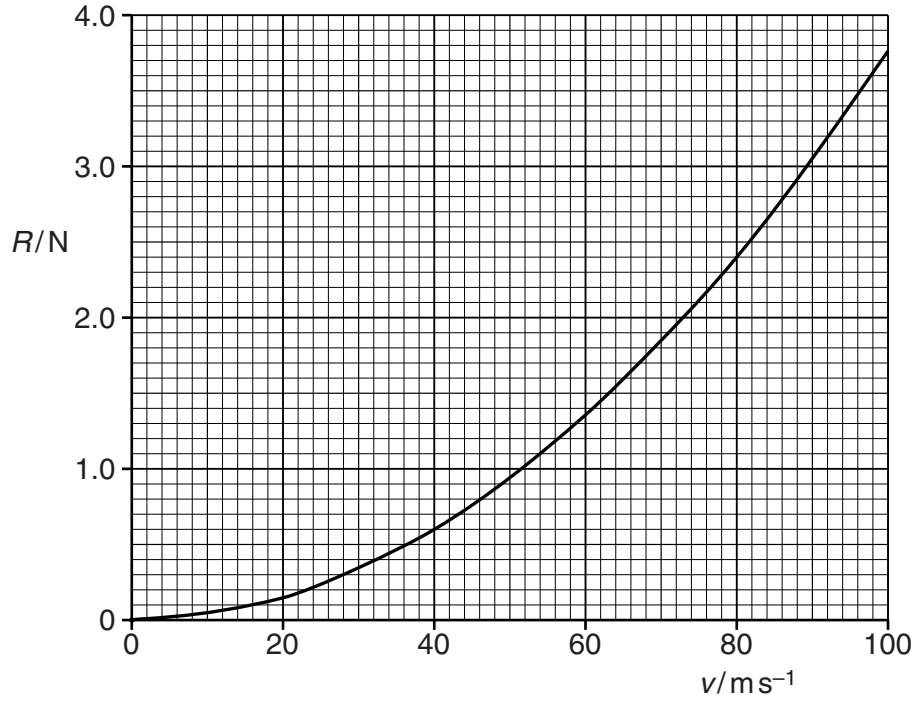

Fig. 3.2

(i) Use Fig. 3.2 to state and explain qualitatively the variation of the acceleration of the ball with the distance fallen by the ball.

.....

.....

.....

.....[3]

(ii) The speed of the ball reaches $40\,m\,s^{-1}$. Calculate its acceleration at this speed.

acceleration = ... $m\,s^{-2}$ [2]

(iii) Use information from **(a)(iii)** and Fig. 3.2 to state and explain whether the ball reaches terminal velocity.

.....

.....

.....[2]