Section B

Answer **one** question from this Section in the spaces provided.

7 A cannon is placed flat on top of a hill. A ball is fired from the stationary cannon at a velocity of 20 m s^{-1} at an angle 50° to the horizontal as shown in Fig. 7.1. The ball lands on a horizontal ground 52 m below the point of projection of cannon on the hill.

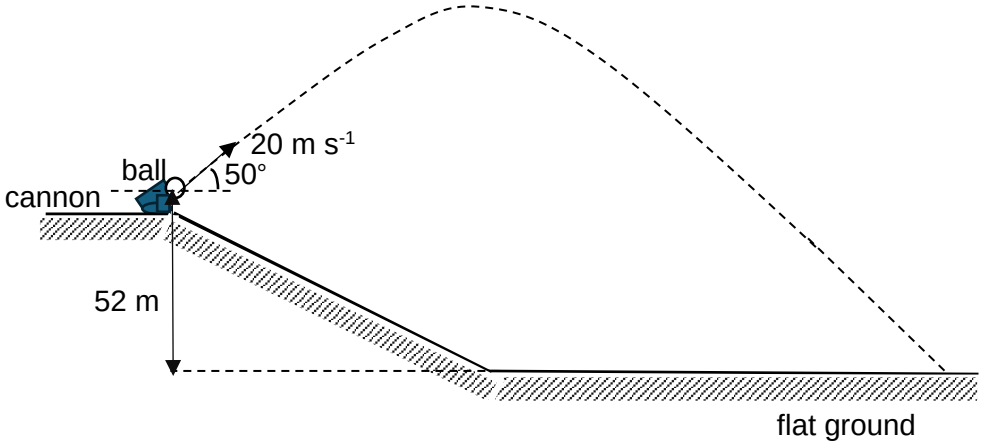


Fig. 7.1

(a) (i) Show that the time taken for the ball to reach the ground after being fired is 5.2 s. Assume air resistance is negligible.

[3]

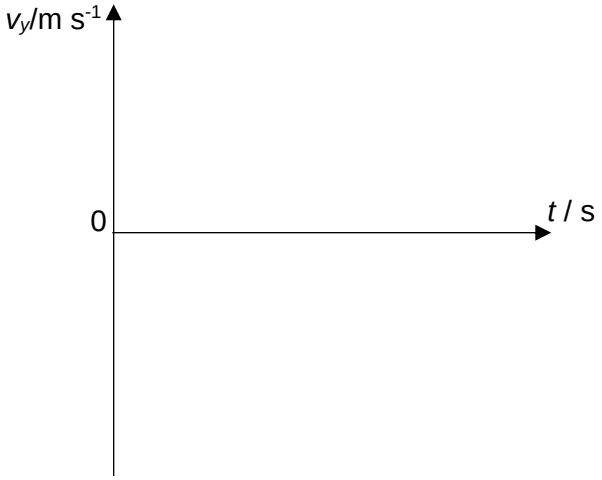
(ii) Hence calculate the horizontal displacement of the ball where it lands.

displacement = ... m [2]

(iii) Determine the vertical component of the ball's velocity just before it hits the ground.

velocity = ... m s^{-1} [2]

(iv) On Fig. 7.2, sketch the variation with time *t* of the vertical component of the ball's velocity v_y after it has been fired up to the time it reaches the ground at t = 5.2 s. Label in your sketch, the velocity of the ball at the start and at t = 5.2 s, and the point where it reaches maximum height as H. Assume air resistance is negligible.



[2]

Fig. 7.2

(v) Sketch in Fig. 7.2 the variation with time *t* of velocity v_y if air resistance is **not** negligible. Label your graph **R**. [2]

(b) The total mass of the same ball and the cannon together before it was fired is 1550 kg. Upon the canon being fired, the ball in Fig. 7.1 leaves the cannon within 0.35 s. The cannon can only recoil horizontally with a speed of 0.45 m s^{-1} as the ball leaves.

(i) State the principle of conservation of momentum.

.....

[1]

.....

(ii) By considering momentum in horizontal direction, show that the mass of the ball is 52 kg.

mass = ... kg [2]

(iii) Determine whether the firing of the cannon and ball, is an elastic or inelastic collision. Show any calculations if any clearly.

[2]

(iv) Determine the magnitude of the average force on the cannon. Explain your answer clearly.

force = ... N [3]

(v) The vertical momentum of the cannon becomes zero after firing. Explain if this violates the principle of conservation of momentum.