Revision - Projectiles

1.

(a) (i) Define speed..[1]

(ii) Distinguish between speed and velocity.

....

....[2]

(b) Use the equations given below, which represent uniformly accelerated motion in a straight line, to obtain an expression for *v* in terms of *u*, *a* and *s* only.

$v = u + at$

$s = (u + v)t/2$

[2]

(c) Fig. 1.1 shows a ball kicked from the top of a cliff with a horizontal velocity of 5.6 m s^{-1}. Air resistance can be neglected.

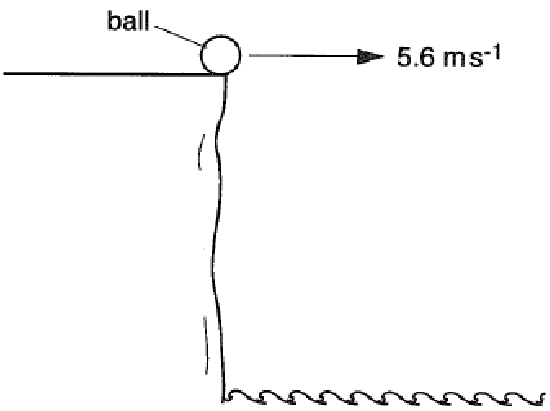


Fig. 1.1

(i) Show that after 0.90 s the vertical component of the velocity is 8.8 m s^{-1}.

[2]

(ii) Use a vector triangle to determine the resultant velocity of the ball after 0.90 s.

resultant velocity: magnitude = ... $m\,s^{-1}$

angle to the horizontal = ... ° [4]

(iii) Calculate

1. the vertical distance the ball falls in 0.90 s,

2. the horizontal distance the ball travels in this time.

1. vertical distance = ... m

2. horizontal distance = ... m [3]

2.

Fig. 3.1 shows the path of a golf ball from the time it ends contact with a golf club, point C, until it hits the ground at G. Assume that there is no air resistance.

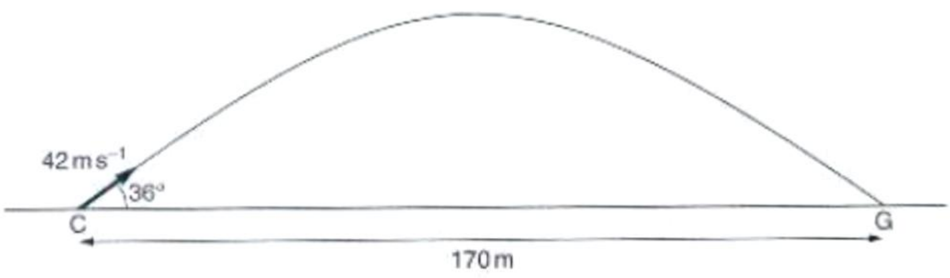


Fig. 3.1

The ball leaves the club with a velocity $42\,m\,s^{-1}$ at an angle of 36° to the horizontal.

(a) Show that the horizontal component of the velocity is $34\,m\,s^{-1}$

[1]

(b) The distance C to G is 170 m. Show that the time taken for the ball to travel from C to G is 5.0 s.

[1]

(c) Calculate

(i) the initial vertical component of the velocity

vertical velocity component = ... $m\,s^{-1}$ [2]

(ii) the maximum height reached.

maximum height = ... m [3]

(d) The ball has a mass of 50 g. Calculate the kinetic energy of the ball at maximum height.

kinetic energy = ... J [3]

(e) (i) On Fig. 3.1 sketch the path of the golf ball if air resistance is assumed **not** to be negligible. [2]

(ii) Explain the shape of your sketch.

....

....[1]

3.

(a) A stone is projected horizontally from a cliff. Fig. 3.1 shows the stone at a position **A** on its path.

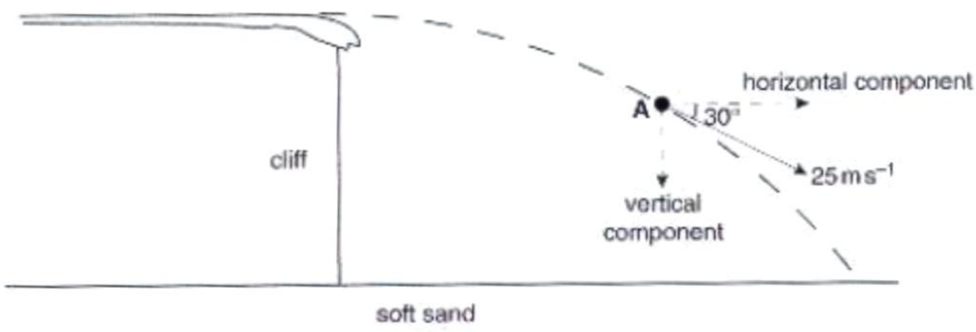


Fig. 3.1

The velocity of the stone at position **A** is 25 m s^{-1} at 30° to the horizontal.

(i) Show that the horizontal component of the velocity of the stone at **A** is 22 m s^{-1}.

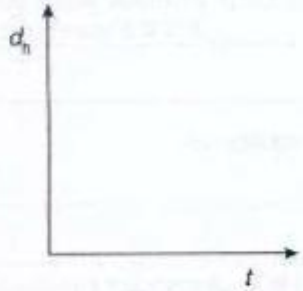
(ii) Calculate the vertical component of the velocity of the stone at **A**.

vertical component...................... m s^{-1} [3]

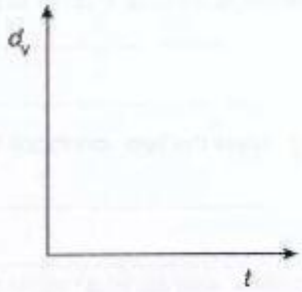
(b) Sketch graphs on the axes on **page 9** to show the horizontal and vertical displacements of the stone from the point of horizontal projection to the point of impact.

Ignore air resistance. Numerical values are not required.

(i) horizontal displacement d_h against time t



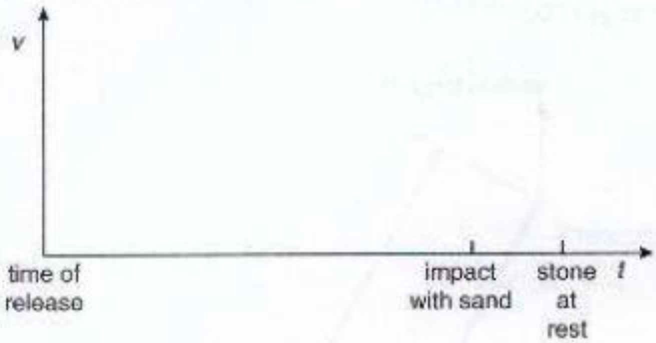
(ii) vertical displacement fallen d_v against time t



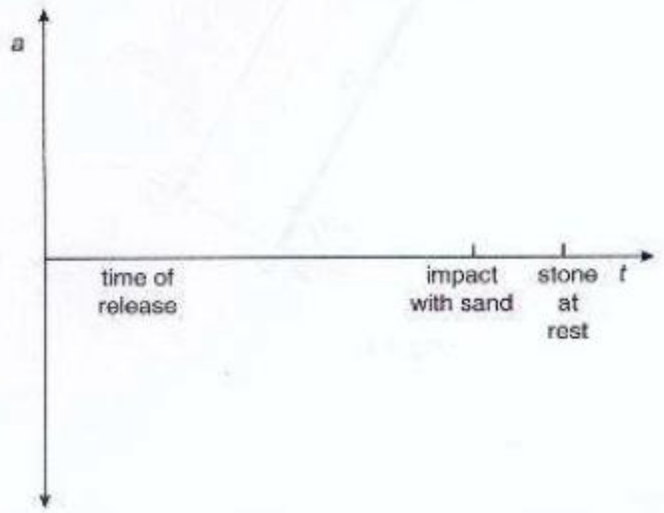
[3]

(c) A second stone is released from rest from the top of the cliff. It falls vertically. Sketch graphs on the axes below to show the velocity v and acceleration a of the stone from the time of release to the time when the stone comes to rest in the sand below. Ignore air resistance. Numerical values are not required.

(i) velocity v against time t



(ii) acceleration a against time t



[5]

4.

A ball is thrown by a girl towards a vertical wall.

The girl throws the ball, of mass 5.0×10^{-2} kg, with a velocity of 10 ms^{-1} at 53° to the horizontal. In this question, ignore air resistance.

(a) (i) Show that the horizontal component of the velocity is 6.0 ms^{-1}.

[1]

(ii) In moving to the wall, the ball travels 4.9m horizontally and 3.3m vertically. Calculate the time taken for the ball to travel from the girl's hand to the wall.

time = ... s [2]

(iii) Calculate the gain in potential energy of the ball from leaving the girl's hand to when it hits the wall.

gain in potential energy = ... J [3]

(b) The ball is moving horizontally at $6.0\,m\,s^{-1}$ when it hits the wall. The ball is in contact with the wall for 0.16 s and rebounds horizontally at $4.0\,m\,s^{-1}$.
Calculate, for the time that the ball is in contact with the wall

(i) the change in velocity of the ball

change in velocity = ... $m\ s^{-1}$ [1]

(ii) the horizontal acceleration of the ball (assumed to be constant)

acceleration = ... unit........... [2]

(iii) the horizontal force acting on the ball

magnitude of the force = ...N

direction of the force ....[3]

(iv) the loss in kinetic energy of the ball when rebounding from the wall.

loss in kinetic energy = ...J [3]