爱德思

Mechanics 2

分类真题

2014-2022 册

A Level Clouds 出品

目录

Chapter 1

Projectiles

Leave blank

6.

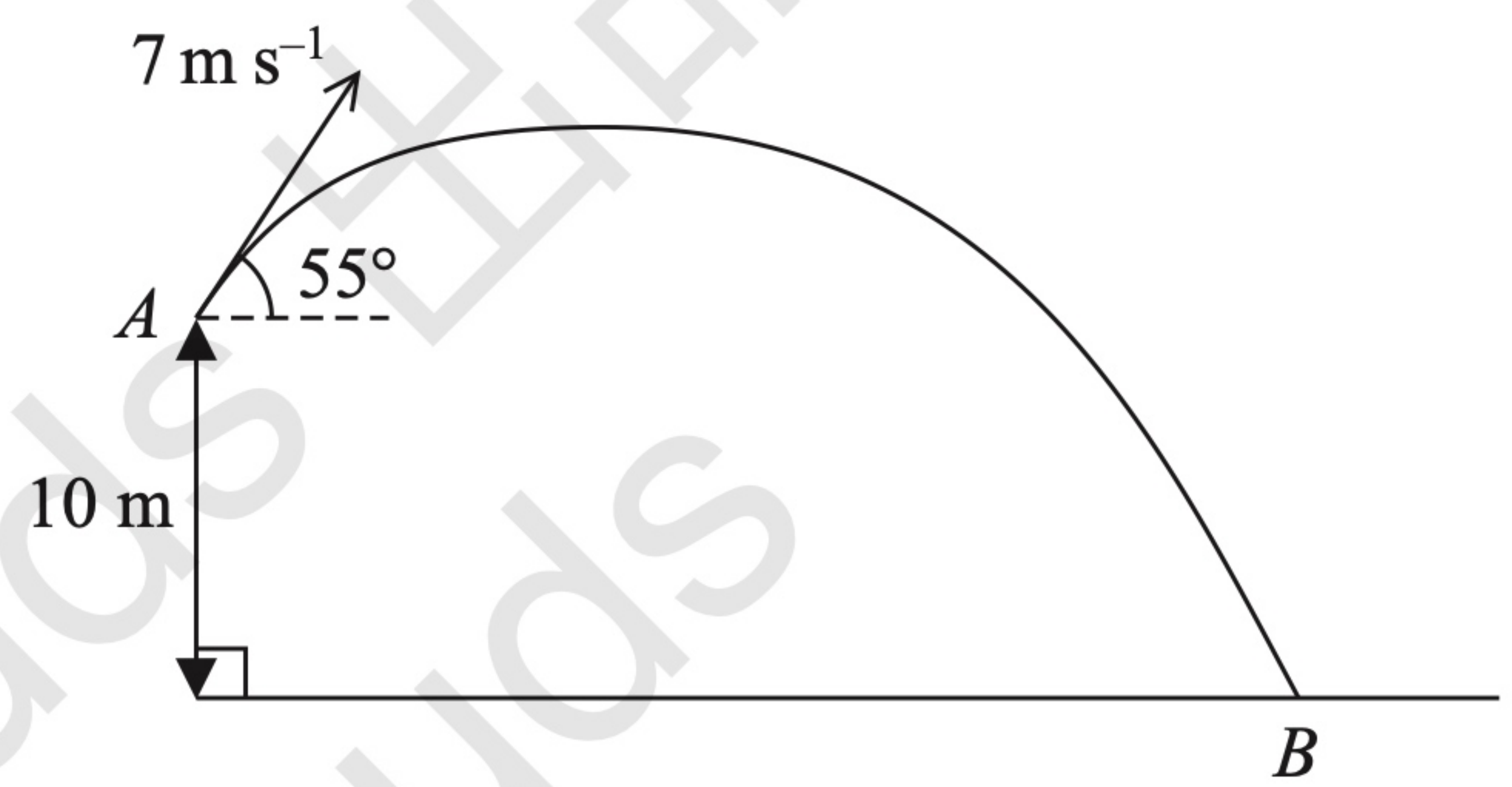

Figure 3

A small ball P is projected with speed 7 m s^{-1} from a point A 10 m above horizontal ground. The angle of projection is 55° above the horizontal. The ball moves freely under gravity and hits the ground at the point B, as shown in Figure 3.

Find

(a) the speed of P as it hits the ground at B,

(4)

(b) the direction of motion of P as it hits the ground at B,

(3)

(c) the time taken for P to move from A to B.

(5)

Leave blank

Leave blank

7. [*In this question, the unit vectors* **i** *and* **j** *are in a vertical plane,* **i** *being horizontal and* **j** *being vertically upwards.*]

At time $t = 0$, a particle P is projected with velocity $(4\mathbf{i} + 9\mathbf{j})$ m s^{-1} from a fixed point O on horizontal ground. The particle moves freely under gravity. When P is at the point H on its path, P is at its greatest height above the ground.

(a) Find the time taken by P to reach H.

(2)

At the point A on its path, the position vector of P relative to O is $(k\mathbf{i} + k\mathbf{j})$ m, where k is a positive constant.

(b) Find the value of k.

(4)

(c) Find, in terms of k, the position vector of the other point on the path of P which is at the same vertical height above the ground as the point A.

(3)

At time T seconds the particle is at the point B and is moving perpendicular to $(4\mathbf{i} + 9\mathbf{j})$

(d) Find the value of T.

(4)

Leave blank

Leave blank

6. [*In this question the unit vectors* **i** *and* **j** *are in a vertical plane,* **i** *being horizontal and* **j** *being vertically upwards.*]

At $t = 0$ a particle P is projected from a fixed point O with velocity $(7\mathbf{i} + 7\sqrt{3}\mathbf{j})\text{ m s}^{-1}$. The particle moves freely under gravity. The position vector of a point on the path of P is $(x\mathbf{i} + y\mathbf{j})$ m relative to O.

(a) Show that

$$y = \sqrt{3}x - \frac{g}{98}x^2$$

(5)

(b) Find the direction of motion of P when it passes through the point on the path where $x = 20$

(4)

At time T seconds P passes through the point with position vector $(2\lambda\mathbf{i} + \lambda\mathbf{j})$ m where λ is a positive constant.

(c) Find the value of T.

(4)

Leave blank

Leave blank

8. At time $t = 0$ seconds, a golf ball is hit from a point O on horizontal ground. The horizontal and vertical components of the initial velocity of the ball are $3U\,\mathrm{m\,s^{-1}}$ and $U\,\mathrm{m\,s^{-1}}$ respectively. The ball hits the ground at the point A, where $OA = 120$ m. The ball is modelled as a particle moving freely under gravity.

(a) Show that $U = 14$

(5)

(b) Find the speed of the ball immediately before it hits the ground at A.

(2)

(c) Find the values of t when the ball is moving at an angle α to the horizontal, where $\tan\alpha = \dfrac{1}{4}$.

(6)

Leave blank

Leave blank

7. A particle is projected from a point O with speed U at an angle of elevation α to the horizontal and moves freely under gravity. When the particle has moved a horizontal distance x, its height above O is y.

(a) Show that

$$y = x\tan\alpha - \frac{gx^2(1+\tan^2\alpha)}{2U^2}$$

(7)

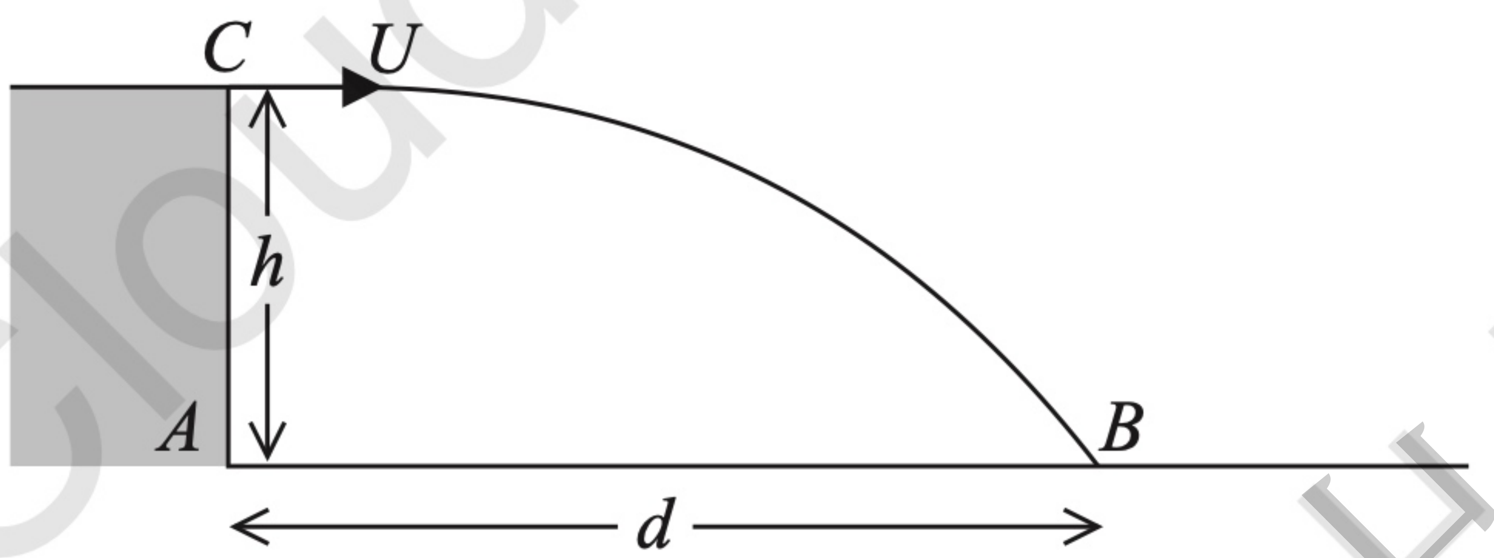

Figure 3

A small stone is projected horizontally with speed U from a point C at the top of a vertical cliff AC so as to hit a fixed target B on the horizontal ground. The point C is a height h above the ground, as shown in Figure 3. The time of flight of the stone from C to B is T, and the stone is modelled as a particle moving freely under gravity.

(b) Find, in terms of U, g and T, the speed of the stone as it hits the target at B.

(4)

It is found that, using the same initial speed U, the target can also be hit by projecting the stone from C at an angle α above the horizontal. The stone is again modelled as a particle moving freely under gravity and the distance $AB = d$.

(c) Using the result in part (a), or otherwise, show that

$$d = \frac{1}{2}gT^2\tan\alpha$$

(6)