

QQQ – Mechanics Year 2 – Chapter 6 – Projectiles (Version 2)

Total Marks: 22

(22 = Platinum, 20 = Gold, 18 = Silver, 15 = Bronze)

1. In this question use $g = 9.8 \text{ m s}^{-2}$

A ball is projected from a point on horizontal ground with an initial velocity of 7 m s^{-1} at an angle θ above the horizontal.

The ball reaches a maximum vertical height of h metres above the ground.

(a) Show that

$$h = 2.5 \sin^2 \theta$$

[3 marks]

(b) Hence, given that $0^\circ \leq \theta \leq 60^\circ$, find the maximum value of h .

[2 marks]

(c) Nisha claims that the larger the size of the ball, the greater the maximum vertical height will be.

State whether Nisha is correct, giving a reason for your answer.

[1 mark]

(Total 6 marks)

2.

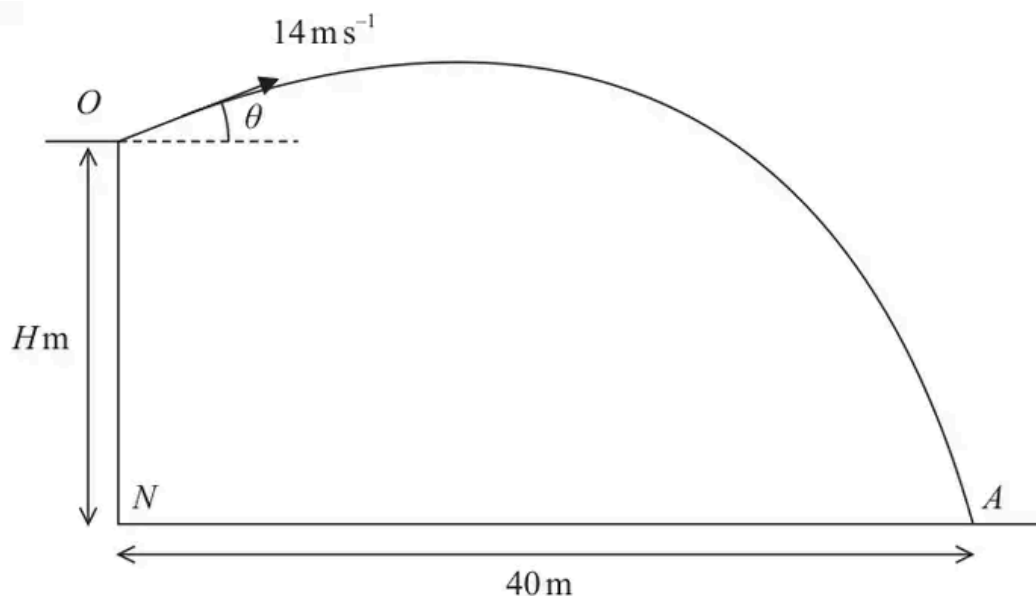


Figure 3

A small stone is projected with speed 14 m s^{-1} from a point O on the top of a cliff.

The point O is H metres vertically above the point N .

Point N is on horizontal ground.

The stone is projected at an angle θ above the horizontal, where $\tan \theta = \frac{1}{2}$

The stone strikes the horizontal ground at the point A , where $NA = 40\text{ m}$, as shown in Figure 3.

The stone is modelled as a particle moving freely under gravity.

Using this model, find

(a) the value of H **(5)**

(b) the maximum height of the stone above the horizontal ground. **(3)**

(Total 8 marks)

3. A vertical cliff is 73.5 m high. Two stones A and B are projected simultaneously. Stone A is projected horizontally from the top of the cliff with speed 28 m s^{-1} . Stone B is projected from the bottom of the cliff with speed 35 m s^{-1} at an angle α above the horizontal. The stones move freely under gravity in the same vertical plane and collide in mid-air. By considering the horizontal motion of each stone,

(a) prove that $\cos \alpha = \frac{4}{5}$. **(4)**

(b) Find the time which elapses between the instant when the stones are projected and the instant when they collide. **(4)**

(Total 8 marks)