

Motion of a Projectile

Question Paper 4

Level	International A Level
Subject	Maths
Exam Board	CIE
Topic	Motion of a Projectile
Sub Topic	
Booklet	Question Paper 4

Time Allowed: 59 minutes

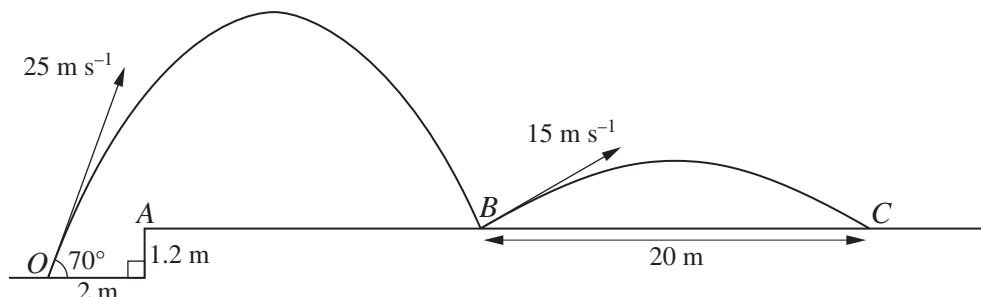
Score: /49

Percentage: /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1



The point O is 1.2 m below rough horizontal ground ABC . A ball is projected from O with speed 25 m s^{-1} at an angle of 70° to the horizontal. The ball passes over the point A after travelling a horizontal distance of 2 m . The ball subsequently bounces once on the ground at B . The ball leaves B with speed 15 m s^{-1} and travels a further horizontal distance of 20 m before landing at C (see diagram).

- (i) Calculate the height above the level of O of the ball when it is vertically above A . [3]
 - (ii) Calculate the time after the instant of projection when the ball reaches B . [3]
 - (iii) Find the angle which the trajectory of the ball makes with the horizontal immediately after it bounces at B . [2]
- 2 A light elastic string has natural length 2.4 m and modulus of elasticity 21 N . A particle P of mass $m \text{ kg}$ is attached to the mid-point of the string. The ends of the string are attached to fixed points A and B which are 2.4 m apart at the same horizontal level. P is projected vertically upwards with velocity 12 m s^{-1} from the mid-point of AB . In the subsequent motion P is at instantaneous rest at a point 1.6 m above AB .

- (i) Find m . [4]
- (ii) Calculate the acceleration of P when it first passes through a point 0.5 m below AB . [4]

- 3 A small ball B is projected with speed 15 m s^{-1} at an angle of 41° above the horizontal from a point O which is 1.6 m above horizontal ground. At time $t \text{ s}$ after projection the horizontal and vertically upward displacements of B from O are $x \text{ m}$ and $y \text{ m}$ respectively.

(i) Express x and y in terms of t and hence show that the equation of the trajectory of B is

$$y = 0.869x - 0.0390x^2,$$

where the coefficients are correct to 3 significant figures. [4]

A vertical fence is 1.5 m from O and perpendicular to the plane in which B moves. B just passes over the fence and subsequently strikes the ground at the point A .

(ii) Calculate the height of the fence, and the distance from the fence to A . [5]

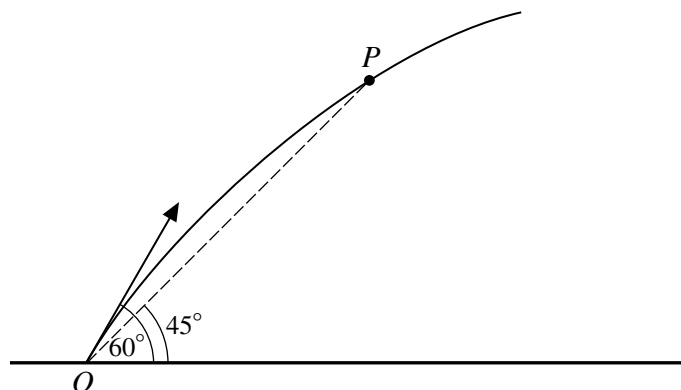
- 4 A particle P is projected with speed 25 m s^{-1} at an angle of 30° above the horizontal from a point O on horizontal ground. Calculate the distance OP at the instant 2 s after projection. [4]

- 5 The equation of the trajectory of a projectile is $y = 0.6x - 0.017x^2$, referred to horizontal and vertically upward axes through the point of projection.

(i) Find the angle of projection of the projectile, and show that the initial speed is 20 m s^{-1} . [3]

(ii) Find the speed and direction of motion of the projectile when it is at a height of 5.2 m above the level of the point of projection for the second time. [7]

6



A particle P is projected from a point O at an angle of 60° above horizontal ground. At an instant 0.6 s after projection, the angle of elevation of P from O is 45° (see diagram).

(i) Show that the speed of projection of P is 8.20 m s^{-1} , correct to 3 significant figures. [4]

(ii) Calculate the time after projection when the direction of motion of P is 45° above the horizontal. [3]

7 A particle is projected with speed 17 m s^{-1} at an angle of 50° above the horizontal from a point on horizontal ground. Calculate the speed of the particle 2 s after the instant of projection. [3]