

Motion of a Projectile

Question Paper 7

Level	International A Level
Subject	Maths
Exam Board	CIE
Topic	Motion of a Projectile
Sub Topic	
Booklet	Question Paper 7

Time Allowed: 60 minutes

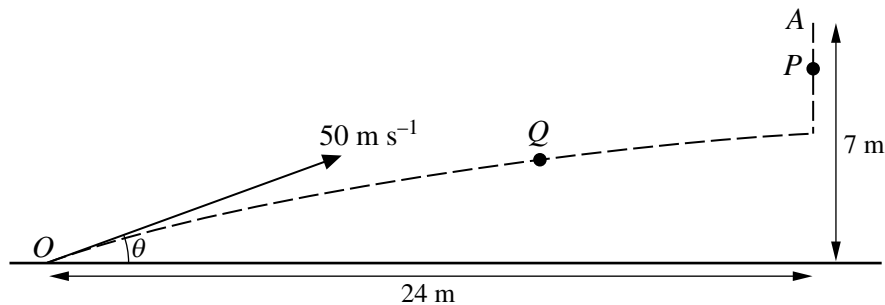
Score: /50

Percentage: /100

Grade Boundaries:

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

1



A particle P is released from rest at a point A which is 7 m above horizontal ground. At the same instant that P is released a particle Q is projected from a point O on the ground. The horizontal distance of O from A is 24 m. Particle Q moves in the vertical plane containing O and A , with initial speed 50 m s^{-1} and initial direction making an angle θ above the horizontal, where $\tan \theta = \frac{7}{24}$ (see diagram). Show that the particles collide. [6]

2 A particle P of mass 0.3 kg is projected vertically upwards from the ground with an initial speed of 20 m s^{-1} . When P is at height x m above the ground, its upward speed is $v \text{ m s}^{-1}$. It is given that

$$3v - 90 \ln(v + 30) + x = A,$$

where A is a constant.

- (i) Differentiate this equation with respect to x and hence show that the acceleration of the particle is $-\frac{1}{3}(v + 30) \text{ m s}^{-2}$. [3]
- (ii) Find, in terms of v , the resisting force acting on the particle. [2]
- (iii) Find the time taken for P to reach its maximum height. [5]

- 3 A small stone is projected from a point O on horizontal ground with speed $V \text{ m s}^{-1}$ at an angle θ° above the horizontal. Referred to horizontal and vertically upwards axes through O , the equation of the stone's trajectory is $y = 0.75x - 0.02x^2$, where x and y are in metres. Find
- (i) the values of θ and V , [4]
 - (ii) the distance from O of the point where the stone hits the ground, [2]
 - (iii) the greatest height reached by the stone. [2]

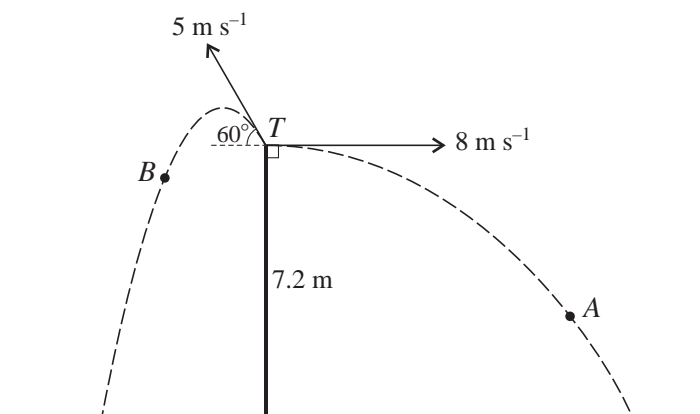
- 4 A particle P is projected from a point O on horizontal ground with speed $V \text{ m s}^{-1}$ and direction 60° upwards from the horizontal. At time t s later the horizontal and vertical displacements of P from O are x m and y m respectively.
- (i) Write down expressions for x and y in terms of V and t and hence show that the equation of the trajectory of P is

$$y = (\sqrt{3})x - \frac{20x^2}{V^2}. \quad [5]$$

P passes through the point A at which $x = 70$ and $y = 10$. Find

- (ii) the value of V , [2]
- (iii) the direction of motion of P at the instant it passes through A . [3]

5



Particles A and B are projected simultaneously from the top T of a vertical tower, and move in the same vertical plane. T is 7.2 m above horizontal ground. A is projected horizontally with speed 8 m s^{-1} and B is projected at an angle of 60° above the horizontal with speed 5 m s^{-1} . A and B move away from each other (see diagram).

- (i) Find the time taken for A to reach the ground. [2]

At the instant when A hits the ground,

- (ii) show that B is approximately 5.2 m above the ground, [2]
 (iii) find the distance AB . [3]

6 A particle is projected from a point O at an angle of 35° above the horizontal. At time T s later the particle passes through a point A whose horizontal and vertically upward displacements from O are 8 m and 3 m respectively.

- (i) By using the equation of the particle's trajectory, or otherwise, find (in either order) the speed of projection of the particle from O and the value of T . [5]
 (ii) Find the angle between the direction of motion of the particle at A and the horizontal. [4]