Motion of a Projectile

Question Paper 9

Level	International A Level
Subject	Maths
Exam Board	CIE
Topic	Motion of a Projectile
Sub Topic	
Booklet	Question Paper 9

Time Allowed: **63 minutes**

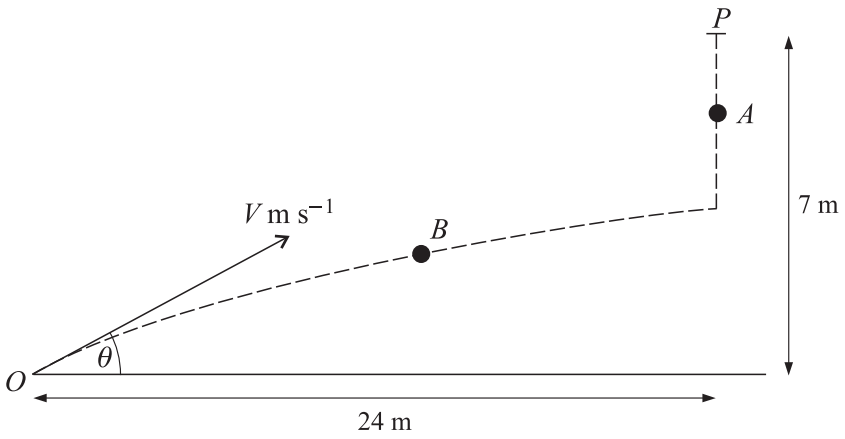
Score: **/52**

Percentage: **/100**

Grade Boundaries:

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

1



A particle A is released from rest at time $t = 0$, at a point P which is 7 m above horizontal ground. At the same instant as A is released, a particle B is projected from a point O on the ground. The horizontal distance of O from P is 24 m. Particle B moves in the vertical plane containing O and P, with initial speed V m s^{-1} and initial direction making an angle of θ above the horizontal (see diagram). Write down

(i) an expression for the height of A above the ground at time t s, [1]

(ii) an expression in terms of V, θ and t for

(a) the horizontal distance of B from O, [1]

(b) the height of B above the ground. [1]

At time $t = T$ the particles A and B collide at a point above the ground.

(iii) Show that $\tan\theta = \frac{7}{24}$ and that $VT = 25$. [6]

(iv) Deduce that $7V^2 > 3125$. [3]

2 A particle is projected from a point O on horizontal ground with speed 50 m s^{-1} at an angle θ to the horizontal. Given that the speed of the particle when it is at its highest point is 40 m s^{-1},

(i) show that $\cos\theta = 0.8$, [2]

(ii) find, in either order,

(a) the greatest height reached by the particle,

(b) the distance from O at which the particle hits the ground. [5]

3 A particle is projected from a point O on horizontal ground. The velocity of projection has magnitude $V\,\text{m s}^{-1}$ and direction upwards at 35° to the horizontal. The particle passes through the point M at time T seconds after the instant of projection. The point M is 2 m above the ground and at a horizontal distance of 25 m from O.

(i) Find the values of V and T. [5]

(ii) Find the speed of the particle as it passes through M and determine whether it is moving upwards or downwards. [4]

4 A stone is projected from a point on horizontal ground with a speed of $20\,\text{m s}^{-1}$ at an angle of $\alpha°$ above the horizontal. The stone is moving horizontally when it hits a vertical wall at a point 7.2 m above the ground.

(i) Find the value of α. [4]

After rebounding at right angles from the wall the speed of the stone is halved. Find

(ii) the distance from the wall of the point at which the stone hits the ground, [4]

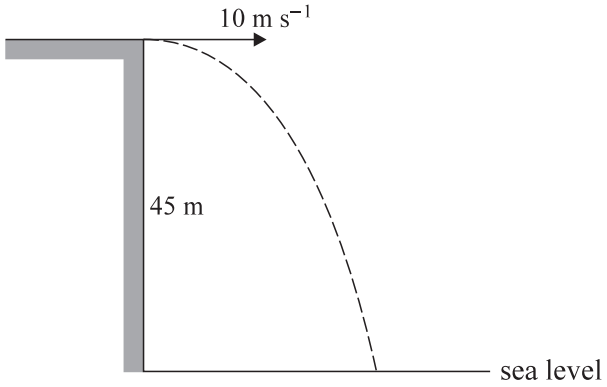
(iii) the angle which the direction of motion of the stone makes with the horizontal, immediately before the stone hits the ground. [3]

5 A particle of mass 0.2 kg moves in a straight line on a smooth horizontal surface. When its displacement from a fixed point on the surface is x m, its velocity is $v\,\text{m s}^{-1}$. The motion is opposed by a force of magnitude $\frac{1}{3v}$ N.

(i) Show that $3v^2\frac{\text{d}v}{\text{d}x} = -5$. [3]

(ii) Find the value of v when $x = 7.4$, given that $v = 4$ when $x = 0$. [4]

6



A stone is projected horizontally, with speed $10\,\text{m}\,\text{s}^{-1}$, from the top of a vertical cliff of height 45 m above sea level (see diagram). At time t s after projection the horizontal and vertically upward displacements of the stone from the top of the cliff are x m and y m respectively.

(i) Write down expressions for x and y in terms of t, and hence obtain the equation of the stone's trajectory. [3]

(ii) Find the angle the trajectory makes with the horizontal at the point where the stone reaches sea level. [3]