Projectiles Example

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6.

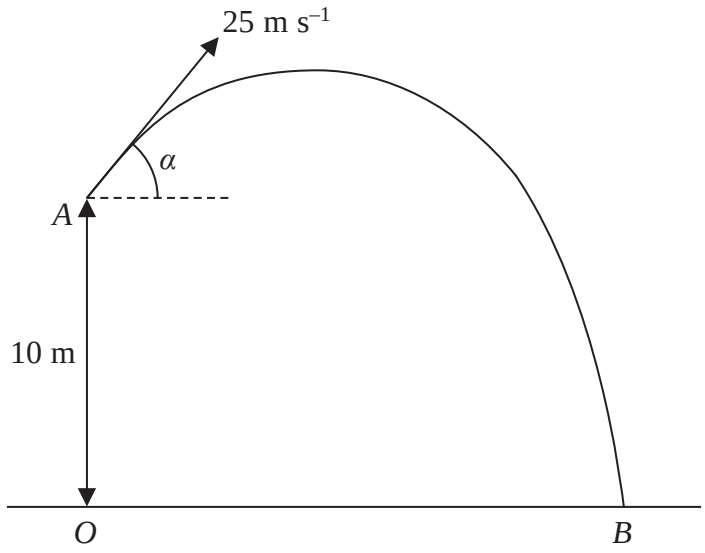

Figure 4

A particle P is projected from a point A with speed 25 m s^{-1} at an angle of elevation α, where $\sin\alpha = \frac{4}{5}$. The point A is 10 m vertically above the point O which is on horizontal ground, as shown in Figure 4. The particle P moves freely under gravity and reaches the ground at the point B.

Calculate

(a) the greatest height above the ground of P, as it moves from A to B,

(3)

(b) the distance OB.

(6)

The point C lies on the path of P. The direction of motion of P at C is perpendicular to the direction of motion of P at A.

(c) Find the time taken by P to move from A to C.

(4)

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Question 6 continued

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Question 6 continued

Question Number	Scheme	Marks	Notes
6. (a)	$0=(25\sin\alpha)^2-2gs$	M1	A complete method using *suvat* to find *s*
	$s=400\div19.6$ (20.4)	A1	Correct expression in *s* only
	Height above ground $=10+400\div19.6=30$ or 30.4 m	A1 (3)	30 or 30.4 only
(b)	$10=-25\times\frac{4}{5}t+\frac{1}{2}\times gt^2$	M1	A complete method using *suvat* to find the total time from *A* to *B*. Condone sign slips.
		A1	Correctly substituted equation in *t*
	$4.9t^2-20t-10=0$ $\quad t=\frac{20\pm\sqrt{400+4\times4.9\times10}}{2\times4.9}$	DM1	Dependent on the preceding M1. Solve for *t*
	$t=4.531...$ s	A1	
	Horiz distance $=25\cos\alpha t\,(=15t$ m$)$	M1	
	$=68$ m	A1 (6)	68 or 68.0 only
(c)	At *C* horiz speed $=15$ m s^{-1}		
	Vert speed $=\frac{15}{\tan\alpha}$	M1	Use similar triangles, or equivalent, to find vertical speed at C
	$=11.25$	A1	
	$11.25=-20+gt$	DM1	Use *suvat* to find time from *A* to *C*. Dependent on the preceding M1
	$t=\frac{20+11.25}{9.8}=3.2$ or 3.19	A1 (4)	3.2 or 3.19 only
		[13]	