8. A particle P is projected from a fixed point O. The particle is projected with speed $u\,\text{m s}^{-1}$ at angle α above the horizontal. The particle moves freely under gravity. At the instant when the horizontal distance of P from O is x metres, P is y metres vertically above the level of O.

(a) Show that $y = x\tan\alpha - \dfrac{gx^2}{2u^2}\left(1 + \tan^2\alpha\right)$

(6)

A small ball is projected from a fixed point A with speed $U\,\text{m s}^{-1}$ at $\theta°$ above the horizontal.
The point B is on horizontal ground and is vertically below the point A, with $AB = 20\,\text{m}$.
The ball hits the ground at the point C, where $BC = 30\,\text{m}$, as shown in Figure 4.

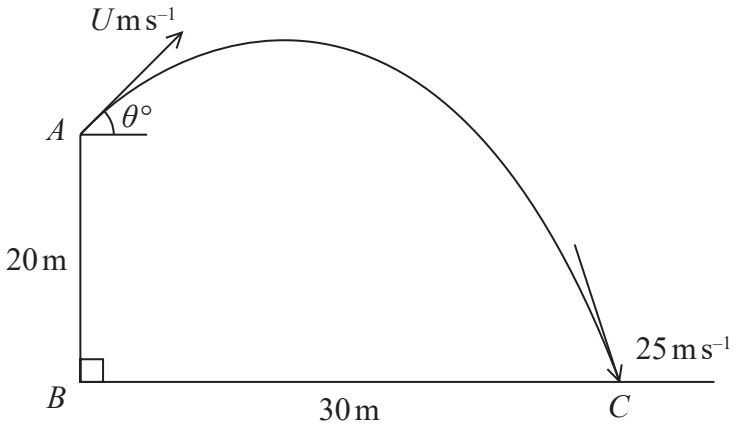


Figure 4

The speed of the ball immediately before it hits the ground is $25\,\text{m s}^{-1}$
The motion of the ball is modelled as that of a particle moving freely under gravity.

(b) Use the principle of conservation of mechanical energy to find the value of U.

(3)

(c) Find the value of θ

(3)

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TOTAL FOR PAPER IS 75 MARKS

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