Mixed Exercise 6.01 Projectiless (Year 2 Applied Maths)

1 *A particle is projected from a point A with a speed of* $\boldsymbol{u}$ *at an angle of elevation* $\boldsymbol{\theta}$ *above the horizontal and moves freely under gravity. When it has moved a horizontal distance of* x*, its vertical height above the point of projection is* y*.*

Show that $y = x\tan\theta - \frac{gx^2}{2u^2}(1 + \tan^2\theta)$

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2 *A particle is projected from a point A with speed* $40.6\ ms^{-1}$ *at an angle of elevation of* $30°$.

The particle moves freely under gravity.

Find the length of time for which the particle is $18\ m$ *or more above A.*

Link to Solutions:
https://youtu.be/YKwBu2hjncU

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3 *A particle P is projected from a point A with position* $25\boldsymbol{j}$ *m with respect to a fixed origin O. The velocity of projection is* $(6u\boldsymbol{i} + 4u\boldsymbol{j})\ ms^{-1}$. *The particle moves freely under gravity, passing through a point B, which has position vector* $(\lambda\boldsymbol{i} + 15\boldsymbol{j})$ *m, where* λ *is a constant, before reaching the point C on the* $x-$*axis, as shown in the diagram. The particle takes 5 s to move from A to B.*

Find: (a) the value of u (b) the value of λ

(c) the angle the velocity of P makes with the $x-$*axis as it reaches C.*