

STEP II, 2001, Q9

- 9 A particle of unit mass is projected vertically upwards with speed u . At height x , while the particle is moving upwards, it is found to experience a total force F , due to gravity and air resistance, given by $F = \alpha e^{-\beta x}$, where α and β are positive constants. Calculate the energy expended in reaching this height. Show that

$$F = \frac{1}{2}\beta v^2 + \alpha - \frac{1}{2}\beta u^2,$$

where v is the speed of the particle, and explain why $\alpha = \frac{1}{2}\beta u^2 + g$, where g is the acceleration due to gravity.

Determine an expression, in terms of y , g and β , for the air resistance experienced by the particle on its downward journey when it is at a distance y below its highest point.



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