A particle P of mass $0.5\,\text{kg}$ is attached to a fixed point O by a light elastic string of natural length $1\,\text{m}$ and modulus of elasticity $16\,\text{N}$. The particle P is projected vertically upwards from O with speed $6\,\text{m}\,\text{s}^{-1}$. A resisting force of magnitude $0.1x^2\,\text{N}$ acts on P when P has displacement $x\,\text{m}$ above O. After projection the upwards velocity of P is $v\,\text{m}\,\text{s}^{-1}$.

  (i) Show that, before the string becomes taut, $v\dfrac{\text{d}v}{\text{d}x} = -10 - 0.2x^2$.   [2]

  (ii) Find the velocity of P at the instant the string becomes taut.   [4]

  (iii) Find an expression for the acceleration of P while it is moving upwards after the string becomes taut.   [2]

  (iv) Verify that P comes to instantaneous rest before the extension of the string is $0.5\,\text{m}$.   [4]