

## 6.3C: Body thrown vertically upwards with initial speed $v_0$

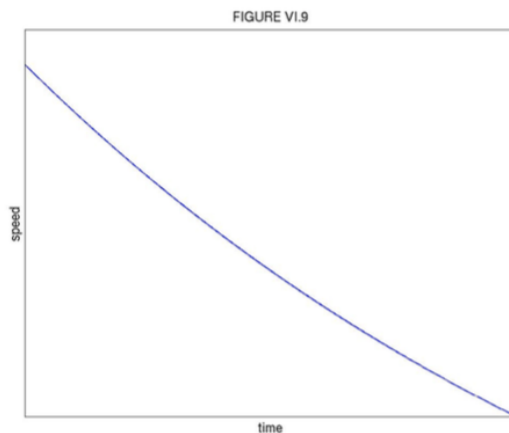
If we measure  $y$  upwards from the ground, the equation of motion is

$$\ddot{y} = -g - \gamma v = -\gamma(\hat{v} + v). \quad (6.3.24)$$

The *first time integral* is

$$v = -\hat{v} + (v_0 + \hat{v})e^{-\gamma t} \quad (6.3.25)$$

and this is shown in Figure VI.9.



It reaches a maximum height after time  $T$ , when  $v = 0$  (at which time the acceleration is just  $-g$ ):

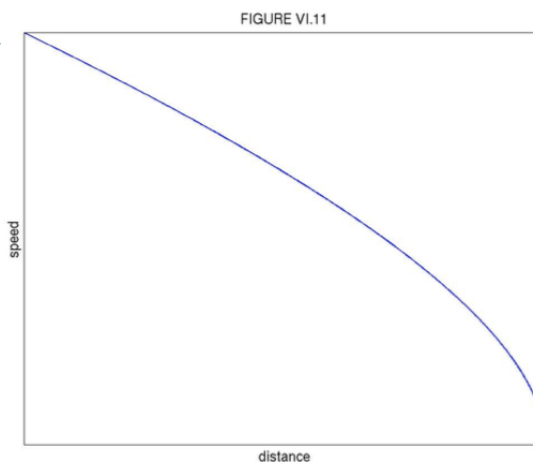
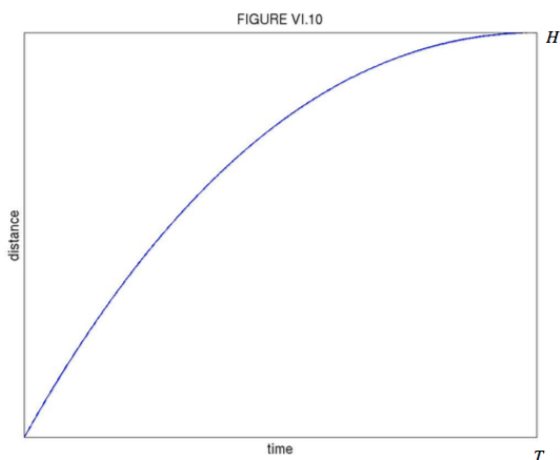
$$t + \frac{1}{\gamma} \ln\left(1 + \frac{v_0}{\hat{v}}\right). \quad (6.3.26)$$

The *second time integral* (obtained by writing  $v$  as  $\frac{dy}{dt}$  in Equation 6.3.25) and the *space integral* (obtained by writing  $\ddot{y}$  as  $v \frac{dv}{dy}$  in the equation of motion) require some patience, but the results are

$$y = \frac{(v_0 + \hat{v})}{\gamma} (1 - e^{-\gamma t} - \hat{v}t), \quad (6.3.27)$$

$$v = v_0 - \gamma y - \hat{v} \ln\left(\frac{\hat{v} + v_0}{\hat{v} + v}\right). \quad (6.3.28)$$

These are illustrated in Figures VI.10 and VI.11.



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