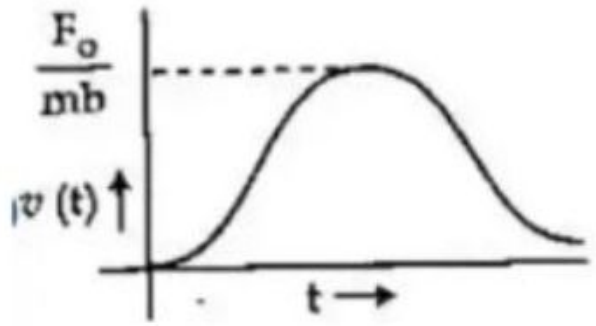
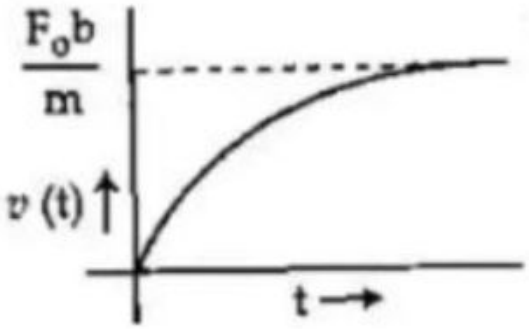
A particle of mass m is at rest at the origin at time t = 0. It is subjected to a force $F(t) = F_0 e^{-bt}$ in the x direction. Its speed v(t) is depicted by which of the following curves ?

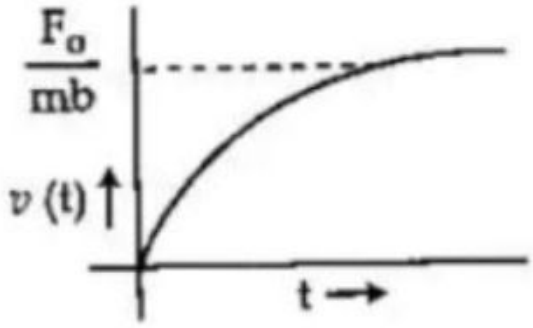
A



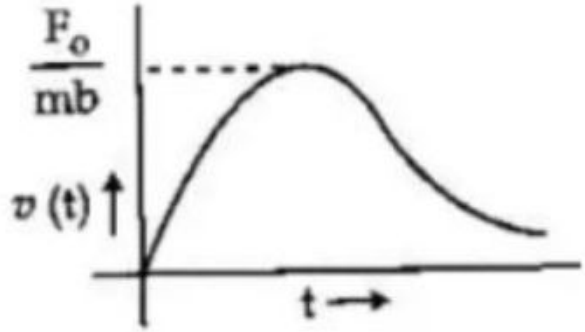
B



C



D



Solution

Correct option is C)

$$F = ma = F_0 e^{-bt}$$

$$\frac{dv}{dt} = \frac{F_0}{m} e^{-bt}$$

$$\int_0^v dv = \frac{F_0}{m} \int_0^t e^{-bt}$$

$$v = \frac{F_0}{m} \left[\frac{e^{-bt}}{-b}\right]_0^t$$

$$v = \frac{F_0}{mb}(1 - e^{-bt})$$

So, option C is correct.