

13. For $x \geq 0$, $m \frac{d^2x}{dt^2} = -m\mu^2 x \Rightarrow \frac{d^2x}{dt^2} + \mu^2 x = 0 \Rightarrow x = A \cos \mu t + B \sin \mu t$
 at $t = 0$, $x = 0$ and $\frac{dx}{dt} = v_0$ so $A = 0$ and $B = \frac{v_0}{\mu}$ i.e. $x = \frac{v_0}{\mu} \sin \mu t$

For $x < 0$, $\frac{d^2x}{dt^2} = -\kappa \frac{dx}{dt} \Rightarrow \frac{d^2x}{dt^2} + \kappa \frac{dx}{dt} = 0 \Rightarrow x = C + D e^{-\kappa t}$

at $t = 0$, $x = 0$ and $\frac{dx}{dt} = v_0$ so $C + D = 0$ and $-\kappa D = v_0$ so $D = -\frac{v_0}{\kappa}$ and $C = \frac{v_0}{\kappa} \Rightarrow x = \frac{v_0}{\kappa} (1 - e^{-\kappa t})$

