

$$a) \quad \ddot{x} + 8\dot{x} + 7x = 0$$

$$\Rightarrow r^2 + 8r + 7 = 0$$

$$(r+7)(r+1) = 0$$

$$r = -7, -1$$

$$\Rightarrow x = c_1 e^{-7t} + c_2 e^{-t}$$

\therefore yes

$$b) \quad \dot{y} = -ky$$

$$\dot{y} + ky = 0$$

$$\text{Assume } y = e^{rt}$$

$$\Rightarrow re^{rt} + ke^{rt} = 0$$

$$r+k=0$$

$$r = -k$$

$$\therefore y = Ce^{-kt}$$

$$c) \quad r = -4, -3, -2, -1, 0, 1, 2, 3$$

$$\therefore x = c_1 e^{-4t} + c_2 e^{-3t} + c_3 e^{-2t} + c_4 e^{-t} + c_5 + c_6 e^t + c_7 e^{2t} + c_8 e^{3t}$$