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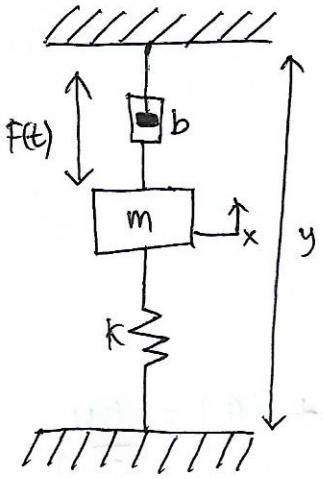
1.



$m = 20\ kg$

$b = 5\ kg/s$

$k = 10\ N/m$

$x_0 = 0.5\ m$

$y = 2\ m$

a. differential equation

$$\Sigma F = m.a$$

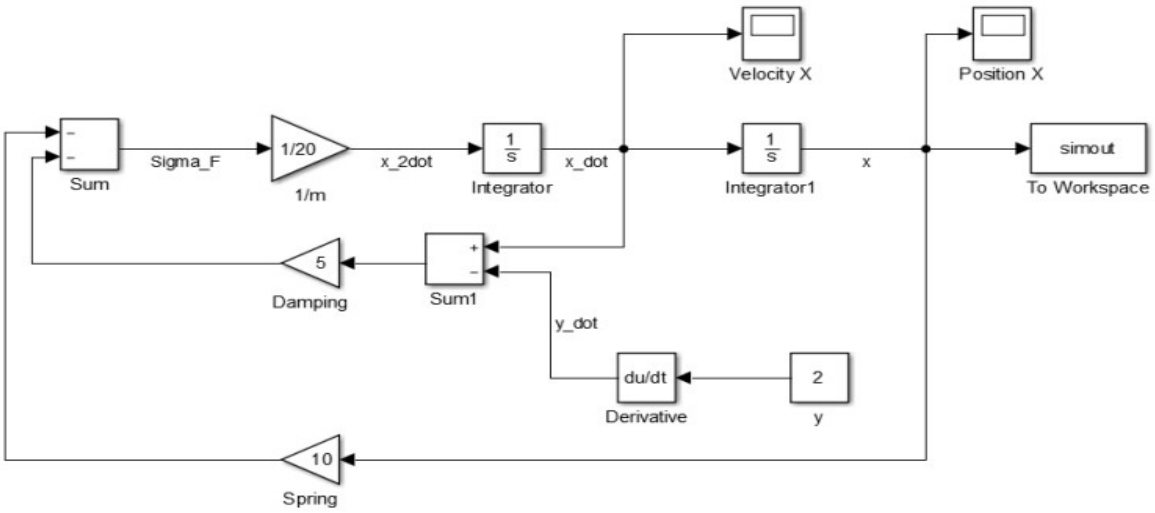
$$-fb - fk = m\ddot{x}$$

$$-b(\dot{x}-\dot{y}) - k(x) = m\ddot{x}$$

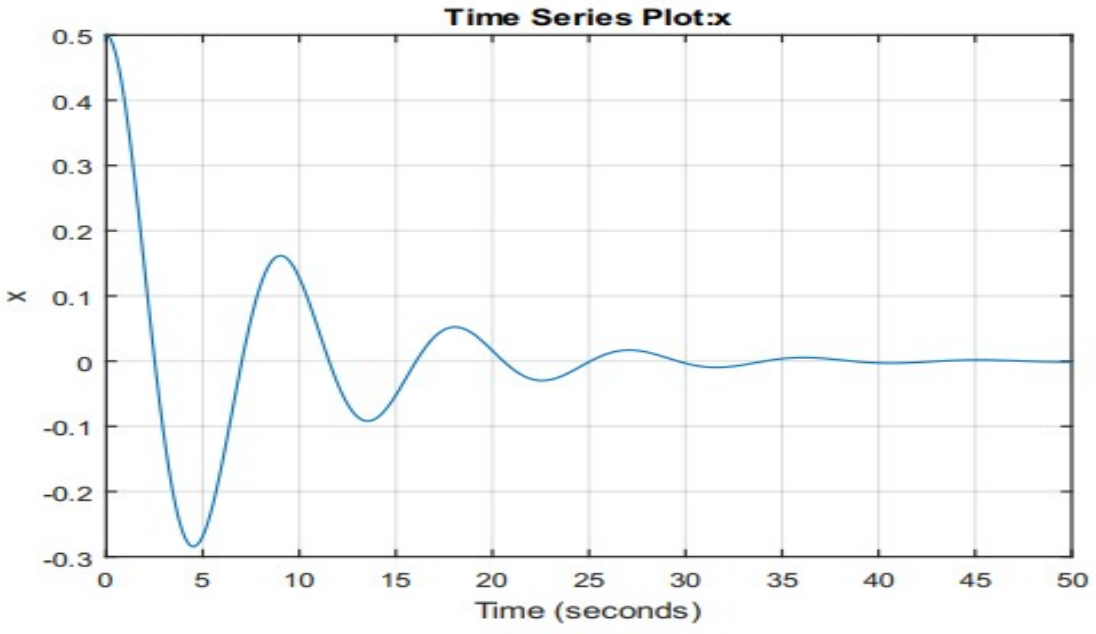
$$\frac{-b(\dot{x}-\dot{y}) - k(x)}{m} = \ddot{x}$$

$$\ddot{x} = \frac{-b}{m}(\dot{x}-\dot{y}) - \frac{k}{m}(x)$$

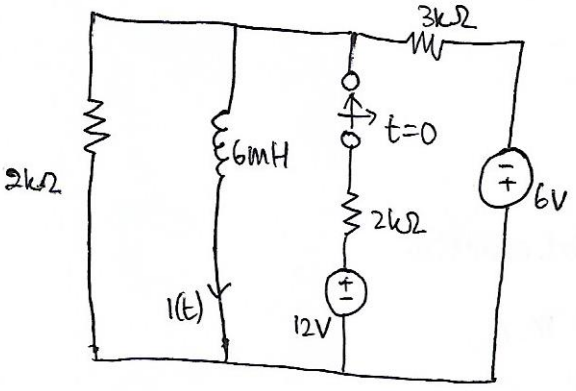
1. b.



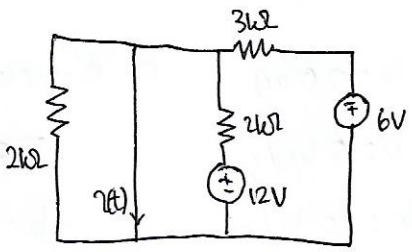
1. c.

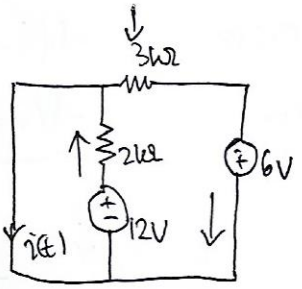


2.



a) i_0, $t=0s$



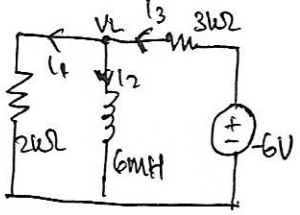


$$\frac{6V}{3k\Omega} + i(t) = \frac{12V}{2k\Omega}$$

$$i(t) = \frac{12V}{2k\Omega} - \frac{6V}{3k\Omega} = 4mA$$

$t=0 \Rightarrow i_0 = 4mA$

b) $t>0$



$$i_3 = i_1 + i_2$$

$$\frac{-6-V_L}{3k} = \frac{V_L}{2k} + i_L$$

$$\frac{-6-L\frac{di}{dt}}{3.10^3} = \frac{L\frac{di}{dt}}{2.10^3} + i_L$$

$$-2.10^{-3} - \frac{6.10^{-3}}{3.10^3}\frac{di_L}{dt} = \frac{6.10^{-3}}{2.10^3}\frac{di_L}{dt} + i_L$$

$$-2.10^{-3} = 5.10^{-6}\frac{di_L}{dt} + i_L$$

$$\frac{-2}{s} = 5.10^{-6}\left(I_L s - 4\right) + I_L$$

$$\frac{-2}{s} = -20.10^{-6} + I_L\left(1+5.10^{-6}s\right)$$

$$\frac{-2}{s} + 20.10^{-6} = I_L\left(1+5.10^{-6}s\right)$$

$$I_L = \frac{\frac{-2}{s} + 20.10^{-6}}{1+5.10^{-6}s}$$

$$I_L = \frac{-2+20.10^{-6}s}{s\left(1+5.10^{-6}s\right)}$$

$$I_L = \frac{A}{s} + \frac{B}{\left(1+5.10^{-6}s\right)}$$

$$A = \left.\frac{-2+20.10^{-6}s}{1+5.10^{-6}s}\right|_{s=0} = -2$$

$$B = \left.\frac{-2+20.10^{-6}}{s}\right|_{s=\frac{-1}{5.10^{-6}}} = 3.10^{-5}$$

$$I_L = \frac{-2}{s} + \frac{30.10^{-6}}{1+5.10^{-6}s}$$

$$= \frac{-2}{s} + \frac{6}{1+\frac{1}{5.10^{-6}}}$$

$$i_L(t) = -2 + 6e^{-t/5.10^{-6}} \text{ mA}$$

2.c. The MATLAB code for Question 2. c.

```
clc;
clear all;

s = tf('s');
I = (-2+(20e-6)*s)/(s*(1+(5e-6)*s));

impulse(I)
```