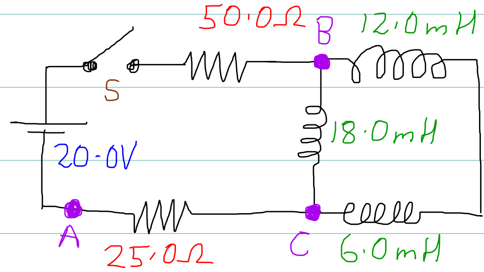


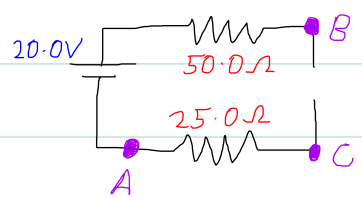
IN THE DEPICTED CIRCUIT, SWITCH S HAS BEEN OPEN FOR A LONG TIME. FIND THE CURRENT AT POINT A AND THE POTENTIAL DIFFERENCE BETWEEN POINTS B AND C:

(a) JUST AFTER SWITCH S IS CLOSED ($t=0$)

(b) AFTER SWITCH S HAS BEEN CLOSED FOR A LONG TIME ($t \to \infty$, OR "STEADY STATE")

(c) AFTER SWITCH S HAS BEEN CLOSED FOR 0.115 ms

(a) EQUIVALENT CIRCUIT IS:

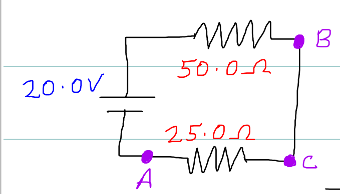


NO CURRENT FLOWS, SO $\underline{\underline{I_A = 0}}$

IF NO CURRENT FLOWS, $V = IR = 0$ AND THERE IS NO VOLTAGE DROP ACROSS ANY RESISTOR, SO $V_B = 20V$

$V_C = 0V$ AND $\underline{\underline{\Delta V_{BC} = 20V}}$

(b) EQUIVALENT CIRCUIT IS:

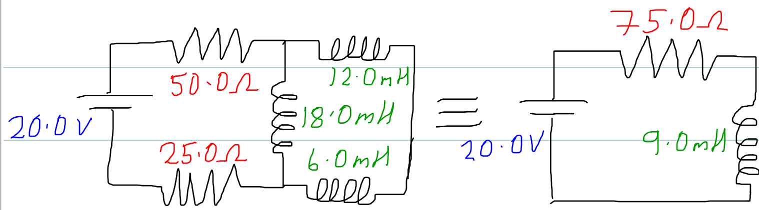


$R_{EQ} = R_1 + R_2 = 50\Omega + 25\Omega = 75\Omega$, $I_{EQ} = \frac{V_{EQ}}{R_{EQ}} = \frac{20V}{75\Omega} = \underline{\underline{0.267A}}$

IN A SERIES CIRCUIT, $I_A = I_{EQ} \Rightarrow \underline{\underline{I_A = 0.267A}}$

THERE IS NO COMPONENT BETWEEN B AND C, SO NO VOLTAGE DROP $\Rightarrow \underline{\underline{\Delta V_{BC} = 0}}$

(c) EQUIVALENT CIRCUIT IS:



WHERE THE RESISTORS SUM AS IN (b) AND THE INDUCTORS ARE COMBINED USING THE SERIES AND PARALLEL RULES AS FOR RESISTORS

$$L_{12,6} = L_{12} + L_6 = 12.0\,mH + 6.0\,mH = 18.0\,mH$$

$$\frac{1}{L_{EQ}} = \frac{1}{L_{12,6}} + \frac{1}{L_{18}} = \frac{1}{18} + \frac{1}{18} = \frac{1}{9} \Rightarrow L_{EQ} = 9.0\,mH$$

WE THUS HAVE AN RL CIRCUIT WITH $R = 75\,\Omega$ AND $L = 9.0\,mH$

FOR AN RL CIRCUIT $i = \frac{\varepsilon}{R}\left(1 - e^{-t/\tau}\right)$ WHILE CHARGING

$\tau = \frac{L}{R} = \frac{9.0\,mH}{75.0\,\Omega} = 0.12\,ms$. AFTER $0.115\,ms$...

$$i_{EQ} = \frac{20.0\,V}{75.0\,\Omega}\left(1 - e^{\frac{-0.115\,ms}{0.12\,ms}}\right) = 0.164\,A$$

IN SERIES, $i_A = i_{EQ} \Rightarrow \underline{\underline{i_A = 0.164\,A}}$

CONSIDER THE EQUIVALENT CIRCUIT... THE DROP ACROSS THE EQUIVALENT RESISTOR IS $V_R = iR_{EQ} = (0.164\,A)(75.0\,\Omega)$

THE VOLTAGE CHANGE AROUND THE EQUIVALENT CIRCUIT IS $(20V) - V_R - V_L = 0$

WHERE $V_L = V_{BC}$ IS THE DROP ACROSS THE INDUCTOR

$$\Rightarrow V_{BC} = V_L = (20V) - V_R = (20V) - \left((0.164A)(75.0\,\Omega)\right) = \underline{\underline{7.67\,V}}$$