Princess Sumaya University for Technology
جامعة الأميرة سمية للتكنولوجيا

King Abdullah II School of Engineering

EE21221
Electric Circuits (1)
Section #4

Quiz #5
Thursday 6/1/2022

Name: ……

Q.1) The switch in the circuit of Figure Q.1 has been closed for a long time. At t=0, the switch is opened. Calculate i(t) for t>0. [4-Points]

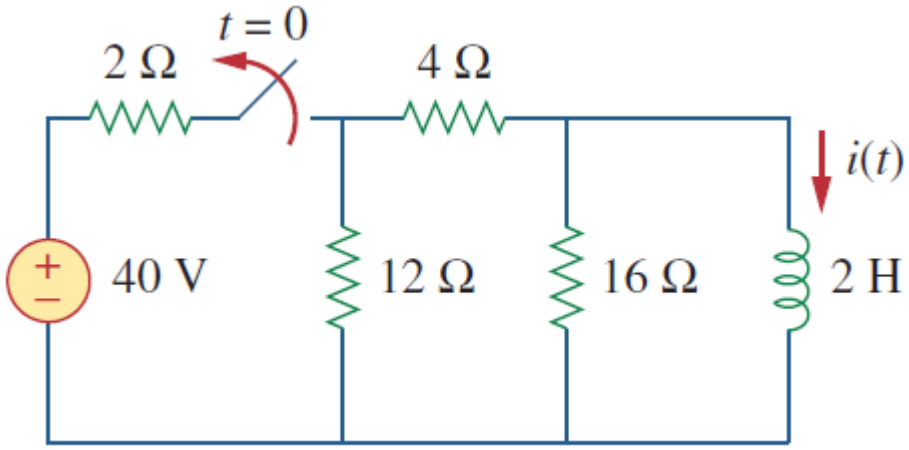
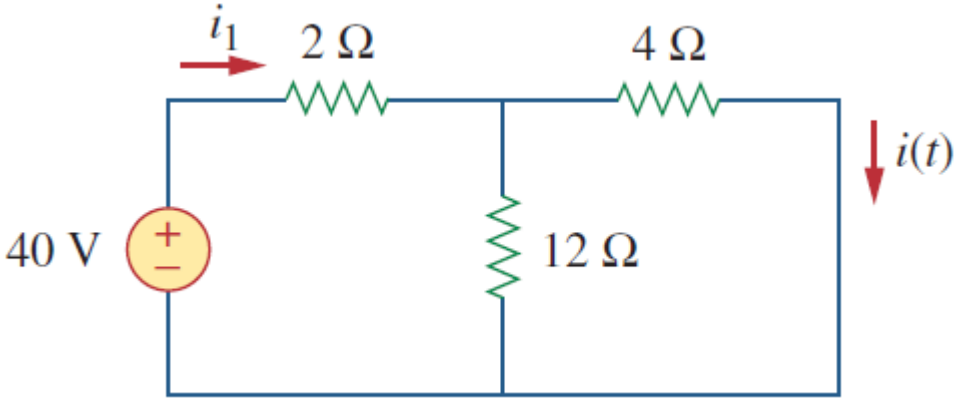
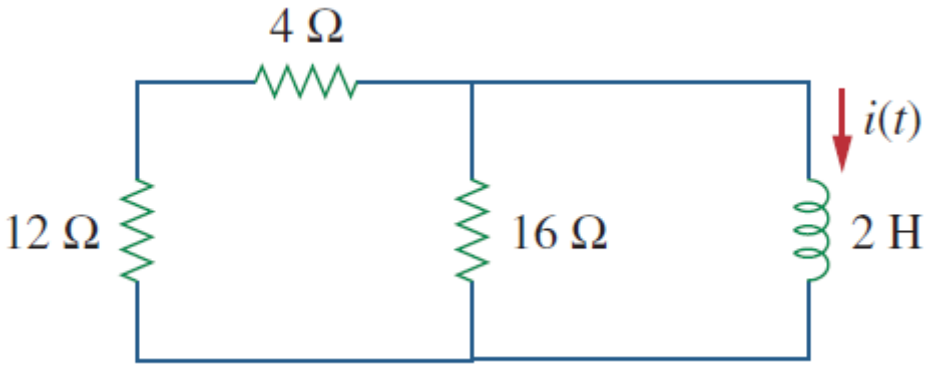


Figure Q.1

Solution:





When $t < 0$,

$$\frac{4 \times 12}{4 + 12} = 3\ \Omega$$

$$i_1 = \frac{40}{2 + 3} = 8\ \text{A}$$

using current division,

$$i(t) = \frac{12}{12 + 4} i_1 = 6\ \text{A}, \qquad t < 0$$

$$i(0) = i(0^-) = 6\ \text{A}$$

When $t > 0$,

$$R_{\text{eq}} = (12 + 4) \parallel 16 = 8\ \Omega$$

$$\tau = \frac{L}{R_{\text{eq}}} = \frac{2}{8} = \frac{1}{4}\ \text{s}$$

$$i(t) = i(0)e^{-t/\tau} = 6e^{-4t}\ \text{A}$$

Q.2) The switch in Figure Q.2 has been in position A for a long time. At t=0, the switch moves to B. Determine v(t) for t>0 and calculate its value at t=1 s and 4 s. [6-Points]

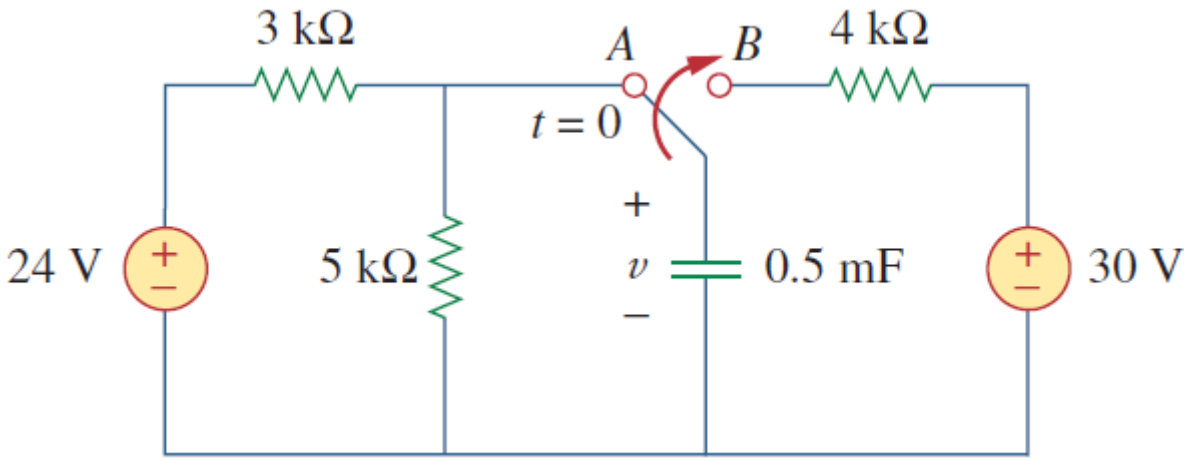


Figure Q.2

Solution:

i=

For $t < 0$,

$$v(0^-) = \frac{5}{5+3}(24) = 15 \text{ V}$$

$$v(0) = v(0^-) = v(0^+) = 15 \text{ V}$$

For $t > 0$,

$R_{\text{Th}} = 4 \text{ k}\Omega$,

$$\tau = R_{\text{Th}}C = 4 \times 10^3 \times 0.5 \times 10^{-3} = 2 \text{ s}$$

$$v(\infty) = 30 \text{ V}.$$

$$v(t) = v(\infty) + [v(0) - v(\infty)]e^{-t/\tau}$$
$$= 30 + (15 - 30)e^{-t/2} = (30 - 15e^{-0.5t}) \text{ V}$$

At $t = 1$,

$$v(1) = 30 - 15e^{-0.5} = 20.9 \text{ V}$$

At $t = 4$,

$$v(4) = 30 - 15e^{-2} = 27.97 \text{ V}$$