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EE21221
Electric Circuits (1)
Section #1

Quiz #4
Tuesday 28/12/2021

Name:

Q.1) Sketch the voltage which develops across the terminals of a 2.5 F capacitor in response to the current waveforms that is shown in Figure Q.1. [3-Points]

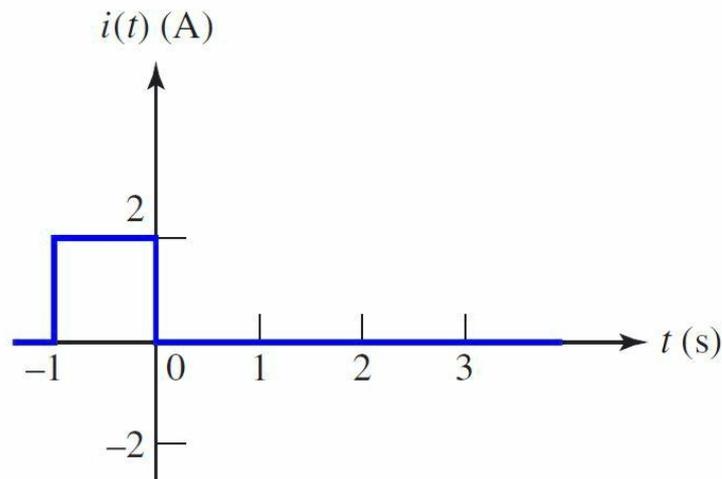


Figure Q.1

Solution:

$$v(t) = \frac{1}{C} \int_{t_0}^t i(t) \cdot dt + v(t_0)$$

For $-\infty \leq t \leq -1$

$$\begin{aligned} i(t) &= 0, -\infty \leq t \leq -1 \\ v(t_0) &= v(-\infty) = 0 \\ v(t) &= \frac{1}{2.5} \int_{-\infty}^t 0 \cdot dt + v(-\infty) \\ v(t) &= 0, -\infty \leq t \leq -1 \end{aligned}$$

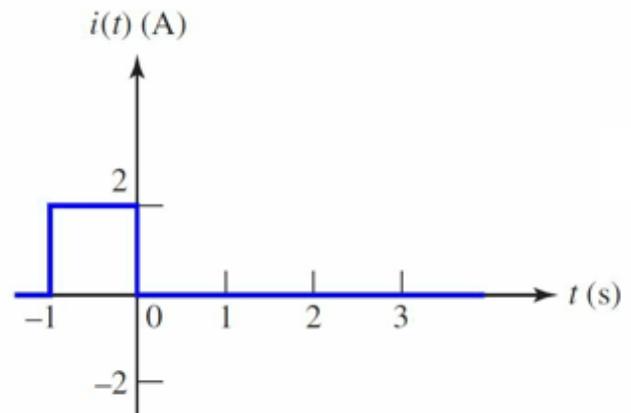
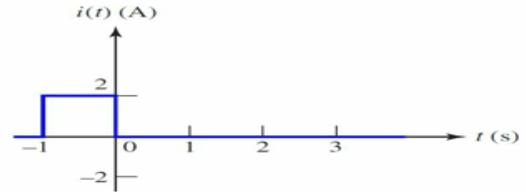
For $-1 \leq t \leq 0$

$$\begin{aligned} i(t) &= 2, -1 \leq t \leq 0 \\ v &= \frac{1}{2.5} \int_{-1}^t 2 \cdot dt + v(-1) \\ &= \frac{2}{2.5} t \Big|_{-1}^t + v(-1) \\ &= 0.8(t+1) + v(-1) \\ v(-1) &= 0 \end{aligned}$$

$$v(t) = 0.8(t+1), -1 \leq t \leq 0$$

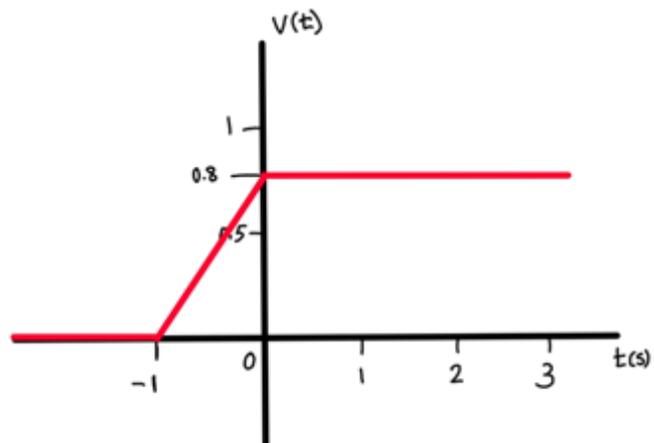
For $0 \leq t$

$$\begin{aligned} v(t) &= \frac{1}{2.5} \int_0^t 0 \cdot dt + v(0) \\ v(0) &= 0.8 \\ v(t) &= 0.8, t \geq 0 \end{aligned}$$



$$\begin{aligned} v(t) &= 0, -\infty \leq t \leq -1 \\ v(t) &= 0.8(t+1), -1 \leq t \leq 0 \\ v(t) &= 0.8, t \geq 0 \end{aligned}$$

$$v(t) = \begin{cases} 0 & , t \leq -1 \\ 0.8(t+1) & , -1 \leq t \leq 0 \\ 0.8 & , t \geq 0 \end{cases}$$



Q.2) Obtain the equivalent resistance R_{ab} in the circuit shown in Figure Q.2 then use it to find i . [4-Points]

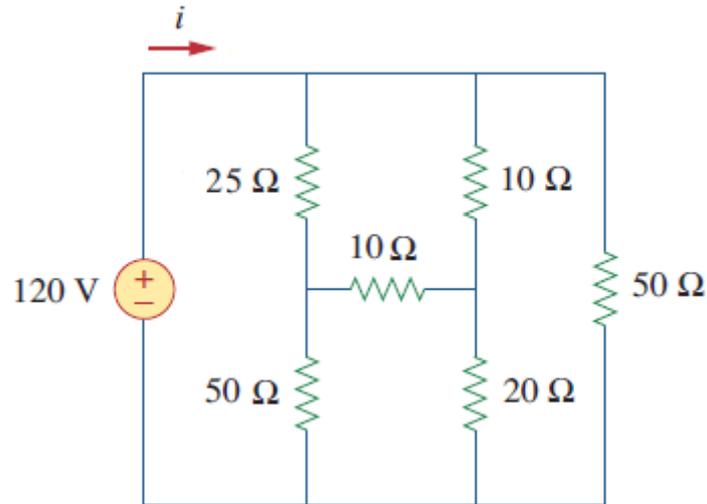
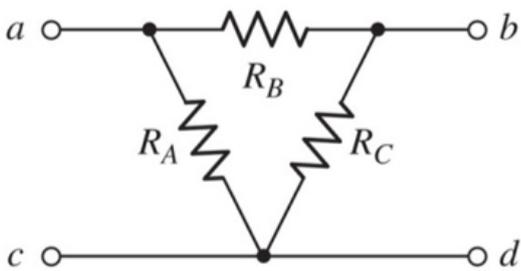


Figure Q.2

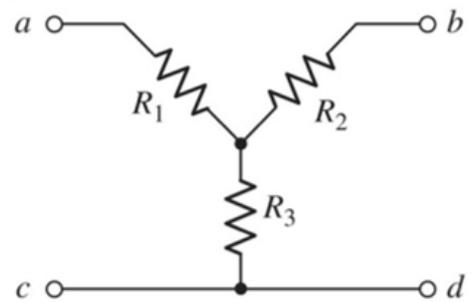


this Δ is equivalent to the Y if

$$R_A = \frac{R_1 R_2 + R_2 R_3 + R_3 R_1}{R_2}$$

$$R_B = \frac{R_1 R_2 + R_2 R_3 + R_3 R_1}{R_3}$$

$$R_C = \frac{R_1 R_2 + R_2 R_3 + R_3 R_1}{R_1}$$



this Y is equivalent to the Δ if

$$R_1 = \frac{R_A R_B}{R_A + R_B + R_C}$$

$$R_2 = \frac{R_B R_C}{R_A + R_B + R_C}$$

$$R_3 = \frac{R_C R_A}{R_A + R_B + R_C}$$

Solution:

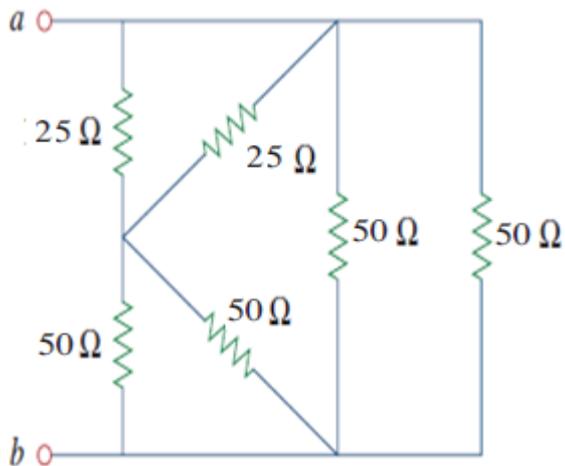
$i =$

$R_1=10\ \Omega$, $R_2=20\ \Omega$, and $R_3=10\ \Omega$

$$R_a=500/20=25\ \Omega$$

$$R_b=500/10=50\ \Omega$$

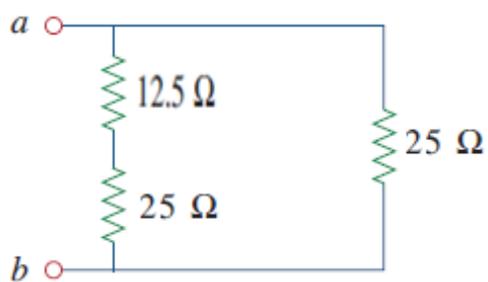
$$R_c=500/10=50\ \Omega$$



$$50//50=25\ \Omega$$

$$25//25=12.5\ \Omega$$

$$50//50=25\ \Omega$$



$$12.5+25=37.5\ \Omega$$

$$37.5//25=15\ \Omega$$

$$i=120/15=8\text{A}$$

Q.3) Obtain the energy stored in the 4 mF capacitor that is shown in Fig. Q.3 under dc conditions. [3-Points]

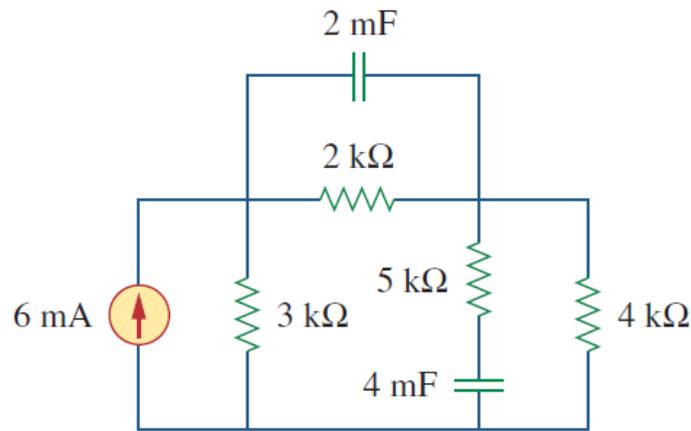
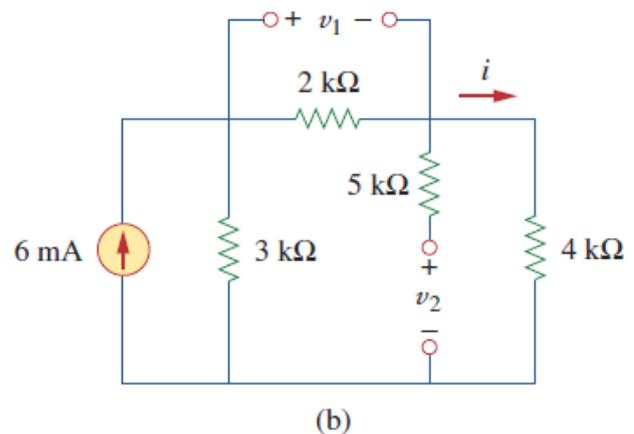
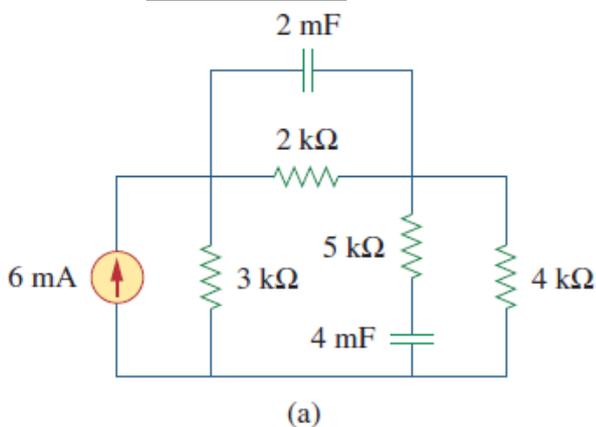


Figure Q.3

Solution:

$W_{4\text{mF}} =$



Solution:

Under dc conditions, we replace each capacitor with an open circuit, as shown in Fig. 6.12(b). The current through the series combination of the 2-kΩ and 4-kΩ resistors is obtained by current division as

$$i = \frac{3}{3 + 2 + 4}(6 \text{ mA}) = 2 \text{ mA}$$

Hence, the voltages v_1 and v_2 across the capacitors are

$$v_1 = 2000i = 4 \text{ V} \quad v_2 = 4000i = 8 \text{ V}$$

and the energies stored in them are

$$w_1 = \frac{1}{2}C_1v_1^2 = \frac{1}{2}(2 \times 10^{-3})(4)^2 = 16 \text{ mJ}$$

$$w_2 = \frac{1}{2}C_2v_2^2 = \frac{1}{2}(4 \times 10^{-3})(8)^2 = 128 \text{ mJ}$$