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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]

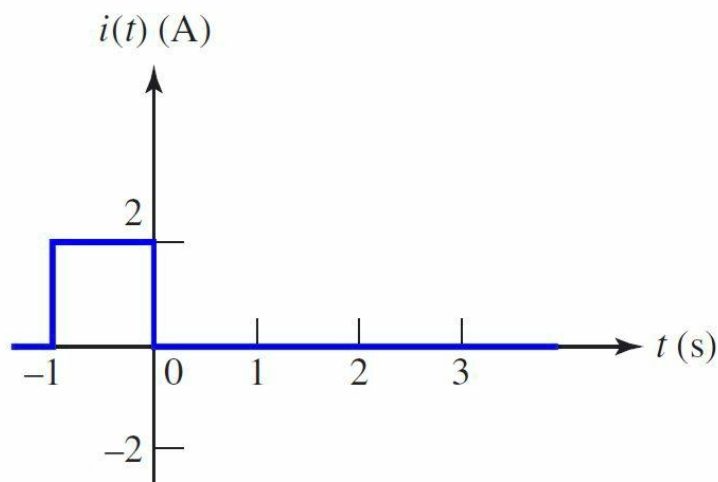


Figure Q.1

Solution:

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

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

$$i(t) = 0, -\infty \leq t \leq -1$$

$$v(t_0) = v(-\infty) = 0$$

$$v(t) = \frac{1}{2.5} \int_{-\infty}^t 0 \cdot dt + v(-\infty)$$

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

For $-1 \leq t \leq 0$

$$i(t) = 2, -1 \leq t \leq 0$$

$$v = \frac{1}{2.5} \int_{-1}^t 2 \cdot dt + v(-1)$$

$$= \frac{2}{2.5} t \Big|_{-1}^t + v(-1)$$

$$= 0.8(t + 1) + v(-1)$$

$$v(-1) = 0$$

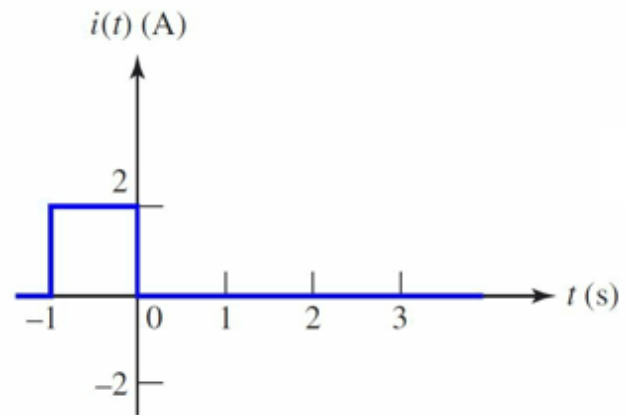
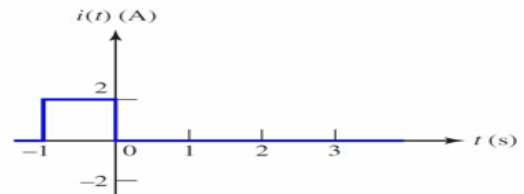
$$v(t) = 0.8(t + 1), -1 \leq t \leq 0$$

For $0 \leq t$

$$v(t) = \frac{1}{2.5} \int_0^t 0 \cdot dt + v(0)$$

$$v(0) = 0.8$$

$$v(t) = 0.8, t \geq 0$$

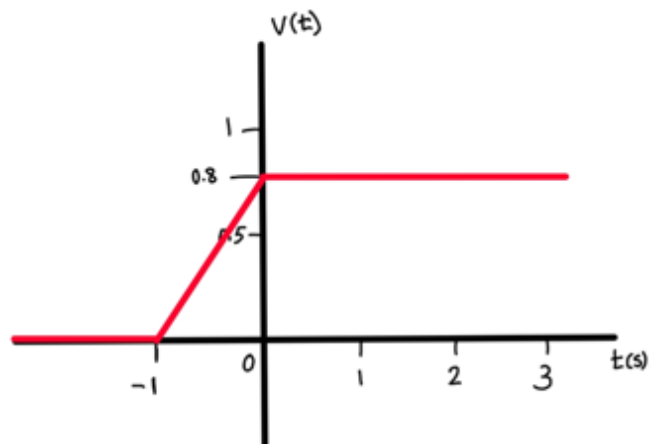


$$v(t) = 0, -\infty \leq t \leq -1$$

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

$$v(t) = 0.8, t \geq 0$$

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



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

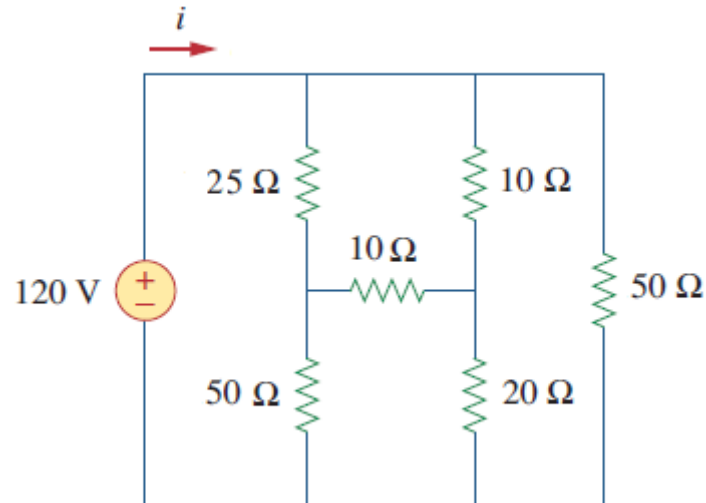
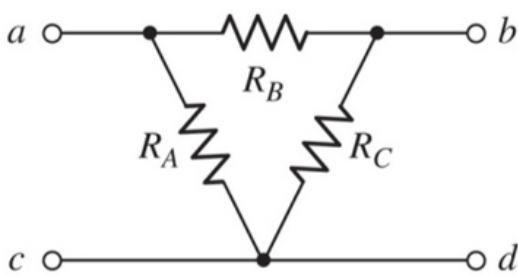
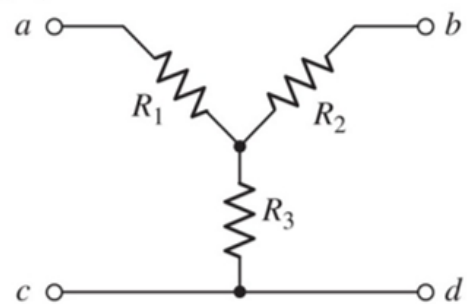


Figure Q.2



this Δ is equivalent to the Y if

$$\begin{aligned} R_A &= \frac{R_1 R_2 + R_2 R_3 + R_3 R_1}{R_2} \\ R_B &= \frac{R_1 R_2 + R_2 R_3 + R_3 R_1}{R_3} \\ R_C &= \frac{R_1 R_2 + R_2 R_3 + R_3 R_1}{R_1} \end{aligned}$$



this Y is equivalent to the Δ if

$$\begin{aligned} R_1 &= \frac{R_A R_B}{R_A + R_B + R_C} \\ R_2 &= \frac{R_B R_C}{R_A + R_B + R_C} \\ R_3 &= \frac{R_C R_A}{R_A + R_B + R_C} \end{aligned}$$

Solution:

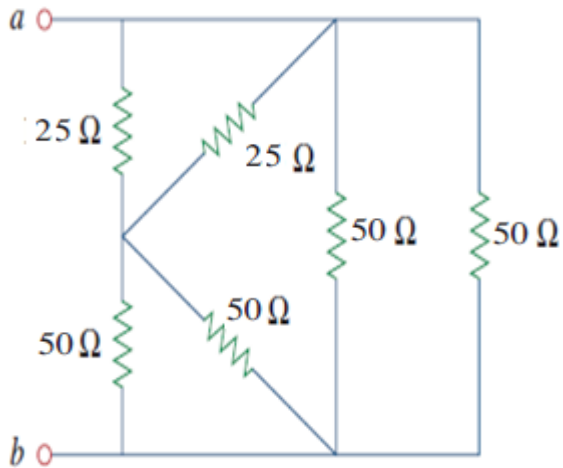
$i =$

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

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

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

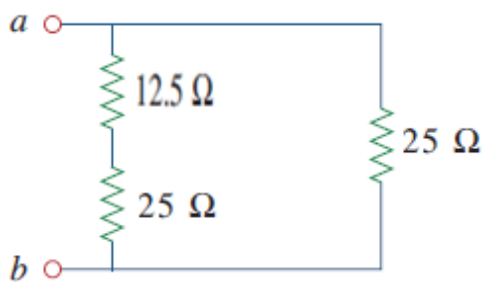
$$R_c=500/10=50\ \Omega$$



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

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

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



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

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

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

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

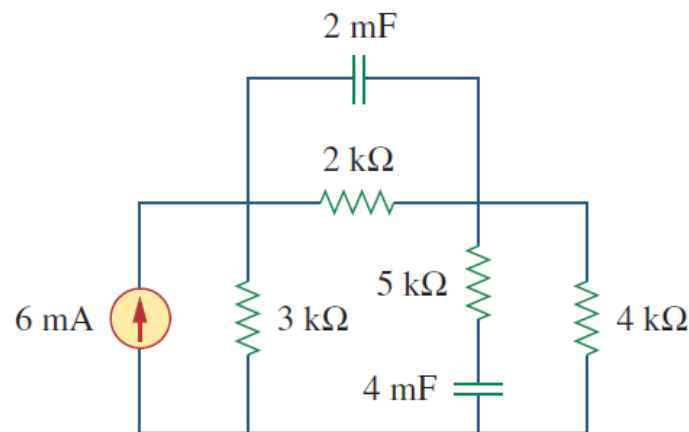
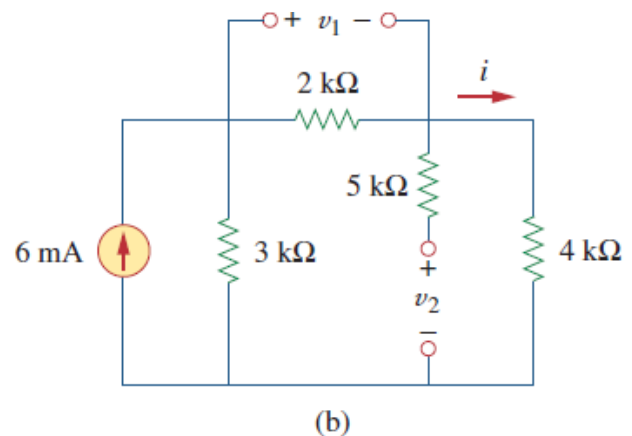
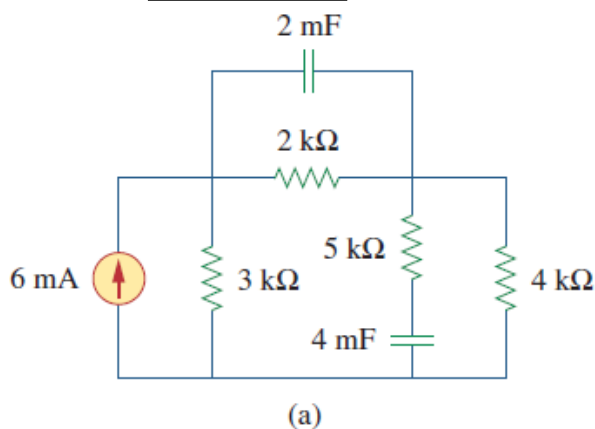


Figure Q.3

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-k Ω and 4-k Ω 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

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

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