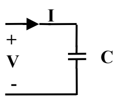
(15)

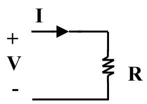
1

$$\therefore \omega = \frac{2\pi}{T} = \frac{2\pi}{\pi} = 2\,rad/s$$

$$\therefore V(t) = Vm\sin\omega t = 10\sin 2t V$$



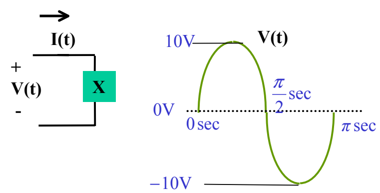
$$\therefore I(t) = C\frac{dV(t)}{dt} = 1m\frac{d}{dt}10\sin 2t = 20\cos 2t\ mA$$



$$\therefore P = \frac{V_{rms}^2}{R} = (\frac{10}{\sqrt{2}})^2\frac{1}{10\Omega} = 5W$$

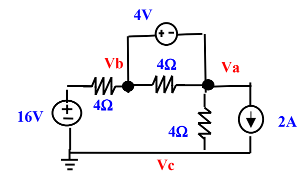
$$\therefore E = Pt = 5W(10s) = 50J$$

1. In the circuit, V(t) is given as shown.
(a) If X = 1mF, find I(t).
(b) If X = 10 Ω, find the total energy dissipated by X in 10 sec.
Given d(sinax) / dx = acosax, d(cosax) / dx = - asinax . (15)



(24)

2



Vb = Va + 4V

Vc = 0V

$$KCL: \frac{16 - Vb}{4} = \frac{16 - Va - 4}{4} = \frac{Va}{4} + 2$$

$$\therefore 16 - Va - 4 = Va + 8$$

$$\therefore Va = 2V$$

$$\therefore Vb = 6V$$

$$Vbc = Vb - Vc = 6 - 0V = 6V$$

$$KCL:$$

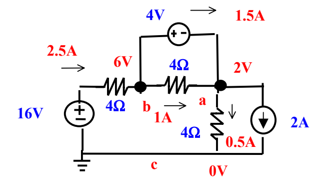
$$\frac{16 - Vb}{4} = i + \frac{4V}{4\Omega} = \frac{16-6}{4}$$

$$\therefore i + 1 = 2.5$$

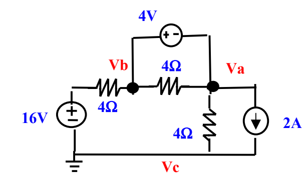
$$\therefore i = 1.5A$$

$$P = iv = 4V(1.5A) = 6W$$

Power is absorbed by 4V source

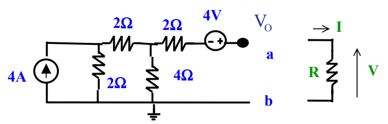


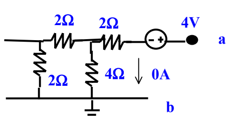
2. In the circuit, find Va, Vb and Vbc. Find also the power delivered or absorbed by the 4V supply. (24)



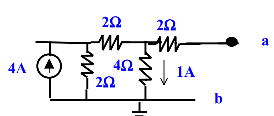
(32)

3



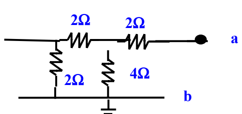


$Va = 4V$

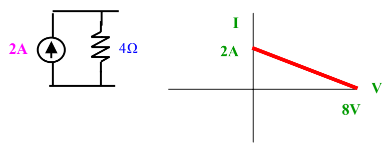


$Va = 4V$

$$\therefore V_O = Va + Vb = 8V$$



$R = 4\Omega$

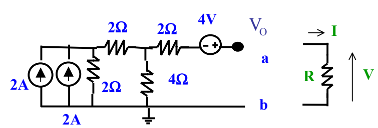


Norton equivalent

Maximum power delivered when R= 4Ω

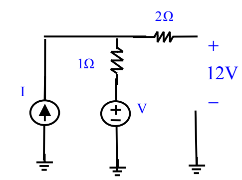
$$\therefore P = I^2R = (1A)^2 4\Omega = 4W$$

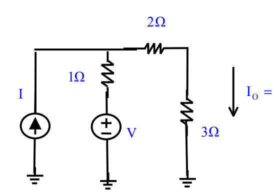
3. (a) Use **superposition method** to show that Vo = 8V.
(b) Hence find the **Norton equivalent** of the network at terminals ab.
(c) **If a load R is connected to ab,** plot I versus V for all values of R (0 to oo ohm). Find also the maximum power that can be dissipated by R (32).

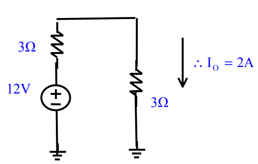


(16)

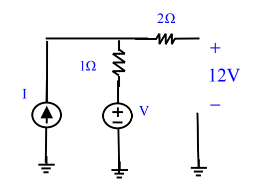
4

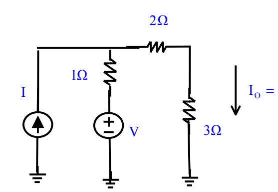






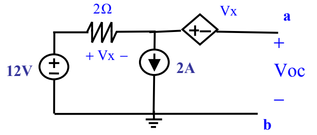
4. In the network, find current Io. Voltage V and current I are not known. Hint: can use Thevenin's Theorem. (16)





(28)

5

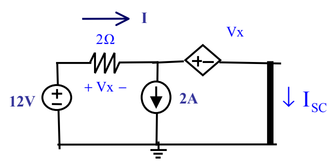


$\therefore V_X = (2A)2\Omega = 4V$

KVL:

$V_{OC} = 12 - V_X - V_X$

$= 12 - 2V_X = 4V$



KVL: $12 - V_X = V_X$

$\therefore V_X = 6V$

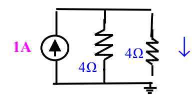
$\therefore I = \frac{6V}{2\Omega} = 3A$

$\therefore I_{SC} = 1A$

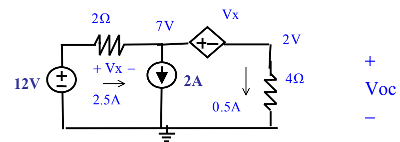
Thevenin resistance

$Rth = \frac{Voc}{Isc}$

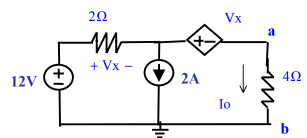
$= \frac{4V}{1A} = 4\Omega$



$\therefore I_O = 0.5A$



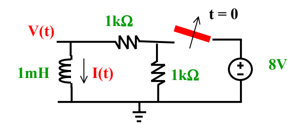
5. In the circuit, find Io using **Norton's Theorem**. The voltage controlled voltage source is in volt and equal to Vx.
Hint: find Voc, Isc at terminals ab and R_N = Voc/Isc.
(28)



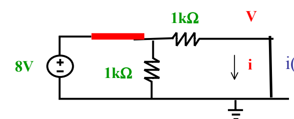
(24)

6

6. In the circuit, the switch has been closed for a long time. **At t = 0 sec, the switch is opened.**
Find V(t) for t ≥ 0. Find also the maximum energy stored in the inductor.
Given that $V_L = L\,(d\,I_L\ /\ dt)$, $i(t) = i(\infty) + [i(0) - i(\infty)]\ e^{-t/\tau}$
and $v(t) = v(\infty) + [v(0) - v(\infty)]\ e^{-t/\tau}$ (24)

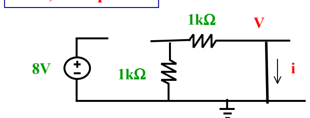


t < 0, S is closed

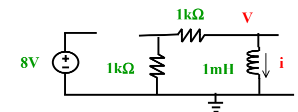


$i(0) = 8mA$

t ≥ 0, S is opened



$i(\infty) = 0A$



$\tau = \frac{L}{R} = \frac{1mH}{2k\Omega} = 0.5\mu s$

$\therefore i(t) = i(\infty) + [i(0) - i(\infty)]\,e^{-t/\tau}$

$= 0 + [8m - 0]\,e^{-t/0.5us}$

$= 8e^{-t/0.5us}mA$

$\therefore v(t) = L\frac{di(t)}{dt} = 1m\frac{d}{dt}[8me^{-t/0.5us}]$

$= 1m(8m)(\frac{-1}{0.5u})e^{-t/0.5us}A$

$= -16e^{-t/0.5u}V$

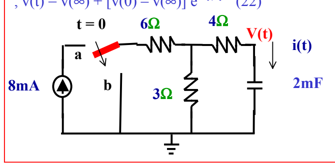
Maximum energy stored in L

$= \frac{1}{2}Li^2 = \frac{1}{2}(1mH)(8mA)^2 = 32x10^{-9}J$

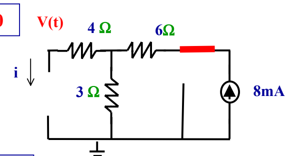
(22)

7

7. At t < 0, the switch is at terminal a and the circuit is steady.
At t = 0 sec, the switch is switched to terminal b. Find V(t) for t ≥ 0. Plot V(t) also and show clearly the voltage and time. Find also the maximum energy stored in the capacitor.
Given that $i(t) = i(\infty) + [i(0) - i(\infty)]\ e^{-t/\tau}$
, $v(t) = v(\infty) + [v(0) - v(\infty)]\ e^{-t/\tau}$ (22)

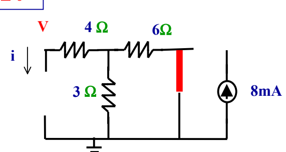


t < 0

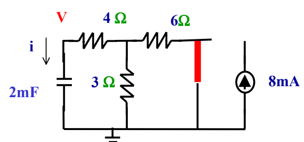


$V(0) = 24mV$

t ≥ 0



$V(\infty) = 0V$

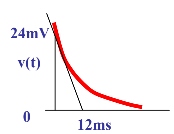


$\tau = CR = 2mF * 6\Omega = 12ms$

$\therefore V(t) = V(\infty) + [V(0) - V(\infty)]\,e^{-t/CR}$

$= 0 + [24m - 0]\,e^{-t/12ms}$

$= 24e^{-t/12m}mV$



Maximum energy stored in C

$= \frac{1}{2}CV^2 = \frac{1}{2}(2mH)(24mV)^2 = 576x10^{-9}J$