MAKE IN INDIA
PAGE NO.:
DATE / /

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SUBJECT :- Electronics System Design

ASSIGNMENT - 1

MAKE IN INDIA
PAGE NO.: 1
DATE / /

CHAPTER - 1

Exercise - Problems [SECTION 1-3]

⇒ P 1.3-1

$$i(t) = \frac{d}{dt}(4)(1 - e^{-5t}) = 20e^{-5t} \text{ A}$$

⇒ P 1.3-2

$$q(t) = \int_0^t i(t)\,dt + q(0)$$

$$= \int_0^t 4(1 - e^{-5t})\,dt + 0$$

$$= \left(4t + \frac{4}{5}e^{-5t} - \frac{4}{5}\right)C$$

⇒ P 1.3-3

$$q(t) = \int_{-\infty}^t i(t)\,dt = \int_{-\infty}^t 0\,dt = 0\,C \quad \text{for } t \le 2$$

$$\therefore q(2) = 0$$

$$q(t) = \int_2^t i(t)\,dt + q(2) = \int_2^t 2\,dt = (2t - 4)\,C \quad \text{for } 2 \le t \le 4$$

$$\therefore q(4) = 4\,C$$

$$q(t) = \int_4^t i(t)\,dt + q(4) = \int_4^t -1\,dt + 4 = (8 - t)\,C \quad \text{for } 4 \le t \le 8$$

$$\therefore q(8) = 0\,C$$

$$q(t) = \int_8^t i(t)\,dt + q(8) = \int_8^t 0\,dt + 0 = 0\,C \quad \text{for } 8 \le t$$

MAKE IN INDIA
PAGE NO.:
DATE / /

⇒ P 1.3-4

$i = 600\ A = 600\ C/s$

Silver deposited $= 600\ \frac{C}{s} \times 20\ min \times 60\ \frac{s}{min} \times 1.118\ \frac{mg}{C}$

$= 8.05 \times 10^5\ mg = 80.5\ g$

[SECTION 1.6]

⇒ P 1.6-1

(a) $q = \int i\,dt = it = (10A)(2hr)(3600\ s/hr) = 7.2 \times 10^4\ C$

(b) $P = vi = (110V)(10A) = 1100\ W$

(c) $cost = \left(0.06\ \frac{\$}{kWhr}\right) \times 1.1 \times 2 = 0.132\ \$$

⇒ P.1.6-2

$P = (6)(10mA) = 0.06\ W$

$\Delta t = \frac{\Delta w}{P} = \frac{200\ Ws}{0.06} = 3.33 \times 10^3\ s$

~~⇒~~ P.1.6-3

⇒ P1.6]

for $0 \le t \le 10$ s

$v = 30$ V & $i = \frac{30}{15} t = 2t$ A

$\therefore p = 60t$ W

for $10 \le t \le 15$ s:

$v = \frac{-2}{5} t + b$ $\quad \therefore v(10) = 30$

$\therefore b = 80$ V

$\therefore v(t) = -5t + 80$

& $i(t) = 2t$ A

$\therefore p(t) = (-10t^2 + 160t)$ W

for $15 \le t \le 25$ s :

$v = 5$ V & $i(t) = \left(\frac{30t + b}{10}\right)$ A

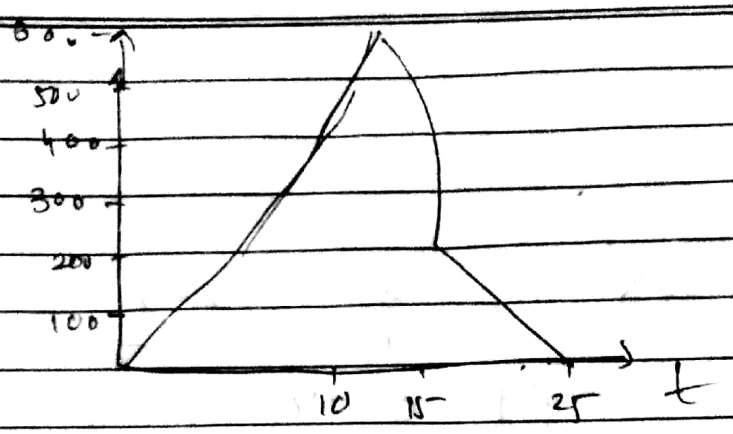
$i(25) = 0 \quad \therefore b = 75 \quad \therefore p(t) = -3t + 75$

$\therefore p = (-15t + 375)$ W

$$\text{Energy} = \int p\,dt = \int_0^{10} 60t\,dt + \int_{10}^{15} (160t - 10t^2)\,dt + \int_{15}^{25} (375 - 15t)\,dt$$

$$= 30\left[t^2\right]_0^{10} + \left[80t^2 - \frac{10t^3}{3}\right]_{10}^{15} + \left[375t - \frac{15}{2}t^2\right]_{15}^{25}$$

$$= 5833.3 \text{ J}$$

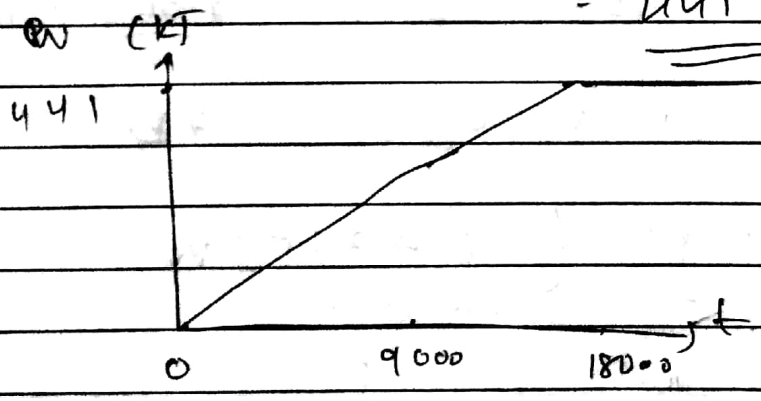


⇒ P. 1.6-4

(a) $w = \int P\,dt = \int_0^t vi\,dt = \int_0^{(3600)5} 2\left(11 + \frac{0.5t}{3600}\right) dt$

$= \left[22t + \frac{0.5\,t^2}{3600}\right]_0^{(3600)5}$

$= 441\ kJ$



(b) $\text{cost} = 441\,kJ \times \frac{1}{3600} \times \frac{10¢}{kWhr} = 1.23¢$

⇒ P. 1.6-5

$$p(t) = \frac{1}{3}(\cos 3t)(\sin 3t) = \frac{1}{6}\sin 6t$$

$$p(0.5) = 0.0235\,W$$
$$p(1) = \frac{1}{6}\sin 6 = -0.0466\,W$$

⇒ P 1.6-6

$$p(t) = 16(\sin 3t)(\sin 3t)$$
$$= 8(\cos 0 - \cos 6t) = (8 - 8\cos 6t)\,W$$

⇒ P 1.6-7

$$p(t) = 4(1-e^{-2t}) \times 2e^{-2t} = 8(1-e^{-2t})e^{-2t}.$$

⇒ P 1.6-8

$$P = VI = 3 \times 0.2 = (0.6)\,W$$
$$W = P \cdot t = 0.6 \times 5 \times 60 = 180\,J$$

MAKE IN INDIA
PAGE NO.:
DATE / /

CHAPTER-2

PROBLEMS

SECTION 2.3

⇒ P 2.3-1

When current is changed, V doesn't change in same proportion. Property of homogeneity is not satisfied.

∴ The element is not linear.

⇒ P2.3.2

(a) Slope is 0.12 V/A · Eq" of line is

$v = 0.12\,i$

∴ Element is linear.

(b) $v = (0.12)(40\text{mA}) = 4.8\text{ mV}$

(c) $i = \frac{4}{0.12} = 33\text{A}$

⇒ P. 2.3-4

when $i = 1\ A$ ⇒

$v = 3i + 5 = 8V$

$i = 2\ A$,

$v' = 6 + 5 = 11$

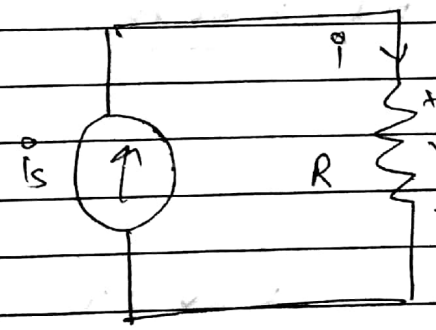
$v' \neq 2v$

∴ Property of homogeneity isn't satisfied

∴ Element is not linear.

(SECTION 2.5)

⇒ P 2.5-1

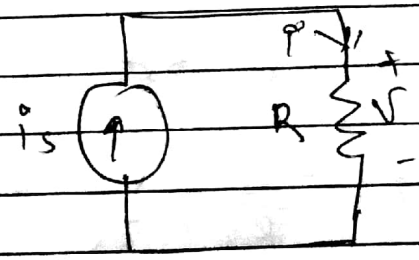


$i = i_s = 3A$ &

$v = Ri = 21V$

$P = vi = 63W$

⇒ P 2.5-2



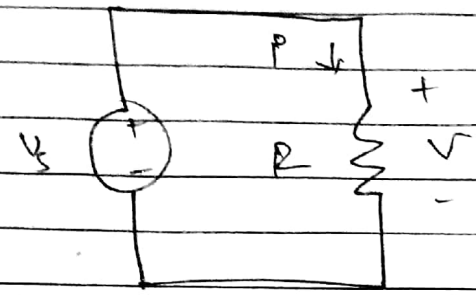
$i = i_s = 3mA$ $v = 24V$

$R = 8k\Omega$

$P = (3 \times 10^{-3}) \times 24 = 72mW$

MAKE IN INDIA
PAGE NO.:
DATE / /

⇒ P 2.5-3

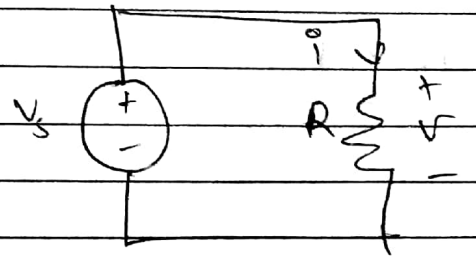


$V = V_s = 10\ V \qquad R = 5\ \Omega$

$\therefore P = 2A$

$\therefore P = vi = 20\ W$

⇒ P 2.5-4

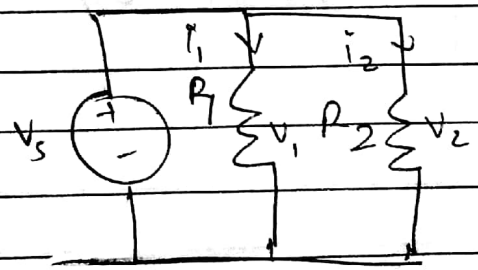


$V = V_s = 24\ V \qquad i = 2A$

$\therefore R = 12\ \Omega$

$\therefore P = Vi = 48\ W$

⇒ P 2.5-5



$V_1 = V_2 = V_s = 150\ W$

$R_1 = 50\ \Omega \quad , R_2 = 25\ \Omega$

$\therefore i_1 = 3A$

$i_2 = \frac{-V_2}{R_2} = \frac{-150}{25} = -6A$

$\therefore P_1 = (150)(3) = 450W$

$\therefore P_2 = (-150)(-6) = 900W$

MAKE IN INDIA
PAGE NO.: 8
DATE / /

⇒ P. 2.5-6

$i_1 = i_2 = i_s = 2A \quad R_1 = 4\Omega \quad \& \quad R_2 = 8\Omega$

$v_1 = -R_1 i_1 = -8V$

$\therefore P_1 = 16W$

$v_2 = R_2 i_2 = 16V$

$\therefore P_2 = (16)(2) = 32W$

⇒ P 2.5-7

With 250V source,

$P = \frac{V^2}{R} \quad \therefore R = \frac{(250)^2}{1000} = 62.5\Omega$

With 210V source,

$P = \frac{V^2}{R} = \frac{(210)^2}{62.5} = 705.6\ W$

⇒ P 2.5-8

current req. $i = P/V = 5000/120 = (125/3)A$

Power loss $= i^2R$.

$\therefore$ Max $R = \frac{(0.05)P}{i^2} = \frac{(0.05)(5000)}{(125/3)^2} = 0.144\Omega$

$l = 200\,m = 20,000\,cm.$

& $R = \rho l / A$

$\therefore A = \frac{1.7 \times 10^{-6} \times 20000}{0.144} = 0.236\,cm^2$

SECTION 2.6

⟹ P 2.6-1

(a) $i = \frac{v_s}{R} = \frac{15}{5} = 3A$ & $P = Ri^2 = 5 \times 9 = 45W$

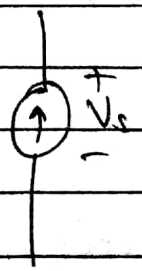
(b) i & P don't depend on i_s

⟹ P 2.6-2

(a) $v = R i_s = (5)(2) = 10V$ & $P = v^2/R = 10^2/5 = 20W$

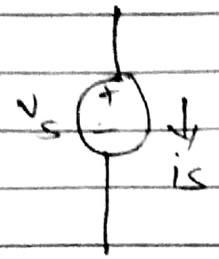
(b) v & P don't depend on v_s.

⟹ P 2.6-3



Here $P_{cs} = i_s v_s = (3)12 = 36W$

is supplied by current source



Here, $P_{vs} = i_s v_s = 36\,W$

is absorbed by voltage source.

$\Rightarrow$ P 2.6-4

(i) $P_{cs} = i_s v_s = 36\,W$ (Absorbed)

(ii) $P_{vs} = i_s v_s = 36\,W$ (supplied)

$\Rightarrow$ P 2.6-5

(a) $P = vi = 2(\cos t)(10\cos t) = 20\cos^2 t\ mW$

(b) $w = \int_0^t P\,dt = 20\left[\frac{1}{2}t + \frac{1}{4}(\sin 2t)\right]_0^t = (10 + 5\sin 2)m$

MAKE IN INDIA
PAGE NO.:
DATE / /

SECTION - 2.7

P 2.7-1

(a) $R = \frac{v}{i} = \frac{5}{0.5} = 10\,\Omega$

(b) $P = (12)(0.5) = 6\,W$ (Received)

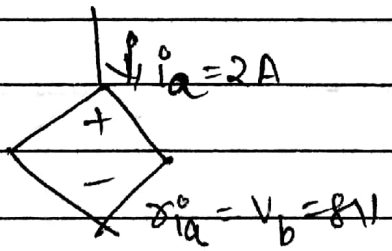
P 2.7-2

$i = -2A$

$40 = 2v \quad \therefore v = 20V$

SECTION 2.8

P 2.8-1



$r = \frac{V_b}{i_a} = \frac{8}{2} = 4\,\Omega$

P 2.8-2

$V_b = 8V$; $gV_b = i_a = 2A$; $g = \frac{i_a}{V_b} = 2/8 = 0.25$

⇒ P 2.8-3

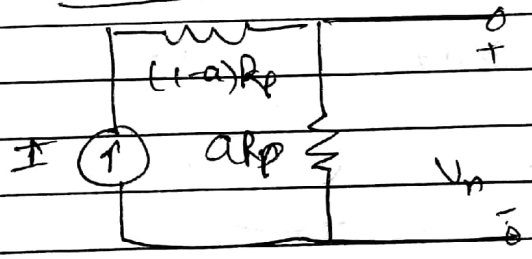
$i_b = 8A$; $di_b = i_a = 32A$; $d = \frac{i_a}{i_b} = \frac{32}{8} = 4$

⇒ P 2.8-4

$V_a = 2V$; $bV_a = V_b = 8$ ∴ $b = 4$

SECTION-9:

⇒ P 2.9-1



$a = \theta/360$; $\theta = \frac{360}{R_p} \frac{V_m}{I}$

∴ $\theta = \frac{(360)(33)}{(100k)(1.1m)} = 75.27$

⇒ P 2.9-2

AD590 ; $K = 1\,\mu A/K$

$V = 20\,V$

$4\,\mu A < i < 13\,\mu A$ ⇒ $4°K < T < 13°K$

$T = i/K$

PAGE NO.:
DATE / /

SECTION - 10

⇒ P 2.10-1 :

At $t = 1s$, ~~I across 10~~

$$i = \frac{V}{R} = \frac{10}{5 \times 10^3} = 2mA$$

At $t = 4$,

$$i = \frac{V}{R} = \frac{15}{5 \times 10^3} = 3mA$$

⇒ P 2.10-2

At $t = 1$, $i = 3mA$ $\therefore V = 15V$

At $t = 4$, $i = 0$ $\therefore V = 0V$

CHAPTER -3

SECTION 3.3

⇒ P 3.3-1

Apply KCL at a $2 + 1 = i + 4$

$\therefore i = -1\,A$

$P_B = 12\,W$

Apply KVL in DFEC,

$4 + v + (-5) - 12 = 0$

$\therefore v = 13\,V$

$P_E = 13\,W$

⇒ P 3.3-2 ∴

→ Apply KCL at a.

$\therefore 2 = i_2 + 6$

$\therefore i_2 = -4\,A$

→ KCL at b $\therefore 3 = i_4 + 6$

$\therefore i_4 = -3\,A$

→ KVL in ABA, $-v_2 - 6 = 0$

$\therefore v_2 = -6\,V$

→ KVL in CDAC, $-v_3 + 2 - 6 = 0$

$\therefore v_3 = -4\,V$

MAKE IN INDIA
PAGE NO.:
DATE / /

→ KVL in CFDF,

$4 - V_6 - 2 = 0$

$\therefore V_6 = 2V$

⇒ P. 3.3-3

KVL : $-12 - R_2(3) + V = 0$ (outside loop)

$\therefore R_2 = \frac{V - 12}{3}$

KCL : $i + \frac{12}{R_1} - 3 = 0$ (top node)

$\therefore R_1 = \frac{12}{3 - i}$

(a) $V = 12 + 9 = 21\ V$

$I = \frac{3 - 12}{6} = 1A$

(b) $R_2 = \frac{2 - 12}{3} = \frac{-10}{3}\ \Omega$; $R_1 = \frac{12}{3 - 1.5} = 8\ \Omega$

(c) $24 = -12i$

$\therefore i = -2A$ & $R_1 = \frac{12}{5} = 2.4\ \Omega$

$9 = 3V$

$\therefore V = 3V$ & $R_2 = \frac{3 - 12}{3} = -3\ \Omega$

⟹ P 3.3-4

$i_1 = \frac{12}{6} = 2A$ $\quad i_2 = \frac{20}{4} = 5A$

$i_3 = 3 - i_2 = -2A$ $\quad i_4 = i_2 + i_3 = 3A$

$P_{(4\Omega)} = 4(i_2)^2 = 100W$

$P_{(6\Omega)} = 6(i_1)^2 = 24W$

$P_{(8\Omega)} = 8(i_4)^2 = 72W$

⟹ P 3.3-5

$v_1 = 8V$ $\quad v_2 = -8 + 8 + 12 = 12V$

$v_3 = (2)(4) = 8V$

4Ω : $P = v_{3/4}^2 = 16W$

6Ω : $P = v_2^2/6 = 24W$

8Ω : $P = v_1^2/8 = 8W$

⟹ P 3.3-6

$P_{2mA} = -[3 \times 2 \times 10^{-3}] = -6mW$

$P_{1mA} = -[-7 \times 1 \times 10^{-3}] = 7mW$

MAKE IN INDIA
PAGE NO.:
DATE / /

⇒ P 3.3-8

KCL: $i_R = 2+1 = 3A$

KVL: $V_R + 0 - 12 = 0 \quad \therefore V_R = 12V$

$R = V_R / i_R = 4\Omega$

⇒ P 3.3-9

KVL: $V_R + 56 + 24 = 0$

$\therefore V_R = -80V$

KCL: $i_R + 8 = 0 \quad \therefore i_R = -8A$

$\therefore R = -80/-8 = 10\Omega$

⇒ P 3.3-10:

KCL at b: $\frac{5-6i}{7} = \frac{3\cdot7i - 5-6i}{R_1} + \frac{12-5\cdot6i}{5}$

$\therefore R_1 = 4\Omega$

KCL at a: $\frac{3\cdot7i}{2} + \frac{3\cdot7i - 5\cdot6i}{4} + \frac{3\cdot7i - 12}{R_2} = 0$

$\therefore R_2 = 6\Omega$

SECTION - 3.4

⇒ P 3.4-1

$$V_1 = \frac{6}{6+3+5+4} = 4\,V$$

$$V_2 = \left(\frac{3}{18}\right)12 = 2\,V$$

$$V_3 = \left(\frac{5}{18}\right)12 = 10/3\,V$$

$$V_4 = \left(\frac{4}{18}\right)12 = 8/3\,V$$

⇒ P 3.4-2

(a) $R = 6+3+2+4 = 15\,\Omega$

(b) $i = 28/R = 1.867\,A$

(c) $p = 28(i) = (52.27)W$

⇒ P 3.4-3

$$iR_2 = v = 8V$$

$$12 = iR_1 + v = iR_1 + 8$$

$$\therefore iR_1 = 4$$

(a) $i = \frac{8}{R_2} = \frac{8}{100}$; $R_1 = \frac{4}{i} = \frac{4 \times 100}{8} = 50\,\Omega$

(b) $i = \frac{4}{R_1} = \frac{4}{100}$; $R_2 = \frac{8}{i} = \frac{8 \times 100}{4} = 200\,\Omega$

(c) $1.2 = 12\,i \;\therefore i = 0.1\,A$; $R_4 = \frac{4}{0.1} = 40\,\Omega$;

$R_2 = \frac{8}{0.1} = 80\,\Omega$

⇒ P 3.4-4

$V_1 = \frac{16}{16+8} \times 12 = 8V$

$V_2 = \frac{4}{4+8} \times 12 = 4V$

KVL : $V_3 - V - V_1 = 0$

$\therefore V = -4V$

⇒ P 3.4-5

$V_0 = \frac{100}{100+2R} \times V_s$ $\therefore R = 50\left(\frac{V_s}{V_0} - 1\right)$

• $V_s = 20V$ & $V_0 > 9V$ ⇒ $R < 61.1\,\Omega$

• $V_s = 28V$ & $V_0 < 13V$ ⇒ $R > 57.7\,\Omega$

} $R = 60\,\Omega$

⇒ P 3.4-6

(a) $\frac{240}{240+120} \times 18 = 12\,V$

(b) $18\left(\frac{18}{120+240}\right) = 0.9\,W$

(c) $\left(\frac{R}{R+120}\right)18 = 2 \;\therefore\; R = 15\,\Omega$

(d) $0.2 = \frac{R}{R+120} \;\therefore\; (0.2)(120) = 0.8R$
$\therefore R = 30\,\Omega$

SECTION 3.5

⇒ P 3.5-1

$i_1 = \left(\frac{1/6}{1/6+1/3+1/2+1/1}\right)4 = 1/3\,A$

$i_2 = \frac{1/3}{1/6+1/3+1/2+1} \times 4 = 2/3\,A$

$i_3 = \frac{1/2}{1/6+1/3+1/2+1} \times 4 = 1A$

$i_4 = \frac{1}{1/6+1/3+1/2+1} \times 4 = 2A$

MAKE IN INDIA
PAGE NO.:
DATE / /

⇒ P 3.5 - 2

(a) $\frac{1}{R} = \frac{1}{6} + \frac{1}{12} + \frac{1}{4} = \frac{1}{2}$

$\therefore R = 2\,\Omega$

(b) $V = 6 \times 2 = 12\,V$

(c) $P = 6 \times 12 = 72\,W$

⇒ P 3.5 - 3

$\cdot i = \frac{\mathcal{E}}{R_1}$

$\cdot \mathcal{E} = R_2(2 - i) \quad \therefore i = 2 - \frac{\mathcal{E}}{R_2}$

$\therefore R_2 = \frac{\mathcal{E}}{2 - i}$

(a) $i = 2 - \frac{\mathcal{E}}{12} = \frac{4}{3}\,A$

$\therefore R_1 = \mathcal{E}/i = 6\,\Omega$

(b) $i = \frac{\mathcal{E}}{12} = \frac{2}{3}\,A \quad \therefore R_2 = \frac{\mathcal{E}}{2 - i}$

$= 6\,\Omega$

(c) $R_1 = R_2 \quad \therefore i = \frac{1}{2} \times 2 = 1\,A.$

$\cdot \; 2 \times \frac{R_1 R_2}{R_1 + R_2} = \mathcal{E} \;\Rightarrow R_1 = R_2$

$\therefore 2 \times \frac{1}{2} R_1 = \mathcal{E} \quad \therefore R_1 = R_2 = \mathcal{E}\,\Omega$

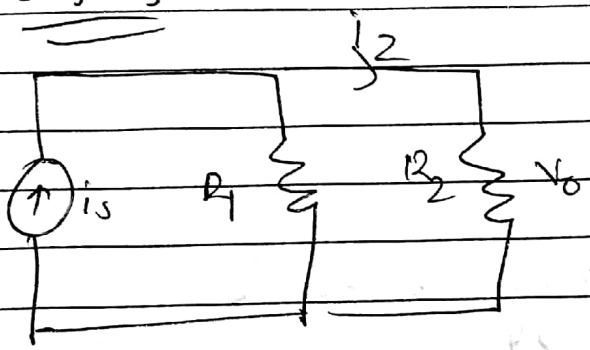
⇒ P 3.5-4

$$i_1 = \frac{8}{16+8} \times (-6) = -2A$$

$$i_2 = \frac{8}{16} \times (-6) = -3A$$

$$i_3 = i_1 - i_2 = +1A$$

⇒ P 3.5-5



$$i_2 = \left(\frac{R_1}{R_1+R_2}\right) i_s$$

$$V_o = i_2 R_2$$

$$\therefore i_s = \frac{V_o}{R_2} \times \frac{R_1+R_2}{R_1}$$

when $R_1 = 4\Omega$, $V_o > 9V \Rightarrow i_s > 3.75A$

$R_1 = 6\Omega$ $V_o < 13V \Rightarrow i_s < 3.47A$

$\therefore 3.15 < i_s < 3.47$

MAKE IN INDIA
PAGE NO.:
DATE / /

⇒ P 3.5-6

(a) $\left(\frac{24}{36}\right) 1.8 = 1.2\ A$

(b) $\left(\frac{R}{R+12}\right) 2 = 1.6 \quad \therefore R = 48\ \Omega$

(c) $0.4 = \frac{R}{R+12} \quad \therefore R = 8\ \Omega$

2

SECTION-B.7

⇒ P 3.7 1:-

(a) $R = 16 + \frac{48 \times 24}{48+24} = 32\ \Omega$

(b) $V = \frac{(32)^2}{8 + \frac{(32)^2}{64}} \times 24 = 16\ V$

(c) $i = 16/32 = 1/2\ A$

(c) $P_2 = \frac{48}{48+24} \times 1/2 = 1/3\ A$

⇒ P 3.7-2

(a) $R_1 = 4 + \frac{3\times6}{3+6} = 6\,\Omega$

(b) $\frac{1}{R_p} = \frac{1}{12} + \frac{1}{8} + \frac{1}{6}$ $\therefore R_p = 2.4\,\Omega$

$\therefore R_2 = 8 + R_p = 10.4\,\Omega$

(c) KCL: $i_2 + 2 = i_1$ & $-24 + 6i_2 + R_2 i_1 = 0$

$\therefore -24 + 6(i_1 - 2) + (10.4)\, i_1 = 0$

$\therefore i_1 = 2.2\,A$

$\therefore V_1 = i_1 R_2$

$V_1 = 22.88\,V$

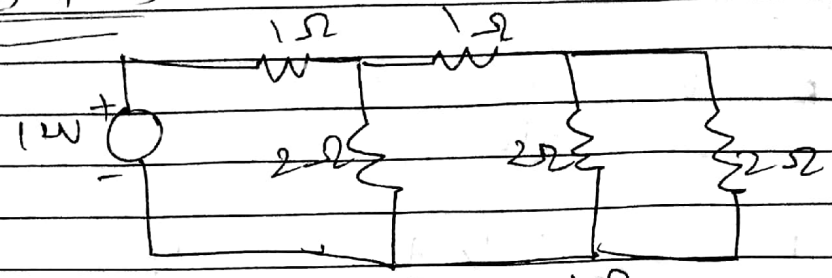
(d) $i_2 = \frac{1/6}{1/6 + 1/6 + 1/12} \times 2.2 = 0.88\,A$

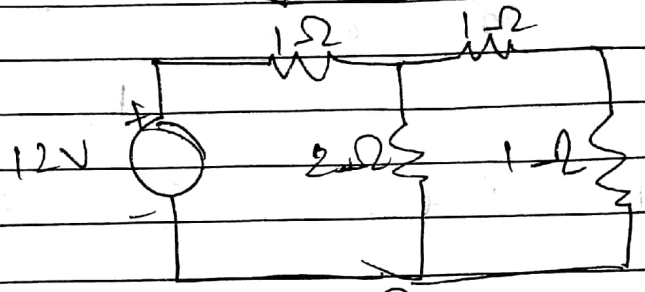
(e) $i_3 = \frac{6}{3+6} \times i_2 = 0.58A$

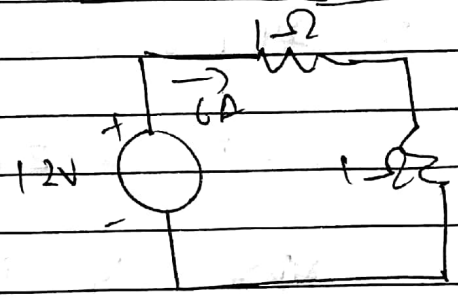
$\therefore P = 3(i_3)^2 = 1.03W$

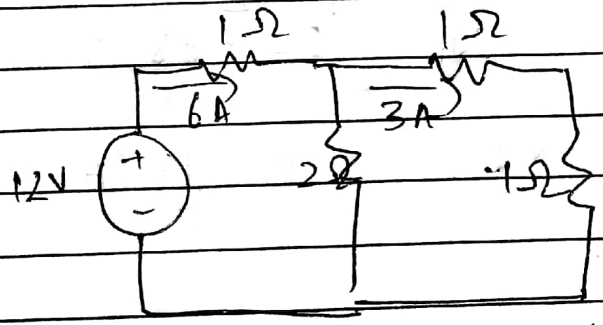
MAKE IN INDIA
PAGE NO.:
DATE / /

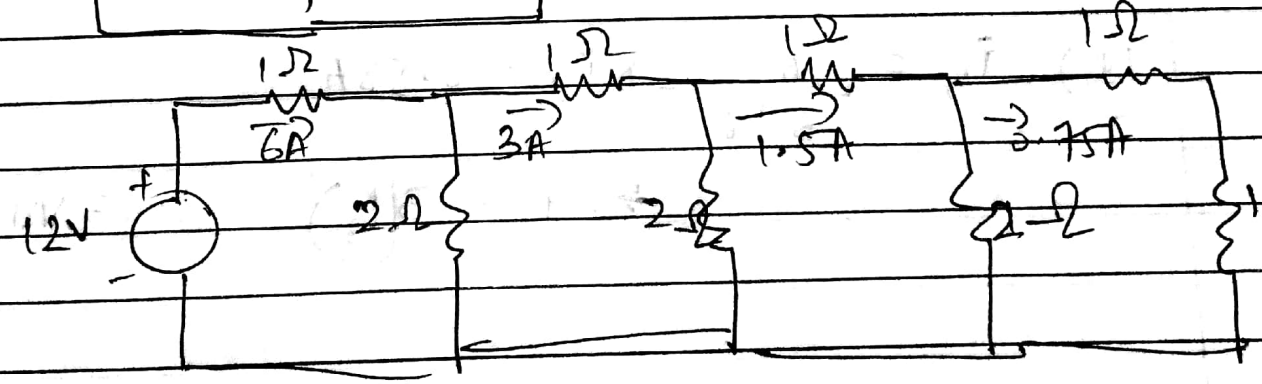
⇒ P. 3.7-3











⇒ P 3.7-4

(a) $\frac{1}{R_2} = \frac{1}{24} + \frac{1}{12} + \frac{1}{8}$ $\therefore R_2 = 4\ \Omega$

$R_1 = \frac{(10+8)\,9}{10+8+9} = 6\ \Omega$

(b) KVL in left mesh:

$-27 + 6i_a + 3i_a = 0$

$\therefore i_a = 3A$

KVL :

$4i_b - 3i_a = 0$

$\therefore i_b = 2.25A$

(c) $i_2 = \frac{1/8}{1/24 + 1/8 + 1/12} \times 2.25 = 1.125A$

and $v_1 = -(10)\left[\frac{9}{10+8+9} \times 3\right] = -10V$

MAKE IN INDIA
PAGE NO.:
DATE / /

⇒ P3.7 -5

$\left(\frac{30}{10+30}\right) V_1 = 6 \quad \therefore V_1 = 8V$

$\left(\frac{R_2}{R_2+10}\right) 12 = 8 \quad \therefore R_2 = 20\Omega$

$\therefore 20 = \frac{R_1(40)}{R_1+40} \quad \therefore R_1 = 40\Omega$

⇒ P.3.7 -6

$2k = \frac{(10k)(2.5k)}{12.5k}$

$\left(\frac{2.5k}{10k+2.5k}\right) 10mA = I_D = 2mA$

$V_c = \frac{1k}{1k+2k} \times 18 = 6V$

$I_b = -16\mu A$

$V_a = -2V$

⇒ P 3.7-7

$$V = 50\ 10^{-3} = \frac{24}{12K + R_p} \quad \therefore R_p = 12K\Omega$$

$$12 \times 10^3 = R_p = \frac{(21 \times 10^3) R}{(21 \times 10^3) + R} \quad \therefore R = 28K\Omega$$

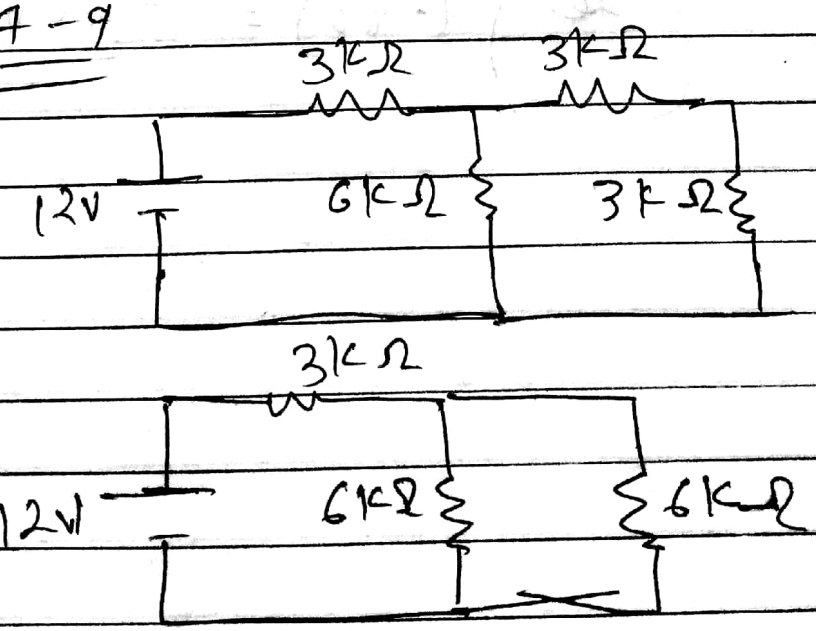
⇒ P 3.7-8

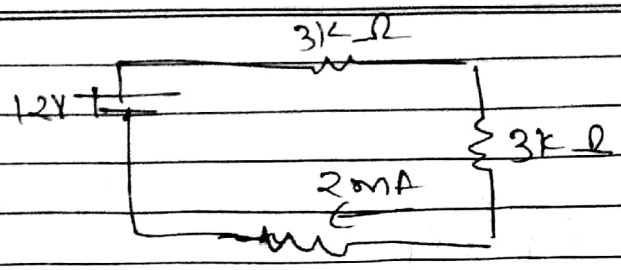
$$V = 50 \left(\frac{130 \,||\, 500}{130 \,||\, 500 + 200 + 20} \right) = 15.963V$$

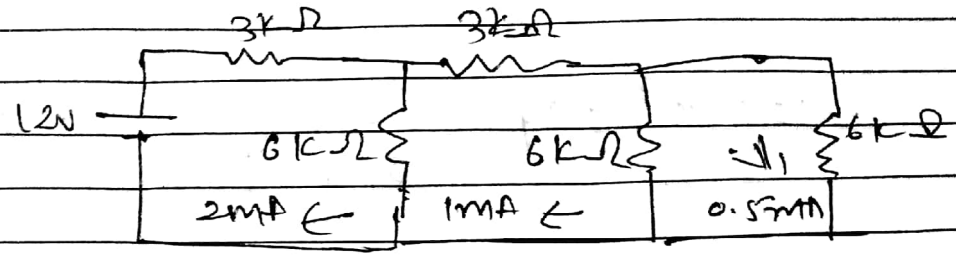
$$\therefore V_h = V \left(\frac{100}{130} \right) = (15.963)\left(\frac{10}{13} \right) = 12.279V$$

$$\therefore i_h = \frac{V_h}{100} = 0.122\,79\,A$$

⇒ P 3.7-9







⇒ P 3.7 → 0

$$R_{eq} = \frac{15(30)}{15+30} = 10\,\Omega$$

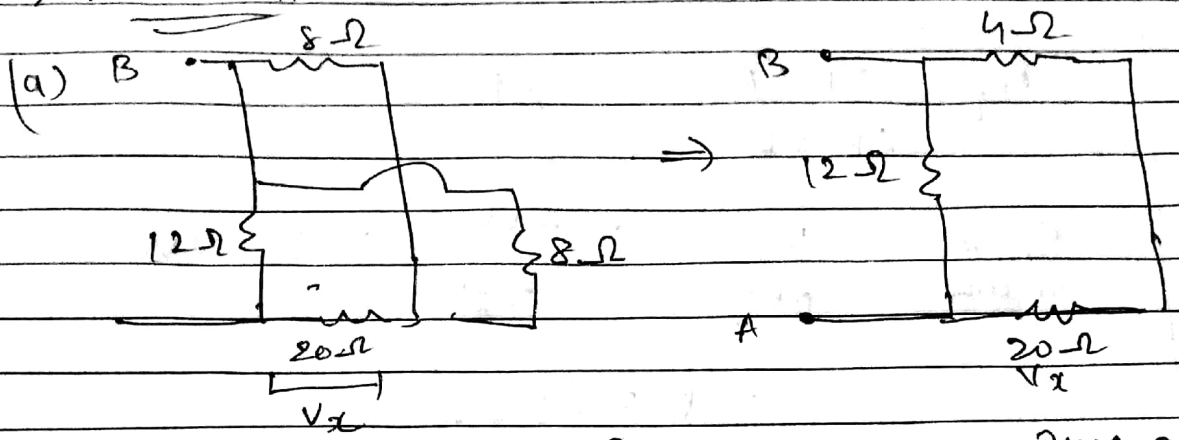
$$i_a = \frac{-60}{R_{eq}} = -6\,A$$

$$i_b = \left(\frac{30}{45}\right)\left(\frac{60}{R_{eq}}\right) = 4\,A$$

$$V_c = \left(\frac{20}{30}\right)(-60) = -40\,V$$

⇒ P 3.7 = 11:

(a)



$$R_{eq} = 24 \| 12 = \frac{24 \times 12}{36} = 8\,\Omega$$

(b) $V_x = 40 \times \frac{20}{24} = \frac{100}{3}\ V$

$$\therefore i_x = \frac{100/3}{20} = 5/3\ A$$

$$i = i_x \left(\frac{8}{8+8}\right) = 5/6\ A$$

⇒ P 3.7 - 12:

$9 + 10 + 17 = 36\,\Omega$

(a) $\frac{36 \times 18}{36+18} = 12\,\Omega$

(b) $\frac{36R}{36+R} = 18 \quad \therefore R = 36$

MAKE IN INDIA
PAGE NO.:
DATE / /

⇒ P 3.7 -13

$$R_{eq} = \frac{2R(R)}{2R+R} = \frac{2}{3}R$$

$$P_{delive\ to\ circuit} = \frac{V^2}{R_{eq}} = \frac{240}{\frac{2}{3}R} = 1920\,W$$

$$\therefore R = 45\ \Omega$$

⇒ P 3.7 -14:

$$R_{eq} = 2 + 1 + (6 \| 12) + (2 \| 12)$$

$$= 8\ \Omega$$

$$\therefore i = \frac{40}{R_{eq}} = 5A$$

$$i_1 = i\left(\frac{6}{18}\right) = \frac{5}{3}\,A$$

$$i_2 = i\left(\frac{2}{4}\right) = \frac{5}{2}\,A$$