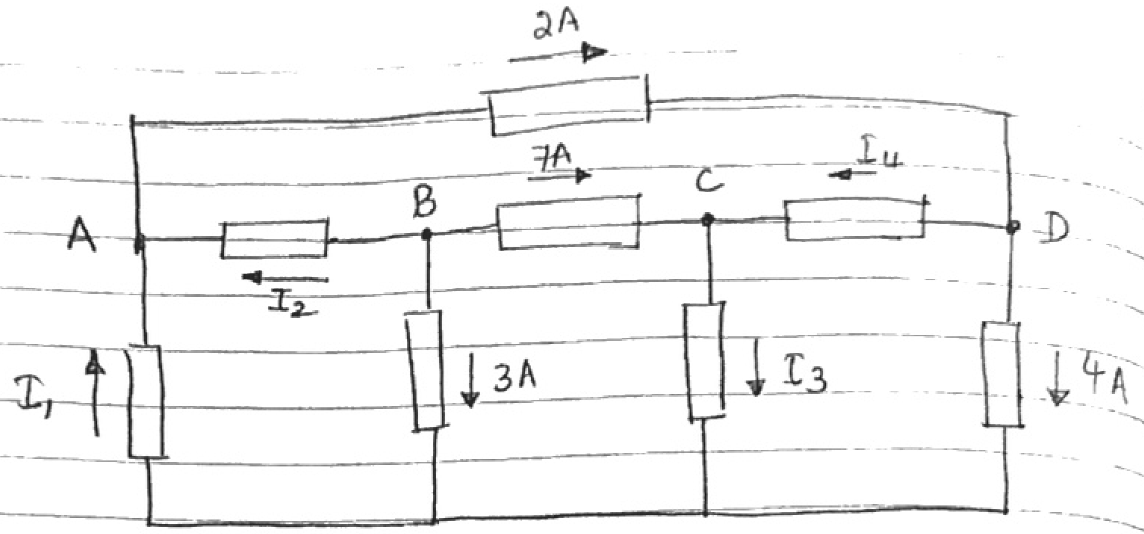
HW # 2 Solutions

Assignment problems:

2.13
2.17
2.25
2.32
2.41
2.44
2.59.(a)
2.59

2.13



At node B, $\Sigma I_0 = 0$ .... (KCL)

$\Rightarrow 3 + 7 + I_2 = 0$

1/2 $\Rightarrow I_2 = -10A$.

At node A, $\Sigma I = 0$ .... (KCL)

1/2 $2 = I_2 + I_1$

$= -10 + I_1$

$\Rightarrow I_1 = 12 A$

At node D, $\Sigma I = 0$ .... (KCL)

1/2 $2 = 4 + I_4$.

$\Rightarrow I_4 = -2A$

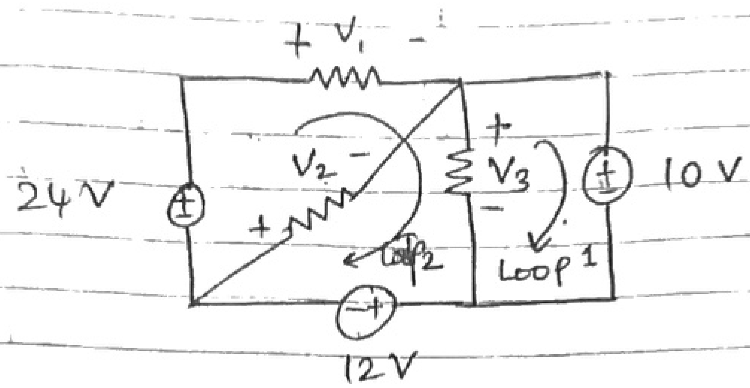
At node C, ΣI_0

1/2 $\Rightarrow I_3 = I_4 + 7$

$= -2 + 7$

$= 5A$

2.17



Applying KVL in Loop1:

½ $v_3 = 10V.$

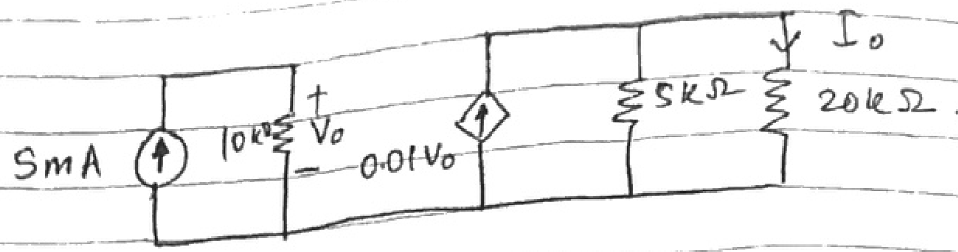
Applying KCL in loop2:

1 $24 - 12 = V_1 + v_3$

$12 = v_1 + 10$

½ $\Rightarrow v_1 = 2V.$

2.25



(1/2)

$V_o = 5\times10^{-3} \times 10\times10^{3} = \underline{\underline{50\,V}}$.

By current divider

(1)

$I_o = \frac{5}{(20+5)} \times 0.01 \times 50$

$= 0.1\ A$.

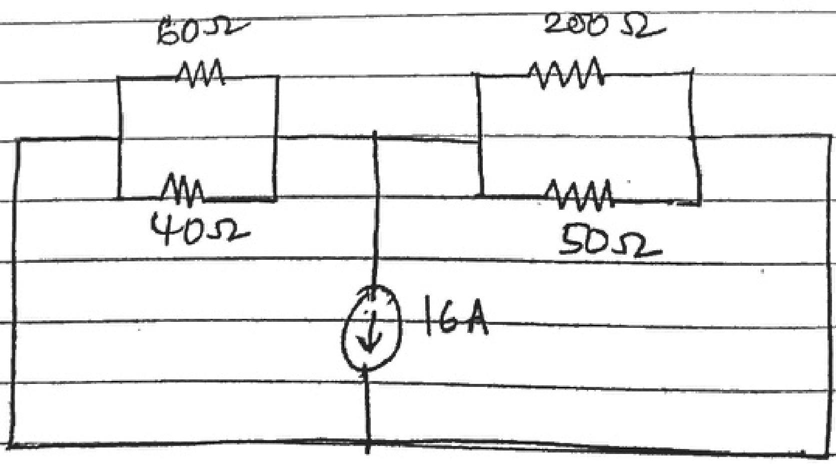
$\therefore$ Power across 20k resistor =

(1)

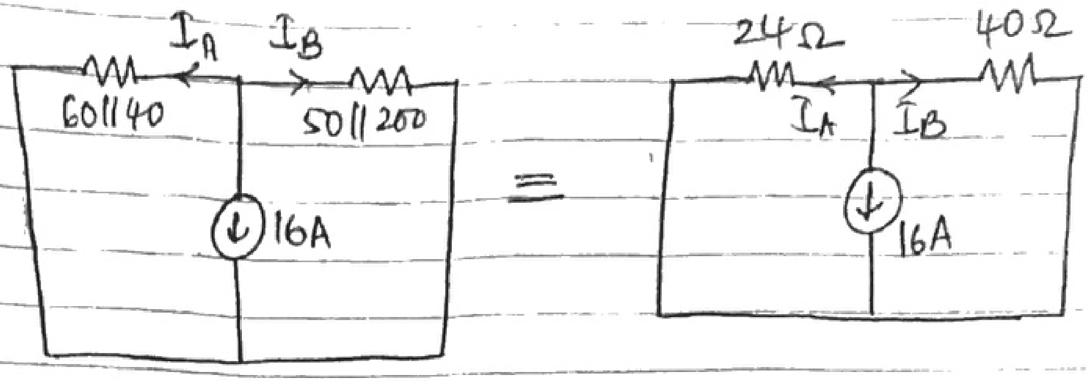
$(0.1)^2 \times 20\times10^{3}$

$= \underline{\underline{0.2\ KW}}$.

2.32



$\Downarrow$



1/2

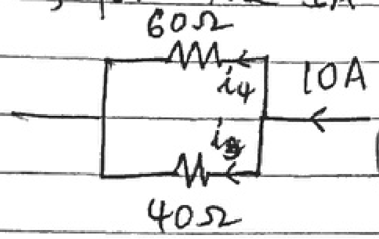
Current Division

$\therefore\ I_A = -\frac{40}{64} \times 16 = -10\ A$

1/2

$\therefore\ I_B = -6\ A.$

Now, for the I_A branch:

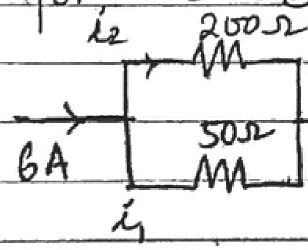


1/2

$\therefore\ i_3 = \frac{60}{100} \times 10 = -6\ A$

$\therefore\ i_4 = -4\ A.$

And for the I_B branch:

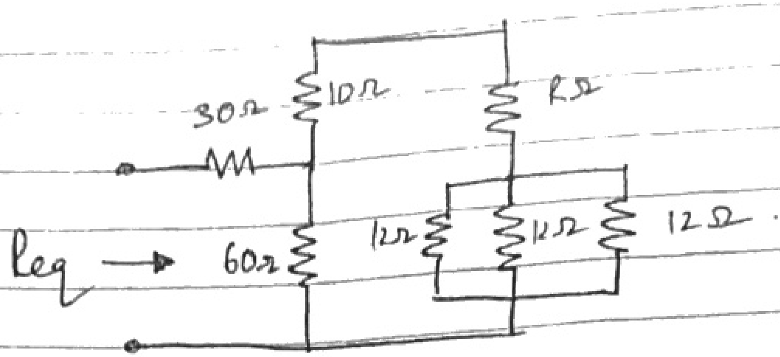


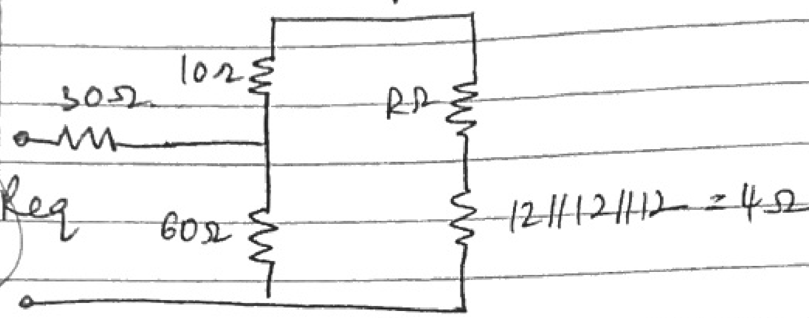
1/2

$\therefore\ i_1 = \frac{200}{250} \times 6 = -4.8A$

$\therefore\ i_2 = -1.2A.$

2.41





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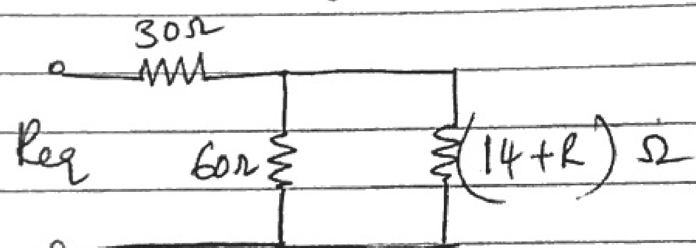

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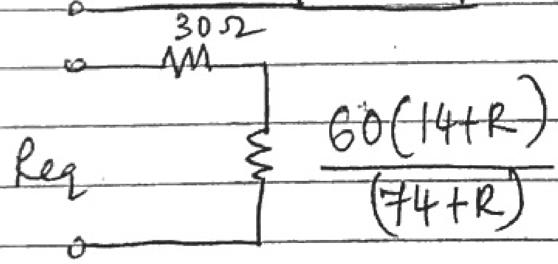


1/2

$$\therefore R_{eq} = 50 = \frac{30(74+R) + 840 + 60R}{74+R}$$

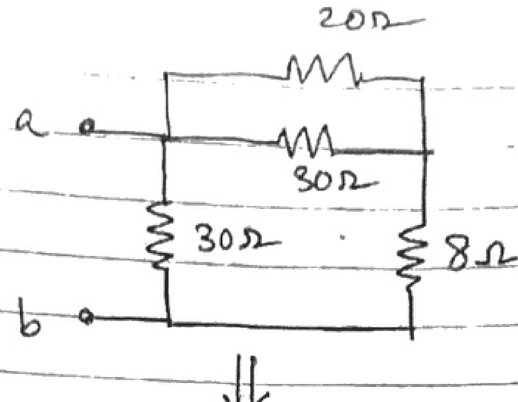
$$3700 + 50R = 2220 + 30R + 840 + 60R$$

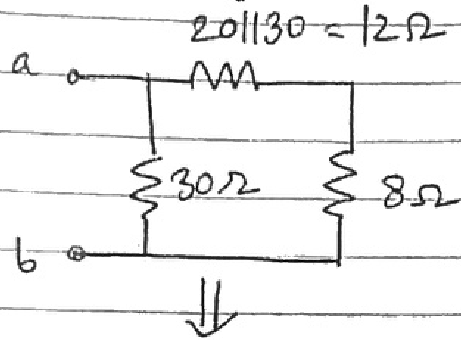
1/2

$$640 = 40R$$

$$\Rightarrow \underline{\underline{R = 16\,\Omega}}$$

2.44





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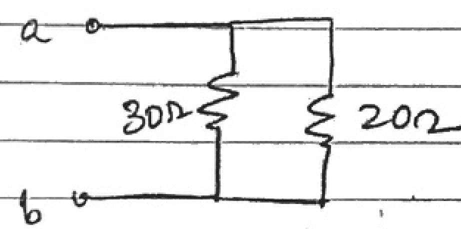
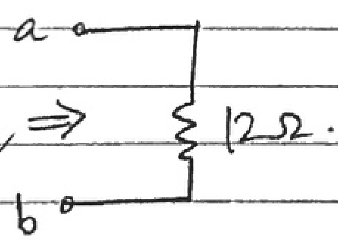


1/2

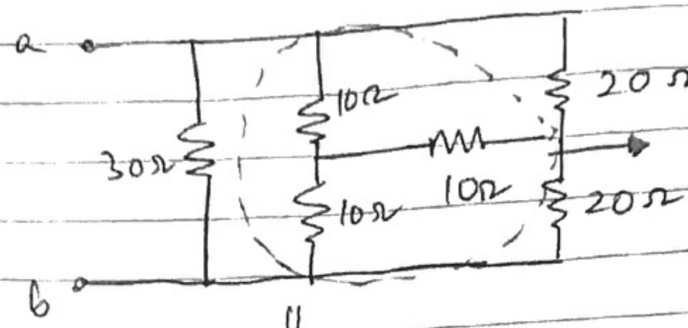
1/2

Req ⇒



$\boxed{\therefore\ R_{ab} = 12\,\Omega}$

2.5|a



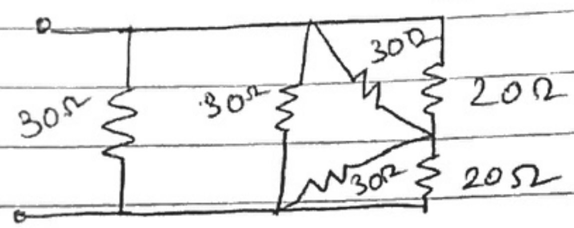
changing from Wye to Delta network

1

∴ For Delta network,

$$R_a = R_b = R_c = \frac{100+100+100}{10} = 30\,\Omega.$$

1



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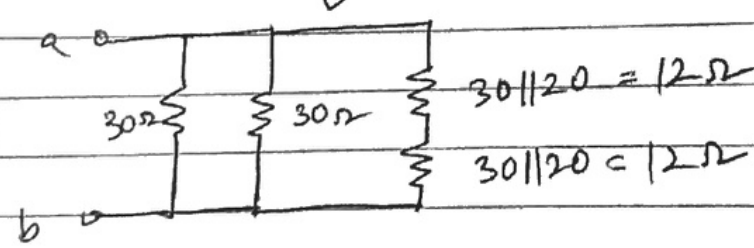

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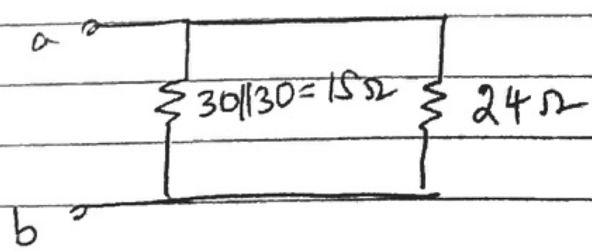
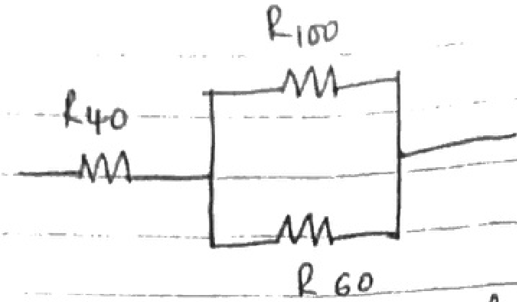


$$\therefore R_{ab} = 15 \| 24 = \frac{120}{13}\,\Omega$$

1/2

$$= 9.231\,\Omega$$

2.59



$\because$ Voltage rating of each bulb is 110 V,
if we replace each bulb by resistors,

1 $R_{40} = (110)^2/40 = 302.5\ \Omega$
$R_{100} = (110)^2/100 = 121\ \Omega$
$R_{60} = (110)^2/60 = 201.67\ \Omega$

$\therefore$ If this ckt is connected to a 220 V supply,

1 $$I_{tot} = \frac{220}{302.5 + (121 \| 201.67)}$$

$$= 0.582\ A.$$

$\therefore$ Voltage across $R_{40} = 302.5 \times 0.582$
$= \underline{\underline{176.05\ V}}$ // Much higher than rated voltage (110V)

1 $\therefore$ This bulb will burn out!

Voltage across R_{100} & R_{60} = 43.95 V.

To prevent the bulbs from burning out,

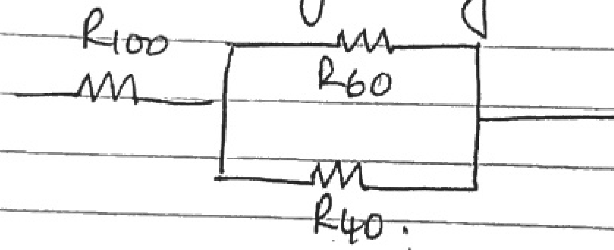
$V_{40} \leq 110\ V$; $V_{60} \leq 110V$; $V_{100} \leq 110V$

Now,

$V = IR$.

$\therefore$ For a given current level,
if $R\uparrow$, $V\uparrow$

So, if we want to use the same series and parallel combination, then the two bulbs with the highest resistances should be in $\parallel^{l}$ with each other, while the bulb with the lowest resistance should be in series with the $\parallel^{l}$ combination, thus yielding:



Checking:

$$R_{tot} = (302.5 \parallel 201.67) + 121 = 242.001\,\Omega$$

$$V_{100} = \frac{121}{242.001} \times 220 \approx 110\ \text{V} !$$

$$V_{60\parallel 40} = 110\,\text{V}. !$$

$\therefore$ This combination will work.