Question 1: (15 marks)
If the cost of electricity is defined as follow:

0.13 SR/kWh,	for on-peak: 12:00 – 5:00 pm
0.05 SR/kWh,	otherwise (off-peak),

what is the total cost of using the following?

1. 860 W air conditioner for 5 h on-peak
2. 4800 W clothes dryer for 30 min off-peak
3. 900 W coffee maker for 20 min on-peak
4. 110 W stereo for 3.5 h on-peak

① $Cost_{①} = (0.86 \times 5 \times 0.13) = 0.559$

② $Cost_{②} = (4.8 \times 0.5 \times 0.05) = 0.12$

③ $Cost_{③} = (0.9 \times (\frac{20}{60}) \times 0.13) = 0.039$

④ $(0.11 \times 3.5 \times 0.13) = 0.05005$

→ Total Cost = $0.559 + 0.12 + 0.039 + 0.05005$

$= \underline{\underline{0.76805 \text{ SR}}}$

Question 2: (20 marks)

Find the unknown quantities for the circuits of Fig. 2 using the information provided.

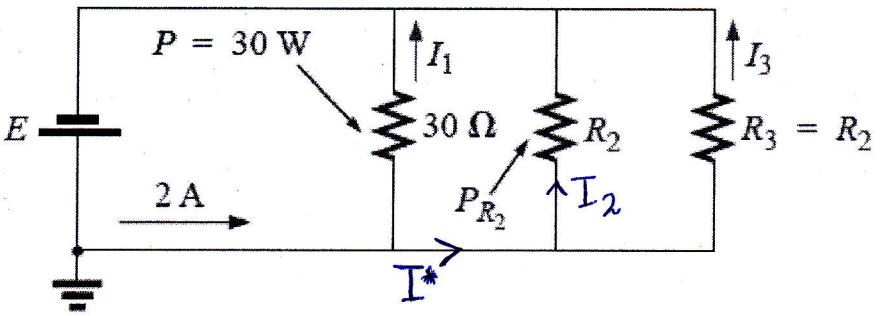


Figure 2

$\because 30 = (I_1)^2 R \rightarrow I_1 = \sqrt{\frac{P}{R}} = \sqrt{\frac{30}{30}} = \underline{1A}$

$\therefore V_{30\Omega} = (I_1)(R) = (1)(30) = \underline{30V}$

$\therefore E = V_{R_2} = V_{R_3} = \underline{30V}$ (∵parallel with 30-Ω)

from KCL:-

$2 = I_1 + I^* \rightarrow I^* = 2 - 1 = \underline{1A}$

$\because R_2 = R_3 \Rightarrow \therefore I_2 = I_3 = \frac{I^*}{2} = \underline{0.5A}$

$\therefore R_2 = R_3 = \frac{V}{I} = \frac{30}{0.5} = \underline{60\Omega}$

$\Rightarrow P_{R_2} = (I_2)^2 R_2 = \frac{(V_2)^2}{R_2} = \underline{15\ W}$

Question 3: (25 marks)
For the series-parallel network of Fig. 3:
a. Find the current I.
b. Find the currents I_3 and I_9.
c. Find the current I_8.
d. Find the voltage V_{ab}.

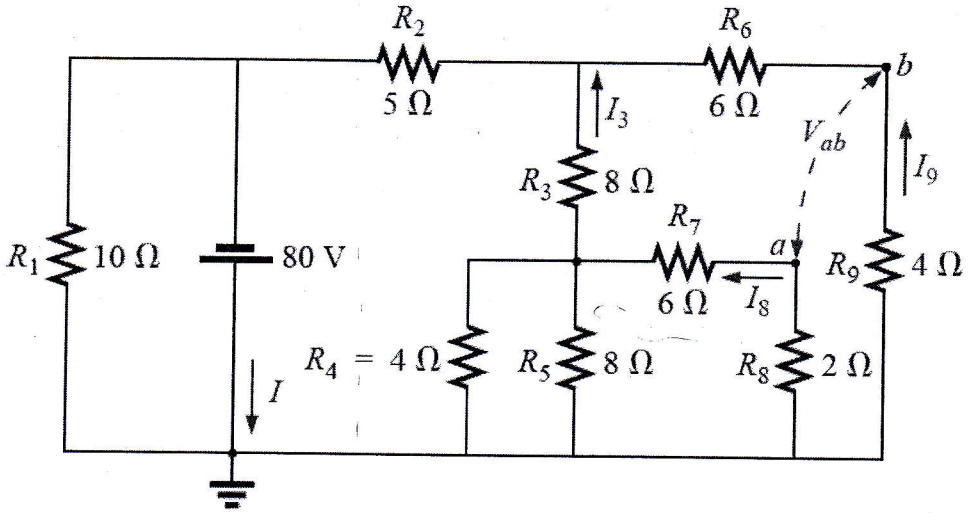


Figure 3

$R_T = (R_1) \,//\, \left(R_5 + \left((R_3 + (R_4 \,//\, R_5 \,//\, (R_8 + R_7)) \,//\, (R_6 + R_9)\right)\right)$

$\Rightarrow R_T = 5\,\Omega$

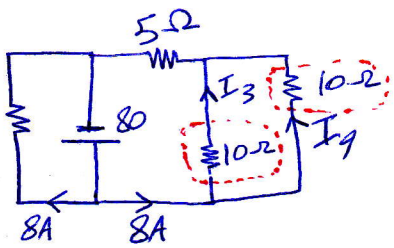
(a)

$I = \frac{V}{R_T} = \frac{80}{5} = 16\,A$

(b)

∵ The equivalent Resistances are equal

$\therefore I_3 = I_9 = \frac{8}{2} = 4\,A$

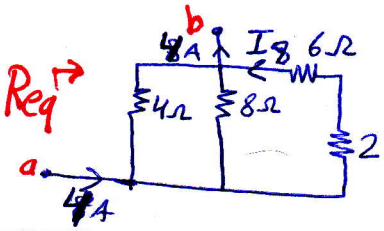


(c)

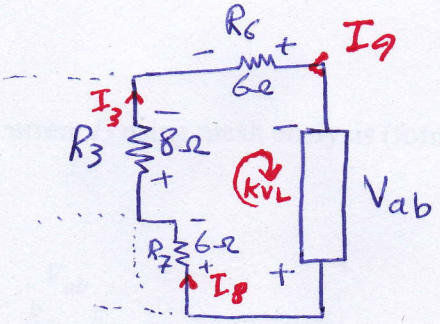
$R_{eq} = 2\ \Omega$

Using CDR (current Divider Rule)

$I_8 = I_T \frac{R_T}{R_x} = (4)\left(\frac{2}{8}\right) = 1\,A$



(d)



Apply KVL

$$-V_{R_3} + V_{R_6} + V_{ab} - V_{R_7} = 0$$

$$-(4\times8) + (4\times6) + V_{ab} - (I \times 6) = 0$$

$$V_{ab} = 14 \text{ V}$$

Question 4: (40 marks)
For the networks of Fig. 4, determine the current I_2 using mesh analysis (format approach), and then find the voltage V_{ab}.

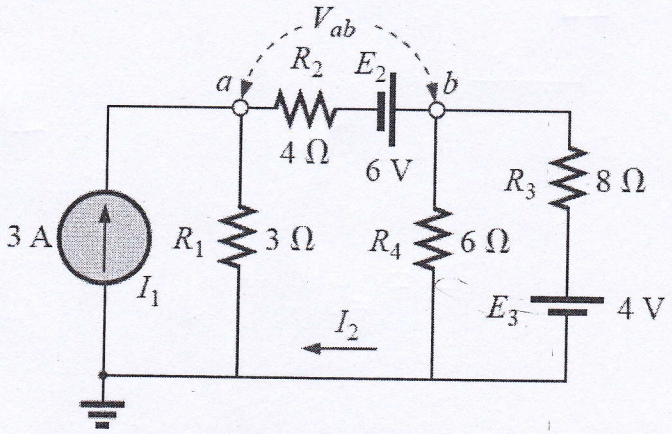
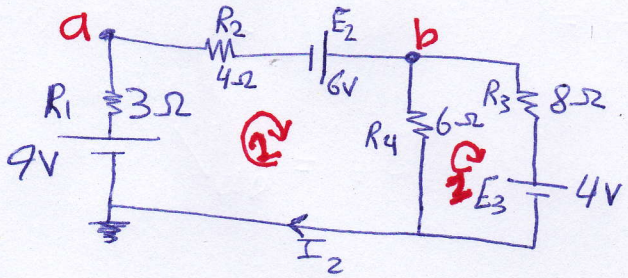


Figure 4

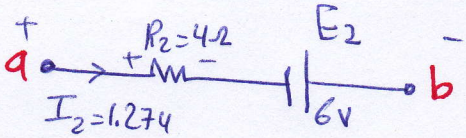
by transforming to voltage source



① $13I_1 - 6I_2 = 15$

② $-6I_1 + 14I_2 = -4$

Solving the equations → $I_2 = 1.274A$, $I_1 = 0.26A$



$V_{ab} = V_{R_2} - 6 = -0.904V$