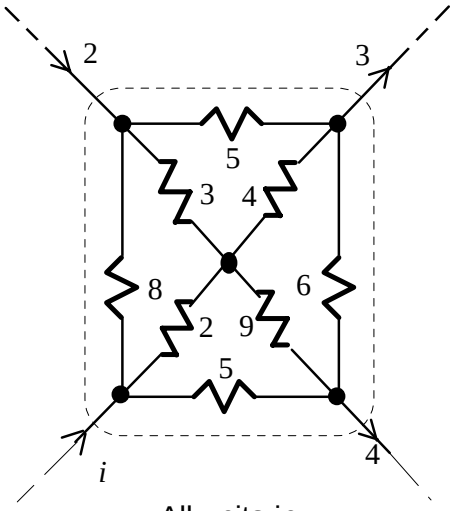
F.1 Probleme Cir El c.c.: Kirchhoff, Putere şi Energie

Q.1

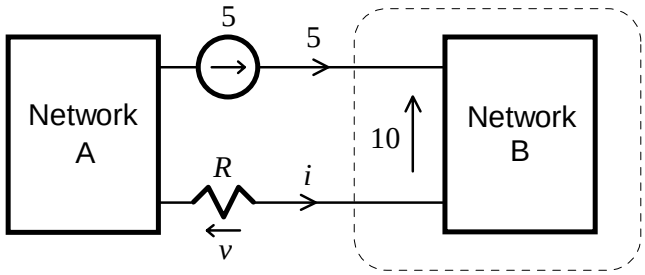


All units in
V, A, Ω

Applying KCL to the dotted surface:

$$i+2=3+4 \Rightarrow i=5$$

Q.2



All units in
V, A, Ω

Applying KCL to the dotted surface:

$$5+i=0 \Rightarrow i=-5\text{A}$$

regardless of the value of R. For $R=2\Omega$,

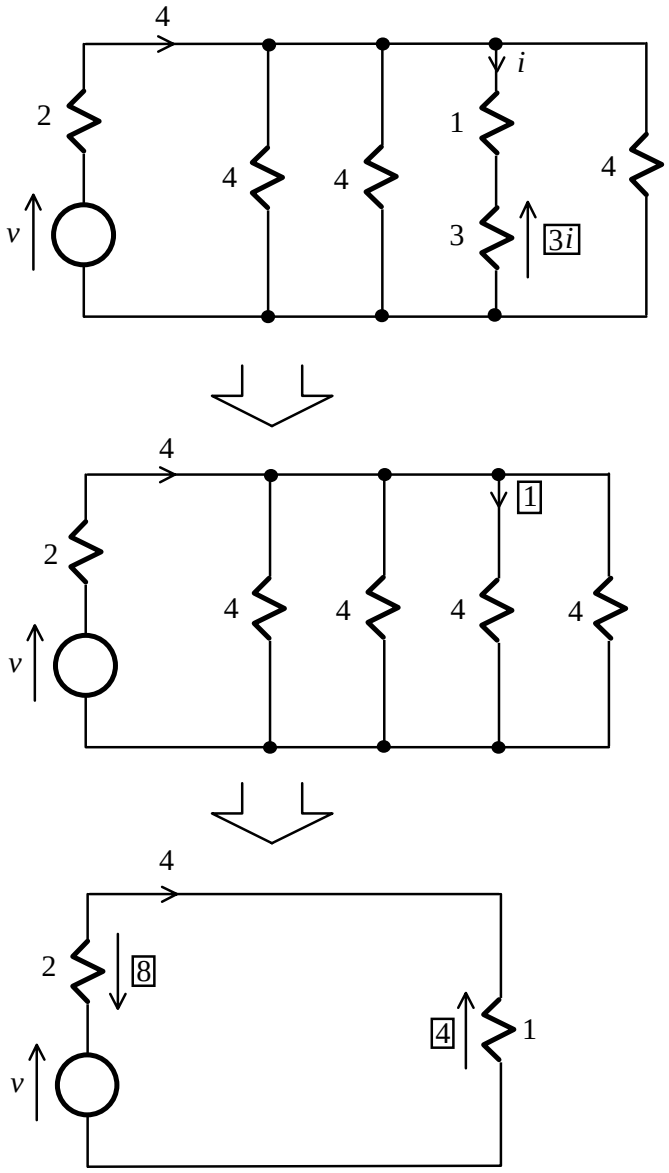
$$v=iR=-5\times 2=-10\,\text{V}$$

For $R=50\,\text{K}\Omega$,

$$v=iR=-5\times 50000=-250\,\text{KV}$$

Q.3

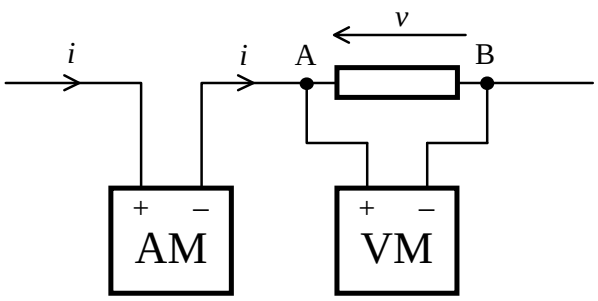
All units in V, A, Ω



$v = 8 + 4 = 12\,\text{V};\ i = 1;$ voltage across 3Ω resistor $= 3i = 3\,\text{V}$

Q.4

(a) Both meters give positive readings



Since the arrows for v and i are in opposite directions

Power consumed $= vi$

Also, AM will give a positive reading if i is positive, while VM will give a positive readings if v is positive.

Since both i and v are positive in this case, vi is positive and power is consumed.

(b) Both meters give negative readings

Both i and v are negative, vi is positive and power is consumed.

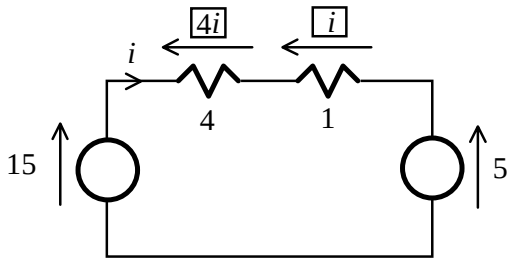
(c) One meter gives a positive reading and the other gives a negative reading

i and v have opposite signs, vi is negative and power is supplied by the device.

(d) One meter or both meter give zero readings

Power neither is consumed nor supplied by the device.

Q.5 *Current in circuit*



All units in V, A, Ω

Applying KVL:

$15 = 4i + i + 5 \Rightarrow i = 2$

Power consumed/supplied

If the voltage and current arrows are in opposite directions,

Power consumed $= (\text{voltage})(\text{current})$

Thus:

Power consumed by 4Ω resistor $= i(4i) = 16\,\text{W}$

Power consumed by 1Ω resistor $= i(i) = 4\,\text{W}$

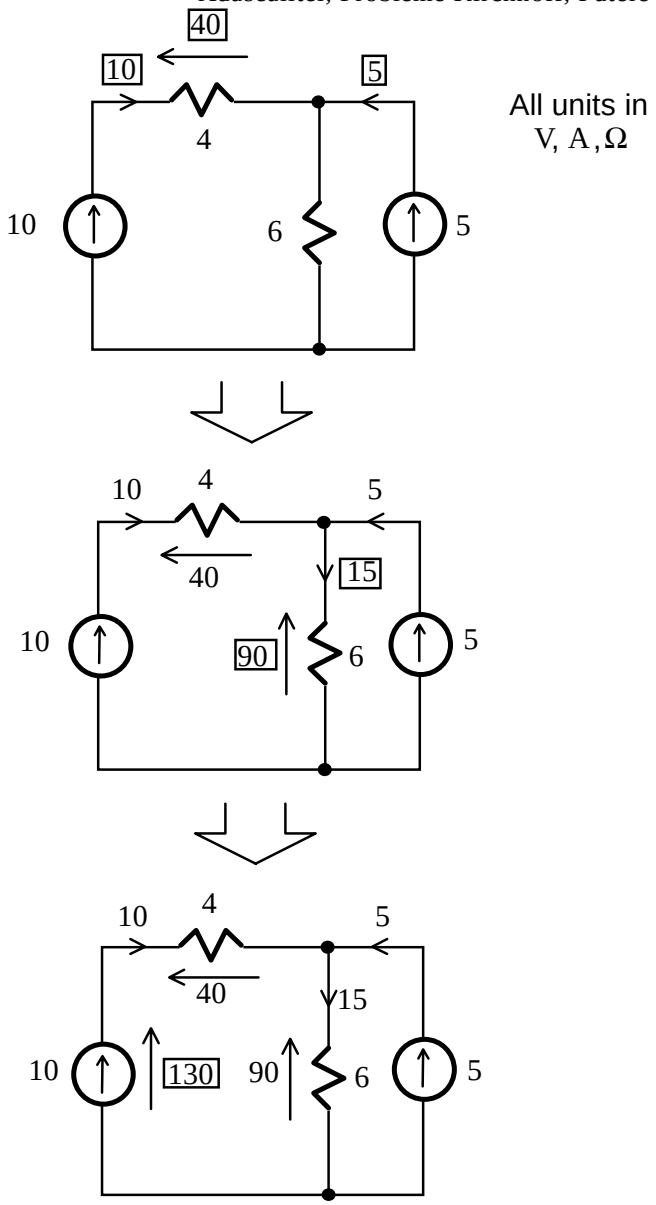
Power consumed by $5\,\text{V}$ source $= i(5) = 10\,\text{W}$

Power consumed by $15\,\text{V}$ source $= -i(15) = -30\,\text{W}$

Or

Power supplied by $15\,\text{V}$ source $= 30\,\text{W}$

Q.6



The $10\,\mathrm{A}$ current source is supplying a power of $(130)(10)=1300\,\mathrm{W}$.

Q.7

Efficiency

Electrical power supplied $=(100)(20)=2000\,\mathrm{W}$

Mechanical power delivered $=(2.5\,\mathrm{h.p.})(746\,\mathrm{W/h.p.})=1865\,\mathrm{W}$

Efficiency $=\dfrac{1865}{2000}=93.25\%$

Torque

Motor speed $=(100\,\mathrm{rev/min})\left(\dfrac{2\pi}{60}\dfrac{\mathrm{rad/rev}}{\mathrm{s/min}}\right)=\dfrac{20\pi}{6}\,\mathrm{rad/s}$

$$\text{Torque} = \frac{\text{Mechanical power delivered}}{\text{motor speed}} = \frac{1865}{20\pi/6} = 178.1\,\text{Nm}$$

Energy lost

$$\text{Power lost} = 2000 - 1865 = 135\,\text{W}$$

$$\text{Energy lost per min} = (135)(60) = 8100\,\text{J}$$

Q.8

$$\text{Generator output power} = (100)(10) = 1000\,\text{W}$$

$$\text{Generator input power} = \frac{1000}{0.9} = 1111.1\,\text{W}$$

$$\text{Generator shaft speed} = \left(\frac{11000}{5}\,\text{rev/min}\right)\left(\frac{2\pi}{60}\,\frac{\text{rad/rev}}{\text{s/min}}\right) = 230.4\,\text{rad/s}$$

$$\text{Torque} = \frac{1111.1}{230.4} = 4.82\,\text{Nm}$$

Q.9

Voltage, current and power gains for system

$$\text{Voltage gain} = g_v = \left|\frac{v_2}{v_1}\right| = \left|\frac{5v_1}{v_1}\right|$$

$$= 5 = 20\log(5)\,\text{dB} = 14\,\text{dB}$$

$$\text{Current gain} = g_i = \left|\frac{i_2}{i_1}\right| = \left|\frac{v_2/8}{v_1/10000}\right|$$

$$= \left|\frac{5v_1/8}{v_1/10000}\right| = 6250 = 20\log(6250)\,\text{dB} = 76\,\text{dB}$$

$$\text{Power gain} = g_p = \left|\frac{v_2 i_2}{v_1 i_1}\right| = g_v g_i$$

$$= (5)(6250) = 10\log[(5)(6250)]\,\text{dB}$$

$$= \frac{1}{2}\left[20\log(5) + 20\log(6250)\right]\text{dB} = \frac{14+76}{2}\,\text{dB} = 45\,\text{dB}$$

Relationship between these gains

$$g_p = g_v g_i$$

$$\left(g_p\,\text{dB}\right) = \frac{\left(g_v\,\text{dB}\right) + \left(g_i\,\text{dB}\right)}{2}$$

$g_p = g_v = g_i$ if load resistance equals amplifier's input resistance

Audio amplifier

Most loudspeakers have resistances in the order of a few Ω. However, in order not to load the CD player or other audio input equipment, the input resistance of the amplifier will have to be large and is usually greater than many $k\Omega$.