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Assignment #2

Question 1

Find v_1 and v_g when $v_o = 5V$.

$$40I_2 + \frac{5}{40} + \frac{5}{10} = 0$$
$$1600i_2 + 5 + 20 = 0$$
$$I_2 = -15.6mA$$

$$v_1 = 80i_2 \rightarrow v_1 = -1.25V$$
$$25I_1 + \frac{-1.25}{20} - 0.015 = 0$$
$$I_1 = 3.125 \times 10^{-3}A$$
$$v_g = 60i_1 + 260i_1 = 320i_1 \rightarrow v_g = 1V$$

Question 2

a)

- 26 and 10 Ω are in series $\rightarrow 26 + 10 = 36\Omega$
- 36 and 18 Ω are in parallel $\rightarrow \frac{36\times18}{36+18} = 12\Omega$
- 12 and 6 Ω are in series $\rightarrow 12 + 6 = 18\Omega$
- 18 and 36 Ω are in parallel $\rightarrow \frac{36\times18}{36+18} = 12\Omega$

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

b)

- 12 and 18 Ω are in series $\rightarrow 12 + 18 = 30\Omega$
- 30 and 10 Ω are in parallel $\rightarrow \frac{30\times10}{30+10} = 7.5\Omega$
- 7.5 and 15 Ω are in parallel $\rightarrow \frac{7.5\times15}{7.5+15} = 5\Omega$
- 5 and 20 Ω are in parallel $\rightarrow \frac{5\times20}{5+20} = 4\Omega$
- 4 and 16 Ω are in series $\rightarrow 4 + 16 = 20\Omega$
- 20 and 30 Ω are in parallel $\rightarrow \frac{20\times30}{20+30} = 12\Omega$

- 4, 12 and 14 Ω are in series $\rightarrow 4 + 12 + 14 = 30\Omega$

$$\therefore \boxed{R_{ab} = 30\Omega}$$

c)

- 500 and 1500 Ω are in parallel $\rightarrow \frac{500\times1500}{500+1500} = 375\Omega$
- 375 and 750 Ω are in parallel $\rightarrow \frac{375\times750}{375+750} = 250\Omega$
- 250 and 250 Ω are in series $\rightarrow 250 + 250 = 500\Omega$
- 500 and 2000 Ω are in parallel $\rightarrow \frac{500\times2000}{500+2000} = 400\Omega$
- 400 and 1000 Ω are in series $\rightarrow 400 + 1000 = 1400\Omega$

$$\therefore \boxed{R_{_{ab}} = 1400\Omega}$$

d)

- 60 Ω is short-circuited and ignored
- 30 and 18 Ω are in series $\rightarrow 30 + 18 = 48\Omega$
- 48 and 16 Ω are in parallel $\rightarrow \frac{48\times16}{48+16} = 12\Omega$
- 12 and 28 Ω are in series $\rightarrow 12 + 28 = 40\Omega$
- 40 and 40 Ω are in parallel $\rightarrow \frac{40\times40}{40+40} = 20\Omega$
- 20 and 20 Ω are in series $\rightarrow 20 + 20 = 40\Omega$
- 40 and 24 Ω are in parallel $\rightarrow \frac{40+24}{40+24} = 15\Omega$
- 25, 15 and 10 Ω are in series $\rightarrow 25 + 15 + 10 = 50\Omega$
- 50 and 50 Ω are in parallel $\rightarrow \frac{50\times50}{50+50} = 25\Omega$

$$\therefore \boxed{R_{ab} = 25\Omega}$$

Question 3

The equivelent resistance for the circuit is:

- 1 and 13 Ω are in series $\rightarrow 15 + 12 + 13 = 40\Omega$
- 520 Ω are in parallel $\rightarrow \frac{5\times20}{5+20} = 4\Omega$
- 64 Ω are in series $\rightarrow 6 + 4 = 10\Omega$
- 1 40 Ω are in parallel $\rightarrow \frac{10\times40}{10+40} = 8\Omega$
- 82 Ω are in series $\rightarrow 8 + 2 = 10\Omega$

$$\therefore \boxed{R_{eq} = 10\Omega}$$

The value of i_g:

$$I = \frac{V}{R} \rightarrow i_g = \frac{V}{R_{eq}} = \frac{125}{10} = 12.5A$$

Using current division law to find $I_{6\Omega}$:

$$I_{6\Omega} = i_g \times \frac{40}{50} = 10A$$

Dividing that current ($I_{6\Omega}$) to find i_o:

$$i_o = I_{6\Omega} \times \frac{5}{25} = 2A$$

$$\therefore \boxed{i_o = 2A}$$

Question 4

a) ...

Using current division to find $I_{6\Omega}$:

$$I_{6\Omega} = 2.4 \times \frac{30}{15} = 4.8A$$

Dividing the current $I_{6\Omega}$ to find i_o:

$$i_o = I_{6\Omega} \times \frac{10}{100} = 0.48A$$

$$\boxed{i_o = 0.48}$$

Using current division to find $I_{20\Omega}$:

$$I_{20\Omega} = 2.4 \times \frac{15}{30} = 1.2A$$

Using Ohm's law to find v_o:

$$V = I \times R \rightarrow v_o = I_{20\Omega} \times 20 = 24V$$

b) ...

The power used by the 6 Ω resistor:

$$P = I^2 \times R = (4.8)^2 \times 6 = 138.24W$$

c) ...

The power supplied by the current source using KVL on the leftmost mesh:

$$-V_{2.4A} + 20 \times 1.2 + 10 \times 1.2 = 0 \rightarrow V_{2.4A} = 36V$$

$$\therefore P_{2.4A} = V \times I = 36 \times 2.4 \rightarrow \boxed{P = 86.4W}$$