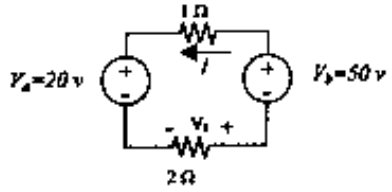
EE 201 ELECTRIC CIRCUITS I

Solution to Major Examination I

Q.1)
In the given electric circuit, calculate:

a. The current i,
b. The voltage v_1,
c. The power generated by the voltage source v_a,
d. The power generated by the voltage source v_b



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a. $1i + 20 + 2i - 50 = 0$ → $3i = 50 - 20 = 30$

$i = \frac{30}{3} = 10\ A$

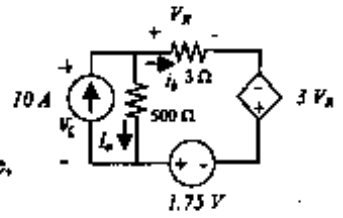
b. $v_1 = -2i = -2(10) = -20\ V$

c. $P_{v_a} = -v_a i = -20(10) = -200\ W$

d. $P_{v_b} = v_b i = 50(10) = 500\ W$

Q.2) Use Ohm's law and Kirchoff's current and voltage laws to find:

5 a. The current i_a,
4 b. The current i_b,
4 c. The voltage V_R,
5 d. The power generated by the current source,
4 e. The power generated by the independent voltage source,
4 f. The power generated by the dependent voltage source,
4 g. The total power dissipated in the two resistors.



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a. $V_R = 3\,i_b$

$i_a + i_b = 10 \rightarrow i_b = 10 - i_a$

$500\,i_a + 1.75 + 3V_R - 3V_R = 0$

$500\,i_a + 1.75 + 2(3i_b) = 0$

$500\,i_a + 1.75 + 6\,i_b = 0$

$500\,i_a + 1.75 + 6(10 - i_a) = 0$

$500\,i_a + 1.75 + 60 - 6i_a = 0$

$494\,i_a = -61.75 \rightarrow i_a = \frac{-61.75}{494} = -0.125\ A$

b. $i_b = 10 - i_a = 10 - (-0.125) = 10.125\ A$

c. $V_R = 3\,i_b = 3(10.125) = 30.375\ V$

d. $V_s = 500\,i_a = 500(-0.125) = -62.5\ V$

$\therefore P_{10A} = 10\,V_s = 10(-62.5) = -625\ W$

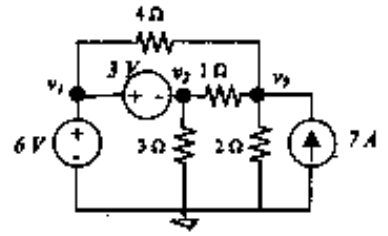
e. $P_{1.75V} = 1.75\,i_b = 1.75(10.125) = 17.71875\ W$

f. $P_{3V_R} = 3V_R\,i_b = 3(30.375)(10.125) = 922.640625\ W$

g. $P_R = i_a^2 500 + i_b^2 3 = 7.8125 + 307.546875$

$= 315.359375\ W$

Q.3) Use the node voltage method to find the voltages $v_1, v_2, and\ v_3$. Calculate also The power generated by the current source.



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5 $v_1 = 6\ V$

5 $v_2 - v_1 = -3 \quad \rightarrow \quad v_2 = v_1 - 3 = 6 - 3 = 3\ V$

$$v_3 - v_2 + \frac{v_3}{2} + \frac{v_3 - v_1}{4} - 7 = 0$$

$$4v_3 - 4v_2 + 2v_3 + v_3 - v_1 - 28 = 0$$

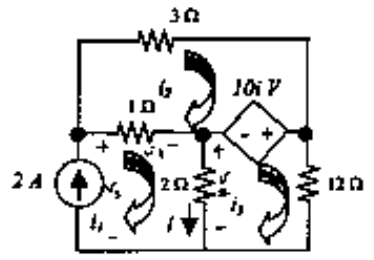
$$7v_3 - 4v_2 - v_1 - 28 = 0$$

$$7v_3 = 28 + 4v_2 + v_1 = 28 + 12 + 6 = 46$$

10 $$v_3 = \frac{46}{7} = 6.571\ V$$

5 $$P_{7A} = 7v_3 = 7(6.571) = 46\ W$$

Q.4) For the circuit shown, calculate the mesh currents i_1, i_2, and i_3. Calculate also the resistance R_{eq} seen by the current source.



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6 $i_1 = 2$

$-i_1 + 4i_2 + 10i = 0$

$-2i_1 + 14i_3 - 10i = 0$

$i = i_1 - i_3$

$-2 + 4i_2 + 10i_1 - 10i_3 = 0$

$-2 + 4i_2 + 20 - 10i_3 = 0 \rightarrow 4i_2 - 10i_3 = -18$

$-2i_1 + 14i_3 - 10i_1 + 10i_3 = 0$

7 $-24 + 24i_3 = 0 \rightarrow i_3 = 1\ A$

$\therefore 4i_2 = 10 - 18 = -8$

7 $i_2 = -2\ A$

$v_1 = 1(i_1 - i_2) = 2 - (-2) = 4\ V$

$v_2 = 2(i_1 - i_3) = 2(2 - 1) = 2\ V$

5 $v_s = v_1 + v_2 = 4 + 2 = 6\ V \rightarrow R_{eq} = \frac{v_s}{i} = \frac{6}{2} = 3\ \Omega$

$\therefore P_{2A} = 2(6) = 12\ W$
