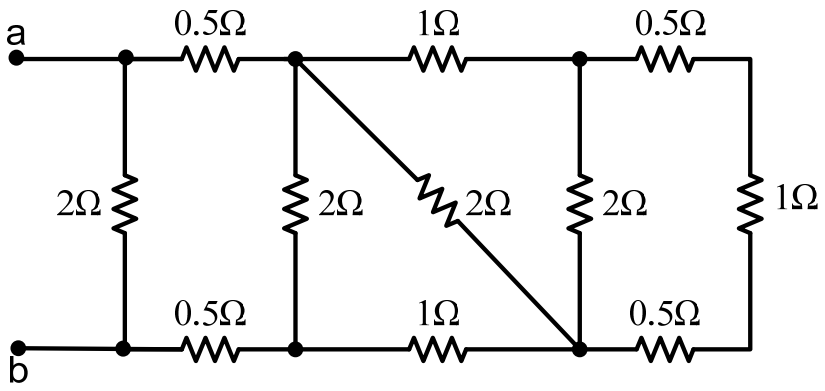
Problem 1: 8points

For the circuit shown, find the equivalent resistance across the terminals a and b.

Show the steps of the solution, marks will be given based on the steps shown.

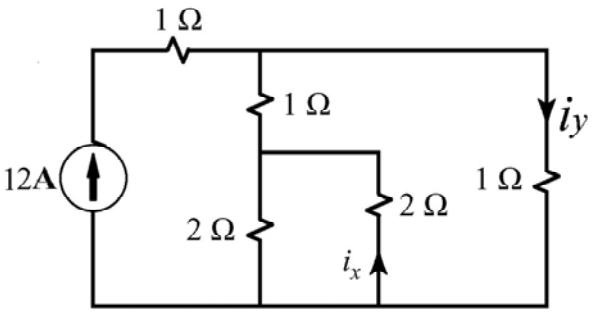


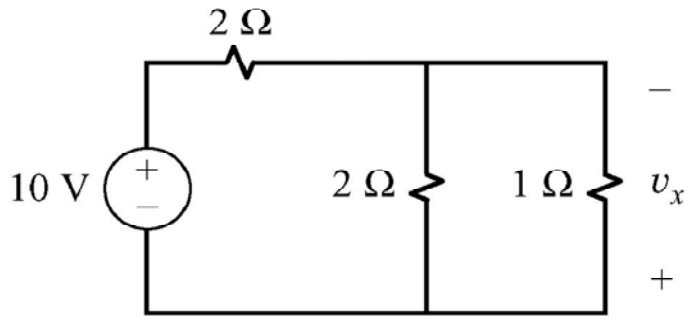
Block1(B1) correct ===➔ 2points 1+0.5+.5=2II 2=1
Block (B2) correct===➔ 4 points (2 points for each triangle) (1+1)II2=>(1+1)II2=1
Block (B3) Correct =➔ 2 points (1+.5+0.5)II2 =1

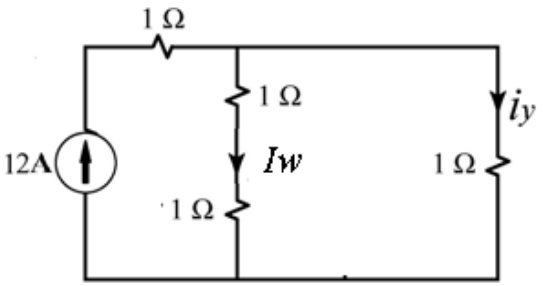
Req =1

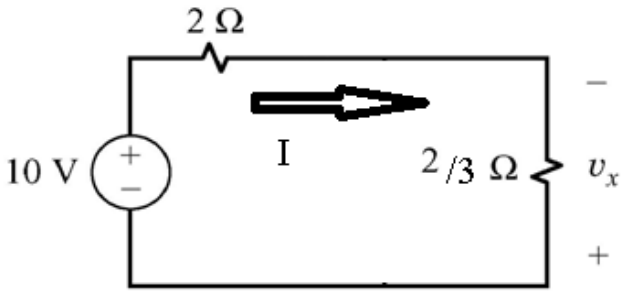
Problem 2: 10 points

Use the current divider rule and the voltage divider rule to determine the currents i_x , i_y , the voltage v_x , and the power supplied by the 10 V source shown in the following circuits.
Show the steps of the solution.









THE POINTS ARE GIVEN FOR USING CDR AND VDR ONLY, OTHERWISE ZERO POINTS (-1 POINT FOR EACH WRONG SIGN)

CDR: *Iw* = 12(1)/(1+1+1) = 4A **VDR: *v*x = -10(2/3)/(2+2/3) = -2.5 V**

CDR: *i*y = 12(2)/(1+1+1) = 8 A

CDR: *i*x = -4(2)/(2+2) = -2 A $P_{10V} = 10I = 10x10/(2+2/3) = 37.5$ W

i_x	i_y	v_x	Power supplied by the 10 V source
-2A	8A	-2.5V	37.5W
4 points	2 points	2 points	2 points

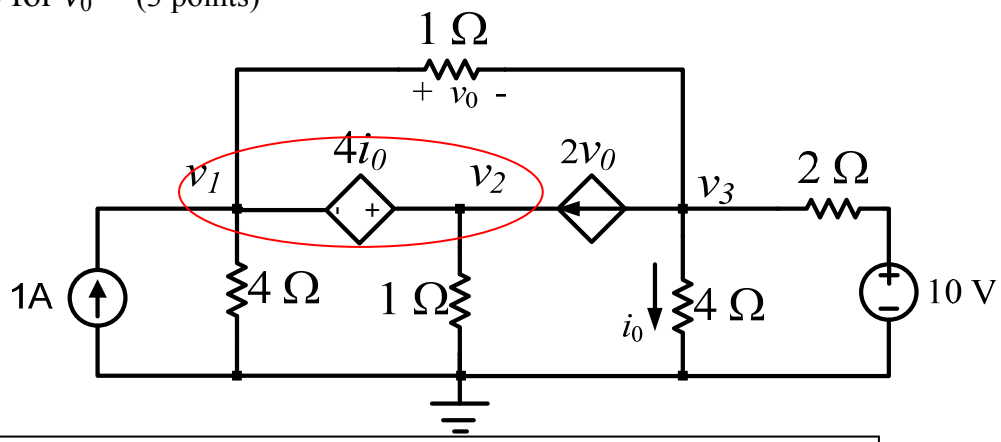
Problem 3: 12 points

i) For the circuit shown below write the node equations needed to solve for the nodes voltages v_1, v_2 and v_3? (9 points)

The equations must be simplified and put in the form:

$$av_1 + bv_2 + cv_3 = d \quad \text{Where } a, b, c \text{ and } d \text{ are scaled to be integers}$$

ii) Determine the value for v_0 (3 points)



The simplified node equations are:

1) $-3V_1 + 4V_2 + 4V_3 = 4$

2) $4V_1 - V_3 = 20$

3) $V_1 - V_2 + V_3 = 0$

$v_0 = 5.1$ v

KCL at SN V_1, V_2

$$-1 + \frac{V_1}{4} + \frac{V_1 - V_3}{1} + \frac{V_2}{1} - 2V_0 = 0$$

$$V_0 = V_1 - V_3$$

$$-1 + \frac{V_1}{4} + \frac{V_1 - V_3}{1} + \frac{V_2}{1} - 2(V_1 - V_3) = 0$$

$$-4 + V_1 + 4V_1 - 4V_3 + 4V_2 - 8V_1 + 8V_3 = 0$$

$$-3V_1 + 4V_2 + 4V_3 = 4 \quad — (1)$$

3 points

KCL at V_3

$$\frac{V_3 - V_1}{1} + 2V_0 + \frac{V_3}{4} + \frac{V_3 - 10}{2} = 0$$

$$V_3 - V_1 + 2(V_1 - V_3) + \frac{V_3}{4} + \frac{V_3 - 10}{2} = 0$$

$$4V_3 - 4V_1 + 8V_1 - 8V_3 + 2V_3 + 2V_3 - 20 = 0$$

$$4V_1 - V_3 = 20 \quad — (2)$$

3 points

Restriction $V_2 - V_1 = 4I_0 = 4\frac{V_3}{4} = V_3$

$$V_1 - V_2 + V_3 = 0 \quad — (3)$$

3 points

Solving ---> v1= 164/33 V , and V3 = -4/33 V

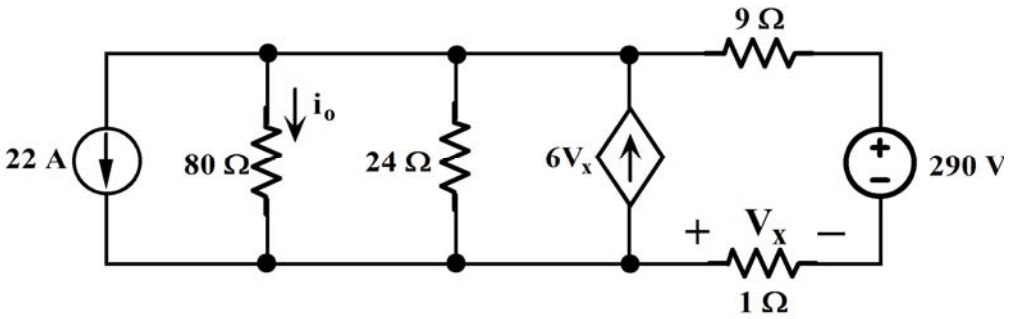
---> V0 = 56/11 = 5.1 V

3 points

Problem 4: 10 points

Given that $i_o = 3A$ and $V_x = 5V$, find the power dissipated (absorbed) in every element of the following circuit. Put the values in the following table.

Show the steps of the solution.



1) For the resistor 80 Ω: the current is i_o & $p = 80*(i_o)^2 = 720$ W dissipated.

2) For the resistor 24 Ω: the voltage is $v_o = 80 \times i_o = 240$ V,
   $p = v_o^2/24 = 2400$ W dissipated

3) For the resistor 1 Ω: the voltage is $V_x=5V$, $p = 5^2/1 = 25$ W dissipated.

4) For the resistor 9 Ω: the current $i_x = 5$ A, $p = 9*(5)^2 = 225$ W dissipated.

5) For the 22 A current source: p = 22*Vo = 5240 W.

6) For the dependent source: p = 6Vx(Vo) = -7200 W dissipated.

7) For the voltage source: p= - 290 ix = -1450 W dissipated.

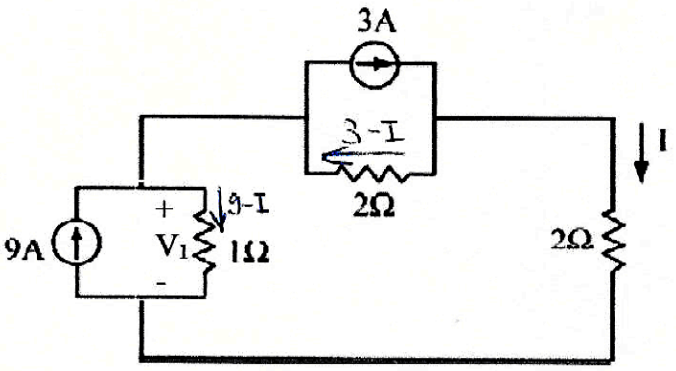
Element	Power
80 Ω resistor	$= 80(3)^2 = 720$ W, $v_o = 80(3) = 240$ V
24 Ω resistor	$=v_o^2/24=2400$ W
9 Ω resistor	= 9 * 5^2 = 225
1 Ω resistor	1*5^2=25
22 A current source	22*240=5280
290 V voltage source	-290(5)=-1450
6 V_x Dependent current source	-6(5)(240)=-7200

Problem 5: 10 points

i) Use **ONLY** KVL, KCL, and Ohm's law to find the value of the current **I** in the following circuit. (8 points)

(NO MARKS WILL BE GIVEN FOR USING ANY OTHER TECHNIQUE TO SOLVE THIS PROBLEM)

Show the steps of the solution, marks will be given based on the steps shown.



* Using KCL it can be shown that
the current in the 2Ω resistor = 3-I
the current in the 1Ω resistor = 9 - I

* Applying KVL

$2I - 2(3-I) - 1(9-I) = 0$

$5I = 15 \quad I = 3A$

I= 3 A

ii) The value of the voltage V_1 is (2 points)

(**CIRCLE THE CORRECT ANSWER ONLY**)

a) $V_1 = I$

b) $V_1 = -I$

c) $V_1 = 9-I$

d) $V_1 = I-9$

e) $V_1 = I-3$

f) $V_1 = 3-I$

g) $V_1 = -9$

h) $V_1 = 9$

j) none of the above