First Partial Integrator Exam

TE1002 Cicuits 1

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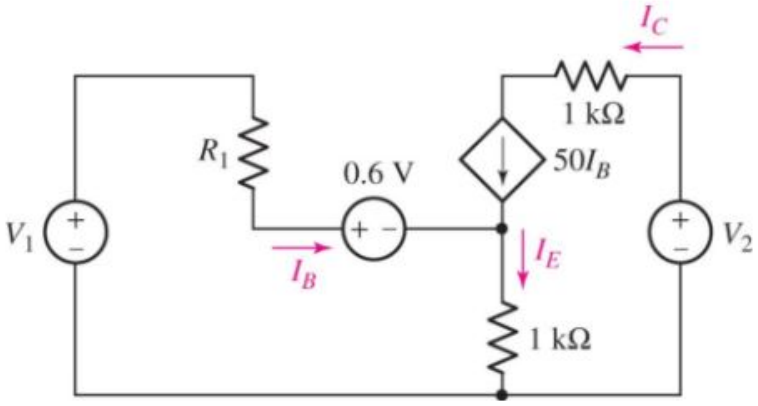
Problem 1

In the given circuit, calculate the voltage across the dependent source ("+" reference on top) if V_2 is 16 V, and I_B is 20 μA.



The voltage across the dependent source is

$$V_2 = 16V$$

$$I_B = 20\mu A$$

$$I_C = 50I_B = 50(20\mu A) = 1mA$$

$$I_E = I_B + 50I_B = 51I_B$$

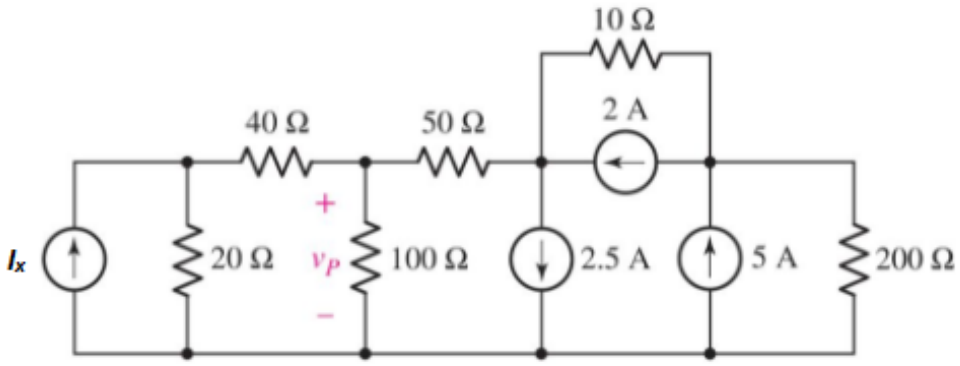
$$I_E = 51(20\mu A) = 1.02mA$$

$$V_{source} + 1000I_E - V_2 + 1000I_C = 0$$

$$V_{source} = -1000I_E + V_2 - 1000I_C = -1000(1.02\cdot 10^{-3}) + 16 - 1000(1\cdot 10^{-3}) = 13.98V$$

Problem 2

Consider the circuit given below.



If I_x = 18 A, determine the value of v_P.

The value of v_P is

$$I_x = 18A$$

$$\frac{v_1 - v_2}{40} + \frac{v_1 - 0}{20} = I_x = 18$$

$$\frac{v_2 - v_1}{40} + \frac{v_2 - 0}{100} + \frac{v_2 - v_3}{50} = 0$$

$$\frac{v_3 - v_2}{50} + \frac{v_3 - v_4}{10} + 2.5 = 2$$

$$\frac{v_4 - v_3}{10} + 2 + \frac{v_4 - 0}{200} = 5$$

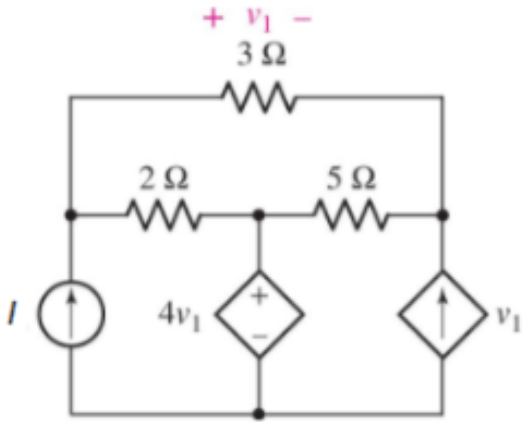
Command Window

```
>> equation1=(v1-v2)/40+(v1-0)/20==18;
>> equation2=(v2-v1)/40+(v2-0)/100+(v2-v3)/50==0;
>> equation3=(v3-v2)/50+(v3-v4)/10+2.5==2;
>> equation4=(v4-v3)/10+2+(v4-0)/200==5;
>> [A,B] = equationsToMatrix([equation1,equation2,equation3,equation4],[v1,v2,v3,v4]);
>> X=vpa(linsolve(A,B))

X =

 326.34453781512605042016806722689
 259.03361344537815126050420168067
 304.41176470588235294117647058824
 318.48739495798319327731092436975

fx >>
```

$$v_P = v_2 = 259.03361V$$

Problem 3

Consider the circuit given below.



If I = 2 A, determine the voltage labeled v_1 across the 3-Ω resistor.

The value of the voltage v_1 across the 3-Ω resistor is *480 ± 2%* mV.

The value of the voltage v_1 across the 3-Ω resistor is

$$\frac{v_A - v_C}{3} + \frac{v_A - v_B}{2} = 2$$

$$v_B - 0 = 4(v_A - v_C)$$

$$\frac{v_C - v_A}{3} + \frac{v_C - v_B}{5} = v_A - v_C$$

Command Window

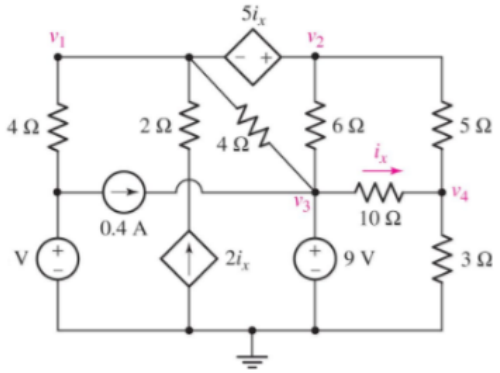
```
>> syms vA vB vC
>> equation1=(vA-vC)/3+(vA-vB)/2==2;
>> equation2=vB-0==4*(vA-vC);
>> equation3=(vC-vA)/3+(vC-vB)/5==vA-vC;
>> [A,B] = equationsToMatrix([equation1,equation2,equation3],[vA,vB,vC]);
>> X=vpa(linsolve(A,B))

X =

  5.6
 1.92
 5.12
```

$$v_1 = v_A - v_C = 5.6V - 5.12V = 0.48V$$

Element	Needed information	Power
3Ω	$v_A - v_C = 5.6V - 5.12V = 0.48V$	$P_{3\Omega} = \frac{(v_A - v_C)^2}{3} = 0.0768W$
2Ω	$v_A - v_B = 5.6V - 1.92V = 3.68V$	$P_{2\Omega} = \frac{(v_A - v_B)^2}{2} = 6.7712W$
5Ω	$v_B - v_C = 3.2V$	$P_{5\Omega} = \frac{(v_B - v_C)^2}{5} = 2.048W$
Independent Current Source	$v_A = 5.6V$ $I = 2A$	$P_{current1} = vi = -(2A)(5.6V) = -11.2W$
Dependent Voltage Source	$I_{voltage} = \frac{v_A - v_B}{2} + \frac{v_C - v_B}{5}$ $I_{voltage} = 2.48A$ $v_B = 1.92V$	$P_{voltage} = vi = (2.48A)(1.92V) = 4.7616W$
Dependent Current Source	$I_{current} = v_1 = v_A - v_C = 0.48A$ $v_C = 5.12V$	$P_{current2} = vi = -(0.48A)(5.12V) = -2.4576W$

Problem 4

Consider the circuit given below.



If V = 12 V, determine the unknown node voltages v_1, v_2, v_3, and v_4.

The value of the node voltage v_1 is

The value of the node voltage v_2 is

The value of the node voltage v_3 is

The value of the node voltage v_4 is

$$V = 12V$$

$$i_x = \frac{v_3 - v_4}{10}$$

$$v_5 = 12V$$

$$v_3 = 9V$$

$$\frac{v_1 - v_5}{4} + \frac{v_1 - v_3}{4} + \frac{v_2 - v_3}{6} + \frac{v_2 - v_4}{5} = 2i_x = 2\left(\frac{v_3 - v_4}{10}\right) = \frac{v_3 - v_4}{5}$$

$$v_2 - v_1 = 5i_x = 5\left(\frac{v_3 - v_4}{10}\right) = \frac{v_3 - v_4}{2}$$

$$\frac{v_4 - v_2}{5} + \frac{v_4 - v_3}{10} + \frac{v_4 - 0}{3} = 0$$

Command Window

```
>> syms v1 v2 v3 v4 v5
>> eqn1=v5==12;
>> eqn2=v3==9;
>> eqn3=(v1-v5)/4+(v1-v3)/4+(v2-v3)/6+(v2-v4)/5==(v3-v4)/5;
>> eqn4=v2-v1==(v3-v4)/2;
>> eqn5=(v4-v2)/5+(v4-v3)/10+(v4-0)/3==0;
>> [A,B]=equationsToMatrix([eqn1, eqn2, eqn3, eqn4,eqn5], [v1, v2, v3,v4,v5]);
>> X=vpa(linsolve(A,B))

X =

                                 9.0
 11.045454545454545454545454545455
                                 9.0
 4.9090909090909090909090909090909
                                12.0
```