ESE 271 First Exam Name:

Spring, 2004 ID Number:

Do not place your answers on this front page.

Every problem is worth 25 points

Prob. 1:

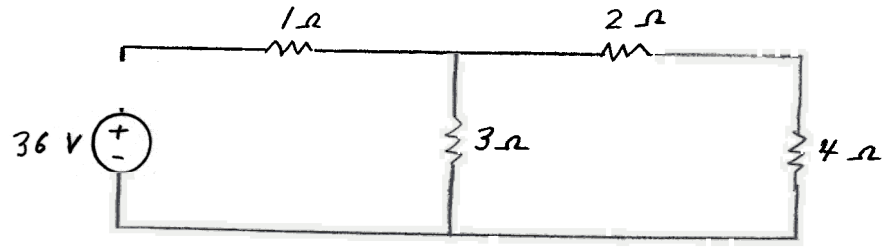
Prob. 2:

Prob. 3:

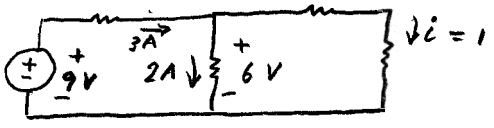
Prob. 4:

Prob. 1:

Find the power dissipated in the 4 Ω resistor.



ONE METHOD: USE PROPORTIONALITY.

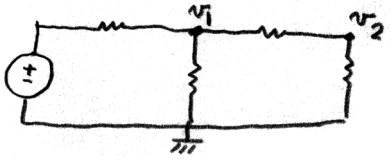


ASSUME $i = 1$ A. THEN, WE GETS

SO, i IS REALLY $i = \frac{36}{9} \times 1 = 4$ A

SO $P_4 = 4^2 \times 4 = 64$ W

ANOTHER METHOD: USE NODAL ANAYSIS.



$$\frac{v_1 - 36}{1} + \frac{v_1 - v_2}{2} + \frac{v_1}{3} = 0$$

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

SOLVING, WE GET $v_2 = 16$

SO, $P_4 = \frac{(16)^2}{4} = 64$ W

STILL ANOTHER METHOD: USE MESH ANALYSIS.

$$i_1 + (i_1 - i_2)\,3 = 36$$

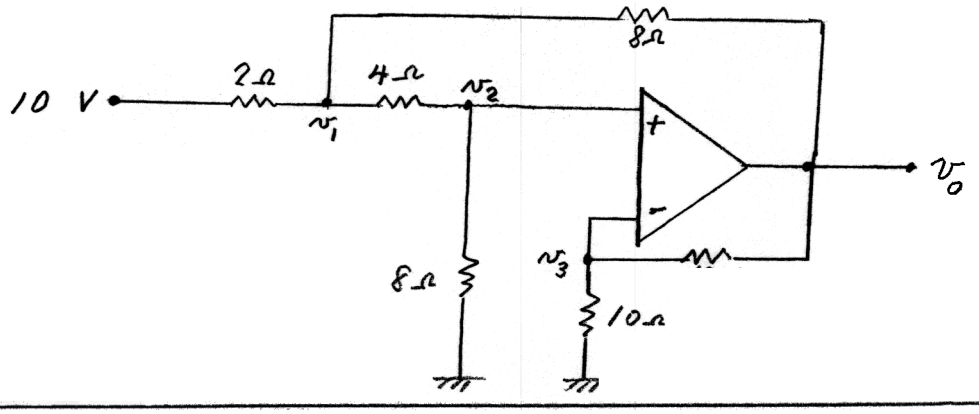
$$(i_2 - i_1)\,3 + 6\,i_2 = 0$$

SOLVING WE GET $i_2 = 4$A

SO, $P_4 = 4^2 \times 4 = 64$ W.

Prob. 2:

Find the output voltage v_o. Use a nodal analysis with the node voltages v_o, v_1, v_2, v_3.



WE MUST USE THE VIRTUAL OPEN – VIRTUAL SHORT MODEL OF THE OP AMP BECAUSE THE GAIN A IS NOT GIVEN.

AT v_1-NODE: $\dfrac{10-v_1}{2} + \dfrac{v_2-v_1}{4} + \dfrac{v_o-v_1}{8} = 0$

AT v_2-NODE: $\dfrac{v_2-v_1}{4} + \dfrac{v_2}{8} = 0$

AT v_3-NODE: $v_3 = v_2 = \dfrac{10}{10+10} v_o = \dfrac{v_o}{2}$

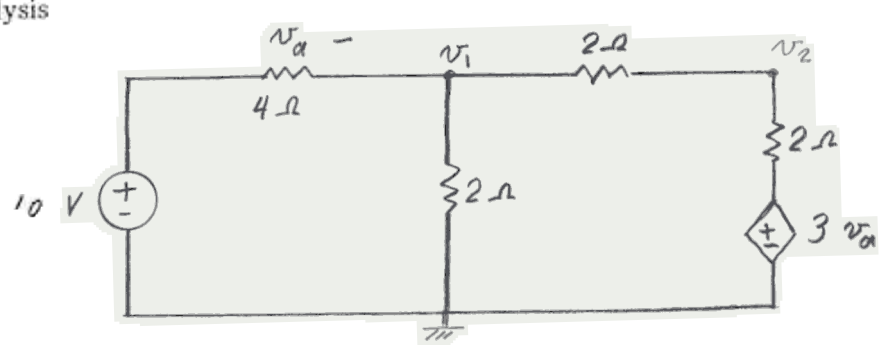
SOLVING THESE EQUATIONS, WE GET

$$v_1 = \frac{3}{4} v_o$$

AND $$v_o = \frac{160}{13} = 12.31 \text{ V}$$

Prob. 3:

In this circuit, v_1 and v_2 node voltages, and v_a branch voltage. Find v_2. Use nodal analysis



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v 10 v_1

5 3 v_a v_1

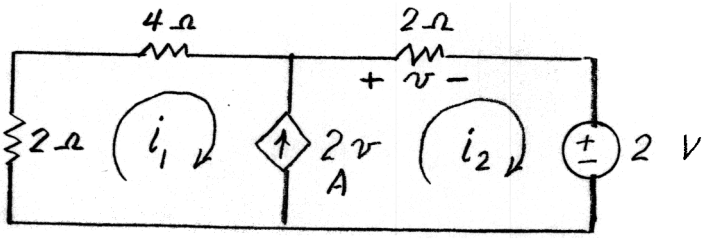
v_1 NODE $\frac{v_1}{4}$ $\frac{v_1}{2}$ v_2 0

AT v_2 NODE $\frac{v_2 - v_1}{2}$ $\frac{v_2 - 30 + 3v_1}{2}$ 0

SOLVING THESE QUATIONS RE v_2 $\frac{65}{7}$ 86 V

Prob. 4:

Finds the branch voltage v. Do a mesh analysis using the mesh currents shown.



AT DEPENDENT CURRENT SOURCE:

$$i_2 - i_1 = 2v = 2 \times 2\, i_2 = 4 i_2$$

So $$i_1 + 3 i_2 = 0$$

KVL AROUND ENTIRE CIRCUIT:

$$(2+4)\, i_1 + 2\, i_2 + 2 = 0$$

SOLVING THESE EQUATIONS WE GET

$$i_2 = \frac{1}{8}$$

So $$v = 2 \times \frac{1}{8} = \frac{1}{4}\ V$$