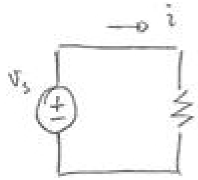
1-13

$v_s = 12V$

$P = 200 W$



(a)

$P = IV$

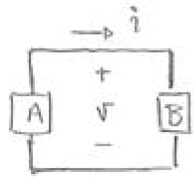
$200 = i \cdot 12$

$i = 16\frac{2}{3}$ A

(b)

$\left(\frac{200}{12} A\right)^{-1} \cdot 100$ Ah $=$ **6 hours**

1-21



(a) $v = +33$ V, $i = -2.2$ A

B transfers power to A

B → A

$P = iv = 72.6$ W

(b) $v = -12V$, $i = -1.2$ mA

A → B

$P = 14.4$ mW

(c) $v = 37.5 V$, $i = 40$ mA

A → B

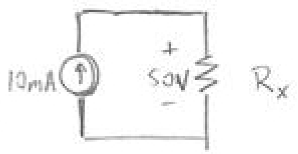
$P = 1.5$ W

(d) $v = -15$ V, $i = -43$ mA

A → B

$P = 645$ mW

2-5



$$.01 = \frac{50}{R_x}$$

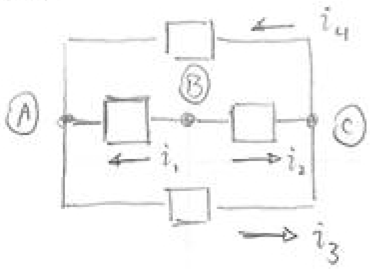
$$\boxed{R_x = 5000\,\Omega}$$

$$P = IV$$

$$= .01 \cdot 50 \quad W$$

$$\boxed{P = .5\ W}$$

2-10



$i_2 = 2A$

$i_3 = -5A$

KCL @ C

$$i_2 + i_3 - i_4 = 0$$

$$2 - 5 - i_4 = 0$$

$$\boxed{i_4 = -3A}$$

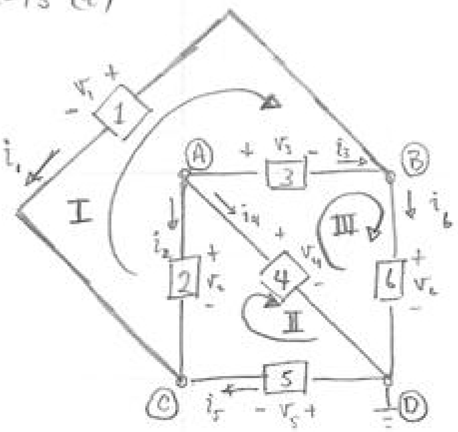
KCL @ A

$$i_1 + i_4 - i_3 = 0$$

$$i_1 - 3 + 5 = 0$$

$$\boxed{i_1 = -2A}$$

2-13 (a)



Nodes are A, B, C, D

Loops are I, II, III

(b) No single element is connected in series or parallel w/ another single element

(C)

KCL

A: $-i_2 - i_3 - i_4 = 0$

B: $-i_1 + i_3 - i_6 = 0$

C: $i_1 + i_2 + i_5 = 0$

D: $i_4 - i_5 + i_6 = 0$

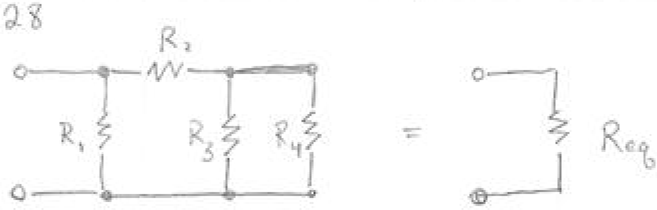
KVL

I: $v_1 + v_3 - v_2 = 0$

II: $v_2 - v_4 - v_5 = 0$

III: $-v_3 - v_6 + v_4 = 0$

2-28



$R_1 = 160\,\Omega$

$R_2 = 30\,\Omega$

$R_3 = 15\,\Omega$

$R_4 = 30\,\Omega$

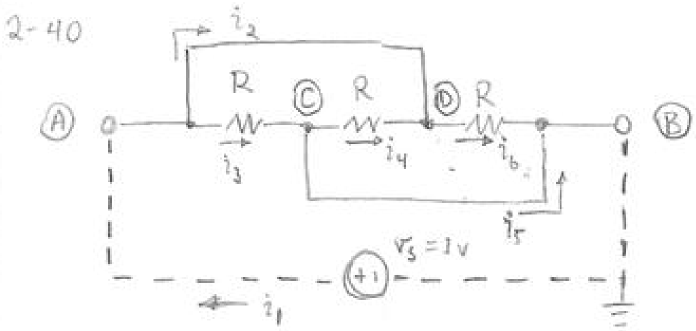
$R_1 \parallel (R_2 \oplus (R_3 \parallel R_4))$

$$R_{3,4} = \frac{R_3 R_4}{R_3 + R_4} = \frac{15 \times 30}{15 + 30} = 10\,\Omega$$

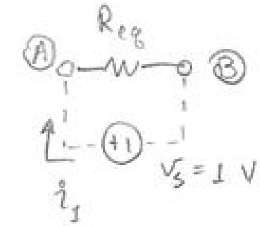
$$R_{2,3,4} = R_2 + R_{3,4} = 30 + 10 = 40\,\Omega$$

$$R_{eq} = \frac{R_1 R_{2,3,4}}{R_1 + R_{2,3,4}} = \frac{160 \times 40}{160 + 40} = 32\,\Omega$$

2-40



=



Equivalent circuit

Notes: An equivalent resistance will draw the same current from any voltage source, so i_1 in the eq. cct is equal to i_1 in the original. This is a fail-safe method for determining eq. resistance in a purely resistive array. (For ease of computation, I chose a source voltage of 1 V)

* Nodes A & D are shorted
  ⇒ they are the same node!
  ⇒ $\varphi_A = \varphi_D = v_s = 1$ V
  * Notation: φ_A = voltage measured @ node A relative to ground

* Likewise $\varphi_C = \varphi_B = 0$ V

KCL @ A

$$i_1 - i_3 + i_4 - i_6 = 0 \qquad (1)$$

By Ohm's Law:

$$i_1 = \frac{v_s - 0}{R_{eq}} = \frac{1}{R_{eq}} \qquad (2)$$

$$i_3 = \frac{v_s - \varphi_c}{R} = \frac{1}{R} \qquad (3)$$

2-40 cont

$$i_4 = \frac{\varphi_C - \varphi_D}{R} = \frac{0-1}{R} = -\frac{1}{R} \qquad (4)$$

$$i_6 = \frac{\varphi_D - 0}{R} = \frac{1}{R} \qquad (5)$$

Subst. 2, 3, 4, 5 → (1)

$$\frac{1}{R_{eq}} - \frac{1}{R} + \left(-\frac{1}{R}\right) - \frac{1}{R} = 0$$

$$\therefore \boxed{R_{eq} = \frac{R}{3}}$$

Always pay attention to short circuits. Doing so will save you much grief both in this class and in the real(ish) world.

The ground node will produce your dependent equation if you correctly set-up the problem.