P548 23 – 27, 32, 71

(23) $R_{eq} = 2.0\Omega + 12.0\Omega + 8.0\Omega = 22\Omega$

$I = \frac{V}{R} = \frac{9.0V}{22\Omega} = \underline{.41\ A}$

$\Sigma V = 9.0V - (.41A)(8.0\Omega) - (.41A)(12.0\Omega) - (.41A)(2.0\Omega)$

$= \underline{0}$

(24) $\Sigma V = 0$

$-18V - 1.0\Omega(I) - 2.0\Omega(I) + 12V - 6.6\Omega(I) = 0$

$-6V - 9.6\Omega(I) = 0$

$I = -.625A$

$\mathcal{E}_{18V}$: $V = (.625A)(1.0\Omega) = .625V$ drop across resistor

$\therefore \underline{V_{18} = 17.4V}$

$\mathcal{E}_{12V}$: $V = (.625A)(2.0\Omega) = 1.25V$ drop across resistor

$\therefore \underline{V_{12} = 10.8V}$

(25) (a) $\Sigma V_{top\ loop} = -30I_1 + 45V - 1I_3 - 40I_3 = 0$

$-30I_1 - 41I_3 = -45$

$\Sigma V_{outside\ loop} = -30I_1 + 20I_2 + 1I_2 - 80V = 0$

$-30I_1 + 21I_2 = 80$

$I_a : I_3 = I_1 + I_2$

to find the potential difference between a and d we need to calculate I_3

25a

$$I_3 = \frac{-45 + 30I_1}{-41} = 1.10 - .73I_1$$

$$I_1 = \frac{80 - 21I_2}{-30} = -2.67 + .7I_2$$

$$I_3 = I_1 + I_2$$

$$1.10 - .73I_1 = I_1 + I_2$$

$$1.10 - .73(-2.67 + .7I_2) = (-2.67 + .7I_2) + I_2$$

$$1.10 + 1.949 - .511I_2 = -2.67 + 1.7I_2$$

$$5.719 = 2.211I_2$$

$$\underline{I_2} = 2.59\,A$$

$$I_1 = -2.67 + .7(2.59)$$

$$I_1 = -0.857\,A$$

$$I_3 = I_1 + I_2 = -.857 + 2.59$$

$$= 1.733\,A$$

$$V_{ad} = 45 - 1I_3 - 40I_3 = 45 - 41(1.733) = \underline{-26\,V}$$

(b) $V_{80} = 80V - 1I_2 = 80 - (2.59) = \underline{77V}$

$V_{45} = 45V - 1I_3 = 45 - (1.733) = \underline{43V}$

(26) $\sum V_{loop} = -IR - 1.5V - IR - IR - 1.5V - IR = 0$

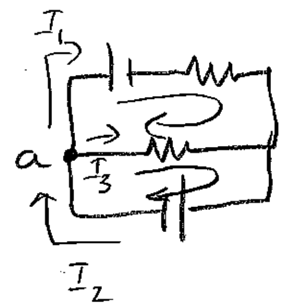
$$-4IR = 3$$

$$I = \frac{3}{-4R} = \frac{3}{-4(75)} = -0.01\,A$$

$$V_{ab} = -IR - 1.5V - IR$$

$$= -2IR - 1.5V = -2(-0.01\,A)(75\,\Omega) - 1.5V = \underline{0}$$

(27) $\sum V_{top} = -9.0V - 22I_1 + 15I_3 = 0$



$\sum V_{bottom} = -15I_3 - 6V = 0$

$I_a: \; I_2 = I_1 + I_3$

$$I_3 = \frac{6}{-15} = -.4\,A$$

$$-22I_1 = 9 - 15I_3$$

$$I_1 = \frac{9 - 15I_3}{-22} = \frac{9 - 15(-.4)}{-22} = -0.68$$

$\underline{I_{R_1} \quad 0.68\,A \quad \text{right to left}}$

$\underline{I_{R_2} \quad 0.40\,A \quad \text{right to left}}$

(32) (a) $\Sigma V_{\text{top loop}} = 1I_1 - 12 + 12I_1 + 10I_2 + 1I_2 - 12 + 8I_1 = 0$

$$21I_1 + 11I_2 = 24$$

$\Sigma V_{\text{bottom loop}} = 12 - 1I_2 - 10I_2 + 18I_3 + 1I_3 - 6 + 15I_3 = 0$

$$-11I_2 + 34I_3 = -6$$

$I_{\text{left junction}}: I_1 = I_2 + I_3$

$$I_1 = \frac{24 - 11I_2}{21} = 1.14 - .523I_2$$

$$I_3 = \frac{-6 + 11I_2}{34} = -.176 + .324I_2$$

$$(1.14 - .523I_2) = I_2 + (-.176 + .324I_2)$$

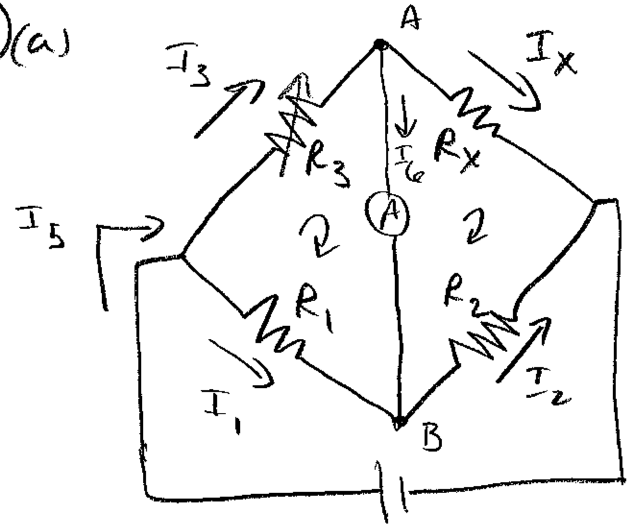
$$1.316 = 1.847I_2$$

$$\underline{I_2 = 0.71\ A}$$

$$I_1 = 1.14 - .523(.71) = \underline{0.77\ A}$$

$$I_3 = -.176 + .324(.71) = \underline{0.054\ A}$$

71 (a)



$$\Sigma V_{left} = -I_3 R_3 + I_1 R_1 = 0$$

$$\Sigma V_{Right} = -I_X R_X + I_2 R_2 = 0$$

$I_A : I_3 = I_6 + I_X$

$I_B : I_1 + I_6 = I_2$

But $I_6 = 0$ if the bridge is balanced.

so... $I_3 = I_X$

$I_1 = I_2$

$$I_X R_X = I_2 R_2$$

$$R_X = \frac{I_2 R_2}{I_X}$$

$$I_3 R_3 = I_1 R_1$$

$$I_X R_3 = I_2 R_1$$

$$I_X = \frac{I_2 R_1}{R_3}$$

$$\underline{R_X = \frac{R_2 R_3}{R_1}}$$

(b) $R_X = \dfrac{(972\,\Omega)(42.6\,\Omega)}{630\,\Omega} = \underline{65.7\,\Omega}$