EE40 HW1 p1

P1.10

$$i(t) = \frac{dq(t)}{dt} = \frac{d}{dt}(3 - 3e^{-2t}) = \boxed{6e^{-2t}\ A}$$

P1.16

V is constant

$$V = \frac{dw}{dq} \rightarrow w = \int V\,dq = V\int dq = Vq$$

$$\rightarrow q = \frac{w}{V} = \frac{600\,J}{12\,V} = \boxed{50\,C}$$

increase chem. energy → absorb electrical energy

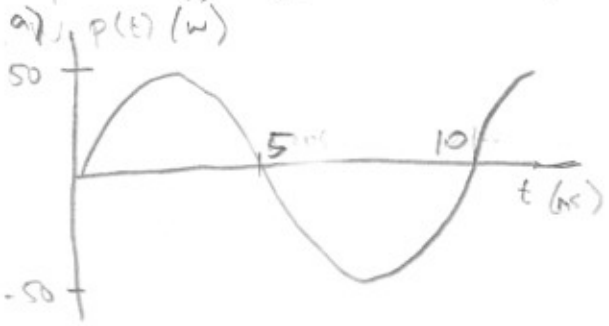
→ $p > 0$ → current in terminal a (+) → electrons out a

→ electrons from L to a

P1.18

$$p(t) = v_{ab}(t)\, i_{ab}(t) = 50\sin(200\pi t)\ W$$

a)



(b)

$$p = \frac{dw}{dt} \rightarrow w = \int p\,dt = \int_0^{0.005} 50\sin(200\pi t)\,dt = -\frac{50}{200\pi}\cos(200\pi t)\Big|_0^{0.005}$$

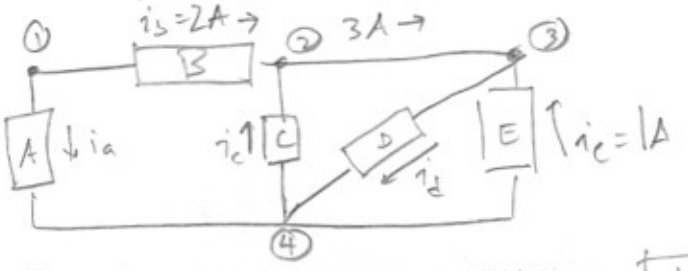
$$w = -\frac{1}{4\pi}(-1-1) = \boxed{\frac{1}{2\pi} = 0.159\ J}$$

(c) From the plot we can see it will be 0 J or doing the math:

$$w = \int_0^{0.01} 50\sin(200\pi t)\,dt = -\frac{50}{200\pi}\cos(200\pi t)\Big|_0^{0.01}$$

$$= -\frac{1}{4\pi}(1-1) = \boxed{0\ J}$$

P1.28



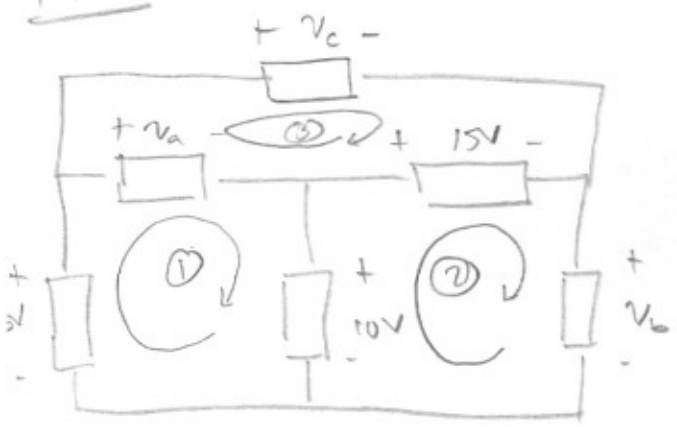
KCL @ ① $i_a + i_b = 0A \rightarrow i_a + 2A = 0A \rightarrow \boxed{i_a = -2A}$

KCL @ ② $-i_b + 3A - i_c = 0A \rightarrow -2A + 3A - i_c = 0A \rightarrow \boxed{i_c = 1A}$

KCL @ ③ $-3A - i_e + i_d = 0A \rightarrow -3A - 1A + i_d = 0A \rightarrow \boxed{i_d = 4A}$

Elements A and B are in series. (All other nodes connect 3 or more elements)

P1.32



KVL on ①: $v_a + 10V - 5V = 0V$

$\boxed{v_a = -5V}$

KVL on ②: $v_b - 10V + 15V = 0V$

$\boxed{v_b = -5V}$

KVL on ③: $v_c - 15V - v_a = 0V$

$v_c - 15V + 5V = 0V$

$\boxed{v_c = 10V}$

P1.36

KVL on ① (acba): $v_{ac} + 15V - 5V = 0V$

$\boxed{v_{ac} = -10V}$

KVL on ② (abcda): $5V - 15V + v_{cd} + 10V = 0V$

$\boxed{v_{cd} = 20V}$

P1.43

$P = vi = v\left(\frac{v}{R}\right) = v^2/R \rightarrow R = v^2/P = \frac{(100V)^2}{100W} = \boxed{100\Omega}$

$P_{new} = \frac{v_{new}^2}{R} = \frac{(0.9\, v_{old})^2}{R} = \frac{0.81\, v_{old}^2}{R} = 0.81\, P_{old}$

So power is reduced by $\boxed{19\%}$

ECE HW1 p3

P 1.45

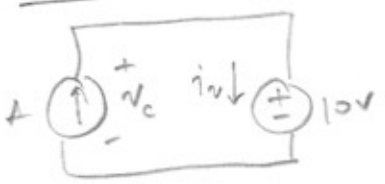
$$R = \frac{\rho L}{A} = 0.5\Omega$$

a) $R_a = \frac{\rho 2L}{A} = 2\frac{\rho L}{A} = 2R = \boxed{1\Omega}$

(b) $R = \frac{\rho L}{A} = \frac{\rho L}{\pi(\frac{d}{2})^2}$

$$R_b = \frac{\rho L}{\pi(\frac{2d}{2})^2} = \frac{\rho L}{4\pi(\frac{d}{2})^2} = \frac{R}{4} = \boxed{0.125\Omega}$$

P 1.47

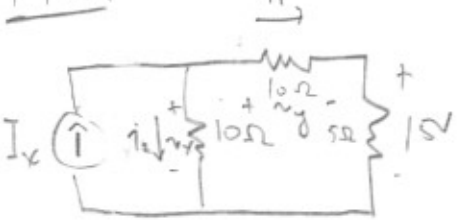


By KCL $i_v = 2A \rightarrow p_v = (10V)(2A) = 20W$

By KVL $v_c = 10V \rightarrow p_c = (10V)(-2A) = 20W$

The current source is supplying power and the voltage source is absorbing it.

P1.51



By ohm's law on the 5Ω:

$$i_1 = \frac{15V}{5\Omega} = 3A$$

By ohm's law on the top 10Ω:

$$v_y = i_1(10\Omega) = (3A)(10\Omega) = 30V$$

By KVL on the loop with all the resistors:

$$v_x - 15V - v_y = 0V$$

$$v_x - 15V - 30V = 0V \rightarrow v_x = 45V$$

By ohm's law on the last resistor:

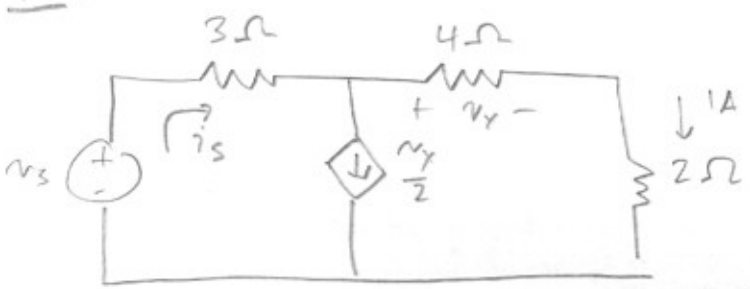
$$i_2 = \frac{v_x}{10\Omega} = \frac{45V}{10\Omega} = 4.5A$$

By KCL at the top left

$$-I_x + 3A + 4.5A = 0A \rightarrow I_x = \boxed{7.5A}$$

HW1 p4

P1.57



Ohm's law on the 4Ω: $v_x = (1A)(4\Omega) = 4V$

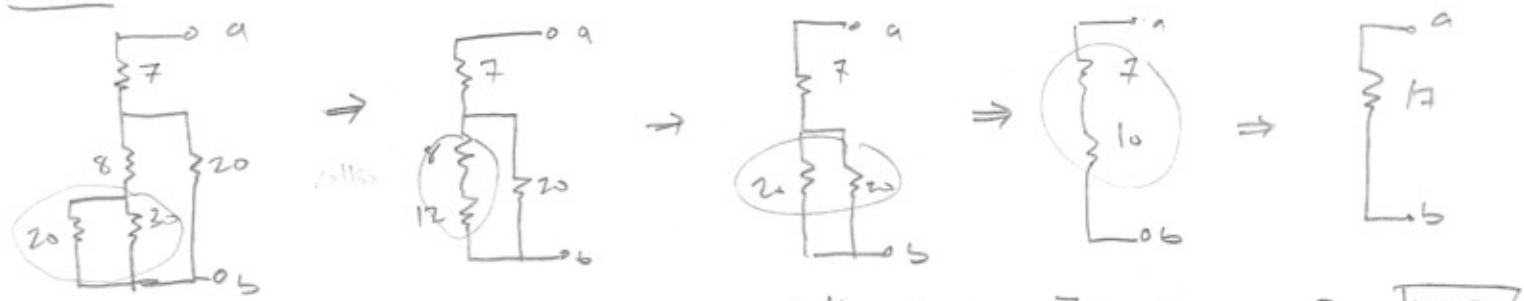
KCL @ bottom: $i_s - \frac{v_x}{2\Omega} - 1A = 0$

$i_s = \frac{4V}{2\Omega} + 1A = 3A$

KVL around outside: $-v_s + 3i_s + 4V + (1A)(2\Omega) = 0$

$v_s = \boxed{15V}$

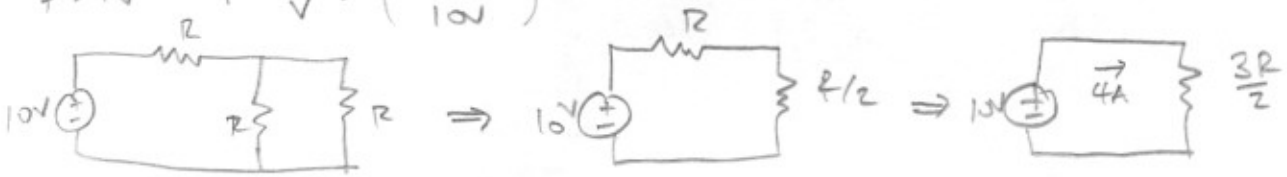
P2.14



$20||30 = 12$ $\quad 8+12=20$ $\quad 20||20=10$ $\quad 7+10=17$ $\quad R_{ab} = \boxed{17\Omega}$

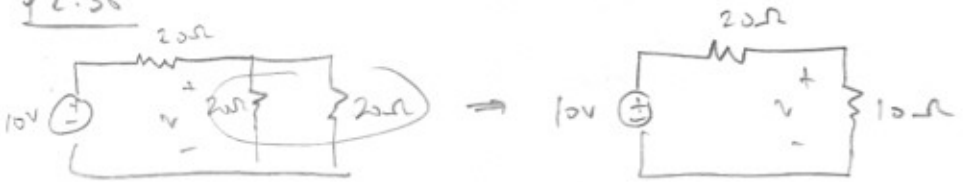
P2.27

$P = -iv \rightarrow i = -\frac{P}{V} = -\left(\frac{-40W}{10V}\right) = 4A$



By ohm's law: $R = \frac{v}{i} \rightarrow \frac{3R}{2} = \frac{10V}{4A} = \boxed{\frac{5}{3}\Omega = 1.667\Omega}$

P2.36



$20||20 = 10$

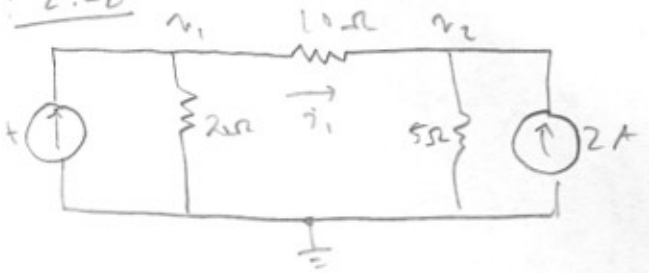
By voltage division:

$v = \left(\frac{10}{10+20}\right)10V = \boxed{\frac{10}{3}V = 3.333V}$

P2.37

$$i_3 = \left(\frac{R_2}{R_2+R_3}\right)(i_s) = \frac{15\Omega}{(15\Omega+5\Omega)}\,10A = \boxed{7.5A}$$

P2.38



① $-1A + \frac{v_1 - v_2}{10\Omega} + \frac{v_1}{20\Omega} = 0$

② $\frac{v_2 - v_1}{10\Omega} + \frac{v_2}{5\Omega} - 2A = 0$

Solving: ① $3v_1 - 2v_2 = 20$

② $-v_1 + 3v_2 = 20$

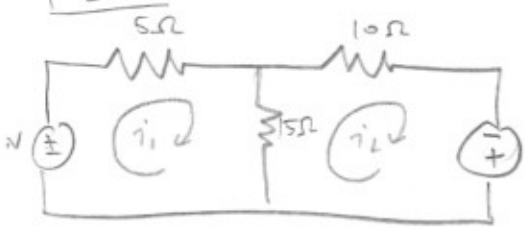
① + 3②: $7v_2 = 80$

$v_2 = \frac{80}{7} = \boxed{11.429 = v_2}$

$v_1 = 3v_2 - 20 = \boxed{14.286 = v_1}$

$i_1 = \frac{v_1 - v_2}{10\Omega} = \boxed{0.286A = i_1}$

P2.52



① $-20V + 5\Omega\, i_1 + 15\Omega(i_1 - i_2) = 0$

② $15\Omega(i_2 - i_1) + 10\Omega\, i_2 - 10V = 0$

Solving:

① $20i_1 - 15i_2 = 20$

② $-15i_1 + 25i_2 = 10$

5① + 3②: $55i_1 = 130$

$i_1 = \frac{130}{55} = \boxed{2.364A = i_1}$

$i_2 = \frac{10 + 15i_1}{25} = \boxed{1.818A = i_2}$