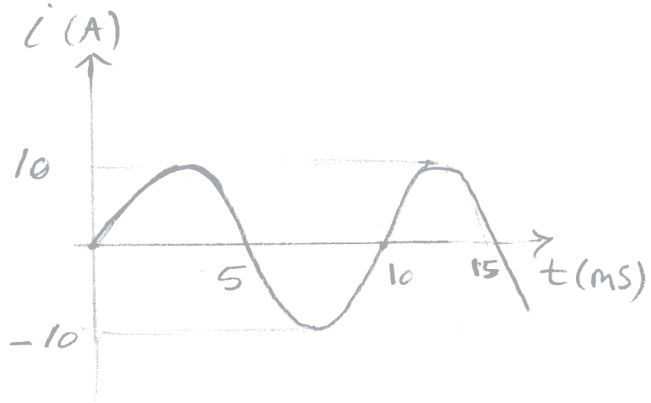
EE 40, Summer 05

HW1 Solution

① P1.8 text book



(a) $i(t) = 10 \sin(200\pi t)$

$\omega = 200\pi = \frac{2\pi}{T}$

$T = 10\ ms$

(b) $Q = \int_{t_1=0}^{t_2=0.005\,s} i(t)\,dt = 10 \int_{t=0}^{t=5ms} \sin(200\pi t)\,dt$

$Q = \frac{10}{200\pi} \cos(200\pi t)\Big|_0^{0.005} \Rightarrow \boxed{Q = 0.0318\,C}$

(c) $Q = \int_{t_1=0}^{t_2=0.01s} i(t)\,dt = 10 \int_0^{0.01} \sin(200\pi t)\,dt \Rightarrow \boxed{Q = 0\,C}$

② P1.14 text book

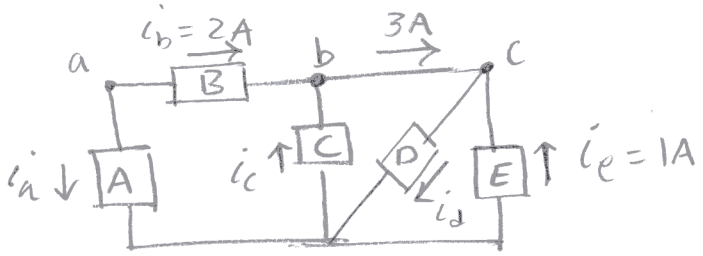
(a) $P = -V_a i_a = -20W$ Energy is being supplied by the element

(b) $P = V_b i_b = 50W$ Energy is being absorbed by the element

(c) $P = -V_c i_c = 40W$ Energy is being absorbed by the element

HW1 Solution

③ P1.28 text book



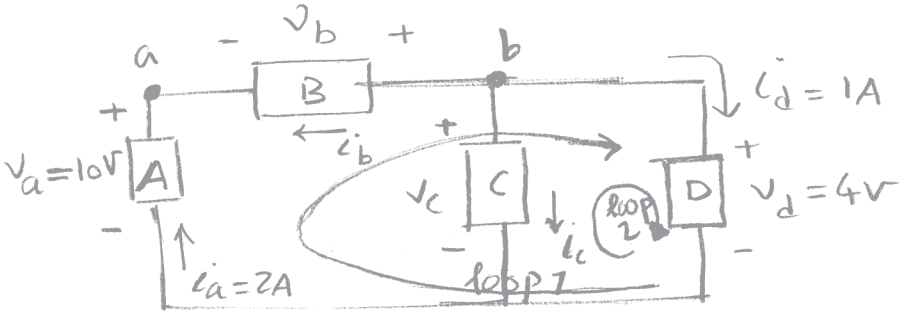
KCL @ node a: $i_a = -i_b \Rightarrow \boxed{i_a = -2A}$

KCL @ node b: $-2A - i_c + 3A = 0 \Rightarrow \boxed{i_c = 1A}$

KCL @ node c: $-3A + i_d - i_e = 0 \Rightarrow \boxed{i_d = 4A}$

Elements A and B are connected in series.

④ P1.34 text book



KCL @ node a: $i_b = -i_a \Rightarrow \boxed{i_b = -2A}$

KCL @ node b: $i_b + i_c + i_d = 0 \Rightarrow i_c = -(i_d + i_b)$

$i_c = -(1A + (-2A))$

$\boxed{i_c = 1A}$

KVL for loop1 (ABDA): $-v_a - v_b + v_d = 0$

$v_b = -v_a + v_d \Rightarrow \boxed{v_b = -6V}$

KVL for loop2 (CDC): $-v_c + v_d = 0 \Rightarrow \boxed{v_c = v_d = 4V}$

Power calculation:

$P_A = -i_a v_a = -20W$

$P_B = i_b v_b = 12W$

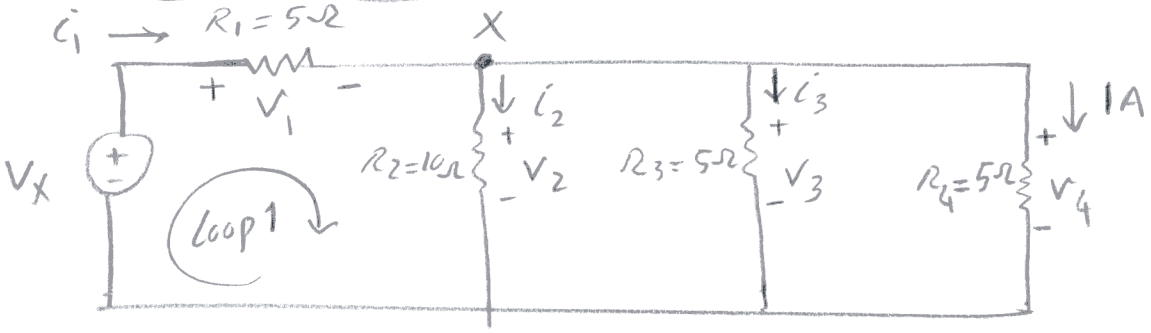
$P_C = i_c v_c = 4W$

$P_D = i_d v_d = 4W$

$P_A + P_B + P_C + P_D = 0$

$\boxed{\therefore \text{Power is conserved}}$

(5) P 1.50 textbook



Ohm's Law for R_4: $V_4 = R_4 \cdot (1A) \Rightarrow \boxed{V_4 = 5V}$

Notice that R_2, R_3 and R_4 are connected in parallel. Therefore, $\boxed{V_2 = V_3 = V_4 = 5V}$

Ohm's Law for R_3: $i_3 = \frac{V_3}{R_3} = \frac{5V}{5\Omega} = 1A$

Ohm's Law for R_2: $i_2 = \frac{V_2}{R_2} = 0.5A$

KCL at X: $-i_1 + i_2 + i_3 + 1A = 0 \Rightarrow i_1 = i_2 + i_3 + 1A$

$i_1 = 2.5A$

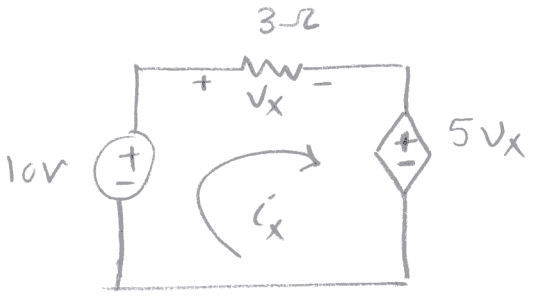
Ohm's Law for R_1: $V_1 = R_1 i_1 = 12.5V$

KVL for loop1: $-V_X + V_1 + V_2 = 0$

$V_X = V_1 + V_2 = 12.5V + 5V$

$\Rightarrow \boxed{V_X = 17.5V}$

⑥ P1.52 text book



(a) $-10 + v_x + 5v_x = 0$

$6v_x = 10 \Rightarrow \boxed{v_x = \frac{10}{6}\,V \simeq 1.67\,V}$

(b) $i_x = \frac{v_x}{R} = \frac{(10/6)\,V}{3\,\Omega} \Rightarrow \boxed{i_x = \frac{10}{18}\,A \simeq 0.56\,A}$

$P_{\text{Independent source}} = (-i_x)(10\,V) = \frac{-100}{18}\,W$ delivered

$P_R = v_x i_x = \left(\frac{10}{6}\,V\right)\left(\frac{10}{18}\,A\right) = \frac{100}{108}\,W$ absorbed

$P_{\text{Dependent source}} = (i_x)(5v_x) = \left(\frac{10}{18}\,A\right)\left(\frac{50}{6}\,V\right)$

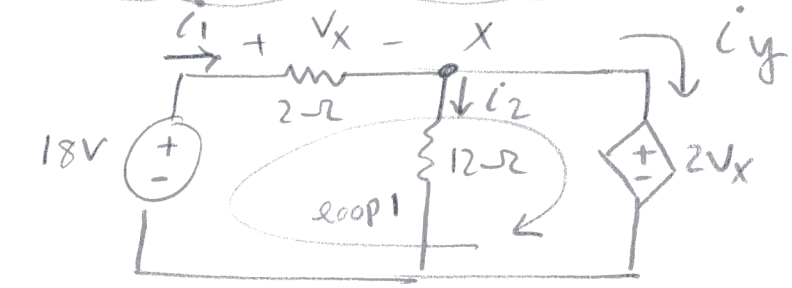
$= \frac{500}{108}\,W$ absorbed

$P_{\text{total}} = \left(\frac{-100}{18}W\right) + \left(\frac{100}{108}W\right) + \left(\frac{500}{108}W\right) = 0$

$\Rightarrow$ Power is conserved

HW1 Solution

(7) P 1.53 text book



KVL loop 1: $-18 + V_x + 2V_x = 0 \Rightarrow 3V_x = 18 \Rightarrow \boxed{V_x = 6\,V}$

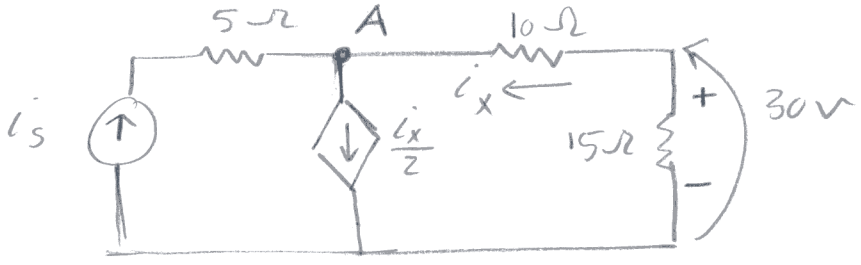
$$i_1 = \frac{V_x}{2\Omega} = 3A$$

$$i_2 = \frac{2V_x}{12\Omega} = 1A$$

KCL at node X: $-i_1 + i_2 + i_y = 0$

$i_y = i_1 - i_2 \Rightarrow \boxed{i_y = 2A}$

(8) P 1.58 text book



$$i_x = \frac{-30\,V}{15\,\Omega} = -2A$$

KCL @ node A: $-i_s + \frac{i_x}{2} - i_x = 0 \Rightarrow i_s = \frac{-i_x}{2}$

$\boxed{i_s = 1A}$

Type of sources: