

KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

DEPARTMENT OF ELECTRICAL ENGINEERING

EE 201-03 ELECTRIC CIRCUITS I

HOME WORK # 1



1.

$$p = (9)(100 \times 10^{-3}) = 0.9 \text{ W}; \quad 5 \text{ hr} \cdot \frac{3600 \text{ s}}{1 \text{ hr}} = 18,000 \text{ s}$$

$$w(t) = \int_0^t p dt \quad w(18,000) = \int_0^{18,000} 0.9 dt = 0.9(18,000) = 16.2 \text{ kJ}$$

2.

Assume we are standing at box A looking toward box B. Then, using the passive sign convention $p = vi$, since the current i is flowing into the + terminal of the voltage v . Now we just substitute the values for v and i into the equation for power. Remember that if the power is positive, B is absorbing power, so the power must be flowing from A to B. If the power is negative, B is generating power so the power must be flowing from B to A.

[a] $p = (120)(5) = 600 \text{ W}$ 600 W from A to B

[b] $p = (250)(-8) = -2000 \text{ W}$ 2000 W from B to A

[c] $p = (-150)(16) = -2400 \text{ W}$ 2400 W from B to A

[d] $p = (-480)(-10) = 4800 \text{ W}$ 4800 W from A to B

3.

$$\begin{aligned} \text{[a]} \quad p = vi &= 30e^{-500t} - 30e^{-1500t} - 40e^{-1000t} + 50e^{-2000t} - 10e^{-3000t} \\ p(1 \text{ ms}) &= 3.1 \text{ mW} \end{aligned}$$

$$\begin{aligned} \text{[b]} \quad w(t) &= \int_0^t (30e^{-500x} - 30e^{-1500x} - 40e^{-1000x} + \\ &\quad 50e^{-2000x} - 10e^{-3000x}) dx \\ &= 21.67 - 60e^{-500t} + 20e^{-1500t} + 40e^{-1000t} - \\ &\quad 25e^{-2000t} + 3.33e^{-3000t} \mu\text{J} \end{aligned}$$

$$w(1 \text{ ms}) = 1.24 \mu\text{J}$$

$$\text{[c]} \quad w_{\text{total}} = 21.67 \mu\text{J}$$

4.

We use the passive sign convention to determine whether the power equation is $p = vi$ or $p = -vi$ and substitute into the power equation the values for v and i , as shown below:

$$\begin{aligned} p_a &= v_a i_a = (0.150)(0.6) = 90 \text{ mW} \\ p_b &= v_b i_b = (0.150)(-1.4) = -210 \text{ mW} \\ p_c &= -v_c i_c = -(0.100)(-0.8) = 80 \text{ mW} \\ p_d &= v_d i_d = (0.250)(-0.8) = -200 \text{ mW} \\ p_e &= -v_e i_e = -(0.300)(-2) = 600 \text{ mW} \\ p_f &= v_f i_f = (-0.300)(1.2) = -360 \text{ mW} \end{aligned}$$

Remember that if the power is positive, the circuit element is absorbing power, whereas if the power is negative, the circuit element is developing power. We can add the positive powers together and the negative powers together — if the power balances, these power sums should be equal:

$$\sum P_{\text{dev}} = 210 + 200 + 360 = 770 \text{ mW};$$

$$\sum P_{\text{abs}} = 90 + 80 + 600 = 770 \text{ mW}$$

Thus, the power balances and the total power developed in the circuit is 770 mW.