JAYPEE INSTITUTE OF INFORMATION TECHNOLOGY
Electronics and Communication Engineering

Electrical Science-1 (15B11EC111)
TUTORIAL 2: Solution

Q1. Find the power supplied by the VCCS in Fig. 1.1.

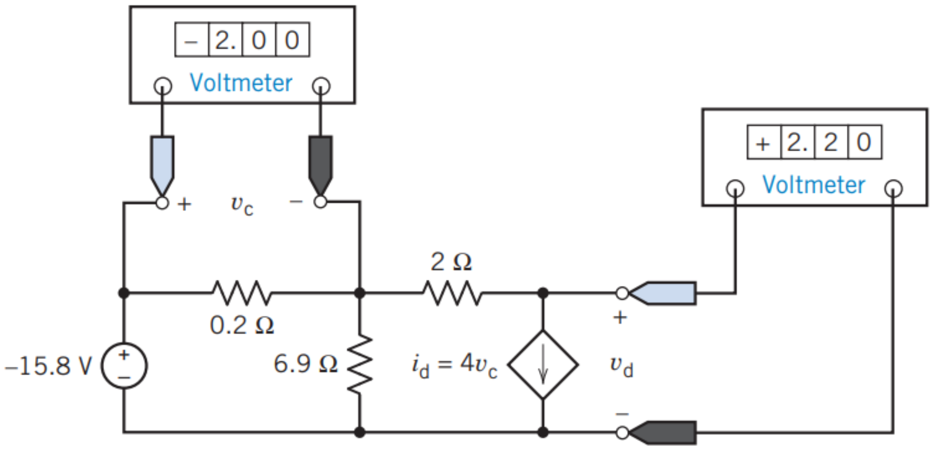

Fig. 1.1

Solution:

$v_c = -2$ V,

$i_d = 4\, v_c = -8$ A and $v_d = 2.2$ V

i_d and v_d adhere to the passive convention so

$P = v_d\, i_d = -\,(2.2)\,(\,8) = -17.6$ W

is the power received by the dependent source. The power supplied by the dependent source is 17.6 W.

Q.2 A current source and a voltage source are connected in parallel with a resistor as shown in Fig. 1.2. All of the elements connected in parallel have the same voltage v_s in this circuit. Suppose that $v_s = 15$ V, $i_s = 3$ A, and $R = 5\Omega$.

(a) Calculate the current i in the resistor and the power absorbed by the resistor. (b) Change the current source current to $i_s = 5$ A and recalculate the current i in the resistor and the power absorbed by the resistor.

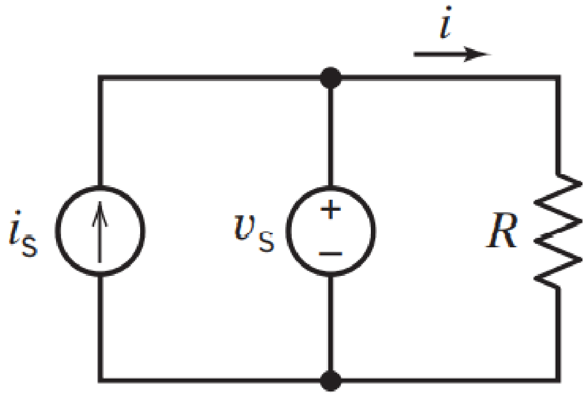

Fig. 1.2

Solution:

(a) $i = v_s /R = 15/5 = 3A$
$P = R\, i^2 = 45W$

(b) i and P do not depend on i_s.
The values of i and P are 3A and 45 W, both when i_s =3 A and when i_s =5 A.

Q.3 Using Kirchhoff's laws, determine the values of i_2, i_4, v_2, v_3, and v_6 in Fig. 1.3.

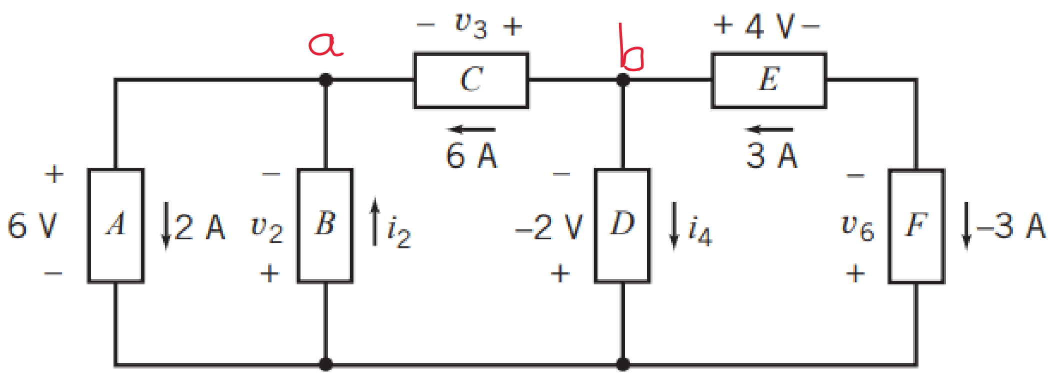

Fig. 1.3

Solution:

Apply KCL at node *a* to get $2 = i_2 + 6 = 0 \Rightarrow i_2 = -4$ A

Apply KCL at node *b* to get $3 = i_4 + 6 \Rightarrow i_4 = -3$ A

Apply KVL to the loop consisting of elements *A* and *B* to get

$$-v_2 - 6 = 0 \Rightarrow v_2 = -6 \text{ V}$$

Apply KVL to the loop consisting of elements *C*, *D*, and A to get

$$-v_3 - (-2) - 6 = 0 \Rightarrow v_4 = -4 \text{ V}$$

Apply KVL to the loop consisting of elements *E*, *F* and *D* to get

$$4 - v_6 + (-2) = 0 \Rightarrow v_6 = 2 \text{ V}$$

Check: The sum of the power supplied by all branches is

$$-(6)(2) - (-6)(-4) - (-4)(6) + (-2)(-3) + (4)(3) + (2)(-3) = -12 - 24 + 24 + 6 + 12 - 6 = 0$$

Q.4 Determine the voltage measured by the voltmeter in the circuit shown in Fig. 1.4.

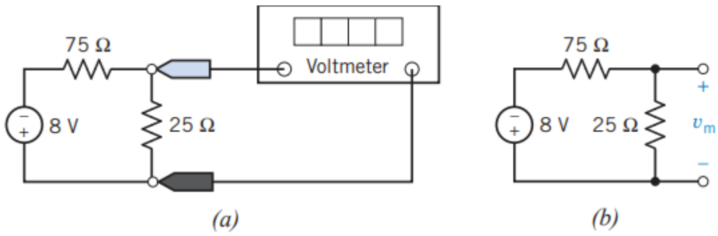

Fig. 1.4

Solution:

$$v_m = \frac{25}{25+75}(-8) = -2\text{V}$$

Q.5 Consider the two similar voltage divider circuits shown in Fig. 1.5. Use voltage division to determine the values of the voltage v_2 in Fig. 1.5(a) and the voltage v_b in Fig. 1.5(b).

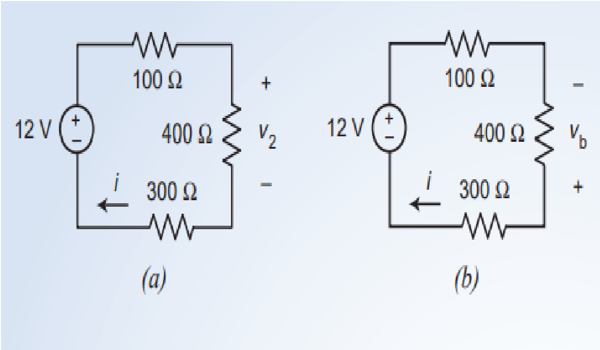

Fig. 1.5

Ans $v_2 =$ 6V and $v_b = -6$V

Solution:

- First, consider the circuit shown in Figure 1.5a. This circuit is an example of a single loop circuit like the circuit shown in Figure 1.5. The 100, 400, and 300Ω resistors are connected in series. The current in the loop is given by

$$i = \frac{12}{100+400+300} = 0.015\ A = 15mA$$

- We can calculate the value of v_2 using voltage division:

$$v_2 = \frac{400}{100+400+300}(12) = 6\text{V}$$

- As a check, notice that $6 = v_2 = 400(i) = 400(0.015)$
- Next, consider the circuit shown in Figure 1.5b. This circuit is also an example of a single loop circuit. Again, the current in the loop is given by

$$i = \frac{12}{100+400+300} = 0.015\ A = 15mA$$

- Notice that the voltage v_b in Figure 1.5b is the same voltage as the voltage v_2 in Figure 1.5a, except for polarity. Consequently

$$v_2 = -v_b$$

- Therefore

$$v_b = \frac{400}{100+400+300}(12) = -6\text{V}$$

Q.6 Use current division to determine the currents i_1, i_2, i_3, and i_4 in the circuit shown in Fig. 1.6.

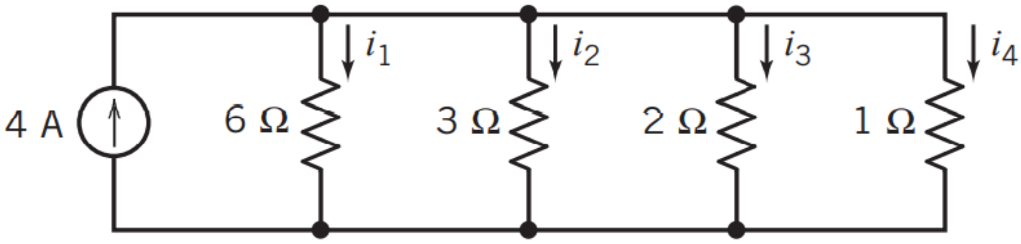

Fig. 1.6

Solution: Applying current divider rule:

$$i_1 = \frac{\frac{1}{6}}{\frac{1}{6}+\frac{1}{3}+\frac{1}{2}+\frac{1}{1}}4 = \frac{1}{1+2+3+6}\ 4 = \underline{\frac{1}{3}\ \text{A}}$$

$$i_2 = \frac{\frac{1}{3}}{\frac{1}{6}+\frac{1}{3}+\frac{1}{2}+\frac{1}{1}}\ 4 = \underline{\frac{2}{3}\ \text{A};}$$

$$i_3 = \frac{\frac{1}{2}}{\frac{1}{6}+\frac{1}{3}+\frac{1}{2}+\frac{1}{1}}\ 4 = \underline{1\ \text{A}}$$

$$i_4 = \frac{1}{\frac{1}{6}+\frac{1}{3}+\frac{1}{2}+1}\ 4 = \underline{2\ \text{A}}$$