Section 2-7 Dependent Sources

P 2.7-1 The ammeter in the circuit shown in Figure P 2.7-1 indicates that $i_a = 2$ A, and the voltmeter indicates that $v_b = 8$ V. Determine the value of r, the gain of the CCVS.
Answer: $r = 4$ V/A

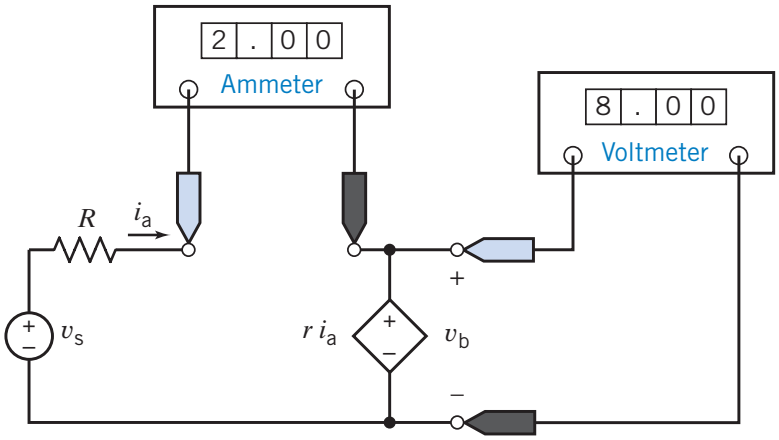
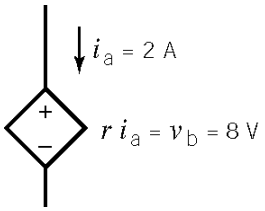


Figure P 2.7-1

Solution:



$$r = \frac{v_b}{i_a} = \frac{8}{2} = \underline{4\ \Omega}$$

P 2.7-2 The ammeter in the circuit shown in Figure P 2.7-2 indicates that i_a = 2 A, and the voltmeter indicates that v_b = 8 V. Determine the value of g, the gain of the VCCS.

Answer: g = 0.25 A/V

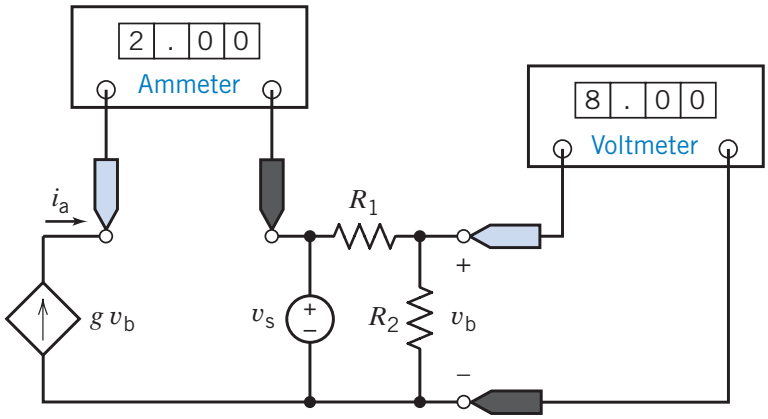


Figure P 2.7-2

Solution:

$$v_b = 8\text{ V};\quad g\,v_b = i_a = 2\text{ A};\quad g = \frac{i_a}{v_b} = \frac{2}{8} = \underline{0.25\ \frac{\text{A}}{\text{V}}}$$

P 2.7-3 The ammeters in the circuit shown in Figure P 2.7-3 indicate that i_a = 32 A and i_b = 8 A. Determine the value of d, the gain of the CCCS.

Answer: d = 4 A/A

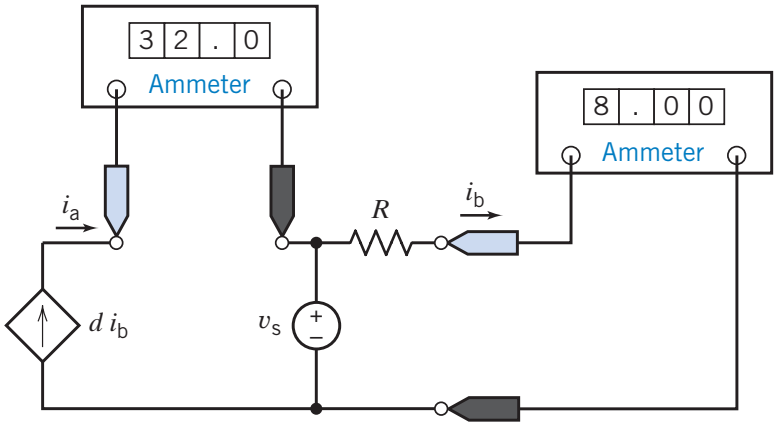


Figure P 2.7-3

Solution:

$$i_b = 8\text{ A};\quad d\,i_b = i_a = 32\text{A};\quad d = \frac{i_a}{i_b} = \frac{32}{8} = \underline{4\ \frac{\text{A}}{\text{A}}}$$

P 2.7-4 The voltmeters in the circuit shown in Figure P 2.7-4 indicate that v_a = 2 V and v_b = 8 V. Determine the value of b, the gain of the VCVS.

Answer: b = 4 V/V

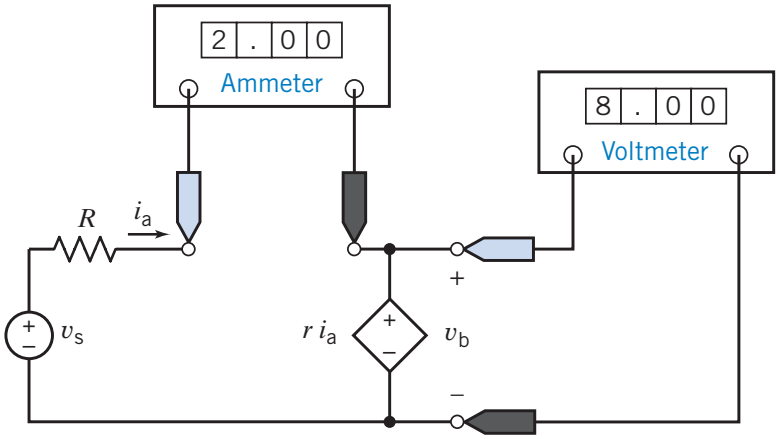


Figure P 2.7-4

Solution:

$$v_a = 2\text{ V};\quad b\,v_a = v_b = 8\text{ V};\quad b = \frac{v_b}{v_a} = \frac{8}{2} = 4\ \frac{\text{V}}{\text{V}}$$

P 2.7-5 The values of the current and voltage of each circuit element are shown in Figure P 2.7-5. Determine the values of the resistance, R, and of the gain of the dependent source, A.

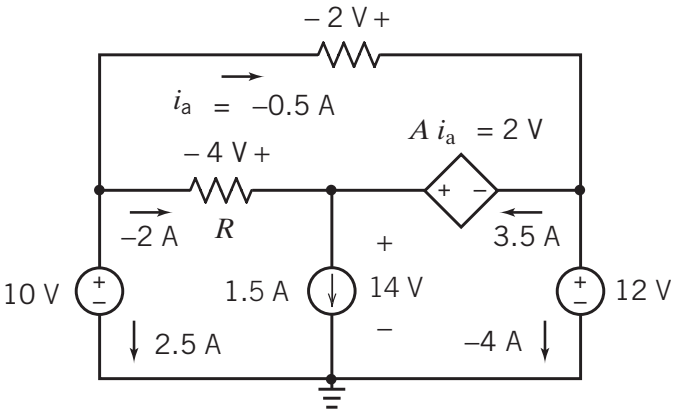


Figure P 2.7-5

Solution:

$$R = -\frac{4}{-2} = 2\ \Omega \quad \text{and} \quad A = \frac{2}{-0.5} = -4\ \frac{\text{V}}{\text{A}}$$

(checked: LNAP 6/6/04)

P 2.7-6 Find the power supplied by the VCCS in Figure P 2.7-6.
Answer: 17.6 watts are supplied by the VCCS. (–17.6 watts are absorbed by the VCCS.)

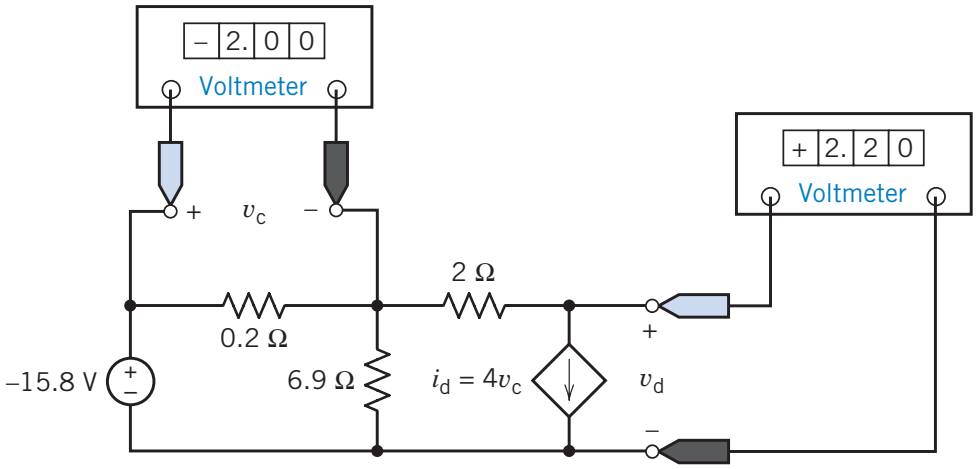


Figure P 2.7-6

Solution:

$$v_c = -2 \text{ V}, \; i_d = 4\, v_c = -8 \text{ A} \text{ and } v_d = 2.2 \text{ V}$$

i_d and v_d adhere to the passive convention so

$$P = v_d \; i_d = (2.2)\,(-8) = \underline{-17.6 \quad \text{W}}$$

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

P2.7-7 The circuit shown in Figure P2.7-7 contains a dependent source. Determine the value of the gain *k* of that dependent source.

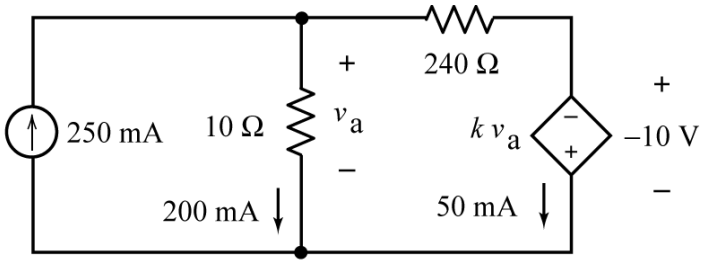


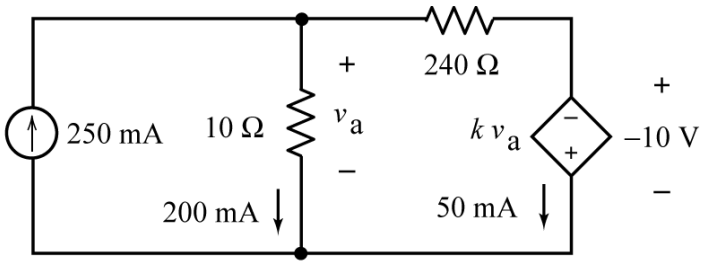
Figure P2.7-7

Solution:

$$v_a = 10(0.2) = 2 \text{ V}$$

$$k\,v_a = -(-10) = 10 \text{ V}$$

$$k = \frac{k\,v_a}{v_a} = \frac{10}{2} = 5 \ \frac{\text{V}}{\text{V}}$$



P2.7-8 The circuit shown in Figure P2.7-8 contains a dependent source. Determine the value of the gain *k* of that dependent source.

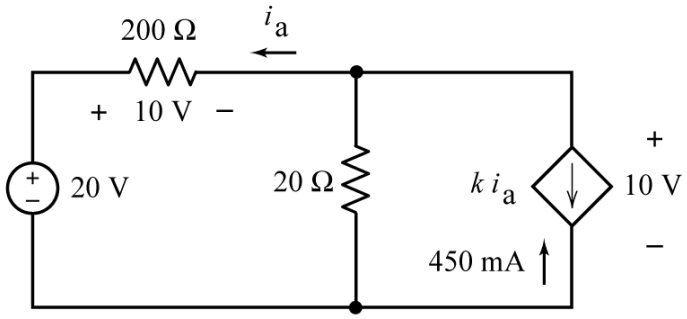


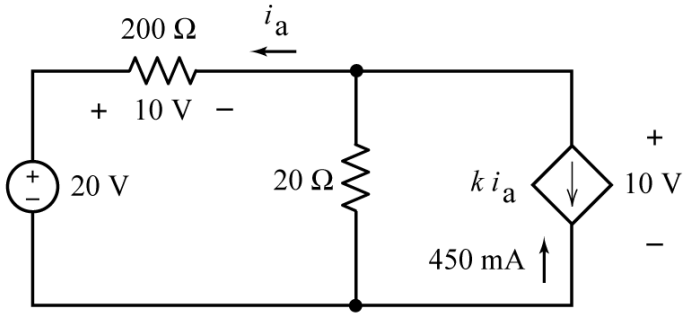
Figure P2.7-8

Solution:

$$i_a = -\frac{10}{200} = -0.05 \text{ A} = -50 \text{ mA}$$

$$k\,i_a = -450 \text{ mA}$$

$$k = \frac{k\,i_a}{i_a} = \frac{-450}{-50} = 9 \ \frac{\text{A}}{\text{A}}$$



P2.7-9 The circuit shown in Figure P2.7-9 contains a dependent source. The gain of that dependent source is

$$k = 25\ \frac{\text{V}}{\text{A}}$$

Determine the value of the voltage v_b.

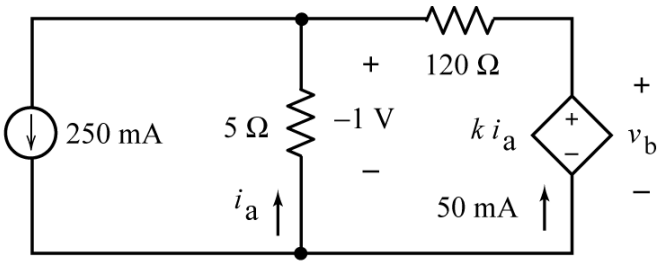


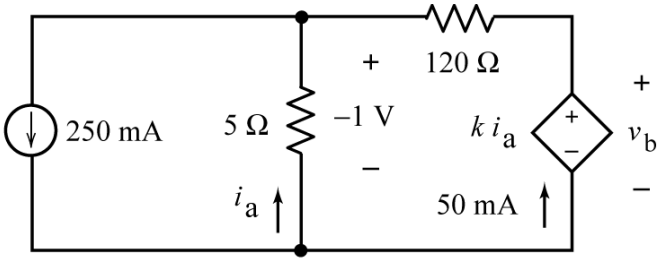
Figure P2.7-9

Solution:

$$i_a = -\frac{-1}{5} = 0.2\ \text{A}$$

$$k = 25\ \frac{\text{V}}{\text{A}}$$

$$v_b = 25(0.2) = 5\ \text{V}$$



P2.7-10 The circuit shown in Figure P2.7-10 contains a dependent source. The gain of that dependent source is

$$k = 90\ \frac{\text{mA}}{\text{V}} = 0.09\ \frac{\text{A}}{\text{V}}$$

Determine the value of the current i_b.

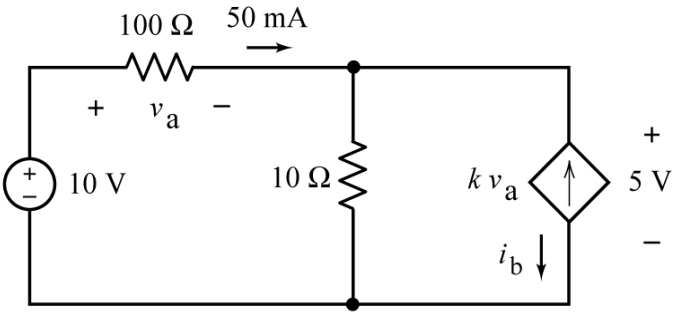


Figure P2.7-10

Solution:

$$v_a = 100(0.05) = 5\ \text{V}$$

$$k = 90\ \frac{\text{mA}}{\text{V}} = 0.09\ \frac{\text{A}}{\text{V}}$$

$$i_b = -(0.09)(5) = -0.45\ \text{A} = -450\ \text{mA}$$