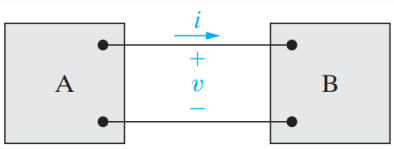
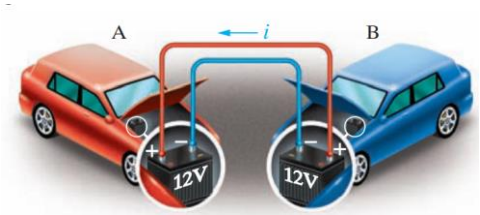
1.11 How much energy is imparted to an electron as it flows through a 6 V battery from the positive to the negative terminal? Express your answer in attojoules.

1.14 Two electric circuits, represented by boxes A and B, are connected as shown in Fig. P1.14. The reference direction for the current i in the interconnection and the reference polarity for the voltage v across the interconnection are as shown in the figure. For each of the following sets of numerical values, calculate the power in the interconnection and state whether the power is flowing from A to B or vice versa.



a) $i = 6$ A, $v = 30$ V
b) $i = -8$ A, $v = -20$ V
c) $i = 4$ A, $v = -60$ V
d) $i = -9$ A, $v = 40$ V

1.15 When a car has a dead battery, it can often be started by connecting the battery from another car across its terminals. The positive terminals are connected together as are the negative terminals. The connection is illustrated in Fig. P1.15. Assume the current i in Fig. P1.15 is measured and found to be 30 A.



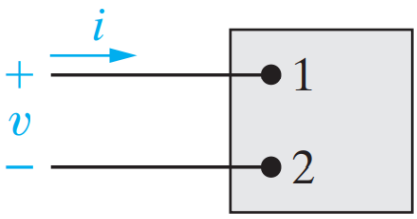
a) Which car has the dead battery?

b) If this connection is maintained for 1 min, how much energy is transferred to the dead battery?

1.16 The manufacturer of a 1.5 V D flashlight battery says that the battery will deliver 9 mA for 40 continuous hours. During that time the voltage will drop from 1.5 V to 1.0 V. Assume the drop in voltage is linear with time. How much energy does the battery deliver in this 40 h interval?

1.18 The voltage and current at the terminals of the circuit element in Fig. 1.5 are zero for $t < 0$. For $t \geq 0$ they are

$$v = 15e^{-250t}\ \text{V},$$
$$i = 40e^{-250t}\ \text{mA}.$$

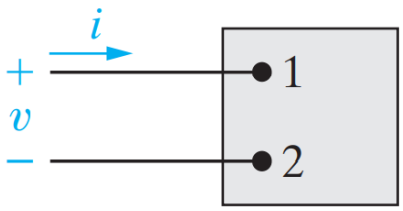


a) Calculate the power supplied to the element at 10 ms.

b) Calculate the total energy delivered to the circuit element.

1.20 The voltage and current at the terminals of the circuit element in Fig. 1.5 are zero for $t < 0$. For $t \geq 0$ they are

$$v = 50e^{-1600t} - 50e^{-400t} \text{ V},$$
$$i = 5e^{-1600t} - 5e^{-400t} \text{ mA}.$$



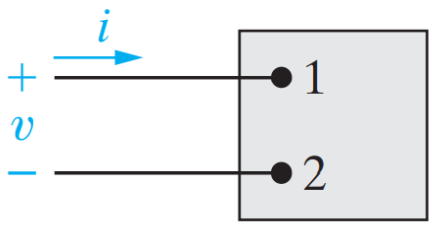
a) Find the power at $t = 625\ \mu s$.

b) How much energy is delivered to the circuit element between 0 and 625 μs?

c) Find the total energy delivered to the element.

1.21 PSPICE MULTISIM The voltage and current at the terminals of the circuit element in Fig. 1.5 are zero for $t < 0$. For $t \geq 0$ they are

$$v = (1500t + 1)e^{-750t} \text{ V}, \qquad t \geq 0;$$
$$i = 40e^{-750t} \text{ mA}, \qquad t \geq 0.$$



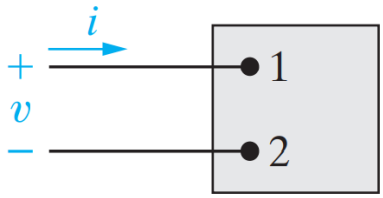
a) Find the time when the power delivered to the circuit element is maximum.

b) Find the maximum value of p in milliwatts.

c) Find the total energy delivered to the circuit element in microjoules.

1.22 PSPICE MULTISIM The voltage and current at the terminals of the circuit element in Fig. 1.5 are zero for $t < 0$. For $t \geq 0$ they are

$$v = (3200t + 4)e^{-1000t} \text{ V},$$
$$i = (128t + 0.16)e^{-1000t} \text{ A}.$$



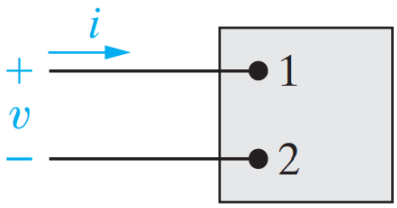
a) At what instant of time is maximum power delivered to the element?

b) Find the maximum power in watts.

c) Find the total energy delivered to the element in microjoules.

1.24 PSPICE MULTISIM The voltage and current at the terminals of the circuit element in Fig. 1.5 are zero for $t < 0$. For $t \geq 0$ they are

$$v = 400e^{-100t} \sin 200t \text{ V},$$
$$i = 5e^{-100t} \sin 200t \text{ A}.$$



a) Find the power absorbed by the element at $t = 10$ ms.

b) Find the total energy absorbed by the element.

1.25 The voltage and current at the terminals of the element in Fig. 1.5 are

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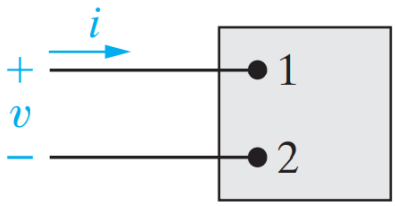
$$v = 250 \cos 800\pi t \text{ V}, \quad i = 8 \sin 800\pi t \text{ A}.$$



a) Find the maximum value of the power being delivered to the element.

b) Find the maximum value of the power being extracted from the element.

c) Find the average value of p in the interval $0 \leq t \leq 2.5$ ms.

d) Find the average value of p in the interval $0 \leq t \leq 15.625$ ms.

1.29 The numerical values for the currents and voltages in the circuit in Fig. P1.29 are given in Table P1.29. Find the total power developed in the circuit.

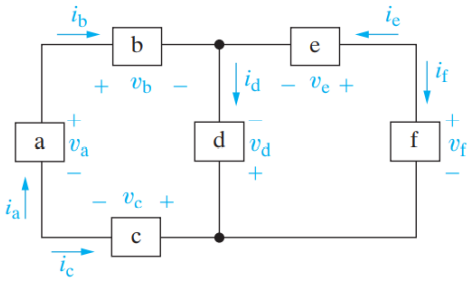


TABLE P1.29

Element	Voltage (V)	Current (mA)
a	40	−4
b	−24	−4
c	−16	4
d	−80	−1.5
e	40	2.5
f	120	−2.5

1.30 The numerical values of the voltages and currents in the interconnection seen in Fig. P1.30 are given in Table P1.30. Does the interconnection satisfy the power check?

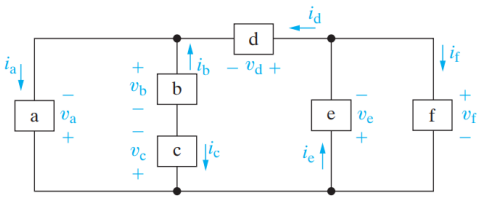


TABLE P1.30

Element	Voltage (kV)	Current (μA)
a	−3	−250
b	4	−400
c	1	400
d	1	150
e	−4	200
f	4	50

1.32 The voltage and power values for each of the elements shown in Fig. P1.32 are given in Table P1.32.

a) Show that the interconnection of the elements satisfies the power check.

b) Find the value of the current through each of the elements using the values of power and voltage and the current directions shown in the figure.

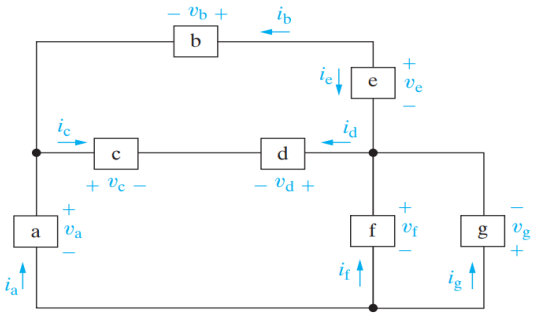


TABLE P1.32

Element	Power (kW)	Voltage (V)
a	0.6 supplied	400
b	0.05 supplied	−100
c	0.4 absorbed	200
d	0.6 supplied	300
e	0.1 absorbed	−200
f	2.0 absorbed	500
g	1.25 supplied	−500

1.33 The current and power for each of the interconnected elements in Fig. P1.33 is measured. The values are listed in Table P1.33.

a) Show that the interconnection satisfies the power check.

b) Identify the elements that absorb power.

c) Find the voltage for each of the elements in the interconnection, using the values of power and current and the voltage polarities shown in the figure.

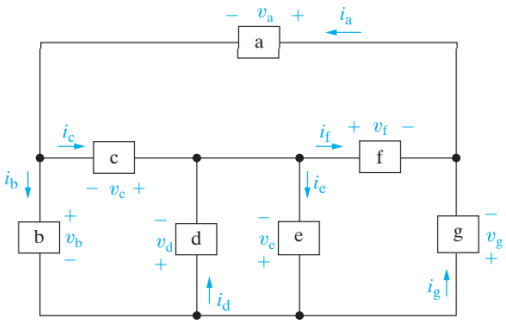


TABLE P1.33

Element	Power (mW)	Current (mA)
a	175	25
b	375	75
c	150	−50
d	−320	40
e	160	20
f	120	−30
g	−660	55