University ☺f P☺rtland
Sch☺☺l ☺f Engineering

Electric Circuits 101
Wednesday, January 26, 2011

http://faculty.up.edu/ainan/

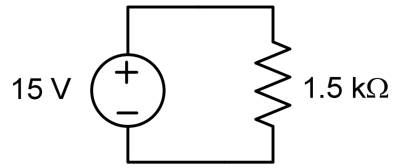
Math puzzler # 1: Can you find my current age if the sum of the prime factors of the reverse of today's date 1262011 plus 1000 yields the year when I will turn 100 years old? (Hint: I was born in May.) ☺

P-1. Basics of electric circuits. Which one of the following statements is incorrect?

(a) Ohm's law is given by $v = iR$
(b) Kirchhoff's voltage law states that the sum of all the voltages in every closed loop must add up to zero
(c) Kirchhoff's current law states that the sum of all the currents at every node must equal to zero
(d) Thévenin equivalent circuit consists of a voltage source in series with a resistor and a Norton equivalent circuit consists of a current source in parallel with a resistor
(e) None of the above

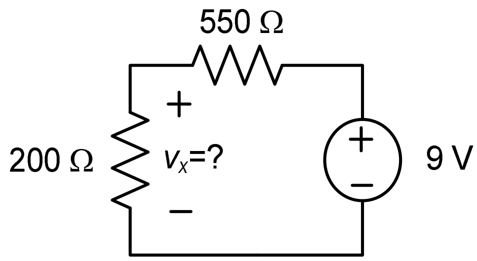
P-2. Kirchhoff's laws, Ohm's law and power dissipation. In the circuit shown below, what is the power dissipated by the 1.5 kΩ resistor?

(a) 0.15 mW (b) 1.5 mW (c) 15 mW (d) 0.15 W (e) 1.5 W



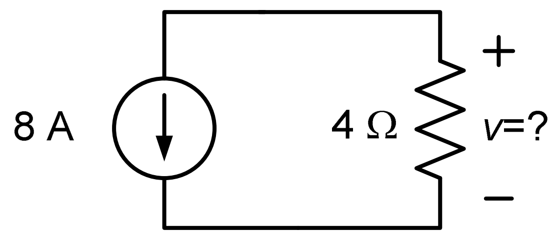
P-3. Kirchhoff's and Ohm's laws. (Voltage divider principle.) For the circuit shown, what is the value of v_x voltage across the 100 Ω resistor?

(a) 1.8 V (b) 2.4 V (c) 3.6 V (d) 4.8 V (e) 6.4 V



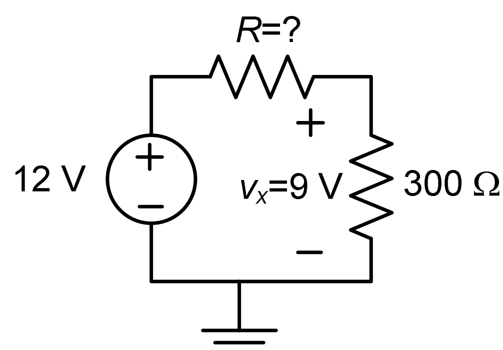
P-4. Kirchhoff's current law and Ohm's law. For the circuit shown below, what is the value of the voltage *v*?

(a) 2 V (b) –2 V (c) 4 V (d) 32 V (e) –32 V



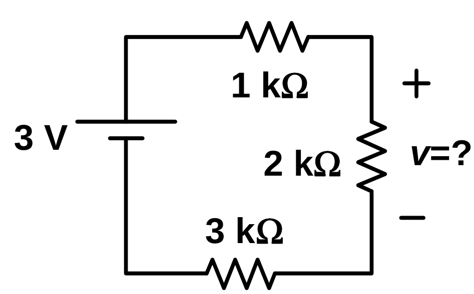
P-5. Kirchhoff's and Ohm's laws. (Voltage divider principle.) In the circuit shown below, given the voltage across the 300 Ω resistor to be 9 volts, what is the value of *R*?

(a) 50 Ω (b) 100 Ω (c) 150 Ω (d) 200 Ω (e) 250 Ω



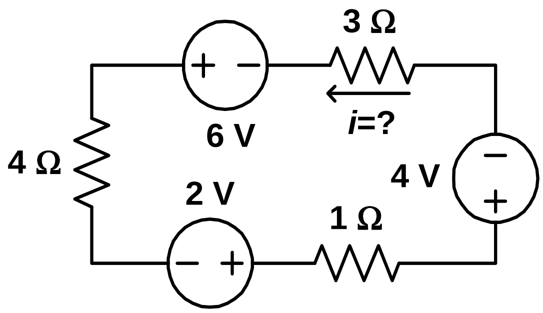
P-6. Kirchhoff's and Ohm's laws. (Voltage divider principle.) What is the voltage *v* in the circuit shown below?

(a) 0.5 V (b) 1 V (c) 1.5 V (d) 2 V (e) 2.5 V



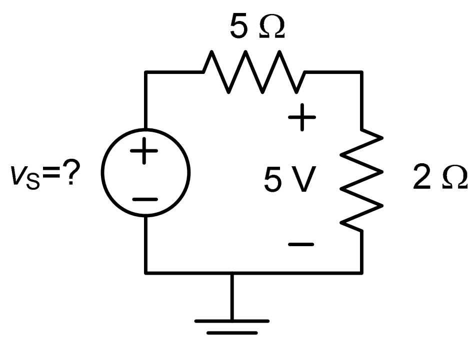
P-7. Kirchhoff's and Ohm's laws. What is the value of the current i flowing in the circuit shown below?

(a) 0.25 A (b) 1/3 A (c) 0.5 A (d) 0.75 A (e) 1 A



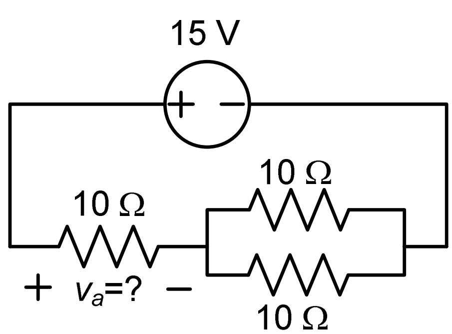
P-8. Kirchhoff's and Ohm's laws. (Voltage divider principle.) For the circuit shown, what is the value of the source voltage v_S?

(a) 12.5 V (b) 15 V (c) 17.5 V (d) 22.5 V (e) 25 V



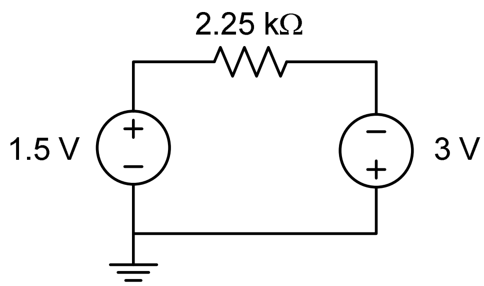
P-9. Kirchhoff's and Ohm's laws. (Voltage divider principle.) For the circuit shown, what is the value of the voltage v_a across the 10 Ω resistor on the left?

(a) 2.5 V (b) 5 V (c) 7.5 V (d) 10 V (e) 12.5 V



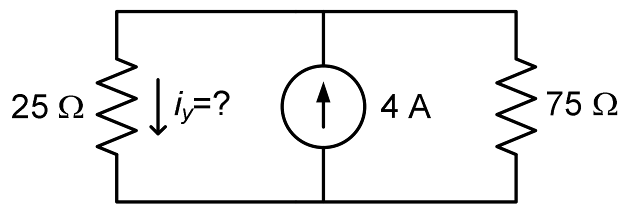
P-10. Power dissipated by a resistor. In the circuit shown below, what is the power dissipated by the 2.25 kΩ resistor?

(a) 1 mW (b) 2 mW (c) 2/3 mW (d) 4.5 mW (e) 9 mW



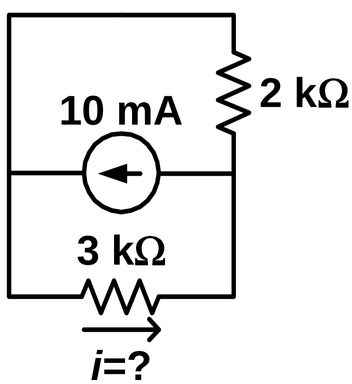
P-11. Kirchhoff's laws. (Current divider principle.) For the circuit shown below, what is the value of the current i_y flowing through the 25 Ω resistor?

(a) 1 A (b) 1.5 A (c) 2 A (d) 2.5 A (e) 3 A



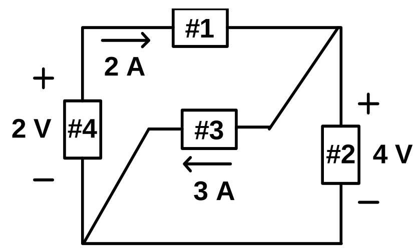
P-12. Kirchhoff's laws. (Current divider principle.) For the circuit shown below, what is the value of the current i flowing through the 3 kΩ resistor?

(a) 2 mA (b) 3 mA (c) 4 mA (d) 5 mA (e) 6 mA



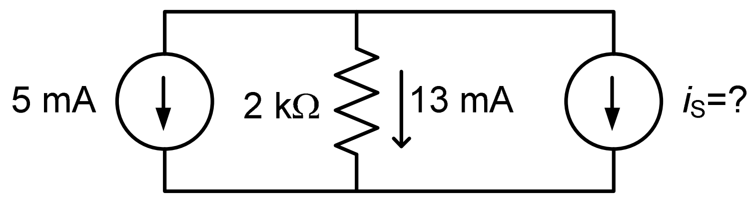
P-13. Kirchhoff's laws and power. For the circuit shown, which box elements dissipate power?

(a) Box 1 (b) Box 2 (c) Box 3 (d) Boxes 2 & 3 (e) Box 4



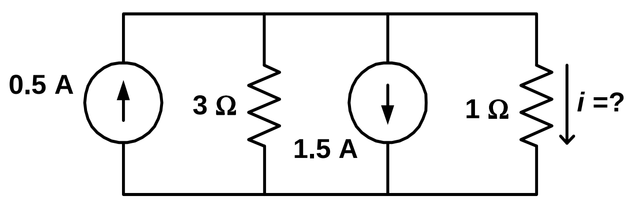
P-14. Kirchhoff's current law. In the circuit shown, if the current flowing through the 2 kW resistor is measured to be 13 mA, what is the value of i_S?

(a) 18 mA (b) 8 mA (c) –18 mA (d) –8 mA (e) –11.5 mA



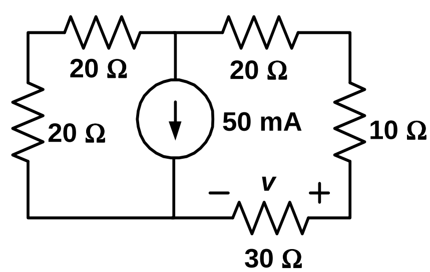
P-15. Kirchhoff's and Ohm's laws. For the dc circuit shown below, what is the value of the current *i* flowing through the 1 Ω resistor?

(a) 0.25 A (b) –0.25 A (c) 0.75 A (d) –0.75 A (e) –1.5 A



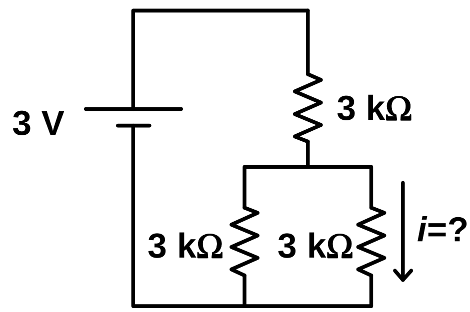
P-16. Kirchhoff's and Ohm's laws. For the dc circuit shown below, what is the voltage *v* across the 30 Ω resistor?

(a) 0.3 V (b) –0.6 V (c) 0.9 V (d) –0.9 V (e) –0.3 V



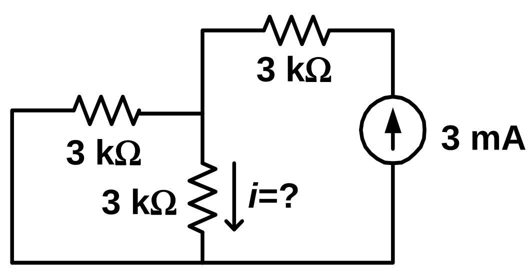
P-17. Kirchhoff's and Ohm's laws. For the dc circuit shown, what is the value of the current *i* flowing through the 3 kΩ resistor?

(a) 1 mA (b) 1/3 mA (c) 4/3 mA (d) 1/6 mA (e) 1.5 mA



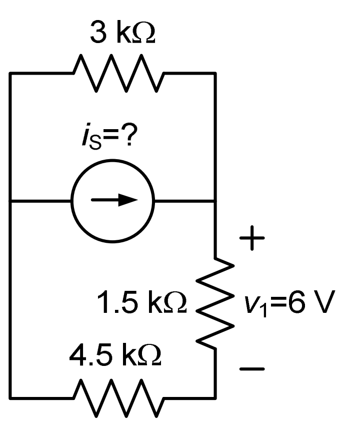
P-18. Current divider principle. For the dc circuit shown, what is the current *i* flowing through the 3 kΩ resistor?

(a) 1 mA (b) 1/3 mA (c) 4/3 mA (d) 1/6 mA (e) 1.5 mA



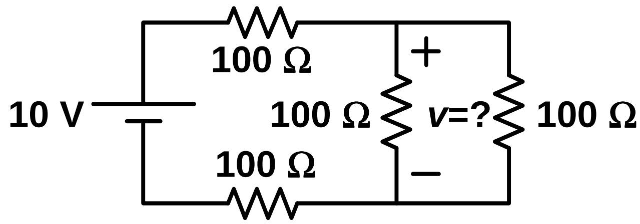
P-19. Current divider principle. In the circuit shown below, given the voltage measured across the 1.5 kΩ resistor to be $v_1 = 6\text{ V}$, which one of the following is the value of the source current i_s?

(a) 4 mA (b) 6 mA (c) 8 mA (d) 10 mA (e) 12 mA



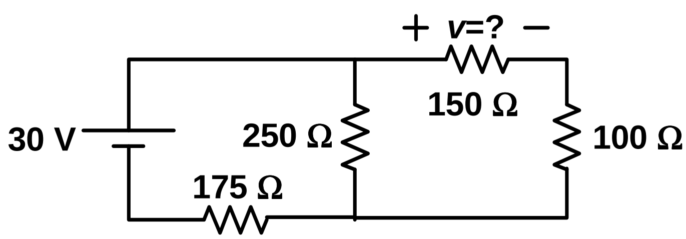
P-20. Voltage divider principle. For the dc circuit shown below, what is the voltage v across the 100 Ω resistor?

(a) 1 V (b) 2 V (c) 2.5 V (d) 3 V (e) 4 V



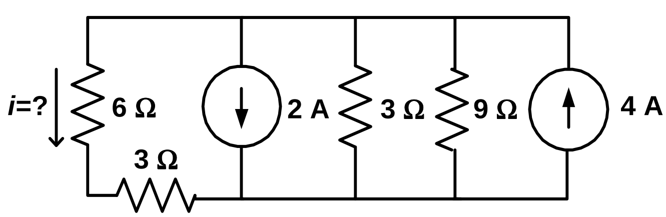
P-21. Voltage divider principle. For the dc circuit shown below, what is the voltage v across the 150 Ω resistor?

(a) 5 V (b) 7.5 V (c) 10 V (d) 12.5 V (e) ~13.33 V



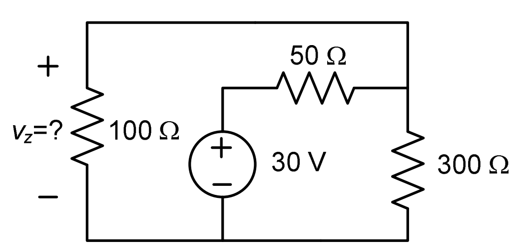
P-22. Current divider principle. For the circuit shown below, what is the value of the current i?

(a) 0.4 A (b) ~0.545 A (c) 0.8 A (d) 1.2 A (e) 1.6 A



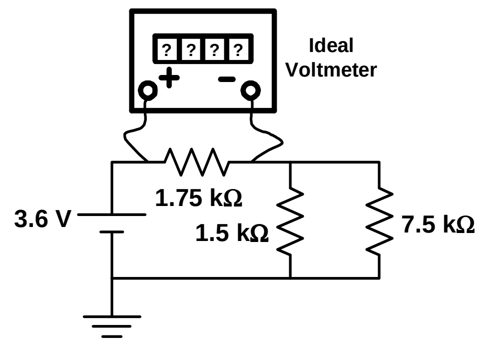
P-23. Voltage divider principle. In the circuit shown, what is the value of the voltage v_z across the 100 Ω resistor?

(a) ~6.67 V (b) 10 V (c) 12 V (d) 18 V (e) 24 V



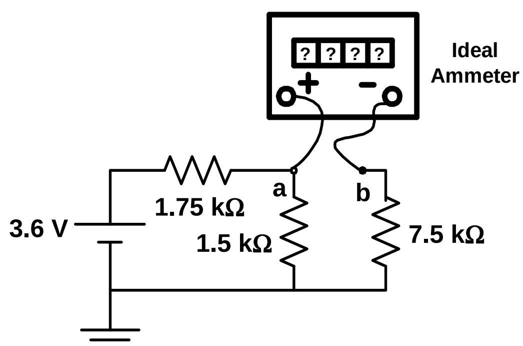
P-24. Voltmeter measurement. For the dc circuit shown below, what is the reading of the voltmeter connected across the 1.75 kΩ resistor? (Assume ideal voltmeter.)

(a) ~0.59 V (b) ~1.09 V (c) 1.2 V (d) 1.5 V (e) 2.1 V



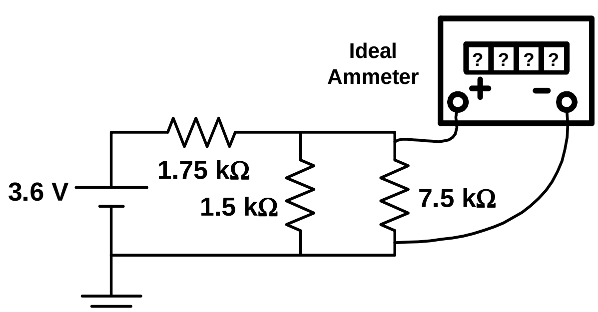
P-25. Ammeter measurement. For the dc circuit shown below, what is the reading of the ammeter connected between terminals "a" and "b"? (Assume ideal ammeter.)

(a) 0.2 mA (b) 0.28 mA (c) 0.4 mA (d) 0.48 mA (e) 1 mA



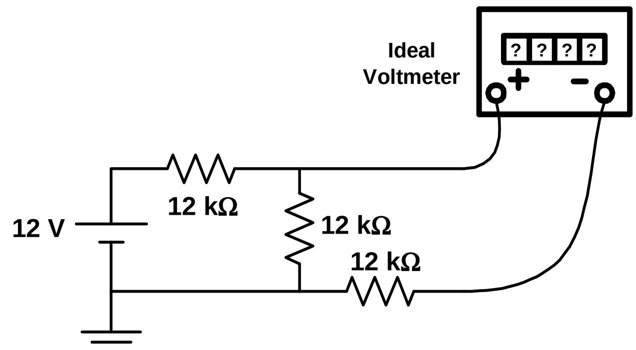
P-26. Ammeter reading. To measure the current through the 7.5 kΩ resistor of the circuit in Problem 12, a student makes a mistake and connects the ammeter in parallel with that resistor as shown below. What will be the reading of the ammeter in the circuit below? (Assume ideal ammeter.)

(a) 0.2 mA (b) 1 mA (c) 1.2 mA (d) ~2.06 mA (e) 2.4 mA



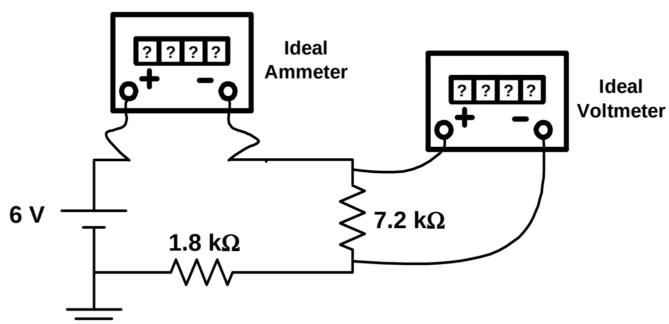
P-27. Voltmeter reading. For the dc circuit shown, what will be the reading of the voltmeter connected between terminals "a" and "b"? (Assume ideal voltmeter.)

(a) 2 V (b) 4 V (c) 6 V (d) 8 V (e) 10 V



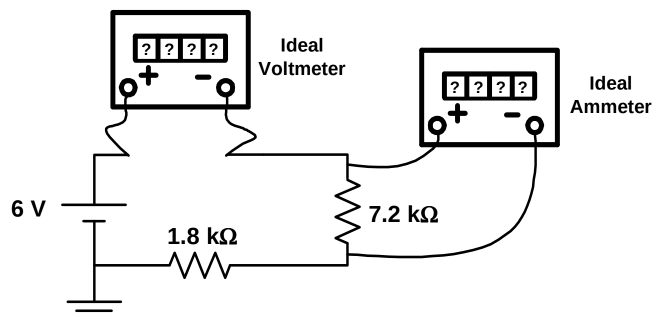
P-28. Voltmeter and ammeter measurements. For the dc circuit shown below, what are the readings of the voltmeter and the ammeter? (Assume ideal meters.)

(a) 1.2 V & ~3.33 mA (b) 2.4 V & ~0.67 mA (c) 3.6 V & ~3.33 mA
(d) 4.8 V & ~0.67 mA (e) 4.8 V & ~3.33 mA



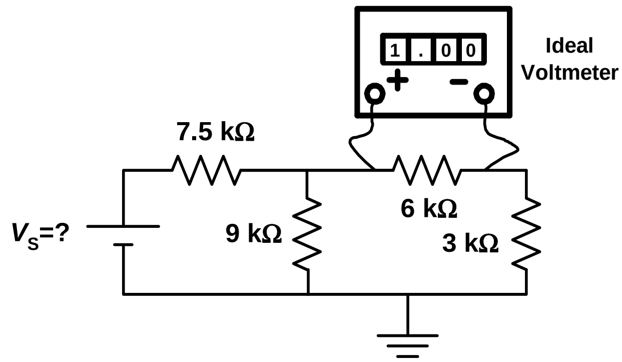
P-29. Voltmeter and ammeter measurements. The ammeter and the voltmeter in the previous circuit are switched as shown below. What will be their new readings? (Again, assume both voltmeter and ammeter to be ideal.)

(a) 6 V & 0 A (b) 6 V & ~3.33 mA (c) 4.8 V & ~3.33 mA
(d) 1.2 V & 0 A (e) 1.2 V & ~3.33 mA



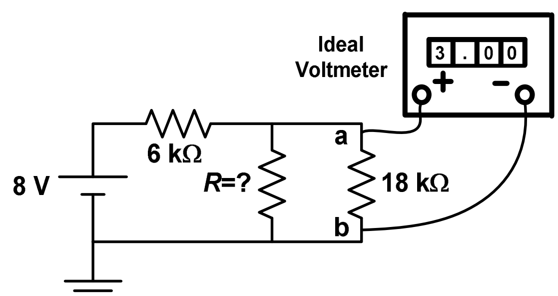
P-30. Voltmeter measurement. In the dc circuit shown below, the voltmeter measures a voltage of 1 V across the 6 kΩ resistor. What is the value of the source voltage?

(a) 1 V (b) 2 V (c) 3 V (d) 4 V (e) 5 V



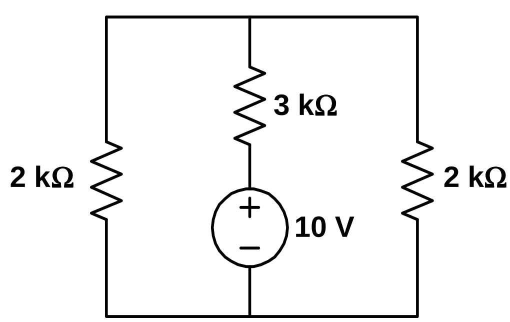
P-31. Voltmeter measurement. For the dc circuit shown, the voltmeter connected across the "a" and "b" terminals of the 18 kΩ resistor measures 3 V. What is the value of the unknown resistor *R*? (Assume ideal voltmeter.)

(a) 36 kΩ (b) 18 kΩ (c) 9 kΩ (d) 4.5 kΩ (e) 3 kΩ



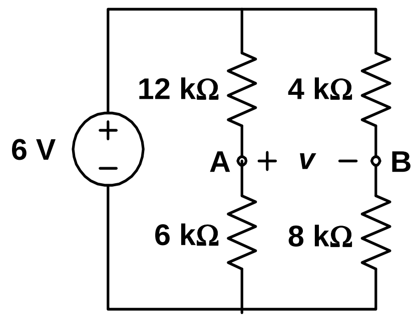
P-32. Voltage divider principle. For the dc circuit shown, what power is dissipated by each 2 kΩ resistor?

(a) 2.5 mW (b) 1.25 mW (c) ~4.08 mW (d) 18.75 mW (e) 3.125 mW



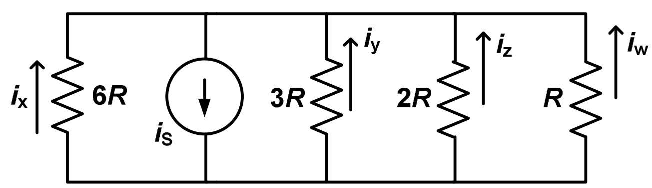
P-33. Voltage divider principle. For the dc circuit shown below, what is the value of the voltage v between terminals "A" and "B"?

(a) 2 V (b) 4 V (c) 6 V (d) –2 V (e) –4 V



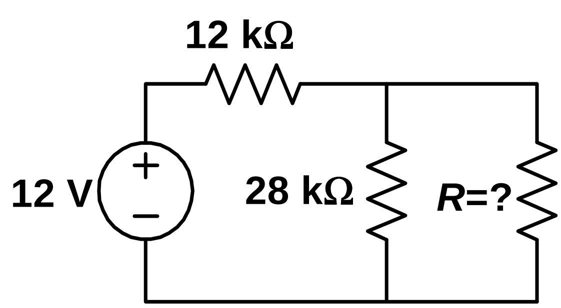
P-34. Current divider principle. For the circuit shown below, which one of the following relationships is <u>*not*</u> correct?

(a) $i_x + i_y = i_z$ (b) $i_w > i_x$ (c) $i_y + i_z = i_w - i_x$ (d) $i_y + i_z = i_x + i_w$ (e) $i_x + i_y + i_z + i_w = i_S$

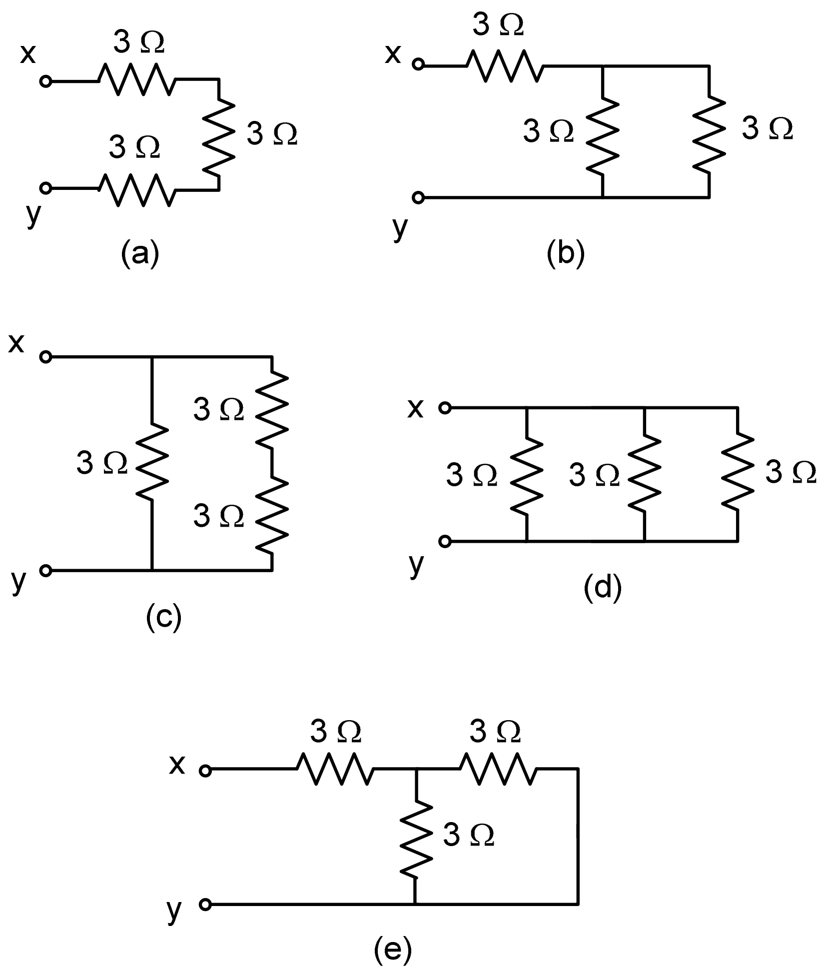


P-35. Unknown resistor. In the circuit shown, if the total power supplied by the 12 V voltage source is measured to be 6 mW, what is the value of the unknown resistor R?

(a) 12 kΩ (b) 18 kΩ (c) 21 kΩ (d) 24 kΩ (e) 70 kΩ

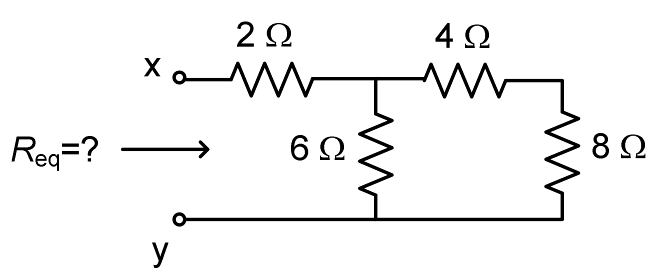


P-36. Equivalent resistance. In the figure shown below, between which "x" and "y" terminals the equivalent resistance is equal to 2 Ω?



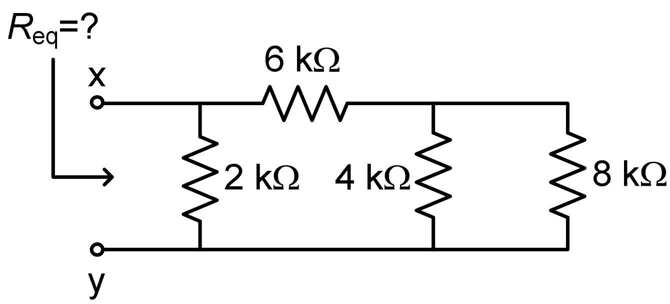
P-37. Equivalent resistance. For the resistive network shown below, what is the equivalent resistance R_{eq} seen between terminals "x" and "y"?

(a) 2 Ω (b) 4 Ω (c) 6 Ω (d) 8 Ω (e) 20 Ω



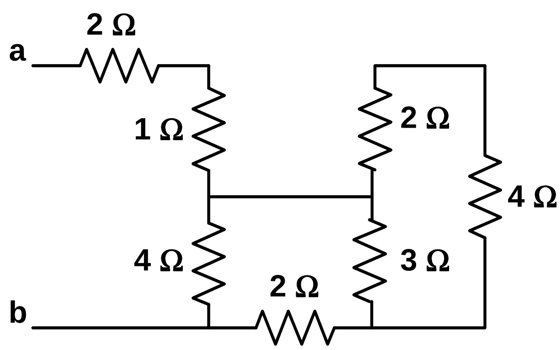
P-38. Equivalent resistance. For the resistive network shown below, what is the equivalent resistance R_{eq} seen between terminals "x" and "y"?

(a) 13/8 kΩ (b) 2 kΩ (c) 6 kΩ (d) 32/3 kΩ (e) 4/3 kΩ



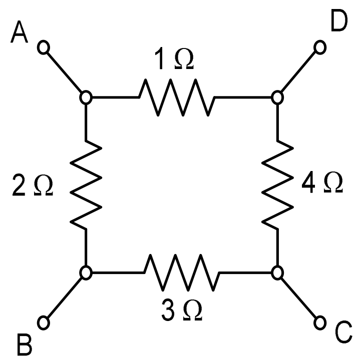
P-39. Equivalent resistor. In the circuit shown below, what is the equivalent resistance seen between terminals "a" and "b"?

(a) 3 Ω (b) 5 Ω (c) ~5.545 Ω (d) 11 Ω (e) ~5.316 Ω



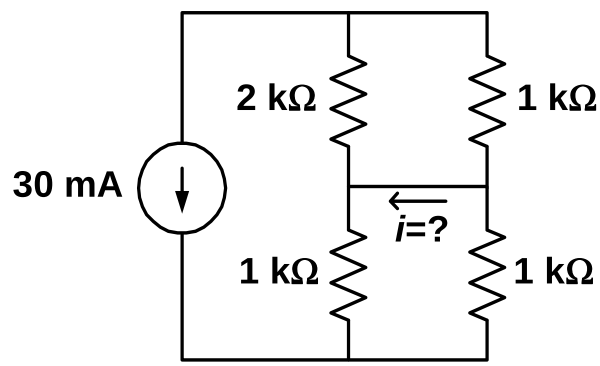
P-40. Equivalent resistance. For the resistive network shown below, between which two terminals the equivalent resistance will be the largest in value?

(a) A-B (b) A-C (c) B-C (d) C-D (e) A-D



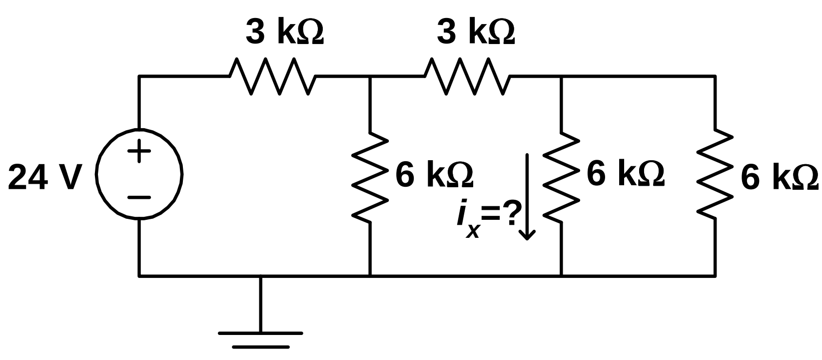
P-41. Current divider principle. For the circuit shown below, what is the current i?

(a) 15 mA (b) –15 mA (c) –10 mA (d) 5 mA (e) –5 mA



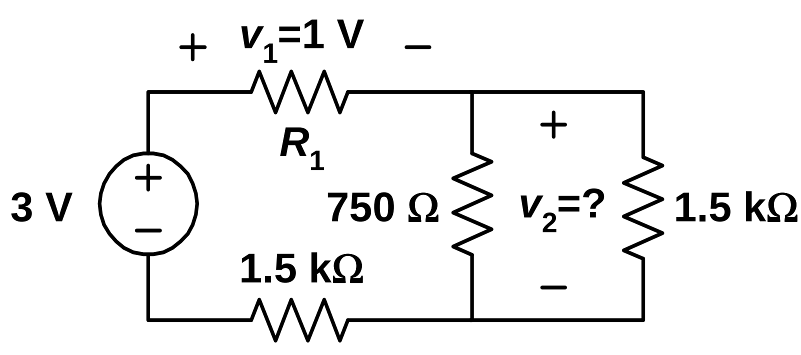
P-42. Current divider principle. For the circuit shown below, what is the current i_x?

(a) 0.5 mA (b) 1 mA (c) 1.5 mA (d) 2 mA (e) 2.5 mA



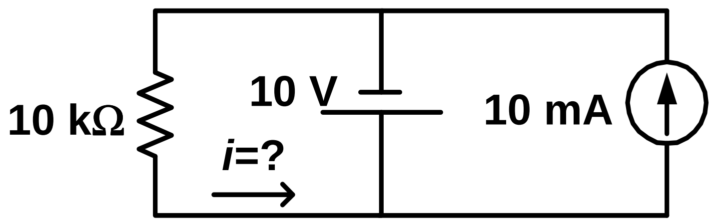
P-43. Voltage divider principle. For the circuit shown below, if voltage v_1 is measured to be $v_1 = 1\text{ V}$, what is the voltage v_2? (Note that the value of resistor R_1 is unknown.)

(a) 0.5 V (b) 1 V (c) 1.5 V (d) 2 V (e) 2.5 V



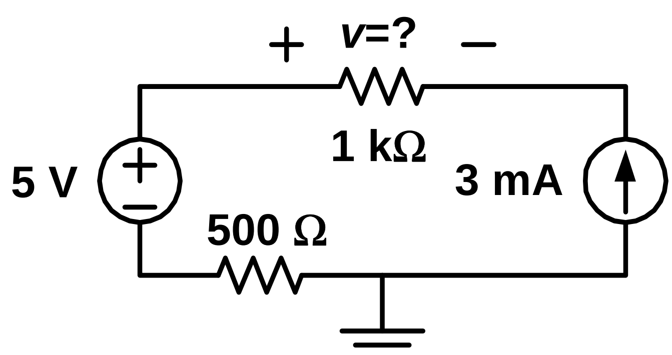
P-44. Kirchhoff's and Ohm's laws. For the circuit shown, what current i flows through the 10 kΩ resistor?

(a) 9 mA (b) –9 mA (c) 11 mA (d) –1 mA (e) 1 mA



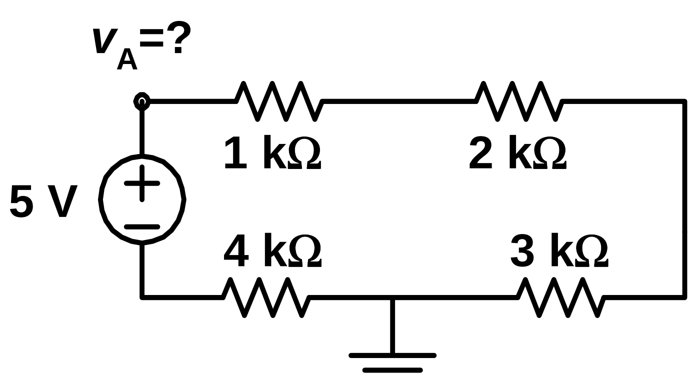
P-45. Ohm's law. For the circuit shown, what voltage v appears across the 1 kΩ resistor?

(a) 2 V (b) –2 V (c) –3 V (d) –8 V (e) 8 V



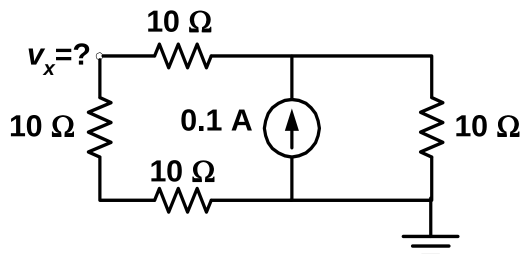
P-46. Node voltage. For the circuit shown below, what is the node voltage v_A?

(a) 1 V (b) 2 V (c) 3 V (d) 4 V (e) 5 V



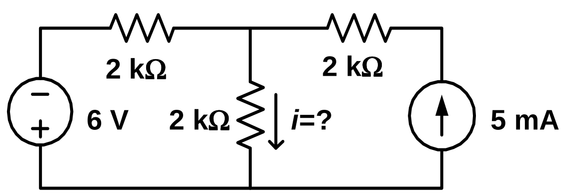
P-47. Node voltage. For the circuit shown, what is the value of the node voltage v_x?

(a) 0.5 V (b) 1 V (c) 1.5 V (d) 2 V (e) 2/3 V



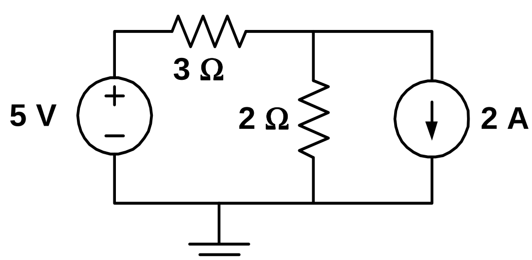
P-48. Superposition principle. In the circuit shown, what is the current *i* that flows through the 2 kΩ resistor in the middle?

(a) 0.25 mA (b) 1 mA (c) 1.5 mA (d) 3.5 mA (e) 4 mA



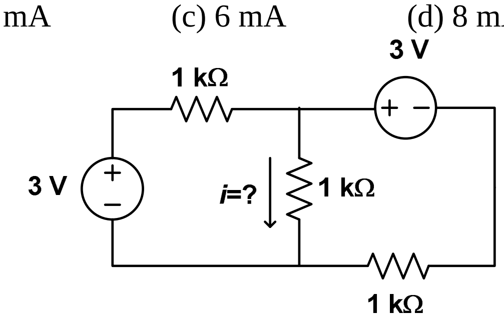
P-49. Superposition principle. In the circuit shown, what is the power dissipated by the 2 Ω resistor?

(a) 80 mW (b) 9.68 W (c) ~4.3 W (d) ~35.6 mW (e) 20.5 W



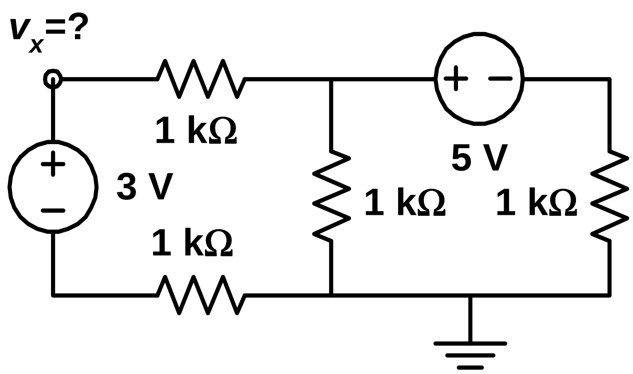
P-50. Superposition principle. In the circuit shown below, which one of the following is the value of the current *i* flowing through the 1 kΩ resistor in the middle?

(a) 2 mA (b) 4 mA (c) 6 mA (d) 8 mA (e) 12 mA



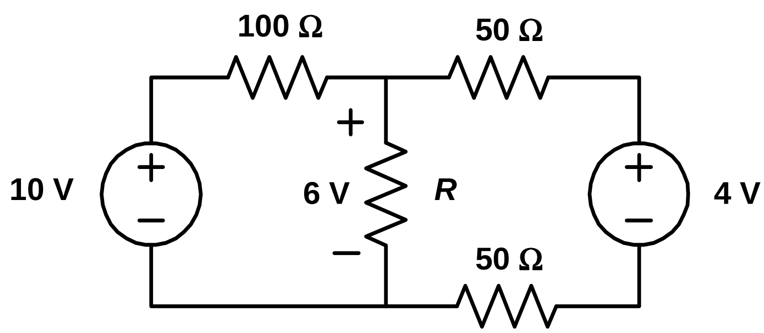
P-51. Node voltage. In the circuit shown, what is thə value of the node voltage v_x?

(a) 0.8 V (b) 1.8 V (c) 2.8 V (d) 3.2 V (e) 5.2 V



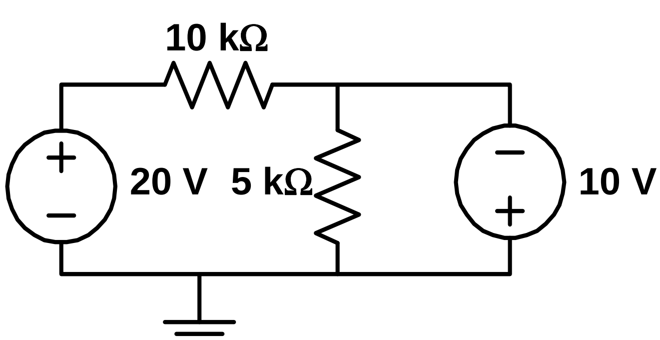
P-52. Kirchhoff's and Ohm's laws. For the circuit shown, the voltage across the unknown resistor *R* is measured to be 6 V. What is the value of the resistor *R*?

(a) 100 Ω (b) 200 Ω (c) 300 Ω (d) 400 Ω (e) 500 Ω

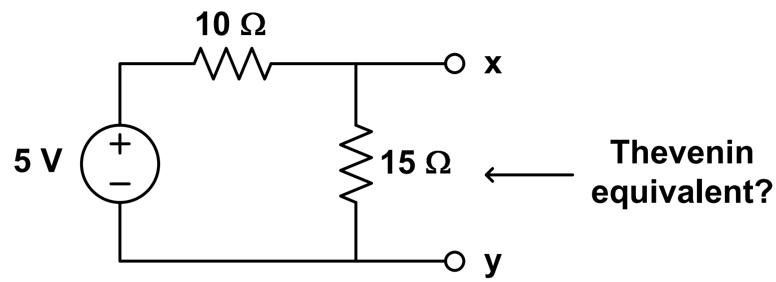


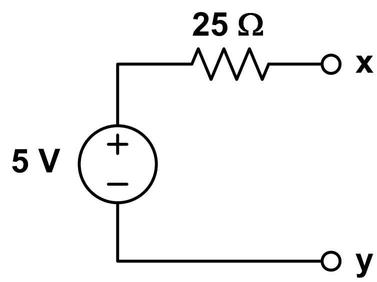
P-53. Kirchhoff's and Ohm's laws. For the circuit shown below, what is the total power supplied by the two voltage sources?

(a) 50 mW (b) 60 mW (c) 80 mW (d) 110 mW (e) 150 mW

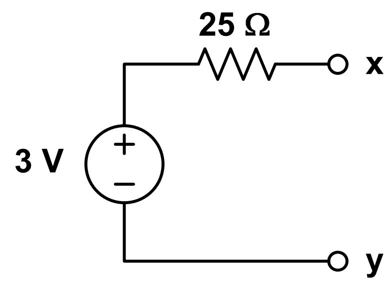


P-54. Thévenin equivalent circuit. Which one of the following is the Thévenin equivalent circuit between the “x” and “y” terminals of the circuit shown below?

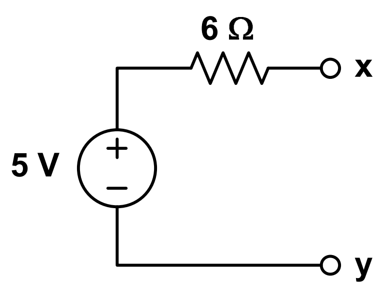




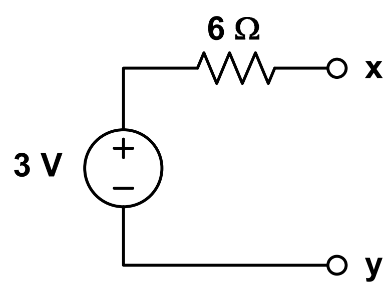
(a)



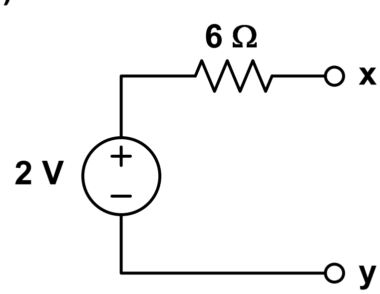
(b)



(c)

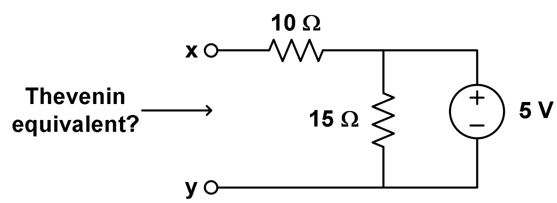


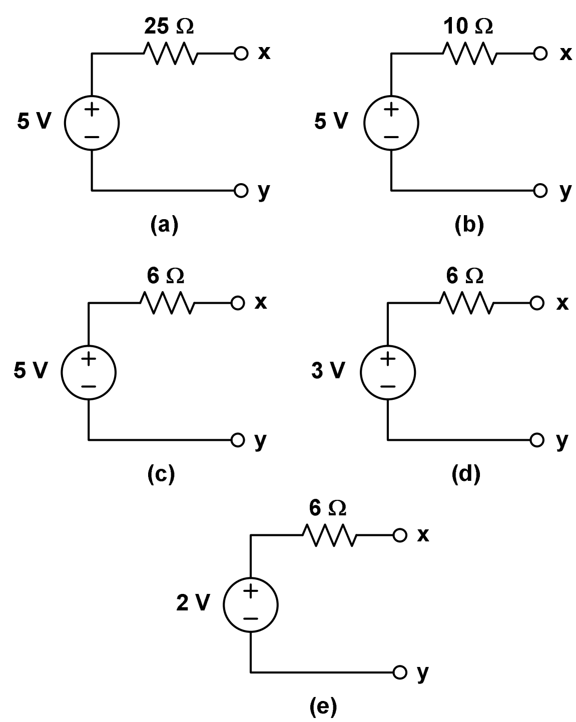
(d)



(e)

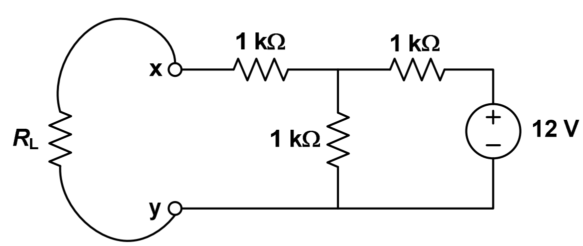
P-55. Thévenin equivalent circuit. Which one of the following is the Thévenin equivalent circuit between the "x" and "y" terminals of the circuit shown below?





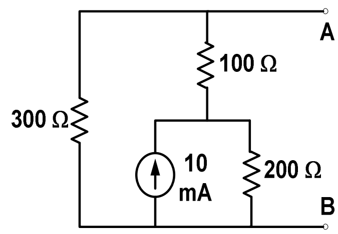
P-56. Maximum power delivered to the load. In the circuit shown below, the value of the load resistance R_L connected between terminals "x" and "y" is chosen such that it receives maximum possible power from the rest of the circuit. What is the maximum power received by R_L?

(a) 6 mW (b) 12 mW (c) 16/3 mW (d) 24 mW (e) 72 mW



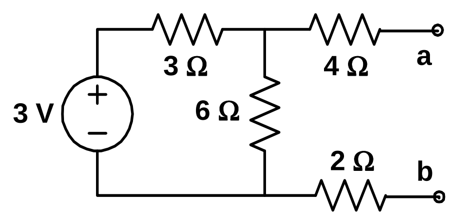
P-57. Thévenin resistance. For the circuit shown, what is the Thévenin resistance seen between the terminals “A” and “B”?

(a) 150 Ω (b) 200 Ω (c) 250 Ω (d) 300 Ω (e) 600 Ω

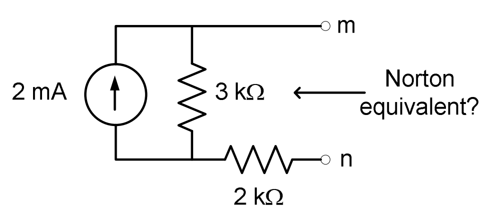


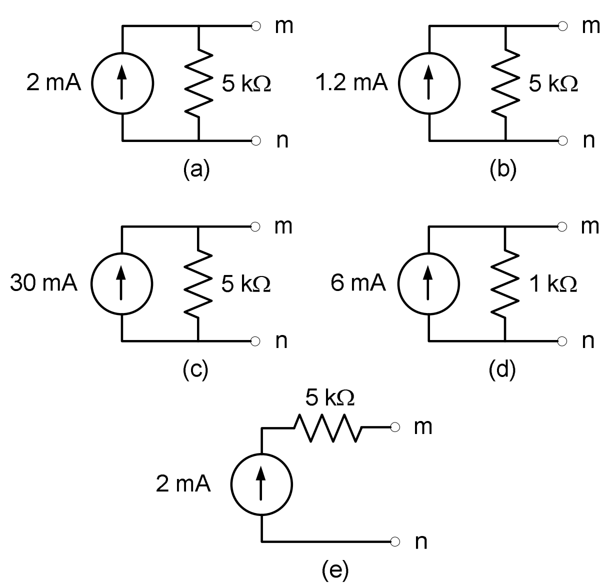
P-58. Thévenin equivalent circuit. For the circuit shown, what is the Thévenin voltage and the Thévenin resistance seen between the terminals “a” and “b”?

(a) 2 V, 6 Ω (b) 2 V, 15 Ω (c) 1.5 V, 8 Ω (d) 2 V, 8 Ω (e) 1.5 V, 6 Ω

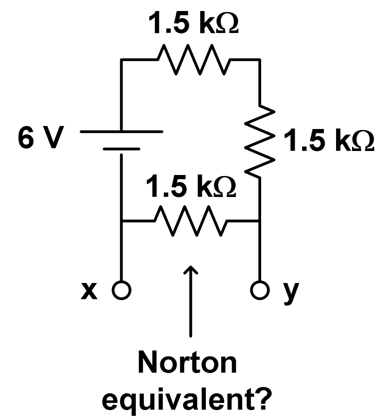


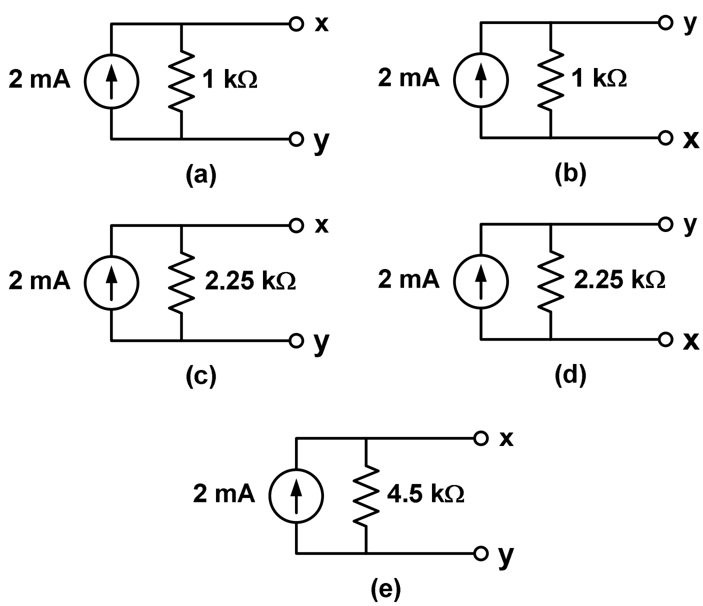
P-59. Norton equivalent circuit. For the circuit shown below, which one of the following is the Norton equivalent circuit seen between terminals “m” and “n”?





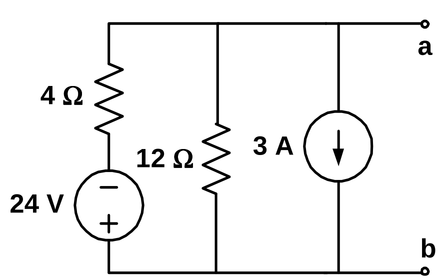
P-60. Norton equivalent circuit. Which one of the following is the Norton equivalent of the circuit shown at the top below?



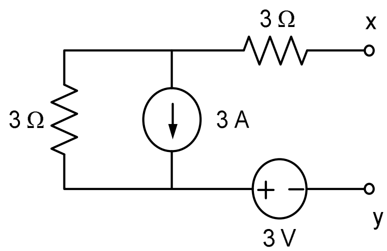


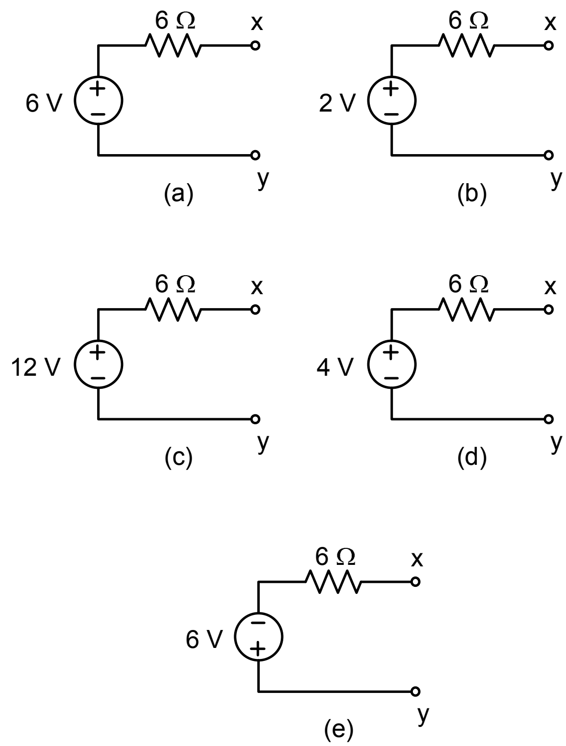
P-61. Norton equivalent circuit. For the circuit shown, what is the Norton current and the Norton resistance seen between the terminals "a" and "b"?

(a) 9 A, 16 Ω (b) 9 A, 3 Ω (c) 27 A, 16 Ω (d) 3 A, 3 Ω (e) 9 A, 12 Ω



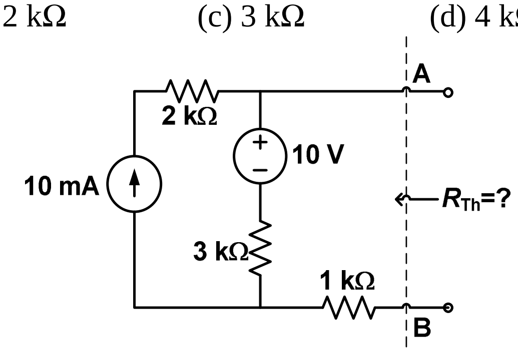
P-62. Thévenin equivalent circuit. Which one of the five Thévenin equivalent circuits provided is the Thévenin equivalent of the circuit shown below seen between terminals "x" and "y"?





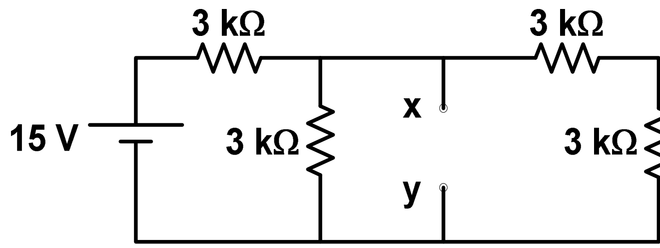
P-63. Thévenin resistance. For the circuit shown, what is the Thévenin resistance seen between terminals "A" and "B"?

(a) 1 kΩ (b) 2.2 kΩ (c) 3 kΩ (d) 4 kΩ (e) 6 kΩ



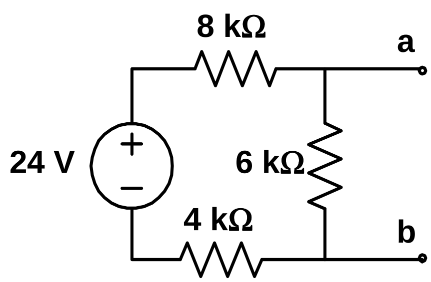
P-64. Norton resistance. For the circuit shown, what is the Norton resistance seen between the terminals "x" and "y"?

(a) 750 Ω (b) 1.2 kΩ (c) 1.5 kΩ (d) 2 kΩ (e) 7.5 kΩ



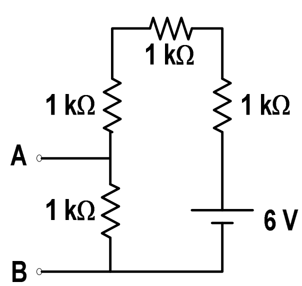
P-65. Maximum power transfer theorem. For the circuit shown, what load resistance R_L should be connected externally between terminals "a" and "b" such that this load resistance will receive maximum power possible from the rest of the circuit and what is the maximum power absorbed by this load?

(a) 6 kΩ, ~10.7 mW (b) 4 kΩ, 4 mW (c) 4 kΩ, 8 mW
(d) 6 kΩ, 24 mW (e) 4 kΩ, 64 mW



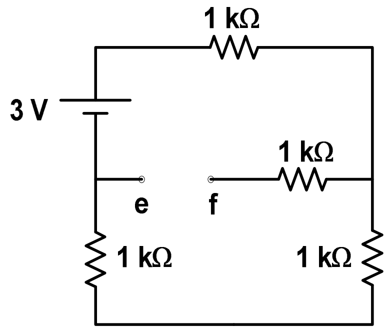
P-66. Maximum power transfer theorem. For the circuit shown, what load resistance R_L should be connected externally between terminals "A" and "B" such that this load resistance will receive maximum power possible from the rest of the circuit and what is the maximum power absorbed by this load?

(a) 4 kΩ, 2.25 mW (b) 750 Ω, 0.75 mW (c) 750 Ω, 1.5 mW
(d) 4 kΩ, 4.5 mW (e) 750 Ω, 12 mW



P-67. Thévenin resistance. For the circuit shown, what is the Thévenin resistance seen between the terminals "e" and "f"?

(a) 2/3 kΩ (b) 1 kΩ (c) 5/3 kΩ (d) 3 kΩ (e) 4 kΩ

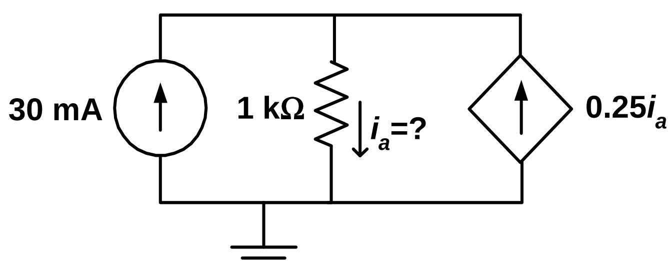


P-68. Power delivered to the load. In the circuit of the Problem 67, if a load resistance of value $R_L \cong 1.67$ kΩ is connected between "e" and "f" terminals, what power is delivered to R_L?

(a) 0.2 mW (b) 0.4 mW (c) 0.6 mW (d) 0.8 mW (e) 1 mW

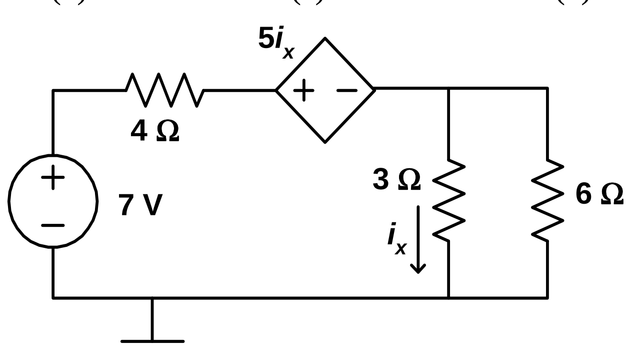
P-69. Dependent sources. In the following circuit shown below, what is the value of the i_a current flowing through the 1 kΩ resistor?

(a) 5 mA (b) 10 mA (c) 20 mA (d) 24 mA (e) 40 mA



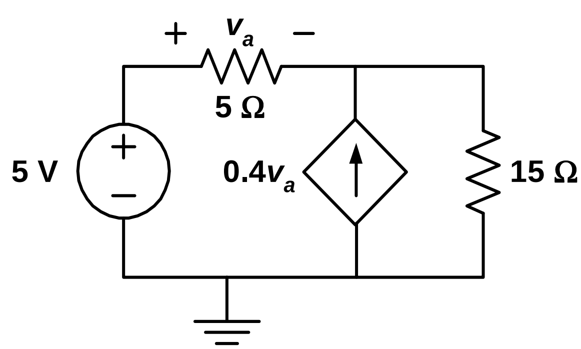
P-70. Dependent sources. The circuit shown below has a dependent voltage source the voltage of which is controlled by a current. What is the value of the current i_x?

(a) 0.35 A (b) 0.5 A (c) 0.7 A (d) 1 A (e) 5 A



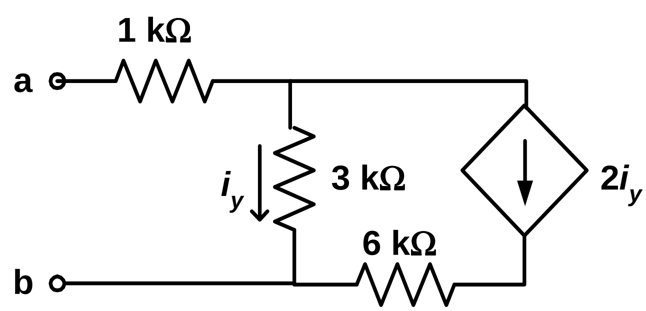
P-71. Dependent sources. In the following circuit shown below, what power is supplied by the 5 V voltage source?

(a) 50 mW (b) 0.5 W (c) 0.9 W (d) 1.4 W (e) 5 W



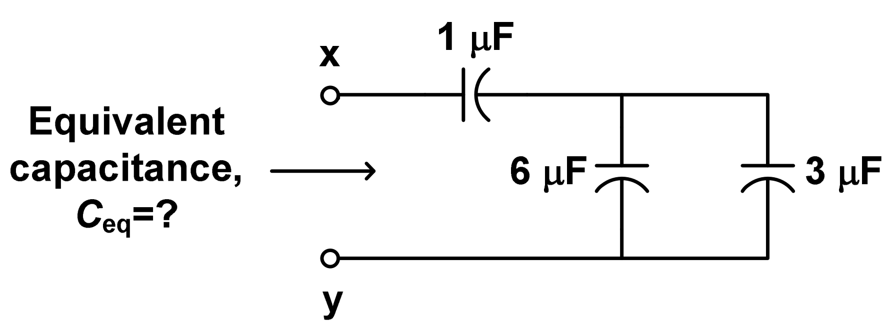
P-72. Thévenin resistance. What is the Thévenin resistance of the circuit shown between terminals "a" and "b"?

(a) 1 kΩ (b) 2 kΩ (c) 3 kΩ (d) 4 kΩ (e) 6 kΩ



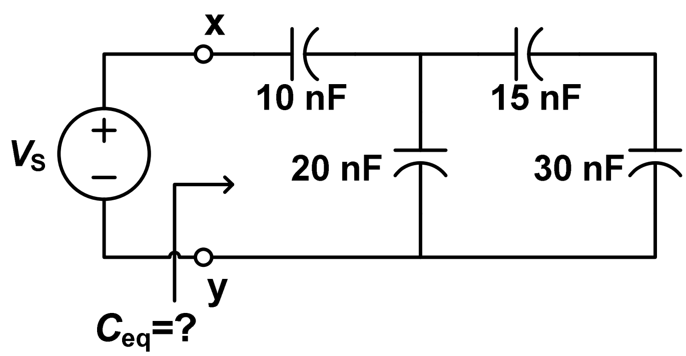
P-73. Equivalent capacitance. In the circuit shown below, what is the value of the equivalent capacitance C_{eq}?

(a) 2/3 μF (b) 0.9 μF (c) 3 μF (d) 9 μF (e) 10 μF



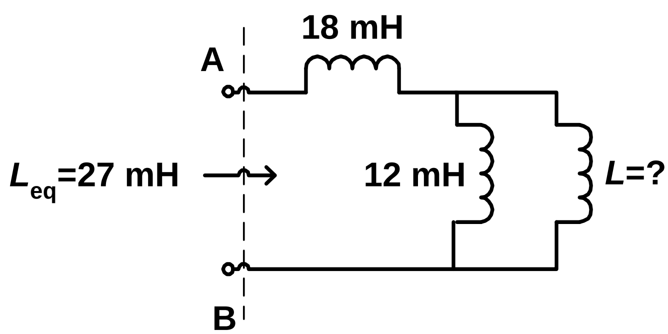
P-74. Equivalent capacitance. In the circuit shown below, what is the equivalent capacitance C_{eq} seen between the "x" and "y" terminals of the voltage source?

(a) 7.5 nF (b) ~16.7 nF (c) ~23.9 nF (d) 40 nF (e) 75 nF



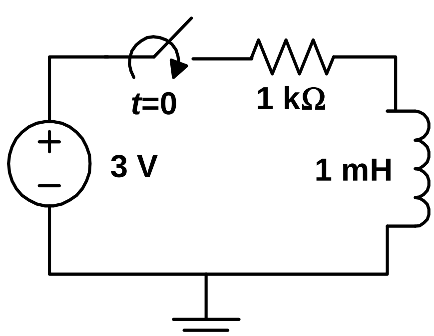
P-75. Equivalent inductance. In the circuit shown, given the equivalent inductance seen between terminals "A" and "B" to be L_{eq}=27 mH, what is the value of L?

(a) 12 mH (b) 18 mH (c) 24 mH (d) 36 mH (e) 48 mH



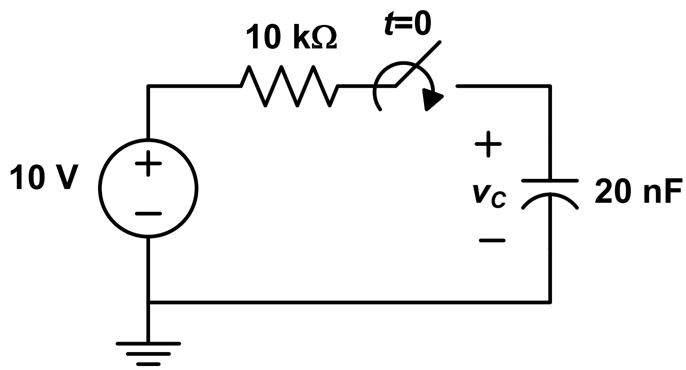
P-76. First-order inductive circuit. What is the time constant of the first-order inductive circuit shown below after the switch closes at t=0?

(a) 0.1 μs (b) 1 μs (c) 10 μs (d) 1 s (e) 3 s



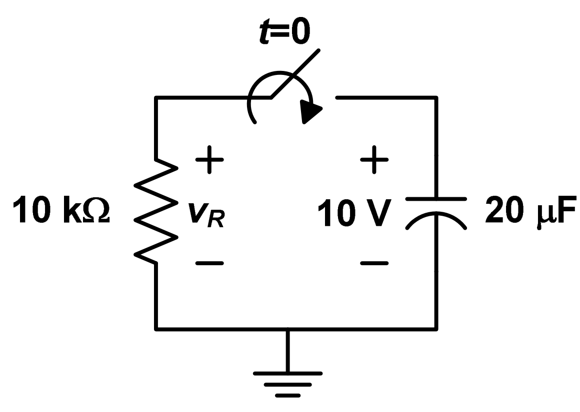
P-77. First-order capacitive circuit. In the first-order capacitive circuit shown below, the switch closes at *t*=0. If the capacitor voltage has the initial value given by $v_C(0) = 3\,\text{V}$, which one of the following is the correct mathematical expression for $v_C(t)$ valid for $t \geq 0$?

(a) $v_C(t) = 10 - 7e^{-5000t}$ V (b) $v_C(t) = 7\left(1 - e^{-5000t}\right)$ V (c) $v_C(t) = 7 - 4e^{-5000t}$ V
(d) $v_C(t) = 3 + 7e^{-5000t}$ V (e) $v_C(t) = 10e^{-5000t} - 7$ V



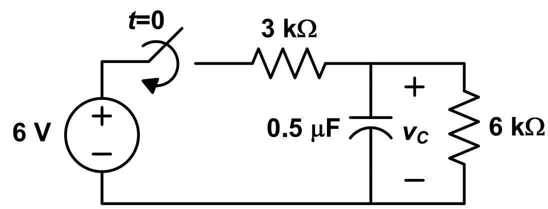
P-78. First-order capacitive circuit. In the first-order capacitive circuit shown below, the switch closes at *t*=0. If the capacitor voltage is initially 10 V, which one of the following is the correct mathematical expression for $v_R(t)$ valid for $t > 0$?

(a) $v_R(t) = 10e^{-5t}$ V (b) $v_R(t) = 10e^{-50t}$ V (c) $v_R(t) = 5e^{-10t}$ V
(d) $v_R(t) = 5e^{-10t}$ V (e) $v_R(t) = 10\left(1 - e^{-5t}\right)$ V



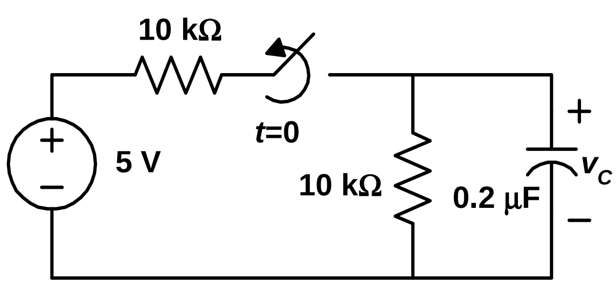
P-79. First-order capacitive circuit. In the circuit shown below, the switch closes at $t = 0$, after being open for a long time. Which one of the following expressions represent the capacitor voltage $v_C(t)$ for $t \geq 0$?

(a) $v_C(t) = 6(1 - e^{-1000t})$ (b) $v_C(t) = 6(1 - e^{-2000t/9})$ (c) $v_C(t) = 4(1 - e^{-2000t/9})$
(d) $v_C(t) = 2(1 - e^{-1000t})$ (e) $v_C(t) = 4(1 - e^{-1000t})$



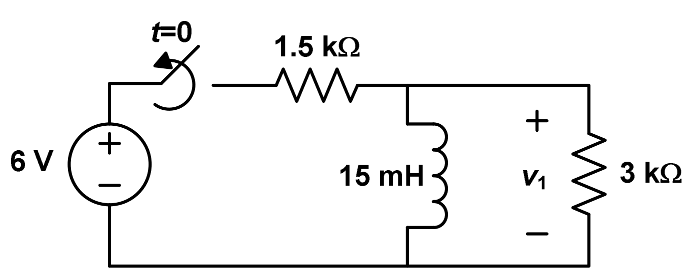
P-80. First-order capacitive circuit. In the circuit shown below, the switch opens at $t = 0$, after being closed for a long time. With what time constant will the capacitor discharge after the switch opens?

(a) 20 ms (b) 10 ms (c) 4 ms (d) 2 ms (e) 1 ms



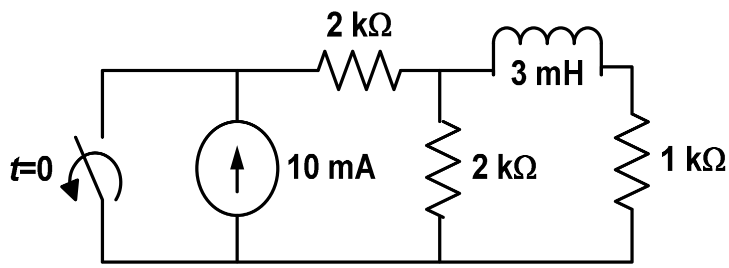
P-81. First-order inductive circuit. In the circuit shown below, the switch opens at $t = 0$, after being closed for a long time. Which one of the following mathematical expressions represents the voltage v_1 across the 3 kΩ resistor for $t > 0$?

(a) $v_1(t) = -12e^{-2\times10^5 t}$ V (b) $v_1(t) = 4e^{-2\times10^5 t}$ V (c) $v_1(t) = -4e^{-2\times10^5 t}$ V
(d) $v_1(t) = -6e^{-3\times10^5 t}$ V (e) $v_1(t) = -4e^{-3\times10^5 t}$ V



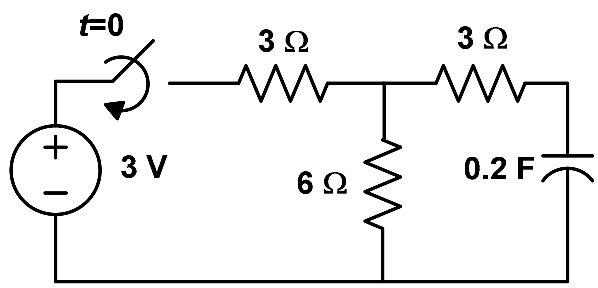
P-82. First-order switching circuit. What is the time constant of the first-order *RL* circuit shown below after t=0?

(a) 0.6 μs (b) 1 μs (c) 1.5 μs (d) 6 s (e) 9 s



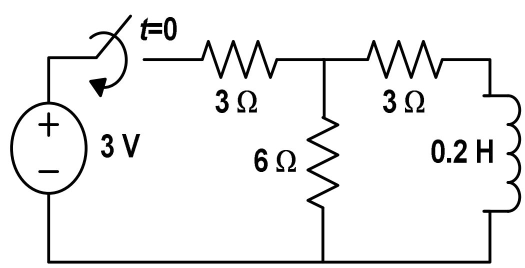
P-83. Time constant of a first-order circuit. What is the time constant of the first-order *RC* circuit shown below after the switch is closed at t=0?

(a) 0.45 s (b) 0.6 s (c) 1 s (d) 1.8 s (e) 2.4 s



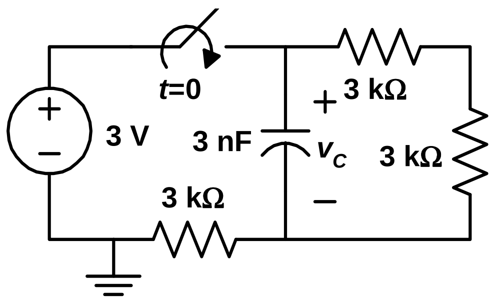
P-84. Time constant of a first-order circuit. What is the time constant of the first-order *RL* circuit shown after the switch is closed at t=0?

(a) ~17 ms (b) 25 ms (c) 40 ms (d) ~67 ms (e) ~89 ms



P-85. Steady-state voltage of the capacitor. In the circuit shown below, the switch closes at t=0. What will be the steady-state voltage of the capacitor after t=0?

(a) 0.5 V (b) 1 V (c) 1.5 V (d) 2 V (e) 3 V



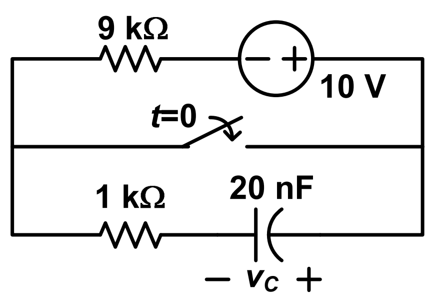
P-86. Time constant of a first-order circuit. In Problem 85, what is the time constant of the circuit after the switch closes at t=0?

(a) 6 μs (b) 27 μs (c) 18 μs (d) 1.5 ps (e) 9 μs

P-87. A first-order capacitor circuit. In the circuit shown, the switch closes at t=0, after being open for a long time. Which one of the following expressions represent the capacitor voltage after t=0?

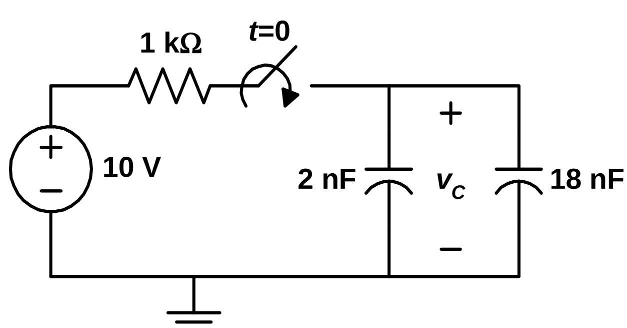
(a) $v_C(t) = 10e^{-5\times10^4 t}$ (b) $v_C(t) = 10e^{-5\times10^3 t}$ (c) $v_C(t) = 9e^{-5\times10^4 t}$

(d) $v_C(t) = e^{-5\times10^4 t}$ (e) $v_C(t) = 9e^{-5\times10^3 t}$



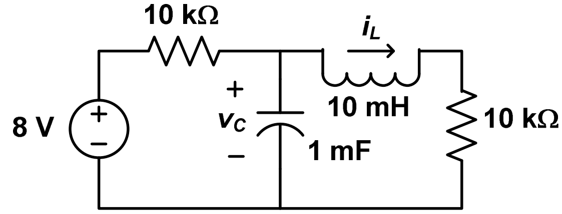
P-88. A first-order circuit with two capacitors. In the following circuit shown, the switch closes at t=0, after being open for a long time. Approximately how long will it take for the capacitor voltage v_c to reach 99% of its final value?

(a) 1.8 μs (b) 9 μs (c) 20 μs (d) 0.1 ms (e) 2 ms



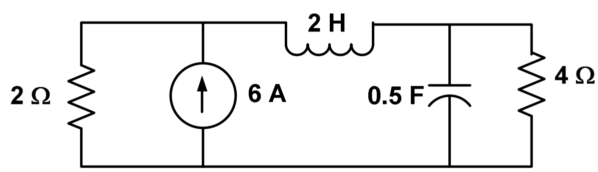
P-89. Energy stored in an inductor at steady state. For the second-order circuit shown below, what is the energy stored in the 10-mH inductor at steady state?

(a) 8 mJ (b) 2 μJ (c) 0.8 nJ (d) 1.6 nJ (e) 80 nJ



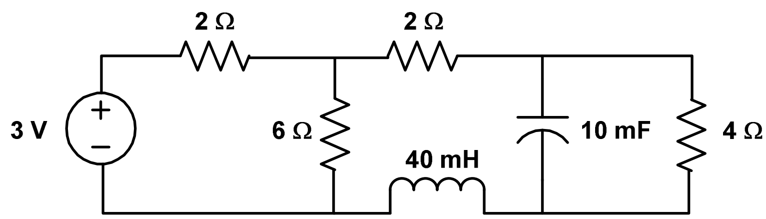
P-90. Energy stored in a capacitor at steady state. For the second-order circuit shown below, what is the energy stored in the 0.5-F capacitor at steady state?

(a) 2 J (b) 4 J (c) 8 J (d) 16 J (e) 64 J



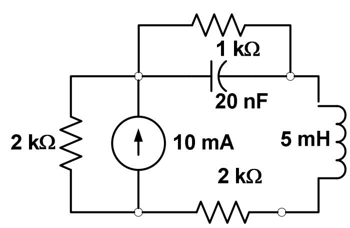
P-91. Energy stored in a capacitor at steady state. For the second-order circuit shown, what is the energy stored in the 10-mF capacitor at steady state?

(a) 5 mJ (b) 7.2 mJ (c) 11.25 mJ (d) ~16.2 mJ (e) ~25.3 mJ



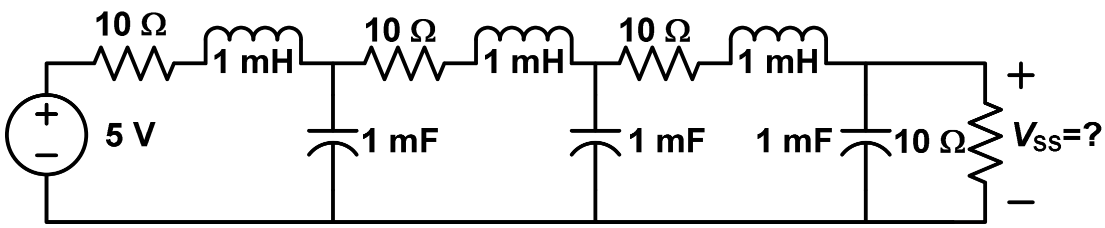
P-92. Energy stored in an inductor at steady state. For the second-order circuit shown below, what is the energy stored in the 5-mH inductor at steady state?

(a) 250 nJ (b) 90 nJ (c) 62.5 nJ (d) 40 nJ (e) 10 nJ



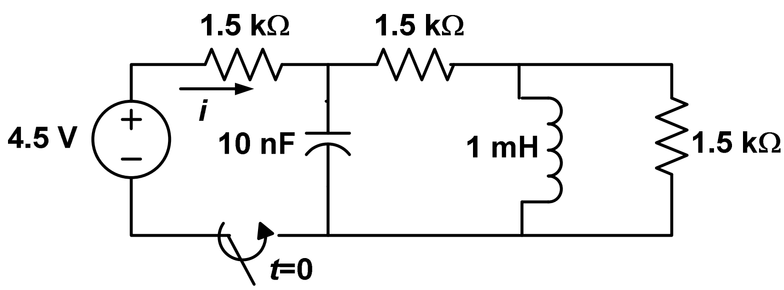
P-93. Steady-state voltage. In the circuit shown, what is the value of the voltage v_{SS} across the 10 Ω resistor on the right-hand-side at steady state?

(a) 0 V (b) 1 V (c) 1.25 V (d) 2.5 V (e) 5 V



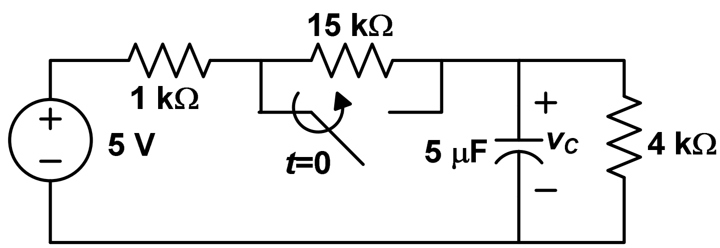
P-94. Second-order switching circuit. For the second-order switching circuit shown, the switch is closed at $t = 0$, after being open for a long time. What is the ratio $i(0^+)/i(\infty)$? (Note that $t = 0^+$ represents the time instant just after the switch is closed.)

(a) 1 (b) 2 (c) 3 (d) 4 (e) 5



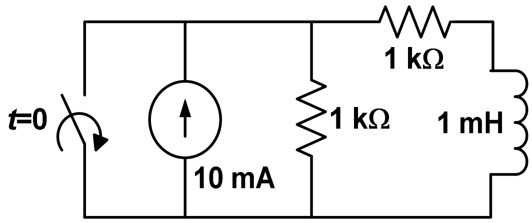
P-95. First-order switching *RC* circuit. For the first-order *RC* circuit shown below, the switch is closed at $t = 0$, after being open for a long time. Which one of the following voltage expressions represents the voltage $v_C(t)$ for $t \geq 0$?

(a) $3-4e^{-40t}$ (b) $4-3e^{-10t}$ (c) $4-3e^{-40t}$
(d) $3-4e^{-250t}$ (e) $4-3e^{-250t}$



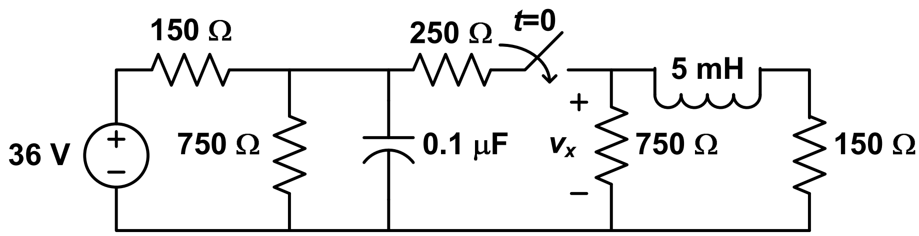
P-96. Approximate time to drop to 1%. In the first-order circuit shown below, the switch is closed at $t = 0$ after being open for a long time. At approximately what time will the inductor current drop to 1% of its initial value at $t = 0$?

(a) 1 μs (b) 2 μs (c) 2.5 μs (d) 3 μs (e) 5 μs



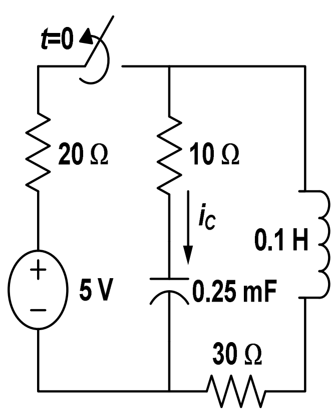
P-97. Second-order switching circuit. In the second-order circuit shown below, the switch closes at $t = 0$, after being open for a long time. Which one of the following is the value of the voltage v_x right after the switch closes (i.e., $v_x(0^+) = ?$)?

(a) 7.5 V (b) 10 V (c) 22.5 V (d) 27 V (e) 30 V



P-98. Second-order switching circuit. In the second-order switching circuit shown below, the switch opens at $t = 0$, after being closed for a long time. What is the value of the capacitor current i_C right after the switch opens? (That is, what is $i_C(0^+)$?)

(a) 0 (b) 0.1 A (c) 5/3 A (d) −5/3 A (e) −0.1 A



P-99. Natural response of a second-order circuit. For the second-order circuit of Problem 98 shown above, right after the switch opens at $t = 0$, what is the <u>total</u> energy stored in the circuit at $t = 0^+$?

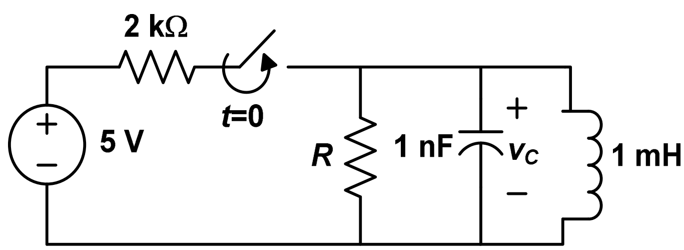
(a) 0.5 mJ (b) 1.125 mJ (c) 1.625 mJ (d) 5 mJ (e) 5.375 mJ

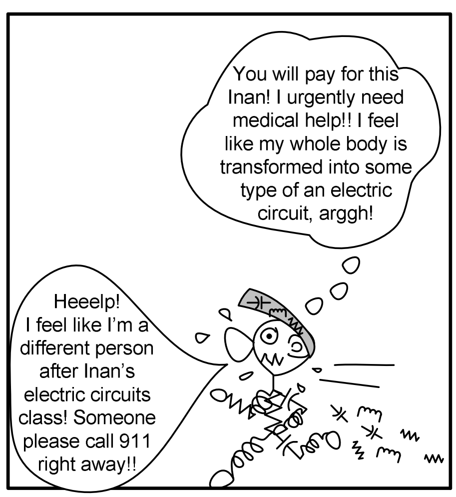
P-100. Natural response of a second-order circuit. For the second-order circuit of Problem 98 shown on the previous page, after the switch opens at $t = 0$, the natural response of the *RLC* circuit will be

(a) over-damped response
(b) critically-damped response
(c) under-damped response
(d) medium-damped response
(e) extremely-damped response

P-101. Natural response of a second-order circuit. In the second-order circuit shown below, the switch opens at $t = 0$, after being closed for a long time. What value of resistance *R* will yield an under-damped natural response $v_C(t)$ for $t > 0$?

(a) 50 Ω (b) 100 Ω (c) 200 Ω (d) 400 Ω (e) 600 Ω





<u>Math puzzler # 2:</u> How many palindrome dates are to occur in the year 2011? ☺