Introduction to Mechatronics and Measurement Systems 5th edition Alciatore Test Bank

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Introduction to Mechatronics and Measurement Systems, 5e **(Alciatore)**
Chapter 2 Electric Circuits and Components

1) A pF is equivalent to
A) 10^{-3} F
B) 10^{-6} F
C) 10^{-9} F
D) 10^{-12} F
E) 10^{-15} F

Answer: D

2) (100 kΩ) * (10 mA) =
A) 1 V
B) 1000 kV
C) 1 mV
D) 1 MV
E) 1 kV

Answer: E

3) (10 kΩ) * (10 mA) =
A) 100 V
B) 10 V
C) 1 V
D) 10 mV
E) 10 kV

Answer: A

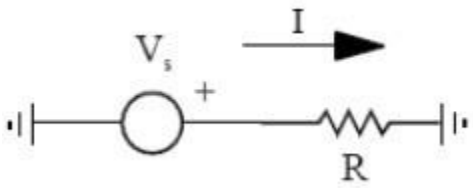
4) (10 kΩ) * (1 mA) =
A) 100 V
B) 10 V
C) 1 V
D) 10 mV
E) 10 kV

Answer: B

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The subsequent problems refer to the following circuit and variable definitions:



5) If V_S=5V, which direction are electrons flowing in the circuit:
A) from left to right
B) from right to left
C) in both directions simultaneously
D) in neither direction

Answer: B

6) If V_S=−5V and R=1kΩ, what is the correct value for I?
A) −5 mA
B) −5 A
C) 5 mA
D) 5 A
E) 1/5 A

Answer: A

7) In a dc electrical circuit with a single voltage source, electrons flow through the circuit (outside of the voltage source) from
A) the negative side of the voltage source to the positive side.
B) the positive side of the voltage source to the negative side.
C) the surrounding air to the circuit components.

Answer: A

8) In a dc electrical circuit with a single voltage source, current flows through the circuit (outside of the voltage source) from
A) the negative side of the voltage source to the positive side.
B) the positive side of the voltage source to the negative side.
C) the surrounding air to the circuit components.

Answer: B

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9) If the voltage (relative to ground) on one side of a 10kΩ resistor is 20 V and the voltage on the other side is 10 V, the current through the resistor is:
A) 1 mA
B) 1 A
C) 3 mA
D) 3 A
E) 2 mA

Answer: A

10) A resistor with a small physical size (i.e., small dimensions) generally has:
A) a low resistance value
B) a high resistance value
C) a low power rating
D) a high power rating
E) b and c

Answer: C

11) A resistor with a large physical size (i.e., large dimensions) generally has:
A) a low resistance value
B) a high resistance value
C) a low power rating
D) a high power rating
E) b and c

Answer: D

12) A 1 kV voltage across a 10 MΩ resistor will produce a current of
A) 10 kA
B) 0.1 kA
C) 10 mA
D) 1 mA
E) 0.1 mA

Answer: E

13) What is the nominal (average) resistance value of a resistor with color bands: a=gray, b=orange, c=black?
A) 83 Ω
B) 38 Ω
C) 3×10^8 Ω
D) 8000 Ω
E) 830 Ω

Answer: A

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14) What is the nominal (average) resistance value of a resistor with color bands: a=brown, b=black, c=red?
A) 1 Ω
B) 10 Ω
C) 100 Ω
D) 1 kΩ
E) 10 kΩ

Answer: D

15) What is the nominal (average) resistance value of a resistor with color bands: a=black, b=brown, c=red?
A) 1 Ω
B) 10 Ω
C) 100 Ω
D) 1 kΩ
E) 10 kΩ

Answer: C

16) What is the minimum possible resistance value of a resistor with color bands: a=brown, b=black, c=red, d=gold?
A) 105 Ω
B) 950 Ω
C) 990 Ω
D) 1050 Ω
E) 1010 Ω

Answer: B

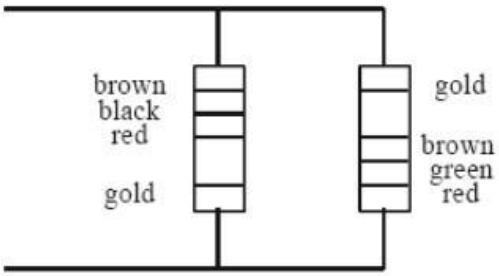
17) What is the maximum possible resistance value of a resistor with color bands: a=brown, b=black, c=red, d=gold?
A) 110 Ω
B) 105 Ω
C) 990 Ω
D) 1050 Ω
E) 1010 Ω

Answer: D

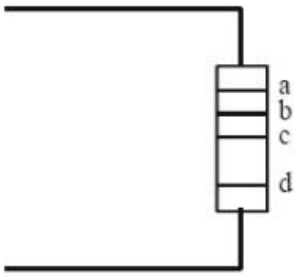
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18) What colors should bands a, b, c, and d be for circuit B to have the equivalent resistance of circuit A?



circuit A



circuit B

A) red, black, brown, gold.
B) red, brown, black, silver.
C) orange, black, brown, silver.
D) orange, black, brown, gold.
E) red, red, red, gold.

Answer: A

19) The equivalent resistance of three resistors (each of resistance R) in series is
A) R
B) 3R
C) R/3
D) 2R/3
E) 3R/2

Answer: B

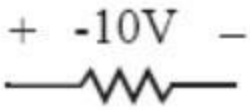
20) The equivalent resistance of three resistors (each of resistance R) in parallel is
A) 3R
B) R/3
C) $R^2/3$
D) 2R/3
E) $3R^2/2$

Answer: B

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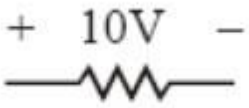
21) Given the voltage polarity and negative value shown below, what is the actual direction of current through the resistor?



A) from left to right
B) from right to left
C) no current is flowing
D) in both directions simultaneously

Answer: B

22) Given there is a voltage across a resistor as shown below, what direction are **electrons** (not current) flowing through the resistor?



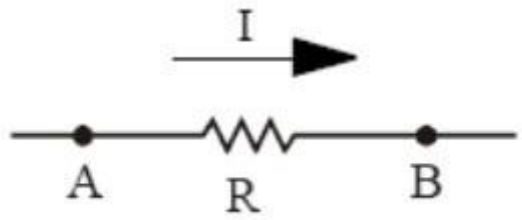
A) from left to right
B) from right to left
C) in both directions simultaneously
D) there is no electron flow through this resistor

Answer: B

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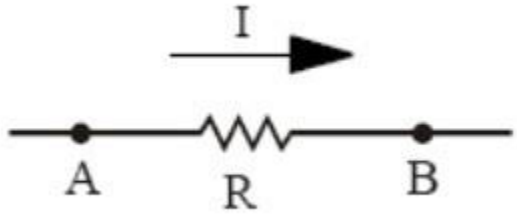
23) In the circuit branch below, with current and node definitions as shown, the red (positive) lead of an ideal voltmeter is attached to node "A" and the black (negative) lead is attached to node "B". If the voltmeter reads +5V, what is the value for I, given the current direction shown in the diagram, if R=1kΩ?



A) 5 mA
B) −5 mA
C) 5 A
D) −5 A
E) −5 kA

Answer: A

24) In the circuit branch below, with current and node definitions as shown, the black (negative) lead of an ideal voltmeter is attached to node "A" and the red (positive) lead is attached to node "B". If the voltmeter reads −5V, what is the value for I, given the current direction shown in the diagram, if R=1kΩ?



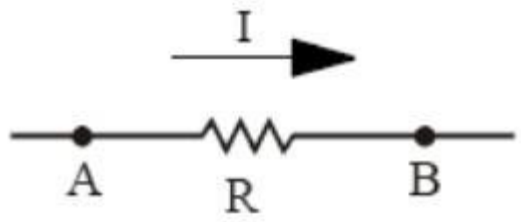
A) 5 mA
B) −5 mA
C) 5 A
D) −5 A
E) −5 kA

Answer: A

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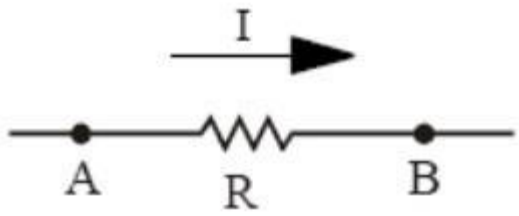
25) For the circuit branch with current and node definitions as shown below, if R=1kΩ and I=5mA, and you connect the red (positive) lead of an ideal voltmeter to node "A" and the black (negative) lead to node "B," what would the voltmeter reading be?



A) 5 V
B) −5 V
C) 5 mV
D) −5 mV
E) −5 kV

Answer: A

26) For the circuit branch with current and node definitions as shown below, if R=1kΩ and I=5mA, and you connect the black (negative) lead of an ideal voltmeter to node "A" and the red (positive) lead to node "B," what would the voltmeter reading be?



A) 5 V
B) −5 V
C) 5 mV
D) −5 mV
E) 5 kV

Answer: B

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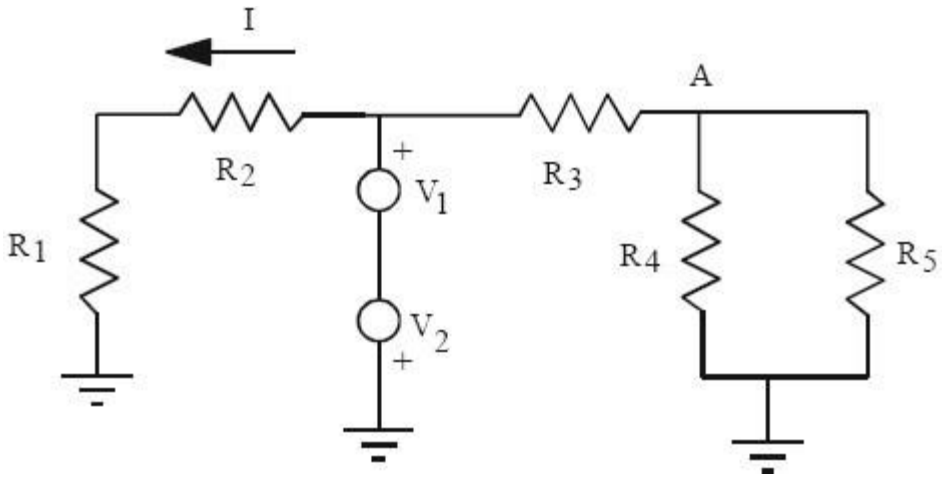
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27) If three currents (I_1, I_2, I_3) are all shown flowing **into** a node of a circuit, which of the following relationships must be true?
A) $I_1 = I_2 + I_3$
B) $I_1 = I_2 - I_3$
C) $I_1 = -I_2 - I_3$
D) $I_1 = I_2\, I_3$
E) $I_1 = (-I_2)\,(-I_3)$

Answer: C

The subsequent problems deal with the circuit below where:

R_1=5kΩ, R_2=10kΩ, R_3=5kΩ, R_4=10kΩ, R_5=10kΩ, V_1=5V, and V_2=10V.



28) The two voltage sources can be replaced by a single voltage source with
A) magnitude 5 V, same polarity as V_1.
B) magnitude 15 V, same polarity as V_1.
C) magnitude 50 V, same polarity as V_1.
D) magnitude 5 V, same polarity as V_2.
E) magnitude 50 V, same polarity as V_2.

Answer: D

29) What is the equivalent resistance of R_4 and R_5 between node A and ground?
A) 10 Ω
B) 20 Ω
C) 20 kΩ
D) 10 kΩ
E) 5 kΩ

Answer: E

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30) What is the equivalent resistance seen by the series voltage supplies?
A) 6 kΩ
B) 8 kΩ
C) 10 kΩ
D) 15 kΩ
E) 20 kΩ

Answer: A

31) What is the voltage across R_1?
A) 1/2 V
B) 1/3 V
C) 2/3 V
D) 5/3 V
E) 10/3 V

Answer: D

32) What is the voltage across R_2?
A) 1/2 V
B) 1/3 V
C) 2/3 V
D) 5/3 V
E) 10/3 V

Answer: E

33) What is the current (I) through resistor R_2 given the direction shown?
A) −1/2 mA
B) −1/3 mA
C) 1/2 A
D) 1/3 A
E) 1/2 mA

Answer: B

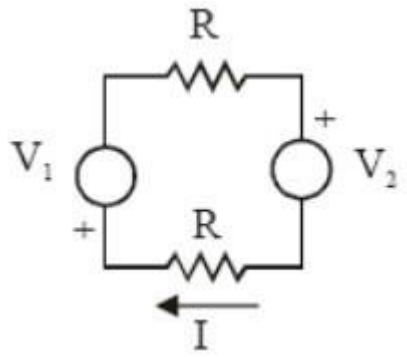
34) What is the voltage at node A?
A) −2.5 V
B) −2.5 mV
C) 2.5 V
D) 2.5 mV
E) 2.5 kV

Answer: A

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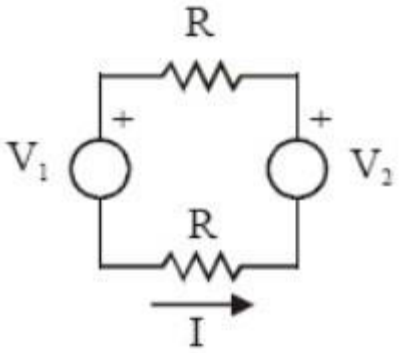
35) What is the proper equation for current I in the circuit below?



A) $(V_2 - V_1) / R$
B) $(V_1 + V_2) / R$
C) $(V_1 + V_2) / 2R$
D) $(V_2 - V_1) / 2R$
E) $-(V_1 + V_2) / 2R$

Answer: E

36) What is the proper equation for current I in the circuit below?



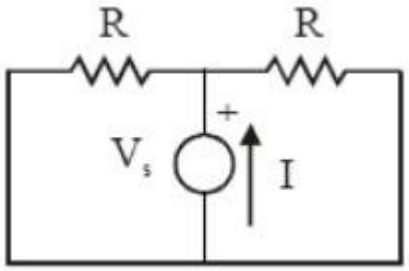
A) $(V_2 - V_1) / R$
B) $(V_1 - V_2) / R$
C) V_2 / R
D) $(V_2 - V_1) / 2R$
E) $(V_1 + V_2) / 2R$

Answer: D

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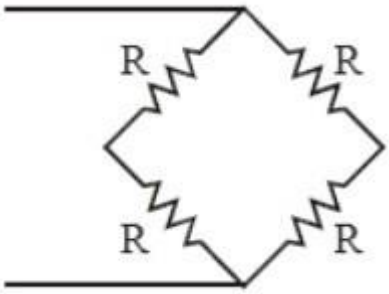
37) What is the proper equation for current I in the circuit below



A) $2V_s / R$
B) V_s / R
C) $V_s / 2R$
D) $2R\ V_s$
E) $R\ V_s$

Answer: A

38) What is the equivalent resistance of the following resistor network?



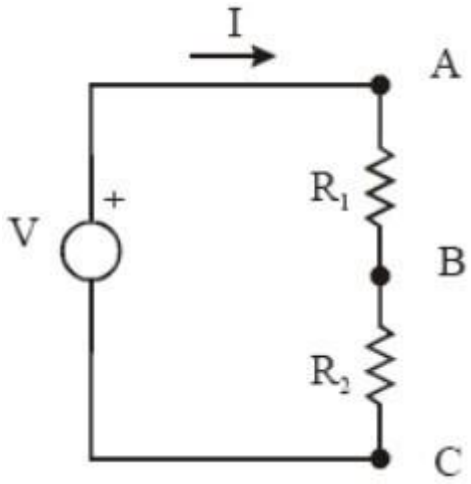
A) R
B) 2R
C) 4R
D) R / 2
E) R / 4

Answer: A

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The subsequent problems with the circuit below where $R_1 = R_2 = R$.



39) If an ideal voltmeter is used to measure the voltage between node A (red or positive lead) and node B (black or negative lead), the displayed value will be
A) 0
B) V
C) V / 2
D) −V
E) −V / 2

Answer: C

40) If an ideal voltmeter is used to measure the voltage between node C (red or positive lead) and node B (black or negative lead), the displayed value will be
A) 0
B) V
C) V / 2
D) −V
E) −V / 2

Answer: E

41) If an ideal voltmeter is used to measure the voltage between node A (red or positive lead) and node C (black or negative lead), the displayed value will be
A) 0
B) V
C) V / 2
D) −V
E) −V / 2

Answer: B

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42) If a real voltmeter, with input impedance 2R, is used to measure the voltage between node A (red or positive lead) and node B (black or negative lead), the displayed value will be
A) 0
B) V
C) 2V / 3
D) 3V / 4
E) 2V / 5

Answer: E

43) If a real voltmeter, with input impedance 2R, is used to measure the voltage between node A (red or positive lead) and node C (black or negative lead), the displayed value will be
A) 0
B) V
C) 2V / 3
D) 3V / 4
E) 2V / 5

Answer: B

44) If an ideal ammeter is used to measure the current I, the displayed value will be
A) V / 2R
B) 2V / R
C) 2R / V
D) R / 2V
E) V / R

Answer: A

45) If a real ammeter, with input impedance R, is used to measure the current I, the displayed value will be
A) V / 3R
B) 3V / R
C) 2V / 3R
D) 3V / 2R
E) 2V / R

Answer: A

46) When an ammeter is used properly to measure the current in a circuit branch, the meter will introduce a voltage drop in the branch which
A) increases with increasing current
B) decreases with increasing current
C) is independent of current

Answer: A

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47) When measuring the voltage across a circuit branch with a voltmeter, the reading will have the largest percentage error when the branch has
A) small resistance
B) large resistance
C) no resistance

Answer: B

48) We wish to measure current in the branch of a circuit. Assume that the circuit contains no current sources. When a real ammeter with nonzero input impedance is used properly to measure the branch current, the measured current will be
A) less than the actual current (i.e., less than the current that was in the branch before the ammeter was inserted)
B) exactly equal to the actual current (i.e., exactly equal to the current that was in the branch before the ammeter was inserted), regardless of what is driving the circuit
C) more than the actual current (i.e., more than the current that was in the branch before the ammeter was inserted)

Answer: A

49) A high quality, but non-ideal, voltmeter has an input impedance that is
A) very small
B) exactly zero
C) very large
D) infinite

Answer: C

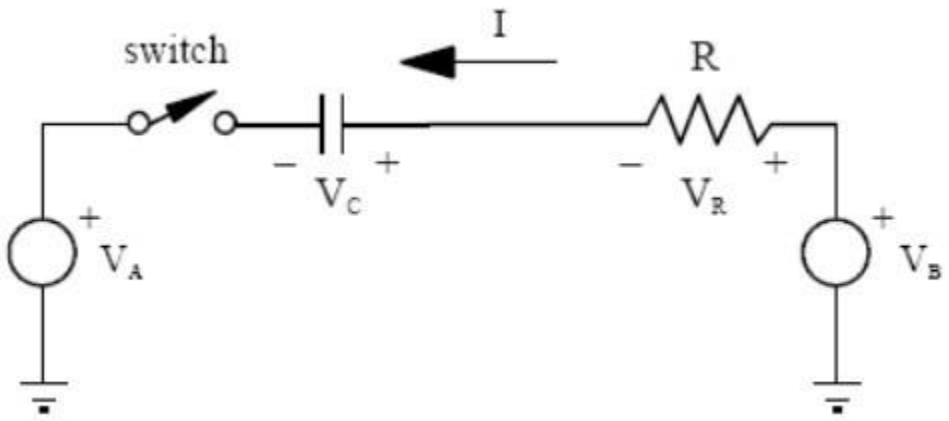
50) If a function generator, with an output impedance of 50Ω, is connected across a 100Ω resistor, what would the voltage across the resistor be if the function generator's output (displayed value) is set to 10Vdc?
A) 5 V
B) 10 V
C) 10/3 V
D) 20/3 V
E) 40/3 V

Answer: D

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The subsequent problems deal with the switched RC circuit below. Assume that the capacitor has no charge to begin with, and assume that V_A and V_B are constant dc voltages.



51) Immediately after the switch is closed (i.e., the circuit is not in steady state yet), what is the correct expression for V_C, given the polarity shown?

A) 0
B) V_A
C) V_B
D) $V_A - V_B$
E) $V_B - V_A$

Answer: A

52) Immediately after the switch is closed (i.e., the circuit is not in steady state yet), what is the correct expression for V_R, given the polarity shown?

A) 0
B) V_A
C) V_B
D) $V_A - V_B$
E) $V_B - V_A$

Answer: E

53) Immediately after the switch is closed (i.e., the circuit is not in steady state yet), what is the correct expression for the current (I), given the polarity shown?

A) 0
B) ∞ or $-\infty$
C) V_A / R
D) $(V_A - V_B) / R$
E) $(V_B - V_A) / R$

Answer: E

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54) A long time after the switch has been closed (i.e., the circuit is in steady state), what is the correct expression for V_C, given the polarity shown?
A) 0
B) V_A
C) V_B
D) $V_A - V_B$
E) $V_B - V_A$

Answer: E

55) A long time after the switch has been closed (i.e., the circuit is in steady state), what is the correct expression for V_R, given the polarity shown?
A) 0
B) V_A
C) V_B
D) $V_A - V_B$
E) $V_B - V_A$

Answer: A

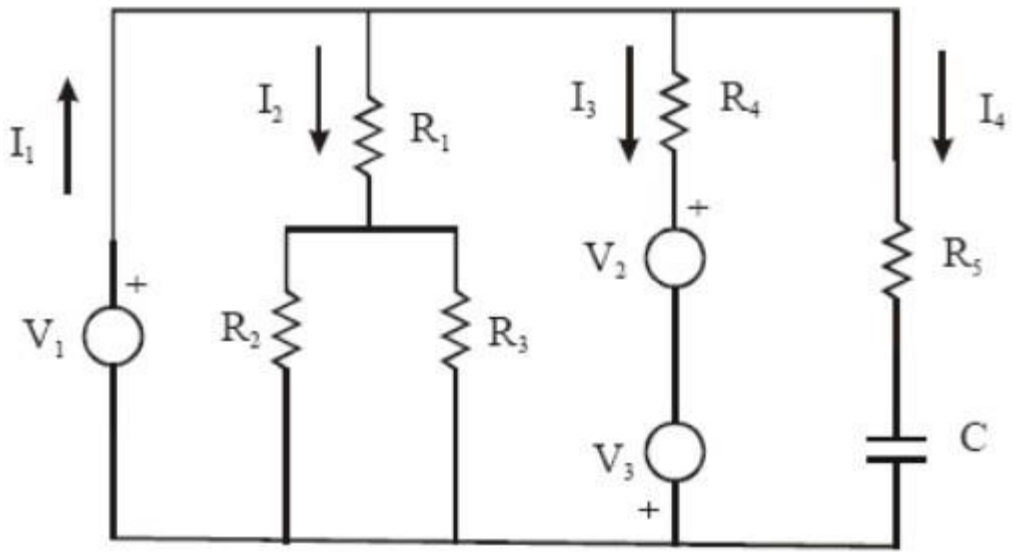
56) A long time after the switch has been closed (i.e., the circuit is in steady state), what is the correct expression for the current (I), given the polarity shown?
A) 0
B) V_A / R
C) V_B / R
D) $(V_B - V_A) / R$
E) $(V_A - V_B) / R$

Answer: A

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The subsequent problems deal with the circuit below where all voltage sources are **dc** and the circuit is assumed to be in **steady state**. Also, $R_1 = R_2 = R_3 = R_4 = R$.



57) I_2 =
A) V_1 / R
B) $V_1 / 2R$
C) $2V_1 / 3R$
D) $(V_1 + V_2 - V_3) / 2R$
E) $2(V_1 + V_2 - V_3) / 3R$

Answer: C

58) The equivalent resistance of the combination of R_1, R_2, and R_3 is
A) R
B) R / 2
C) 3R / 2
D) 2R / 3
E) 3R

Answer: C

59) If $I_2 = 2$ A, the current through R_2 is
A) 1/2 A
B) 1 A
C) 3/2 A
D) 2 A
E) 4 A

Answer: B

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60) The voltage across R_4 is
A) V_2
B) $V_2 - V_3$
C) $-V_2 + V_3$
D) $V_1 - V_2 + V_3$
E) $V_1 + V_2 - V_3$

Answer: D

61) I_3 =
A) $(V_1 - V_2 + V_3) / R$
B) $(-V_2 + V_3) / R$
C) $(V_1 + V_2 - V_3) / R$
D) $(V_2 - V_3) / R$
E) V_2 / R

Answer: A

62) The power added to the circuit by source V_2 is
A) I_3V_2
B) $-I_3V_2$
C) I_3 / V_2
D) $-I_3 / V_2$
E) 0

Answer: B

63) The power added to the circuit by source V_3 is
A) I_3V_3
B) $-I_3V_3$
C) I_3 / V_3
D) $-I_3 / V_3$
E) 0

Answer: A

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64) I_4 =
A) 0
B) V_1 / R
C) $-V_1 / R$
D) $V_1 / (R + C)$
E) $-V_1 / (R + C)$

Answer: A

65) The voltage across R_5 is
A) 0
B) V_1
C) $V_2 - V_3$
D) $V_2 + V_3$
E) $V_1 + V_2 - V_3$

Answer: A

66) The voltage across the capacitor is
A) 0
B) V_1
C) $V_2 - V_3$
D) $V_2 + V_3$
E) $V_1 + V_2 - V_3$

Answer: B

67) The voltage across R_2 is
A) V_1
B) $V_1 / 2$
C) $V_1 / 3$
D) $2V_1 / 3$
E) $2V_1$

Answer: C

68) If the voltage across R_3 is 1V, then the voltage across R_2 is
A) 0 V
B) 1/2 V
C) 1/3 V
D) 1 V
E) 2 V

Answer: C

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69) If the voltage across R_3 is 1V, then the voltage across R_1 is
A) V_1
B) $V_1 + 1$ V
C) $V_1 - 1$ V
D) $V_1 + 2$ V
E) $V_1 - 2$ V

Answer: C

70) If source V_3 is replaced by an open circuit, I_3 is
A) 0
B) V_2 / R_4
C) $(V_1 - V_2) / R_4$
D) $(V_1 + V_2) / R_4$
E) $(V_1 - V_2) / (R_4 + R_5)$

Answer: A

71) If source V_3 is replaced by an open circuit, the total voltage across R_5 and the capacitor is
A) 0
B) V_1
C) V_2
D) $V_1 - V_2$
E) $V_1 + V_2$

Answer: B

72) If R_3 is replaced by an open circuit and I_2 is known, the current through R_2 will be
A) 0
B) I_2
C) $I_2 / 2$
D) $2I_2$
E) $-I_2$

Answer: B

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73) If R_3 is replaced by an open circuit and I_2 is known, the current through the open circuit (where R_3 was) will be
A) 0
B) I_2
C) $I_2 / 2$
D) $2I_2$
E) $-I_2$

Answer: A

74) If R_3 is replaced by an closed (short) circuit and I_2 is known, the current through R_2 will be
A) 0
B) I_2
C) $I_2 / 2$
D) $2I_2$
E) $-I_2$

Answer: A

75) If R_3 is replaced by an closed (short) circuit and I_2 is known, the current through the closed circuit (where R_3 was) will be
A) 0
B) I_2
C) $I_2 / 2$
D) $2I_2$
E) $-I_2$

Answer: B

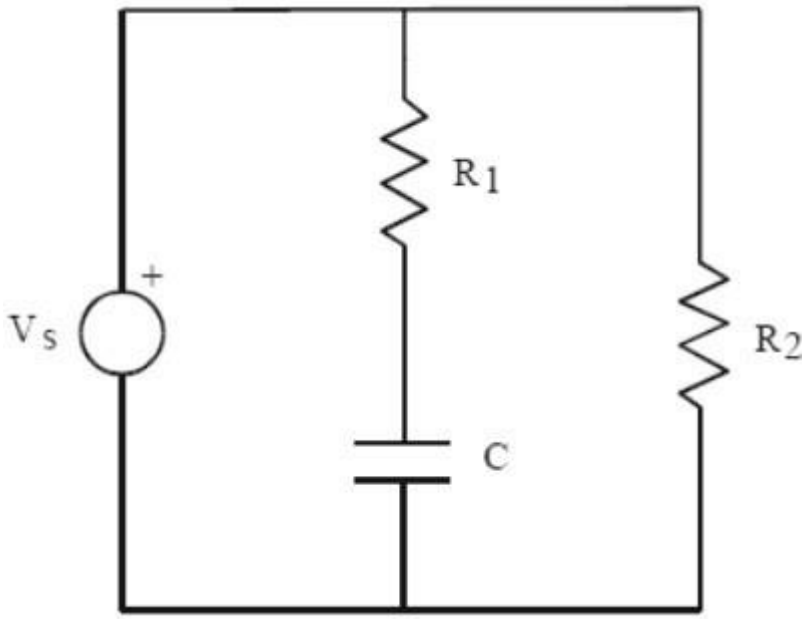
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The subsequent problems deal with the circuit below where:

V_s=10V dc, R_1=1kΩ, R_2=1kΩ, and C=0.01μf

Assume the circuit is operating in steady state (transients are already dissipated).



76) What is the voltage across R_1?
A) 20 V
B) 10 V
C) 5 V
D) 0 V
E) −20 V

Answer: D

77) What is the voltage across R_2?
A) 20 V
B) 10 V
C) 5 V
D) 0 V
E) −20 V

Answer: B

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78) What is the voltage across C?
A) 20 V
B) 10 V
C) 5 V
D) 0 V
E) −20 V

Answer: B

79) In a dc circuit operating in steady state (transients already gone), a capacitor behaves like
A) a closed (short) circuit
B) an open circuit
C) a current source
D) a resistor
E) an inductor

Answer: B

80) In a dc circuit operating in steady state (transients already gone), an inductor behaves like
A) a closed (short) circuit
B) an open circuit
C) a current source
D) a resistor
E) a capacitor

Answer: A

81) What is the phase (in units of radians) for the ac signal: 2 sin (5t + 1) V?
A) 1
B) 2
C) π/180
D) π/90
E) 90/π

Answer: A

82) What is the peak-to-peak voltage for the ac signal: 2 sin (5t) V?
A) 0
B) 2
C) 4
D) 5
E) 10

Answer: C

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83) What is the voltage amplitude (not peak-to-peak) for the ac signal: 2 sin (5t) V?
A) 1
B) 2
C) 4
D) 5
E) 10

Answer: B

84) What is the frequency, in units of Hertz, of the ac signal: 2 sin (5t) V?
A) 5
B) 5π
C) 5/π
D) 10π
E) 5/(2π)

Answer: E

85) A 20 kHz sine wave has a radian frequency of
A) 20,000 rad/sec
B) 20,000π rad/sec
C) 40,000 rad/sec
D) 40,000π rad/sec
E) 10,000/π rad/sec

Answer: D

86) What is the phase angle corresponding to a phasor represented in rectangular form (−1 + j)?
A) 0 deg
B) 45 deg
C) −45 deg
D) −135 deg
E) 135 deg

Answer: E

87) What is the phase angle corresponding to a phasor represented in rectangular form (−1 − j)?
A) 0 deg
B) 45 deg
C) −45 deg
D) −135 deg
E) 135 deg

Answer: D

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88) What is the phase angle corresponding to a phasor represented in rectangular form (1 − j)?
A) 0 deg
B) 45 deg
C) −45 deg
D) −135 deg
E) 135 deg

Answer: C

89) What is the equivalent impedance, in rectangular form, of the series combination of 1<0°> and 1<−90°>?
A) 2 + 2j
B) 2 − 2j
C) 0
D) 1 + j
E) 1 − j

Answer: E

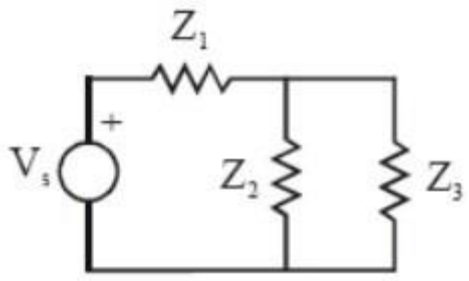
90) What is the equivalent impedance, in rectangular form, of the series combination of 1<0°> and 1<90°>?
A) 2 + 2j
B) 2 −2j
C) 0
D) 1 + j
E) 1 − j

Answer: D

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The subsequent problems deal with the circuit below containing complex impedances.



91) If Z_1=0Ω, Z_2=∞Ω, and Z_3=10Ω, what is the equivalent impedance of the circuit?
A) 0 Ω
B) ∞ Ω
C) 1/10 Ω
D) 10 Ω
E) (∞ + 10) Ω

Answer: D

92) If Z_1=10Ω, Z_2=∞Ω, and Z_3=10Ω, what is the equivalent impedance of the circuit?
A) 0 Ω
B) ∞ Ω
C) 10 Ω
D) 20 Ω
E) 50 Ω

Answer: D

93) If Z_1=10jΩ, Z_2=10jΩ, and Z_3=10jΩ, what is the equivalent impedance of the circuit?
A) 10 jΩ
B) 15 jΩ
C) −15 jΩ
D) 20 jΩ
E) −30 jΩ

Answer: B

94) If Z_1=0Ω, Z_2=10Ω, and Z_3=10jΩ, what is the equivalent impedance of the circuit?
A) 10 / (j−1) Ω
B) −10 / (j−1) Ω
C) 10j / (j−1) Ω
D) −10j / (j−1) Ω
E) 10 + 10 jΩ

Answer: B

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95) If Z_1=10jΩ, Z_2=10Ω, and Z_3=∞Ω, what is the magnitude of the equivalent impedance of the circuit?

A) $10\sqrt{2}$ Ω

B) $2\sqrt{10}$ Ω

C) 10 Ω

D) 20 Ω

E) 100 Ω

Answer: A

96) If Z_1=10jΩ, Z_2=10Ω, and Z_3=∞Ω, what is the argument (phase angle) of the equivalent impedance of the circuit?

A) 0°

B) 45°

C) −45°

D) 135°

E) −135°

Answer: B

97) If Z_1=−10jΩ, Z_2=10Ω, and Z_3=∞Ω, what is the argument (phase angle) of the equivalent impedance of the circuit?

A) 0°

B) 45°

C) −45°

D) 135°

E) −135°

Answer: C

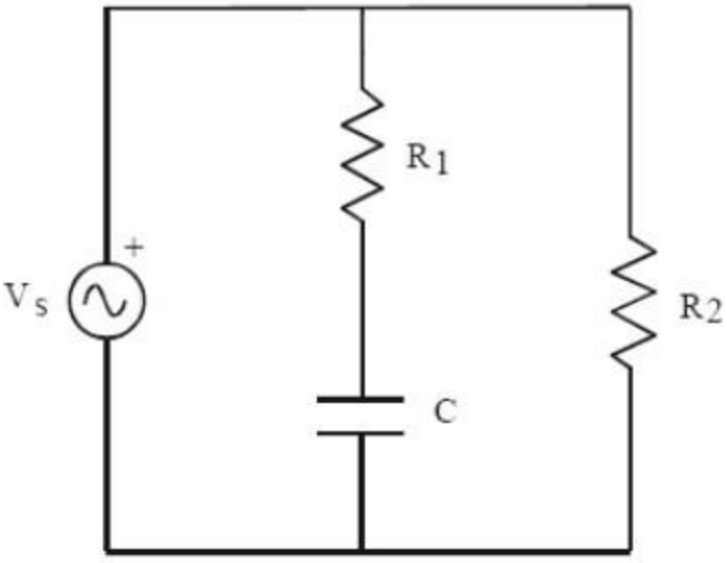
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The subsequent problems deal with the circuit below where:

V_s=2 sin (100 t) V, R_1=1kΩ, R_2=1kΩ, and C=1μf

Assume the circuit is operating in steady state (transients already gone).



98) What is the voltage across R_2?
A) 2 sin (100 t)
B) 1 sin (100 t)
C) 2
D) 1
E) 0

Answer: A

99) What is the rectangular form of the equivalent impedance (in Ω) of the R_1−C branch?
A) 1000 + 10000 j
B) 1000 − 10000 j
C) 1000 − 100 j
D) 1000 + 100 j
E) 1000

Answer: B

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100) What is the polar form of the equivalent impedance (in Ω) of the R_1−C branch?
A) 10050 <84.3°>
B) 10050 <−84.3°>
C) 1005 <−5.71°>
D) 1005 <5.71°>
E) 1000 < 0°>

Answer: B

101) What is the polar form of the impedance (in Ω) of resistor R_2?
A) 1000 <0°>
B) 1000 <45°>
C) 1000 <−45°>
D) 1000 <90°>
E) 1000 < −90°>

Answer: A

102) For very high input frequencies [V_s = 2 sin (ωt), where ω is large], the voltage across R_1 approaches
A) 2 sin (ωt)
B) 1 sin (ωt)
C) 2
D) 1
E) 0

Answer: A

103) For very high input frequencies [V_s = 2 sin (ωt), where ω is large], the voltage across C approaches
A) 2 sin (100t)
B) 1 sin (100t)
C) 2
D) 1
E) 0

Answer: E

104) The rms value for the voltage of a sine wave is
A) equal to the amplitude
B) less than the amplitude
C) greater than the amplitude
D) zero

Answer: B

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