Technician Licensing Class

Electrical principles, math for electronics, electronic principles, Ohm's Law

T5A - T5D

Valid
July 1, 2018 Through June 30, 2022

Developed by Bob Bytheway, K3DIO, and
updated to 2018 Question Pool by NQ4K for Sterling Park Amateur Radio Club

T 5A
Topics

- Electrical principles, units, and terms:
  - current and voltage;
  - conductors and insulators;
  - alternating and direct current;
  - series and parallel circuits

T 5 A

- The name for the flow of electrons in an electric circuit is current. T5A03
- Electrical current is measured in amperes. T5A01
- The basic unit of electromotive force is the volt. T5A11
- The electrical term for the electromotive force (EMF) that causes electron flow is voltage. T5A05

T 5 A

- The term that describes the rate at which electrical energy is used is called Power. T5A10

- Electrical power is measured in Watts. T5A02

T 5 A

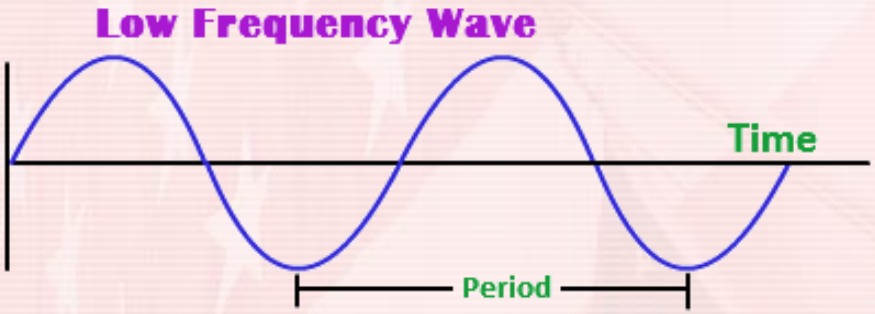
- The name for a current that flows only in one direction is called direct current. T5A04

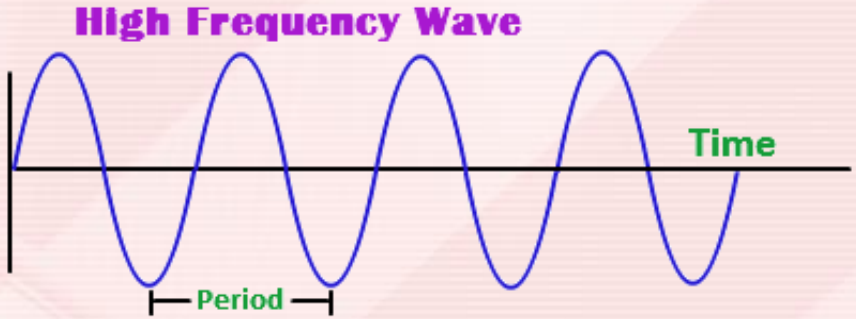
- A mobile transceiver usually requires 12 volts. T5A06

T 5 A

- The name for a current that reverses direction on a regular basis is alternating current. T5A09

- Frequency is the number of times per second that an alternating current makes a complete cycle. T5A12





- The unit of frequency is the Hertz. T5C05

T 5 A

- Copper is a good electrical conductor. T5A07
- A good electrical insulator is glass. T5A08
- The type of circuit in which the current is the same through all components is **series**. T5A13
- The type of circuit in which the voltage is the same across all components is **parallel**. T5A14

T5B
Topics

- Math for electronics:
  - conversion of electrical units;
  - decibels;
  - the metric system

T 5 B

Number prefixes

1,000,000,000,000
1,000,000,000
1,000,000
1,000
1
0.1
0.01
0.001
0.000 001
0.000 000 001
0.000 000 000 001

Prefixes for Powers of 10		
Prefix	Symbol	Notation
tera	T	10^{12}
giga	G	10^{9}
mega	M	10^{6}
kilo	k	10^{3}
Unit		10^{0}
deci	d	10^{-1}
centi	c	10^{-2}
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}

T 5 B

- **1.5 amperes** is the same as **1,500 milliamperes.** T5B01
- Another way to specify a radio signal frequency of **1,500,000** hertz is **1,500 KHz.** T5B02
- One **kilovolt** is **thousand volts.** T5B03
- One **microvolt** is one **one-millionth of a volt.** T5B04

T 5 B

- 500 milliwatts is equivalent to 0.5 watts. T5B05
- If an ammeter calibrated in amperes is used to measure a 3000-milliampere current, the reading would show 3 amperes T5B06
- A frequency display calibrated in megahertz shows a reading of 3.525 MHz, if calibrated in kilohertz it would show 3525 kHz T5B07

T 5 B

- 1,000,000 picofarads is the same as 1 microfard T5B08
- The frequency of **28,400 kHz** is equal to **28.400 MHz** T5B12
- If a frequency readout shows a reading of 2425 MHz, it can be read as 2.425 GHz T5B13

T 5 B

- Number of $DB = 10 \log \frac{Measured}{Reference}$

Power Radio

- $3 = 10 \log \frac{2}{1}$

Source Level (dB)		Power Ratio
1	=	1.3
3	=	2.0
5	=	3.2
6	=	4.0
7	=	5.0
10	=	$10 = 10_1$
20	=	$100 = 10_2$
30	=	$1000 = 10_3$
40	=	$10,000 = 10_4$
50	=	$100,000 = 10_5$
60	=	$1,000,000 = 10_6$
70	=	$10,000,000 = 10_7$
100	=	10_{10}
110	=	10_{11}
140	=	10_{14}

T 5 B

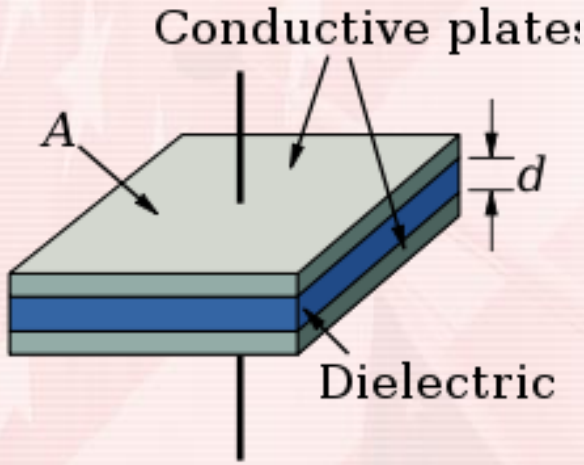
- 3 dB is the approximate amount of change, measured in decibels (dB) of a power increase from 5 watts to 10 watts. T5B09
- The approximate amount of change, measured in decibels (dB) of a power decrease from 12 watts to 3 watts is -6 dB. T5B10
- The approximate amount of change, measured in decibels (dB), of a power increase from 20 watts to 200 watts is 10 dB. T5B11

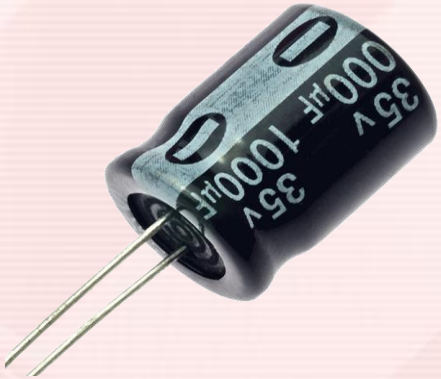
T 5 C
Topics

- Electronic principles:
  - capacitance;
  - inductance;
  - current flow in circuits;
  - alternating current;
  - definition of RF;
  - definition of polarity;
  - DC power calculations;
  - impedance

T 5 C

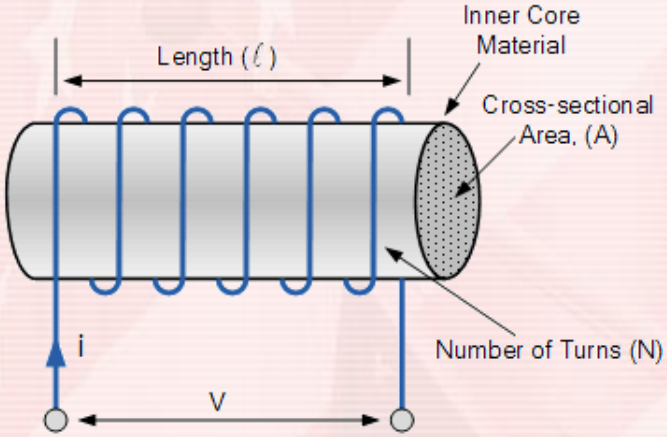
- The ability to store energy in an electric field is called capacitance. T5C01
- The basic unit of capacitance is the farad. T5C02

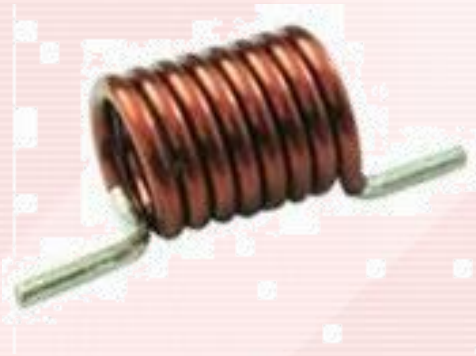




T 5 C

- The ability to store energy in a magnetic field is called Inductance. T5C03
- The basic unit of inductance is the henry. T5C04





T 5 C

- The unit of frequency is hertz. T5C05
- The abbreviation “RF” refers to radio frequency signals of all types. T5C06
- A radio wave is made up of Electromagnetic energy. T5C07

T 5 C

- The formula used to calculate electrical power in a DC circuit is

Power (P) equals voltage (E) multiplied by current (I). T5C08

$$\text{Power} = \text{voltage} \times \text{current}$$

T 5 C

- The power being used in a circuit when the applied voltage is 13.8 volts DC and the current is 10 amperes is: T5C09

  - Solving for "P" so cover up the P and plug in the other two numbers
  - **E** is given as 13.8 volts and **I** is given as 10 amperes

P = I x E

P = 10 x 13.8

P = 138 Watts

T 5 C

- The power being used in a circuit when the applied voltage is 12 volts DC and the current is 2.5 amperes is: T5C10
  - Solving for "P" so cover up the "P" and plug in the other two numbers
  - **E** is given as 12 volts and **I** is given as 2.5 amperes

P = I x E

P = 2.5 x 12

P = 30 watts

T 5 C

- The number of amperes flowing in a circuit when the applied voltage is 12 volts DC and the load is 120 watts is: T5C11
  - Solving for “I” so cover up the “I” and plug in the other two numbers
  - **P** is given as 120 watts and **E** is given as 12 volts and

I = P / E

I = 120 ÷ 12

I = 10 Amperes

T 5 C

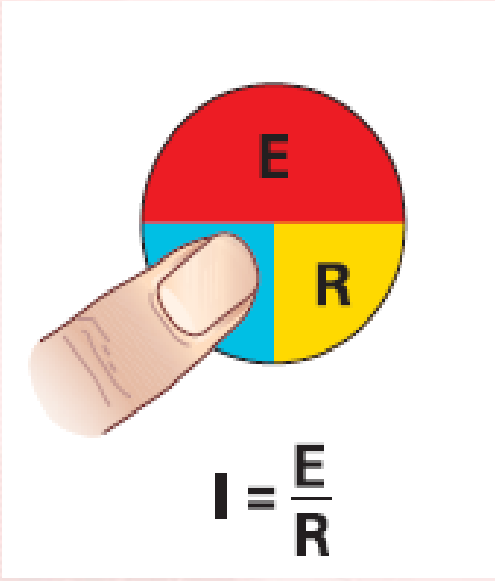
- Impedance is a measure of the opposition to AC current flow in a circuit. T5C12
- The unit of impedance is the ohm. T5C13
- The proper abbreviation for megahertz is MHz T5C14

T 5 D
Topics

- Ohm’s Law:
  - formulas and usage;
  - components in series and parallel

T 5 D

- The formula used to calculate current in a circuit is **Current** (I) equals **Voltage** (E) divided by **Resistance** (R). T5D01

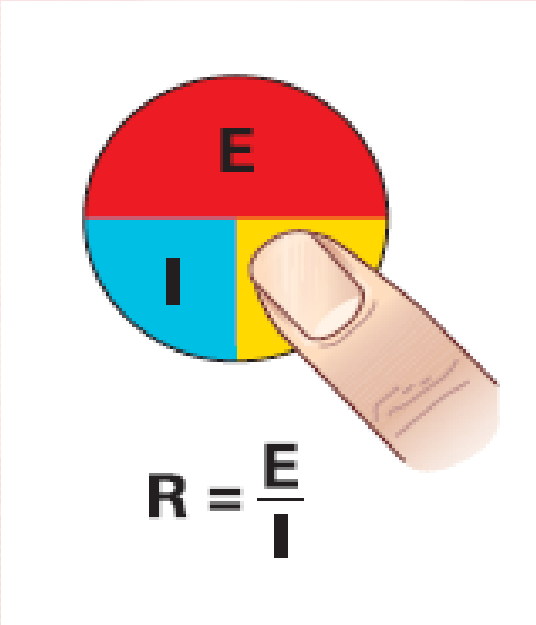


T 5 D

- This formula used to calculate voltage in a circuit is **Voltage** (E) equals **Current** (I) multiplied by **Resistance** (R). T5D02

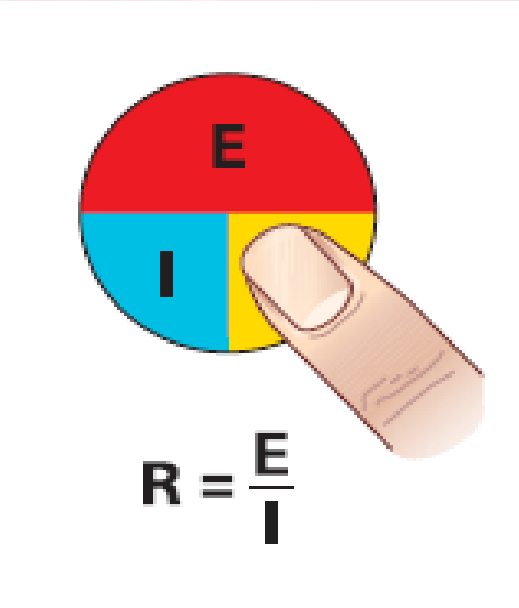
T 5 D

- This formula used to calculate resistance in a circuit is **Resistance** (R) equals **Voltage** (E) divided by **Current** (I).T5D03



T 5 D

- The resistance of a circuit in which a current of 3 amperes flows thru a resistor connected to 90 volts is: T5D04



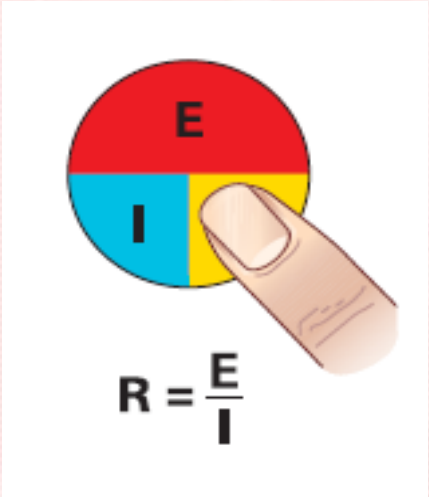
R = E / I

R = 90 ÷ 3

R = 30 Ohms

T 5 D

- The resistance in a circuit for which the applied voltage is 12 volts and the current flow is 1.5 amperes is: T5D05



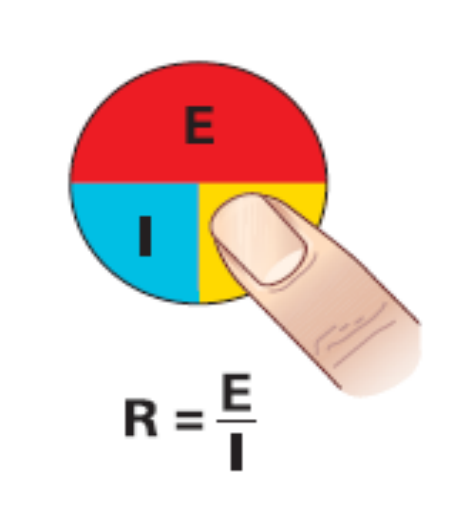
R = E / I

R = 12 ÷ 1.5

R = 8 Ohms

T 5 D

- The resistance of a circuit that draws 4 amperes from a 12-volt source is: T5D06



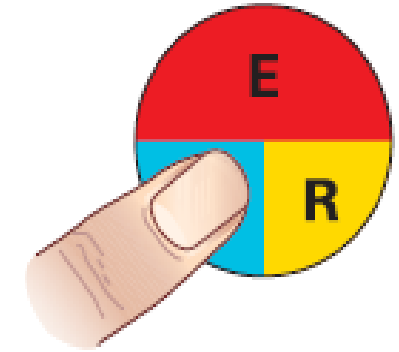
R = E / I

R = 12 ÷ 4

R = 3 Ohms

T 5 D

- The current in a circuit with an applied voltage of 120 volts and a resistance of 80-ohm is: T5D07



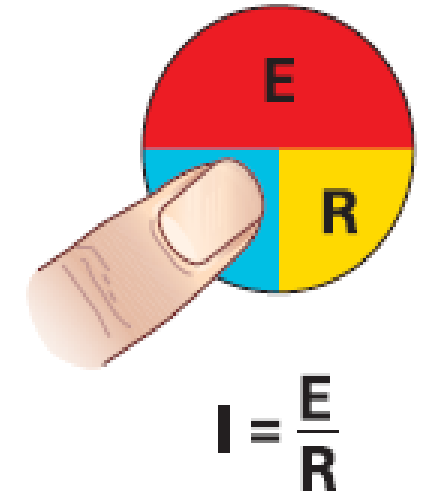
I = E / R

I = 120 ÷ 80

I = 1.5 Amperes

T 5 D

- The current through a 100-ohm resistor connected across 200 volts is: T5D08



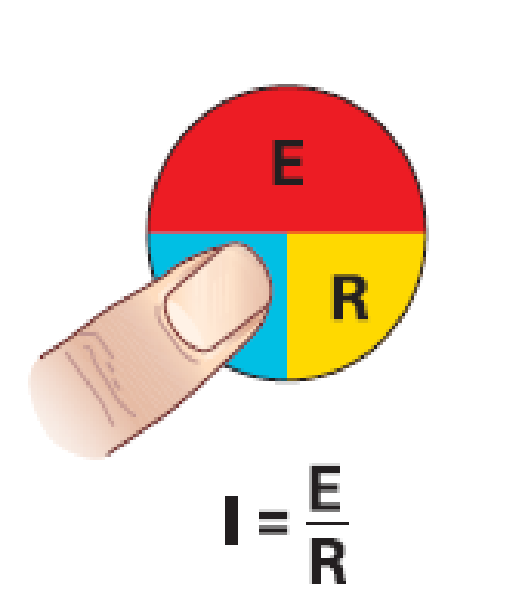
I = E / R

I = 200 ÷ 100

I = 2 Amperes

T 5 D

- The current through a 24-ohm resistor connected across 240 volts is: T5D09



I = E / R

I = 240 ÷ 24

I = 10 Amperes

T 5 D

- The voltage across a 2-ohm resistor if a current of 0.5 amperes flows thru it is:T5D10

E = I x R

E = 0.5 x 2

E = 1 Volt

T 5 D

- The voltage across a 10-ohm resistor if a current of 1 amperes flows thru it is: T5D11

E = I x R

E = 1.0 x 10

E = 10 Volts

T 5 D

- The voltage across a 10-ohm resistor if a current of 2 amperes flows thru it is: T5D12

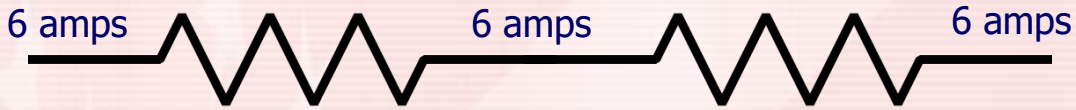
E = I x R

E = 2.0 x 10

E = 20 Volts

T5D

- The current at the junction of two components in series is unchanged. T5D13

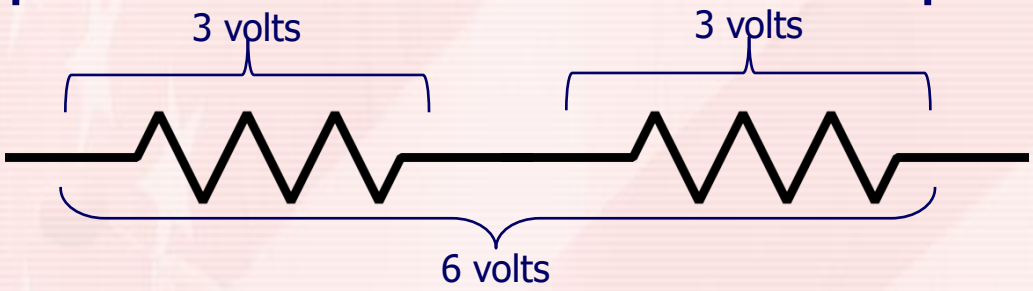


- The current at the junction of two components is parallel divides between them dependent on the value of the components. T5D14

T5D

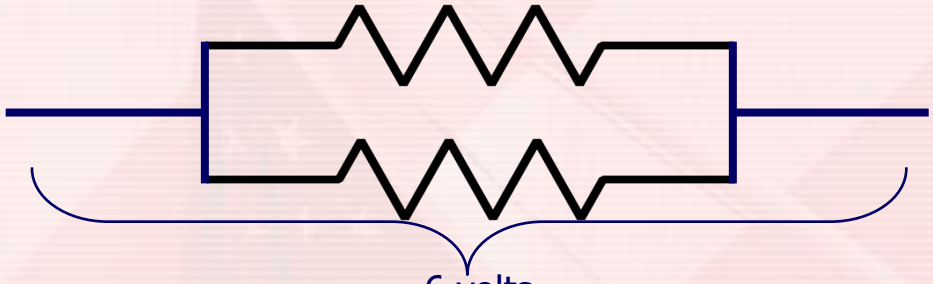
- The voltage across each of two components in series with a voltage source is determined by the type and value of the components.

T5D15



- The voltage across each of two components in parallel is the same voltage as the source.

T5D16



Element 2 Technician Class Question Pool

T 5 A – T 5 D

T5A01 Electrical current is measured in which of the following units?

A. Volts

B. Watts

C. Ohms

D. Amperes

T5A02 Electrical power is measured in which of the following units?

A. Volts

B. Watts

C. Ohms

D. Amperes

T5A03 What is the name for the flow of electrons in an electric circuit?

A. Voltage

B. Resistance

C. Capacitance

D. Current

T5A04 What is the name for a current that flows only in one direction?

A. Alternating current

B. Direct current

C. Normal current

D. Smooth current

T5A05 What is the electrical term for the electromotive force (EMF) that causes electron flow?

A. Voltage

B. Ampere-hours

C. Capacitance

D. Inductance

T5A06 How much voltage does a mobile transceiver typically require?

A. About 12 volts

B. About 30 volts

C. About 120 volts

D. About 240 volts

T5A07 Which of the following is a good electrical conductor?

A. Glass

B. Wood

C. Copper

D. Rubber

T5A08 Which of the following is a good electrical insulator?

A. Copper

B. Glass

C. Aluminum

D. Mercury

T5A09 What is the name for a current that reverses direction on a regular basis?

A. Alternating current

B. Direct current

C. Circular current

D. Vertical current

T5A10 Which term describes the rate at which electrical energy is used?

A. Resistance

B. Current

C. Power

D. Voltage

T5A11 What is the basic unit of electromotive force?

A. The volt

B. The watt

C. The ampere

D. The ohm

T5A12 What term describes the number of times per second that an alternating current makes a complete cycle?

A. Pulse rate

B. Speed

C. Wavelength

D. Frequency

T5A13 In which type of circuit is current the same through all components?

A. Series

B. Parallel

C. Resonant

D. Branch

T5A14 In which type of circuit is voltage the same across all components?

A. Series

B. Parallel

C. Resonant

D. Branch

T5B01 How many milliamperes is 1.5 amperes?

A. 15 milliamperes

B. 150 milliamperes

C. 1,500 milliamperes

D. 15,000 milliamperes

T5B02 What is another way to specify a radio signal frequency of 1,500,000 hertz?

A. 1500 kHz

B. 1500 MHz

C. 15 GHz

D. 150 kHz

T5B03 How many volts are equal to one kilovolt?

A. One one-thousandth of a volt

B. One hundred volts

C. One thousand volts

D. One million volts

T5B04 How many volts are equal to one microvolt?

A. One one-millionth of a volt

B. One million volts

C. One thousand kilovolts

D. One one-thousandth of a volt

T5B05 Which of the following is equivalent to 500 milliwatts?

A. 0.02 watts

B. 0.5 watts

C. 5 watts

D. 50 watts

T5B06 If an ammeter calibrated in amperes is used to measure a 3000-milliampere current, what reading would it show?

A. 0.003 amperes

B. 0.3 amperes

C. 3 amperes

D. 3,000,000 amperes

T5B07

If a frequency display calibrated in megahertz shows a reading of 3.525 MHz, what would it show if it were calibrated in kilohertz?

A. 0.003525 kHz

B. 35.25 kHz

C. 3525 kHz

D. 3,525,000 kHz

T5B08 How many microfarads are 1,000,000 picofarads?

A. 0.001 microfarads

B. 1 microfarad

C. 1000 microfarads

D. 1,000,000,000 microfarads

T5B09 What is the approximate amount of change, measured in decibels (dB), of a power increase from 5 watts to 10 watts?

A. 2 dB

B. 3 dB

C. 5 dB

D. 10 dB

T5B10 What is the approximate amount of change, measured in decibels (dB), of a power decrease from 12 watts to 3 watts?

A. -1 dB

B. -3 dB

C. -6 dB

D. -9 dB

T5B11 What is the approximate amount of change, measured in decibels (dB), of a power increase from 20 watts to 200 watts?

A. 10 dB

B. 12 dB

C. 18 dB

D. 28 dB

T5B12 Which of the following frequencies is equal to 28,400 kHz?

A. 28.400 MHz

B. 2.800 MHz

C. 284.00 MHz

D. 28.400 kHz

T5B13 If a frequency readout shows a reading of 2425 MHz, what frequency is that in GHz?

A. 0.002425 GHz

B. 24.25 GHz

C. 2.425 GHz

D. 2425 GHz

T5C01 What is the ability to store energy in an electric field called?

A. Inductance

B. Resistance

C. Tolerance

D. Capacitance

T5C01 What is the ability to store energy in an electric field called?

A. Inductance

B. Resistance

C. Tolerance

D. Capacitance

T5C03 What is the ability to store energy in a magnetic field called?

A. Admittance

B. Capacitance

C. Resistance

D. Inductance

T5C04 What is the basic unit of inductance?

A. The coulomb

B. The farad

C. The henry

D. The ohm

T5C05 What is the unit of frequency?

A. Hertz

B. Henry

C. Farad

D. Tesla

T5C06 What does the abbreviation “RF” refer to?

A. Radio frequency signals of all types

B. The resonant frequency of a tuned circuit

C. The real frequency transmitted as opposed to the apparent frequency

D. Reflective force in antenna transmission lines

T5C07 A radio wave is made up of what type of energy?

A. Pressure

B. Electromagnetic

C. Gravity

D. Thermal

T5C08 What is the formula used to calculate electrical power in a DC circuit?

A. Power (P) equals voltage (E) multiplied by current (I)

B. Power (P) equals voltage (E) divided by current (I)

C. Power (P) equals voltage (E) minus current (I)

D. Power (P) equals voltage (E) plus current (I)

T5C09

How much power is being used in a circuit when the applied voltage is 13.8 volts DC and the current is 10 amperes?

A. 138 watts

B. 0.7 watts

C. 23.8 watts

D. 3.8 watts

T5C10

How much power is being used in a circuit when the applied voltage is 12 volts DC and the current is 2.5 amperes?

A. 4.8 watts

B. 30 watts

C. 14.5 watts

D. 0.208 watts

T5C11

How many amperes are flowing in a circuit when the applied voltage is 12 volts DC and the load is 120 watts?

A. 0.1 amperes

B. 10 amperes

C. 12 amperes

D. 132 amperes

T5C12 What is impedance?

A. It is a measure of the opposition to AC current flow in a circuit

B. It is the inverse of resistance

C. The Q or Quality Factor of a component

D. The power handling capability of a component

T5C13 What is the unit of impedance?

A. Volts

B. Amperes

C. Coulombs

D. Ohms

T5C14 What is the proper abbreviation for megahertz?

A. mHz
B. mhZ
C. Mhz
D. MHz

T5D01 What formula is used to calculate current in a circuit?

A. Current (I) equals voltage (E) multiplied by resistance (R)

B. Current (I) equals voltage (E) divided by resistance (R)

C. Current (I) equals voltage (E) added to resistance (R)

D. Current (I) equals voltage (E) minus resistance (R)

T5D02 What formula is used to calculate voltage in a circuit?

A. Voltage (E) equals current (I) multiplied by resistance (R)

B. Voltage (E) equals current (I) divided by resistance (R)

C. Voltage (E) equals current (I) added to resistance (R)

D. Voltage (E) equals current (I) minus resistance (R)

T5D03 What formula is used to calculate resistance in a circuit?

A. Resistance (R) equals voltage (E) multiplied by current (I)

B. Resistance (R) equals voltage (E) divided by current (I)

C. Resistance (R) equals voltage (E) added to current (I)

D. Resistance (R) equals voltage (E) minus current (I)

T5D04 What is the resistance of a circuit in which a current of 3 amperes flows through a resistor connected to 90 volts?

A. 3 ohms

B. 30 ohms

C. 93 ohms

D. 270 ohms

T5D05 What is the resistance in a circuit for which the applied voltage is 12 volts and the current flow is 1.5 amperes?

A. 18 ohms

B. 0.125 ohms

C. 8 ohms

D. 13.5 ohms

T5D06 What is the resistance of a circuit that draws 4 amperes from a 12-volt source?

A. 3 ohms

B. 16 ohms

C. 48 ohms

D. 8 ohms

T5D07 What is the current in a circuit with an applied voltage of 120 volts and a resistance of 80 ohms?

A. 9600 amperes

B. 200 amperes

C. 0.667 amperes

D. 1.5 amperes

T5D08 What is the current through a 100-ohm resistor connected across 200 volts?

A. 20,000 amperes

B. 0.5 amperes

C. 2 amperes

D. 100 amperes

T5D09 What is the current flowing through a 24-ohm resistor connected across 240 volts?

A. 24,000 amperes

B. 0.1 amperes

C. 10 amperes

D. 216 amperes

T5D10 What is the voltage across a 2-ohm resistor if a current of 0.5 amperes flows through it?

A. 1 volt

B. 0.25 volts

C. 2.5 volts

D. 1.5 volts

T5D11 What is the voltage across a 10-ohm resistor if a current of 1 ampere flows through it?

A. 1 volt

B. 10 volts

C. 11 volts

D. 9 volts

T5D12 What is the voltage across a 10-ohm resistor if a current of 2 amperes flows through it?

A. 8 volts

B. 0.2 volts

C. 12 volts

D. 20 volts

T5D13 What happens to current at the junction of two components in series?

A. It divides equally between them

B. It is unchanged

C. It divides based on the on the value of the components

D. The current in the second component is zero

T5D14 What happens to current at the junction of two components in parallel?

A. It divides between them dependent on the value of the components

B. It is the same in both components

C. Its value doubles

D. Its value is halved

T5D15 What is the voltage across each of two components in series with a voltage source?

A. The same voltage as the source

B. Half the source voltage

C. It is determined by the type and value of the components

D. Twice the source voltage

T5D16 What is the voltage across each of two components in parallel with a voltage source?

A. It is determined by the type and value of the components

B. Half the source voltage

C. Twice the source voltage

D. The same voltage as the source