Amateur Radio Technician License Training

Welcome to 2023 Amateur Radio Technician Class License Training

Amateur Radio Technician License Training

These presentations are sponsored by:

Mendocino Auxiliary Communications Service (MACS)
Office of Emergency Services

Mendocino County Amateur Radio Communications Service (McARCS)

Willits Amateur Radio Society (WARS)

Adventist Health

Public Health of Mendocino County

Long Valley Health Center

Topics on Exam

Section	Contents	Questions on Exam	Questions in Pool	Covered in Session
T1	FCC Rules and Regulations	6	67	**Session 5**
T2	Operating Procedures	3	36	**Session 4**
T3	Radio Wave Propagation	3	34	**Session 3**
T4	Amateur Radio Practices	2	24	**Session 4**
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T9	Antennas and Feedlines	2	24	**Session 3**
T0	Safety	3	36	**Session 2**

Lesson 1 – electrical principles

Topics in the lesson:

- **Basic electrical principles**
  - Concepts/definitions
  - Units of measure
  - Ohm's law
  - Power calculations
  - Basic electrical components
  - Unit prefix/multipliers and conversion

Basic Electrical Theory

- **Outer electrons in atoms that make up a material**
  - Many free (loosely held) electrons = conductor (metals)
  - Tightly held = insulator (glass, rubber, plastic)
- **Voltage (EMF) is force (pressure) that make electrons move**
  - Basic unit of EMF = volt, “E” in equations
- **Flow of electrons in an electrical circuit is “current”**
  - Basic unit of current = ampere, “I” in equations

Basic Electrical Theory

Not all conductors equal

- Good conductors require less voltage to achieve same flow
- Property that resists electron flow = electrical resistance
- Basic unit of electrical resistance = ohm, R in equation

Basic Electrical Theory

DC vs AC

- **Direct current (DC) flows in one direction**
- **Alternating current (AC) alternates between positive and negative directions**
  - Frequency (Hertz) = times per second that a cycle (+/-) is completed
  - Opposition to AC flow = impedance
  - Basic unit of impedance = ohm

Basic Electrical Theory

Direct Current

Batteries supply DC

- Most mobile amateur equipment operates on DC
- AC can be converted to DC to power amateur equipment
- Mobile transceivers typically operate on 12 VDC

Basic Electrical Theory

Alternating Current

Commercial power grid supplies AC

- Radio waves are a form of AC
- Radio frequency energy (RF) is electromagnetic

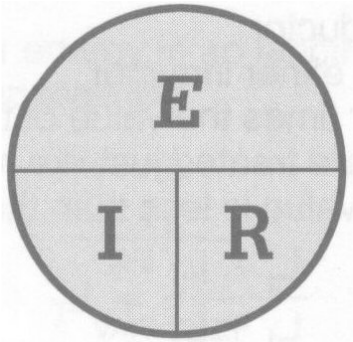
Basic Electrical Theory

Ohm's Law

- **Defines relationship between current, voltage, resistance**
  - With fixed resistance, current increases as voltage increases
  - With fixed voltage, current decreases as resistance increases
  - *Voltage "E" equals current "I" multiplied by resistance "R" (**E = I X R**)*
  - *Current "I" equals voltage "E" divided by resistance "R" (**I = E/R**)*
  - *Resistance "R" equals voltage "E" divided by current "I" (**R = E /I**)*

Basic Electrical Theory

Ohm's Law



Cover unknown value, apply resulting formula:

R = 2 ohms and I = 0.5 amps, E = ? volts Cover E, then I x R = 1 volts
E = 120 volts and R = 80 ohms, I = ? amps Cover I, then E / R = 1.5 amps
E = 90 volts and I = 3 amps, R = ? ohms Cover R, then E / I = 30 ohms

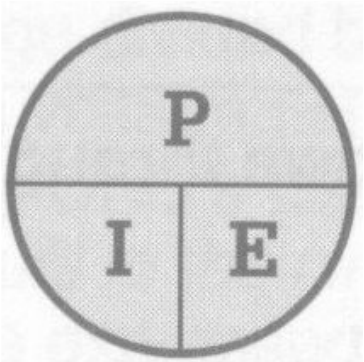
Basic Electrical Theory

Power

- **Rate at which electrical energy is used**
  - Basic unit of electrical power = Watt (P)
  - Power “P” equals voltage “E” multiplied by current “I” (**P = E X I**)
  - **E = P / I**
  - **I = P / E**

Basic Electrical Theory

Power calculation



Cover unknown value, apply resulting formula:

E = 13.8 volts and I =10 amps, P = ? watts Cover P, then I x E = 138 watts

E = 12 volts and I =2.5 amps, P = ? watts Cover P, then I x E = 30 watts

E = 12 volts and P = 120 watts, I = ? amps Cover I, then P / E = 10 amps

Basic Electrical Theory

Power

Changes in power levels expressed in decibels (dB)

- Doubling power = +3 dB change *(from 5W to 10W = +3 dB)*
- Halving power = -3 dB change
- Quartering power = -6 dB change *(from 12W to 3W = -6 dB)*
- 10 X increase in power = +10 dB change *(from 20W to 200W = +10 dB)*

Section questions:

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

A. Voltage
B. Resistance
C. Capacitance
D. Current

Section questions:

Why are metals generally good conductors of electricity?

A. They have relatively high density
B. They have many free protons
C. They have many free electrons
D. All these choices are correct

Section questions:

Which of the following describes alternating current?

A. Current that alternates between positive and negative directions
B. Current that alternates between a positive direction and zero
C. Current that alternates between a negative direction and zero
D. All these answers are correct

Section questions:

Electrical power is measured in which of the following units?

A. Volts
B. Ohms
C. Watts
D. Amperes

Section questions:

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

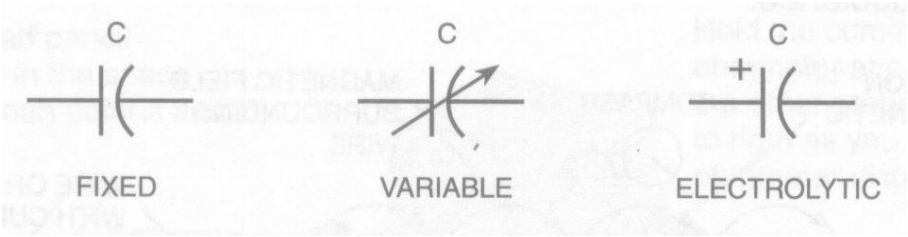
A. 3 ohms
B. 270 ohms
C. 30 ohms
D. 93 ohms

Basic Electrical Theory

Basic components

- **Resistor is used to add resistance to an electrical circuit**

- **Capacitors store energy in electric field**
  - metal plates separated by a thin layer of insulating material
  - Basic unit = farad



Basic Electrical Theory

Basic components

- **Resistors:**

Basic Electrical Theory

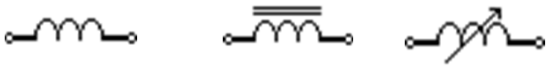
Basic components

- **Capacitors:**

Basic Electrical Theory

Basic components

- **Inductors store energy in magnetic field**
  - coiled wire, air or ferrous core
  - Basic unit = henry



Basic Electrical Theory

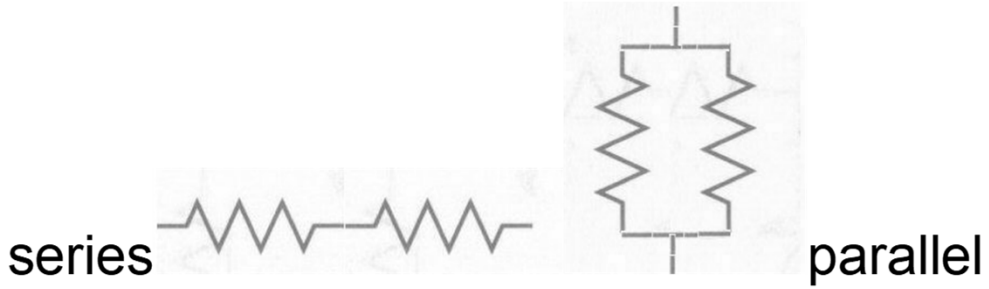
Basic components

- **Inductors**

Basic Electrical Theory

Basic components

- **Components may be connected in series (end to end)**
- **or parallel (side by side)**



Basic Electrical Theory

Series circuits

- Components connected end to end
- Same DC current flows through all components

Parallel circuits

- Components connected side by side
- Same voltage appears across all components

Section questions:

What describes the ability to store energy in a magnetic field?

A. Admittance
B. Capacitance
C. Resistance
D. Inductance

Section questions:

What is the unit of frequency?

A. Hertz
B. Henry
C. Farad
D. Tesla

Section questions:

What is the unit of capacitance?

A. The farad
B. The ohm
C. The volt
D. The henry

Section questions:

How much power is delivered by a voltage of 13.8 volts DC and a current of 10 amperes?

A. 138 watts
B. 0.7 watts
C. 23.8 watts
D. 3.8 watts

Section questions:

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

A. Parallel

B. Series

C. Resonant

D. Branch

Section questions:

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

A. Parallel
B. Resonant
C. Branch
D. Series

Basic Electrical Theory

Unit multipliers and conversion

- The actual value of a component or unit of measure may be several times greater, or only a small fraction of the base unit
- Frequencies may be in the millions of Hertz
- Capacitance may be in millionths of a Farad
- Unit multipliers used to simplify measurement

pico =	*1 trillionth*	*multiplier 10^{-12}*
micro =	*1 millionth*	*multiplier 10^{-6}*
milli =	*1 thousandth*	*multiplier 10^{-3}*
kilo =	*thousand*	*multiplier 10^{3}*
mega =	*million*	*multiplier 10^{6}*
giga =	*billion*	*multiplier 10^{9}*

Basic Electrical Theory

Unit multipliers and conversion

- 1000 Hertz = 1.0 kilo Hertz (**k**Hz)
- 1,000,000 Hz = 1000 kHz = 1.0 mega Hertz (**M**Hz)
- 1 V = 1000 millivolts = 1,000,000 microvolts
- 1 microfarad = 1,000,000 picofarads

- The difference between the exponents of unit multipliers may be used to determine decimal placement. (+ move decimal right, - move decimal left)

To convert 3.525 MHz (10^6) to kHz (10^3) 6-3 = 3 move decimal <u>right</u> 3 places (3525 kHz)

To convert 500 milliwatts (10^{-3}) to watts (10^0) -3-0 = -3 move decimal <u>left</u> 3 places (0.5 watts)

Basic Electrical Theory

Unit multipliers and conversion

- 1.5 amps = 1500 milliamps
- 1,500,000 Hz = 1500 kHz
- 1 kilovolt = 1000 volts
- 1 microvolt = one-millionth of a volt
- 500 milliwatts = 0.5 watts
- 3000 milliamps = 3 amps
- 3.525 MHz = 3525 kHz
- 1,000,000 picofarads = 1 microfarad
- 28,400 kHz = 28.400 MHz
- 2425 MHz = 2.425 GHz

Section questions:

Which is equal to one microvolt?

A. One million volts

B. One one-thousandth of a volt

C. One thousand kilovolts

D. One one-millionth of a volt

Section questions:

Which is equal to 3000 milliamperes?

A. 3,000,000 amperes

B. 0.003 amperes

C. 0.3 amperes

D. 3 amperes

Section questions:

Which is equal to 3.525 MHz?

A. 0.003525 kHz

B. 35.25 kHz

C. 3,525,000 kHz

D. 3525 kHz

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