Amateur Radio License Class

Radio and Electronics Fundamentals

Presented by Steve Gallafent

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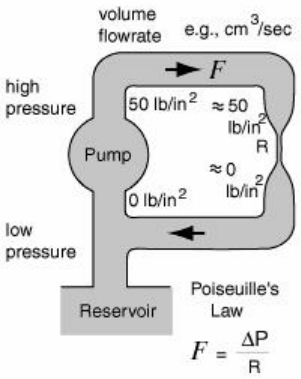
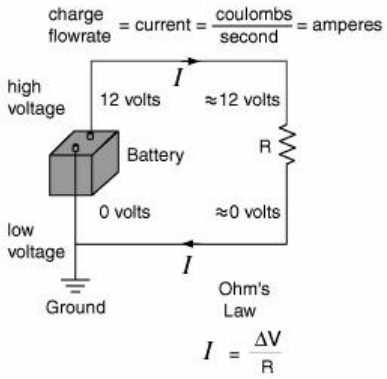
Radio and Electronics Fundamentals

Voltage, Current, and Resistance

- Electric current is the flow of electrons similar to the flow of water in pipes

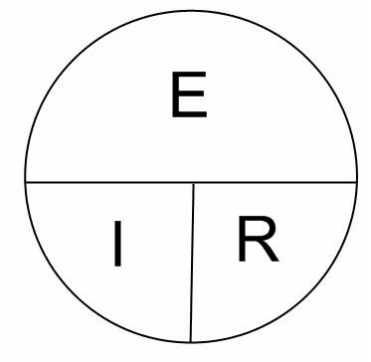




Radio and Electronics Fundamentals

Voltage, Current, and Resistance

- Voltage (E) is electromotive force
- Current (I) is the flow of electrons in a circuit
- Resistance (R) opposes the flow of electrons
- Power (P) is a measure of the amount of energy used



Radio and Electronics Fundamentals

Voltage, Current, and Resistance

- Voltage is measured with a voltmeter
- Current is measured with an ammeter
- Resistance is measured with an ohmmeter
- Power is measured with a wattmeter

- Metals are good electrical conductors
- Some common insulators: rubber, glass, wood

Radio and Electronics Fundamentals

Voltage, Current, and Resistance

- There are two types of electrical current
  - Direct current (DC) – Stays constants
    - Automobile battery – 12 Volts DC
    - Alkaline battery – 1.5 Volts DC
    - Nickel-cadmium battery – 1.2 Volts DC
    - Lithium-ion battery – 3.7 Volts DC
  - Alternating current (AC) – Changes direction on a regular basis (defined by the frequency)
    - Wall outlet – 120 Volts AC 60 Hertz

Radio and Electronics Fundamentals

Voltage, Current, and Resistance

- Voltage is measured in Volts
- Current is measured in Amperes
- Resistance is measured in Ohms
- Power is measured in Watts
- Prefixes you want to know
  - Mega = 1,000,000
  - Kilo = 1,000
  - Milli = 1/1,000
  - Micro = 1/1,000,000

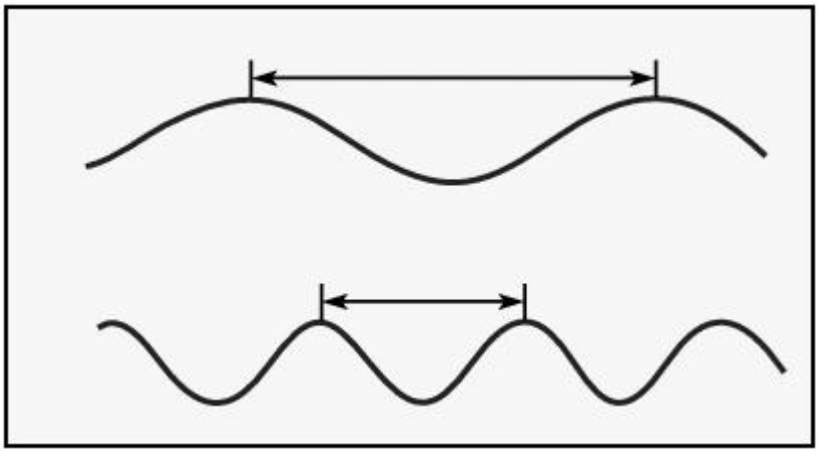
Radio and Electronics Fundamentals

Signals and Waves

- Radio waves are defined by several measures
  - Frequency – How many times the wave cycles or alternates per second (Hertz)
  - Wavelength – The distance the wave travels in one cycle
  - Frequency and wavelength are inversely proportionate – As frequency goes up, wavelength goes down
  - Frequencies over 20,000 cycles per second (20 kHz) are considered radio waves

Radio and Electronics Fundamentals

Signals and Waves



Radio and Electronics Fundamentals

Signals and Waves

- Wavelength can be calculated by dividing 300 by the frequency
  - This is related to the speed of light
- Amateur bands are often identified by wavelength
  - 6m = 50 to 54 MHz
  - 2m = 144 to 148 MHz
  - 1.25m = 222 to 225 MHz
  - 70cm = 420 to 450 MHz
- Voice frequencies are 300 to 3000 Hertz

Radio and Electronics Fundamentals

Radio Components

- Most modern radios consist of two combined components
  - Receiver – Converts radio signals to electrical signals that are converted to sound in a speaker
  - Transmitter – Sound is converted to electrical signals by a microphone and then the electrical signals are converted to radio waves
  - A transceiver is a transmitter and receiver

Radio and Electronics Fundamentals

Radio Components

- An amplifier increases the power of a radio signal
- A power supply converts AC voltage (typically from the wall) to DC voltage

Radio and Electronics Fundamentals

Power from Batteries

- Common battery types
  - Nickel-cadmium
  - Nickel-metal hydride
  - Lithium-ion
  - Lead-acid
  - Alkaline
  - Carbon-zinc
- Batteries have internal resistance
  - Batteries gradually lose charge over time
  - High current consumes batteries faster

Amateur Radio License Class

Radio and Electronics Fundamentals

Exam Questions

Electrical current is measured in which of the following units?

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

T4A01

Electrical power is measured in which of the following units?

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

T4A02

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

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

T4A03

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

A. An alternating current
B. A direct current
C. A normal current
D. A smooth current

T4A04

What is the standard unit of frequency?

A. The megacycle
B. The Hertz
C. One thousand cycles per second
D. The electromagnetic force

T4A05

How much voltage does an automobile battery usually supply?

A. About 12 volts
B. About 30 volts
C. About 120 volts
D. About 240 volts

T4A06

What is the basic unit of resistance?

A. The volt
B. The watt
C. The ampere
D. The ohm

T4A07

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

A. An alternating current
B. A direct current
C. A circular current
D. A vertical current

T4A08

Which of the following is a good electrical conductor?

A. Glass
B. Wood
C. Copper
D. Rubber

T4A09

Which of the following is a good electrical insulator?

A. Copper
B. Glass
C. Aluminum
D. Mercury

T4A10

What is the term used to describe opposition to current flow in ordinary conductors such as wires?

A. Inductance
B. Resistance
C. Counter EMF
D. Magnetism

T4A11

What instrument is used to measure the flow of current in an electrical circuit?

A. Frequency meter
B. SWR meter
C. Ammeter
D. Voltmeter

T4A12

What instrument is used to measure Electromotive Force (EMF) between two points such as the poles of a battery?

A. Magnetometer
B. Voltmeter
C. Ammeter
D. Ohmmeter

T4A13

What is the name for the distance a radio wave travels during one complete cycle?

A. Wave speed
B. Waveform
C. Wavelength
D. Wave spread

T4B01

What term describes the number of times that an alternating current flows back and forth per second?

A. Pulse rate
B. Speed
C. Wavelength
D. Frequency

T4B02

What does 60 hertz (Hz) mean?

A. 6000 cycles per second
B. 60 cycles per second
C. 6000 meters per second
D. 60 meters per second

T4B03

Electromagnetic waves that oscillate more than 20,000 times per second as they travel through space are generally referred to as what?

A. Gravity waves
B. Sound waves
C. Radio waves
D. Gamma radiation

T4B04

How fast does a radio wave travel through space?

A. At the speed of light

B. At the speed of sound

C. Its speed is inversely proportional to its wavelength

D. Its speed increases as the frequency increases

T4B05

How does the wavelength of a radio wave relate to its frequency?

A. The wavelength gets longer as the frequency increases

B. The wavelength gets shorter as the frequency increases

C. There is no relationship between wavelength and frequency

D. The wavelength depends on the bandwidth of the signal

T4B06

What is the formula for converting frequency to wavelength in meters?

A. Wavelength in meters equals frequency in Hertz multiplied by 300
B. Wavelength in meters equals frequency in Hertz divided by 300
C. Wavelength in meters equals frequency in megahertz divided by 300
D. Wavelength in meters equals 300 divided by frequency in megahertz

T4B07

What are sound waves in the range between 300 and 3000 Hertz called?

A. Test signals
B. Ultrasonic waves
C. Voice frequencies
D. Radio frequencies

T4B08

What property of a radio wave is often used to identify the different bands amateur radio operators use?

A. The physical length of the wave

B. The magnetic intensity of the wave

C. The time it takes for the wave to travel one mile

D. The voltage standing wave ratio of the wave

T4B09

What is the frequency range of the 2 meter band in the United States?

A. 144 to 148 MHz

B. 222 to 225 MHz

C. 420 to 450 MHz

D. 50 to 54 MHz

T4B10

What is the frequency range of the 6 meter band in the United States?

A. 144 to 148 MHz
B. 222 to 225 MHz
C. 420 to 450 MHz
D. 50 to 54 MHz

T4B11

What is the frequency range of the 70 centimeter band in the United States?

A. 144 to 148 MHz
B. 222 to 225 MHz
C. 420 to 450 MHz
D. 50 to 54 MHz

T2C02

What is used to convert radio signals into sounds we can hear?

A. Transmitter
B. Receiver
C. Microphone
D. Antenna

T4C01

What is used to convert sounds from our voice into radio signals?

A. Transmitter
B. Receiver
C. Speaker
D. Antenna

T4C02

What two devices are combined into one unit in a transceiver?

A. Receiver, transmitter
B. Receiver, transformer
C. Receiver, transistor
D. Transmitter, deceiver

T4C03

What device is used to convert the alternating current from a wall outlet into low-voltage direct current?

A. Inverter
B. Compressor
C. Power supply
D. Demodulator

T4C04

What device is used to increase the output of a 10 watt radio to 100 watts?

A. Amplifier
B. Power supply
C. Antenna
D. Attenuator

T4C05

Which of the battery types listed below offers the longest life when used with a hand-held radio, assuming each battery is the same physical size?

A. Lead-acid
B. Alkaline
C. Nickel-cadmium
D. Lithium-ion

T4C06

What is the nominal voltage per cell of a fully charged nickel-cadmium battery?

A. 1.0 volts
B. 1.2 volts
C. 1.5 volts
D. 2.2 volts

T4C07

What battery type on this list is not designed to be re-charged?

A. Nickel-cadmium
B. Carbon-zinc
C. Lead-acid
D. Lithium-ion

T4C08

What is required to keep rechargeable batteries in good condition and ready for emergencies?

A. They must be inspected for physical damage and replaced if necessary
B. They should be stored in a cool and dry location
C. They must be given a maintenance recharge at least every 6 months
D. All of these answers are correct

T4C09

What is the best way to get the most amount of energy from a battery?

A. Draw current from the battery as rapidly as possible
B. Draw current from the battery at the slowest rate needed
C. Reverse the leads when the battery reaches the ½ charge level
D. Charge the battery as frequently as possible

T4C10

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)

T4D01

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)

T4D02

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)

T4D03

What is the resistance of a circuit when 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

T4D04

What is the resistance in a circuit where 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

T4D05

What is the current flow 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

T4D06

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

A. 1 volt

B. 0.25 volts

C. 2.5 volts

D. 1.5 volts

T4D07

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

A. 10 volts

B. 1 volt

C. 11 volts

D. 9 volts

T4D08

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

A. 20 volts

B. 0.2 volts

C. 12 volts

D. 8 volts

T4D09

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

A. 20,000 amperes

B. 0.5 amperes

C. 2 amperes

D. 100 amperes

T4D10

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

T4D11

What unit is used to describe electrical power?

A. Ohm
B. Farad
C. Volt
D. Watt

T4E01

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)

T4E02

How much power is represented 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

T4E03

How much power is being used in a circuit when the voltage is 120 volts DC and the current is 2.5 amperes?

A. 1440 watts
B. 300 watts
C. 48 watts
D. 30 watts

T4E04

How can you determine how many watts are being drawn by your transceiver when you are transmitting?

A. Measure the DC voltage and divide it by 60 Hz
B. Check the fuse in the power leads to see what size it is
C. Look in the Radio Amateur's Handbook
D. Measure the DC voltage at the transceiver and multiply by the current drawn when you transmit

T4E05

How many amperes are flowing in a circuit when the applied voltage is 120 volts DC and the load is 1200 watts?

A. 20 amperes
B. 10 amperes
C. 120 amperes
D. 5 amperes

T4E06

How many milliamperes is the same as 1.5 amperes?

A. 15 milliamperes
B. 150 milliamperes
C. 1500 milliamperes
D. 15000 milliamperes

T4E07

What is another way to specify the frequency of a radio signal that is oscillating at 1,500,000 Hertz?

A. 1500 kHz

B. 1500 MHz

C. 15 GHz

D. 150 kHz

T4E08

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

T4E09

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

T4E10

How many watts does a hand-held transceiver put out if the power is 500 milliwatts?

A. 0.02 watts
B. 0.5 watts
C. 5 watts
D. 50 watts

T4E11