Amateur Radio Technician License Training

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Topics on Exam

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SUB-ELEMENT T6

Electrical Components

Circuit Diagrams

Component Functions

Presented by

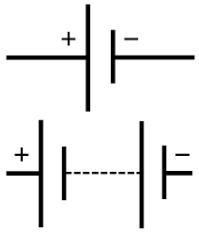
Michael Carroll KM6OTE

Electronics – Controlling the Flow of Current

- electronic components are used to create circuits in electronic devices
- *Schematic diagrams are electrical wiring diagrams that use standard component symbols*
- Component functions

Electronic Components and Schematic Symbols

Batteries



Rechargeable

Lead Acid
NiCad
Nickle Metal Hydride
Lithium Ion

Not Rechargeable

Carbon Zinc

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T6A10
Which of the following battery chemistries is rechargeable?
A. Nickel-metal hydride
B. Lithium-ion
C. Lead-acid
D. All these choices are correct

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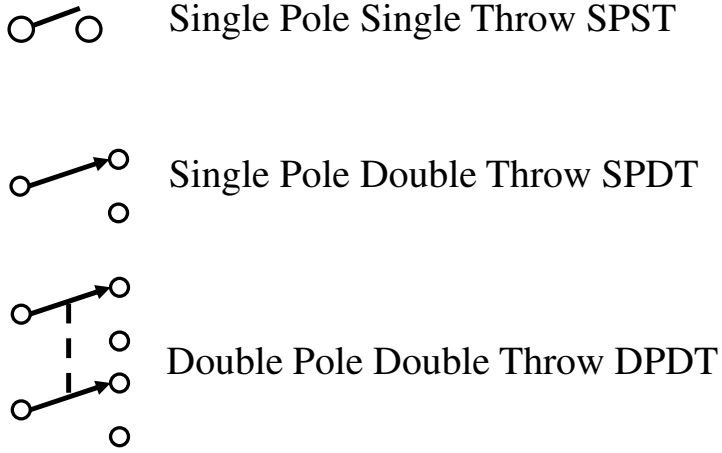
T6A11
Which of the following battery chemistries is not rechargeable?
A. Nickel-cadmium
B. Carbon-zinc
C. Lead-acid
D. Lithium-ion

Electronic Components and Schematic Symbols

Switches

- Switches are used to connect or disconnect electrical circuits
  - Each circuit controlled by the switch is a *pole*
  - Each position is called a *throw*

- Schematic symbol
- Designator (S or SW)



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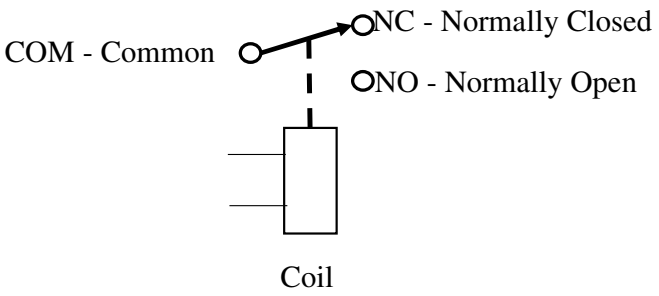
T6A08
What is the function of an SPDT switch?
A. A single circuit is opened or closed
B. Two circuits are opened or closed
C. A single circuit is switched between one of two other circuits
D. Two circuits are each switched between one of two other circuits

Electronic Components and Schematic Symbols

Relays

- **Relays are electrically-controlled switches activated by current in a coil (electromagnet)**
- Relays use the same pole/throw names as switches
- *Contacts* are named by when they are connected

- Schematic symbol
- Designator (K or RLY)



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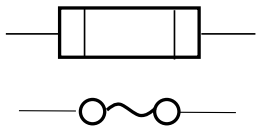
T6D02
What is a relay?
A. An electrically-controlled switch
B. A current controlled amplifier
C. An inverting amplifier
D. A pass transistor

Protective Components

- Fuses and circuit breakers are used to protect other circuit components from circuit overload.
  - Fuses blow – one time protection
  - Circuit breakers trip – can be reset and reused
  - Always use proper rating

- Schematic symbol
- Designator (F or CB)



Fuses

Circuit Breaker

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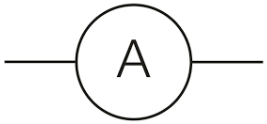
T6A09
What electrical component is used to protect other circuit components from current overloads?
A. Fuse
B. Thyratron
C. Varactor
D. All these choices are correct

Electronic Components and Schematic Symbols

Indicators and Displays

- Indicators communicate status
  - ON/OFF, ready/stand-by, left/right
  - **LEDs,** light bulbs, symbols, audio tones
- A meter displays an electrical quantity as numeric value

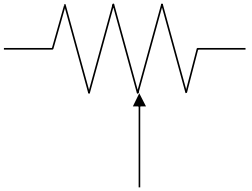
Symbol 

Electronic Components and Schematic Symbols

The Resistor

- **The function of a resistor is to oppose the flow of current in a Direct Current (DC).**
- **A potentiometer controls resistance**

- Schematic symbol



Potentiometer or "Pot" is a **Variable resistor**

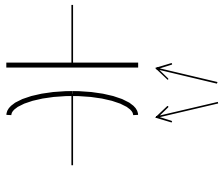
Arrow indicates adjustable resistance, such as for a *volume control*.

Electronic Components and Schematic Symbols

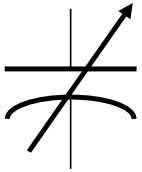
The Capacitor

- The function of a capacitor is to **store energy in an electrical field**– called *capacitance.*
- **A capacitor consists of two or more conductive surfaces separated by an insulator**

- Schematic symbol



Electrodes



Variable Capacitor

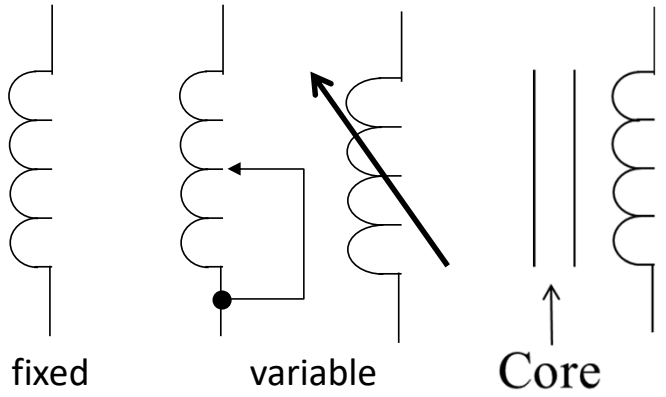
capacitance is measured in farads (F)

Electronic Components and Schematic Symbols

The Inductor

- The function of an inductor is to store energy is a magnetic field – called *inductance.*
- **An inductor is usually a coil of wire** around a *core* of air or magnetic material like iron or ferrite
- **Stores energy in a magnetic field** created by current in the wire

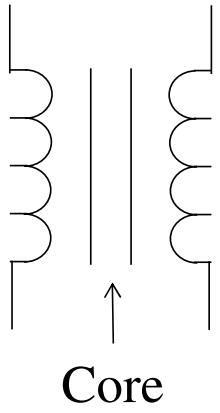
- Schematic symbol



Inductance = henrys (H)

The Transformer

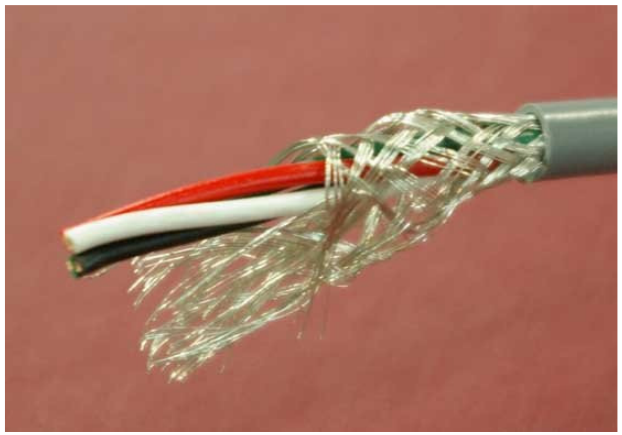
- A pair of inductors sharing a common core
  - Also share their magnetic field
  - Used to transfer energy from one circuit to another without a direct connection
  - Changes the ratio of voltage and current
- Schematic symbol



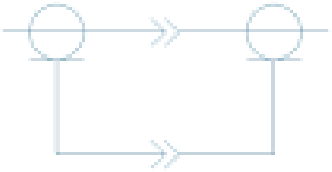
Electronic Components and Schematic Symbols

Shielded Wire

Shielded wire is used to prevent coupling of unwanted signals to or from the wire



Schematic symbol

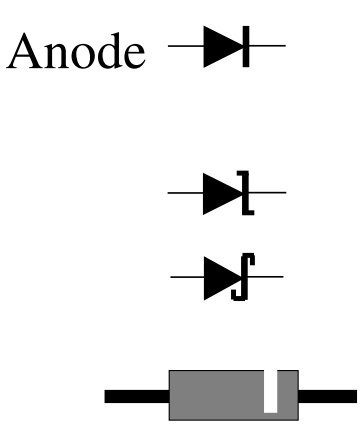


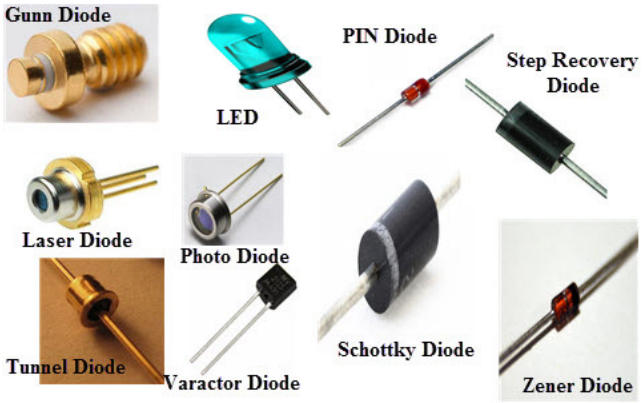
Semiconductors and Schematic Symbols

The Diode

- A diode allows current to flow in only one direction.
- **Two electrodes: *anode* and *cathode***
- **Cathode is often marked with a stripe**

- Schematic symbol
- Designator (D or CR)



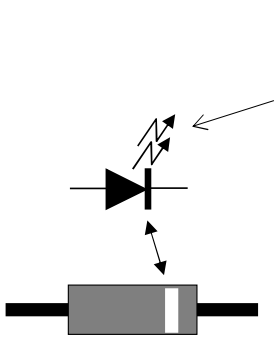


Cathode is often marked with a stripe

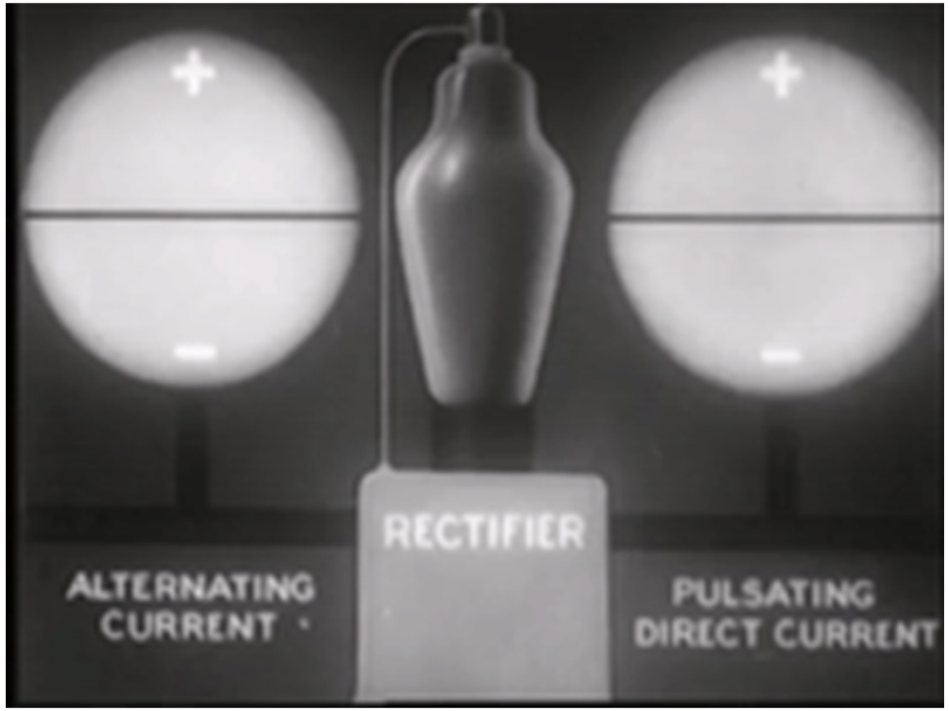
Semiconductors and Schematic Symbols

The Diode

- Diodes used to change alternating current AC power to varying direct current DC are called *rectifiers*



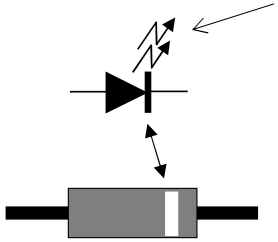
Arrows indicate Light Emitting Diode(LED)



Semiconductors and Schematic Symbols

The Diode

- Light Emitting Diodes are commonly used as a visual indicator

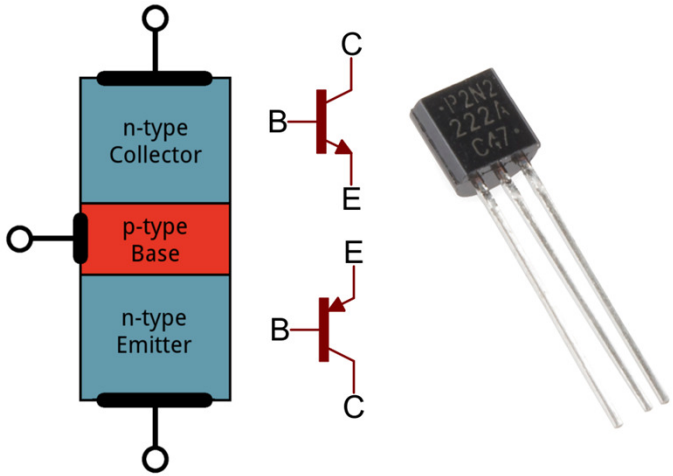


Arrows indicate Light Emitting Diode(LED)

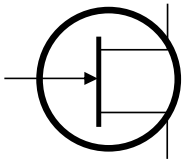
Semiconductors and Schematic Symbols

The Transistor

- **A transistor consists of three layers of semiconductor material.**



- Schematic symbol
- Designator (Q)



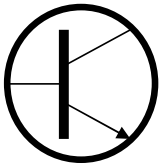
Field-Effect Transistor (FET)

Semiconductors and Schematic Symbols

The Transistor

- **The function of a transistor is to use a small voltage or current signal to control a larger current flow.**
- **Can be an amplifier or a switch**
- **A Transistor can amplify signals**

- Schematic symbol
- Designator (Q)



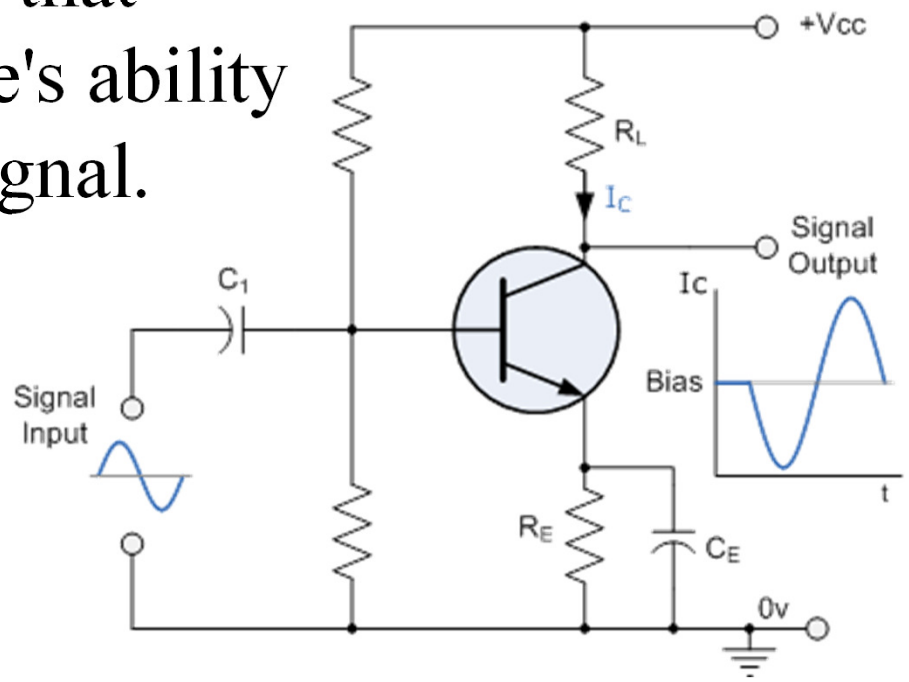
Bipolar Junction Transistor (BJT)

Semiconductors and Schematic Symbols

What is GAIN

GAIN is the term that describes a device's ability to AMPLIFY a signal.

Low level signal



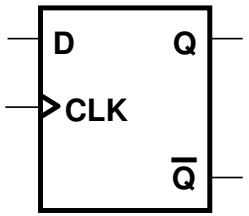
High level signal

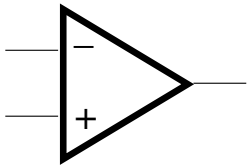
Semiconductors and Schematic Symbols

The Integrated Circuit

- The **integrated circuit combines several semi-conductors and other components into one device** that accomplishes a specific task.

- Schematic symbol
- Designator (IC or U)





Circuit Diagram and Schematic Symbols

The symbols on the schematic diagram represent electrical components

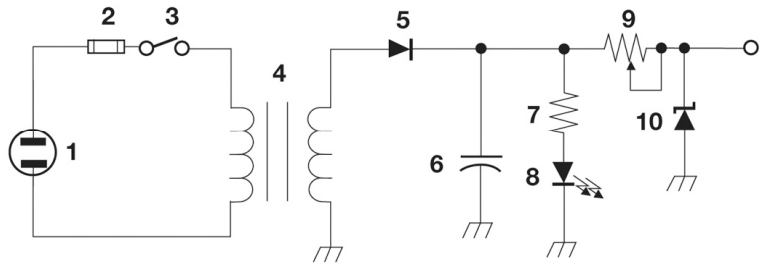


Figure T-2

Electrical schematics accurately represent the way components are interconnected

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T6A12
What type of switch is represented by component 3 in figure T-2?
A. Single-pole single-throw
B. Single-pole double-throw
C. Double-pole single-throw
D. Double-pole double-throw

Circuit Diagram and Schematic Symbols

Identify the components in this circuit

What is component 1

What is component 2,
what is it's function?

What is component 3

What is component 4

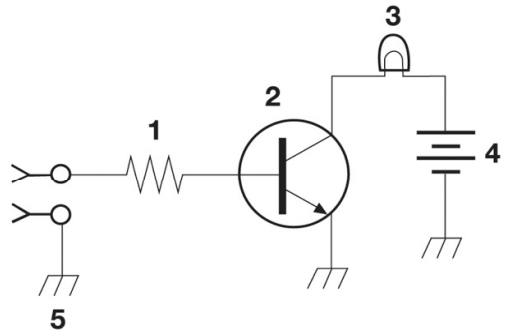


Figure T-1

Circuit Diagram and Schematic Symbols

Identify the components in this circuit

What is component 6

What is component 8

What is component 9

What is component 4

What type of switch is 3

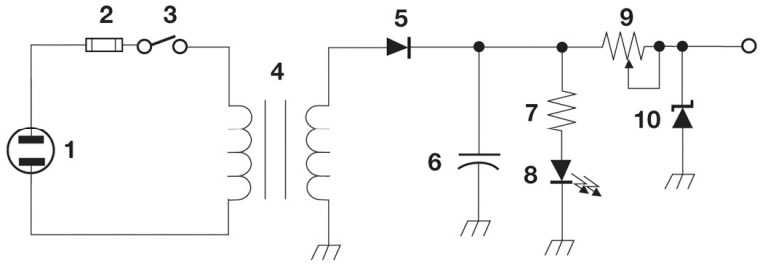
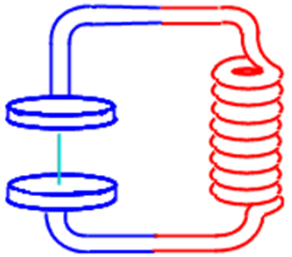


Figure T-2

Reactance

- Capacitors and inductors store energy, rather than dissipating it like resistors.
- Energy storage creates an effect called *reactance* (symbol *X*) that acts like a resistance in opposing the flow of ac current.
  - Capacitors create *capacitive reactance* (X_C)
  - Inductors create *inductive reactance* (X_L)
  - The effects of each are complementary

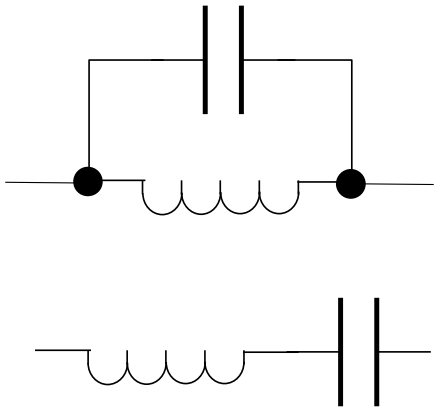


Impedance

- The combination of resistance (R) and reactance (X) is called *impedance*, represented by the symbol Z.
- Impedance represents a circuit's opposition to both ac and dc currents.

Resonant or Tuned Circuit

- Capacitors and inductors connected together create a *tuned circuit*.
  - When X_L and X_C are equal, the circuit is *resonant*.
  - If C or L are adjustable the resonant frequency can be varied or tuned.



Electronic Components and Schematic Symbols

Antenna and Ground

Circuit Diagram and Schematic Symbols

Identify the components in this circuit

What is component 3

What is component 4

What is component

What is component

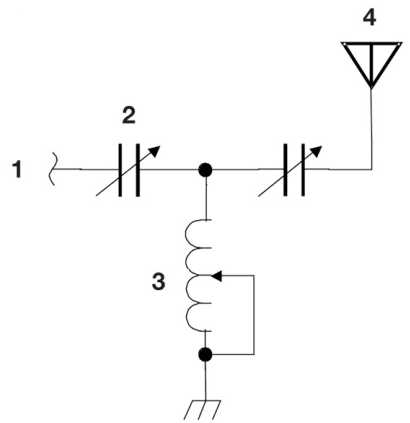


Figure T-3

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T6A01
What electrical component opposes the flow of current in a DC circuit?
A. Inductor
B. Resistor
C. Inverter
D. Transformer

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T6A02
What type of component is often used as an adjustable volume control?
A. Fixed resistor
B. Power resistor
C. Potentiometer
D. Transformer

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T6A03
What electrical parameter is controlled by a potentiometer?
A. Inductance
B. Resistance
C. Capacitance
D. Field strength

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T6A04
What electrical component stores energy in an electric field?
A. Varistor
B. Capacitor
C. Inductor
D. Diode

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T6A05
What type of electrical component consists of conductive surfaces separated by an insulator?
A. Resistor
B. Potentiometer
C. Oscillator
D. Capacitor

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T6A06
What type of electrical component stores energy in a magnetic field?
A. Varistor
B. Capacitor
C. Inductor
D. Diode

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T6A07
What electrical component is typically constructed as a coil of wire?
A. Switch
B. Capacitor
C. Diode
D. Inductor

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T6B01
Which is true about forward voltage drop in a diode?
A. It is lower in some diode types than in others
B. It is proportional to peak inverse voltage
C. It indicates that the diode is defective
D. It has no impact on the voltage delivered to the load

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T6B02
What electronic component allows current to flow in only one direction?
A. Resistor
B. Fuse
C. Diode
D. Driven element

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T6B03
Which of these components can be used as an electronic switch?
A. Varistor
B. Potentiometer
C. Transistor
D. Thermistor

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T6B04
Which of the following components can consist of three regions of semiconductor material?
A. Alternator
B. Transistor
C. Triode
D. Pentagrid converter

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T6B05
What type of transistor has a gate, drain, and source?
A. Varistor
B. Field-effect
C. Tesla-effect
D. Bipolar junction

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T6B06
How is the cathode lead of a semiconductor diode often marked on the package?
A. With the word "cathode"
B. With a stripe
C. With the letter C
D. With the letter K

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T6B07
What causes a light-emitting diode (LED) to emit light?
A. Forward current
B. Reverse current
C. Capacitively-coupled RF signal
D. Inductively-coupled RF signal

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T6B08

What does the abbreviation FET stand for?

A. Frequency Emission Transmitter

B. Fast Electron Transistor

C. Free Electron Transmitter

D. Field Effect Transistor

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T6B09
What are the names for the electrodes of a diode?
A. Plus and minus
B. Source and drain
C. Anode and cathode
D. Gate and base

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T6B10
Which of the following can provide power gain?
A. Transformer
B. Transistor
C. Reactor
D. Resistor

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T6B11
What is the term that describes a device's ability to amplify a signal?
A. Gain
B. Forward resistance
C. Forward voltage drop
D. On resistance

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T6B12
What are the names of the electrodes of a bipolar junction transistor?
A. Signal, bias, power
B. Emitter, base, collector
C. Input, output, supply
D. Pole one, pole two, output

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T6C01
What is the name of an electrical wiring diagram that uses standard component symbols?
A. Bill of materials
B. Connector pinout
C. Schematic
D. Flow chart

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T6C12
Which of the following is accurately represented in electrical schematics?
A. Wire lengths
B. Physical appearance of components
C. Component connections
D. All these choices are correct

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T6D01
Which of the following devices or circuits changes an alternating current into a varying direct current signal?
A. Transformer
B. Rectifier
C. Amplifier
D. Reflector

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T6D03
Which of the following is a reason to use shielded wire?
A. To decrease the resistance of DC power connections
B. To increase the current carrying capability of the wire
C. To prevent coupling of unwanted signals to or from the wire
D. To couple the wire to other signals

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T6D04
Which of the following displays an electrical quantity as a numeric value?
A. Potentiometer
B. Transistor
C. Meter
D. Relay

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T6D05
What type of circuit controls the amount of voltage from a power supply?
A. Regulator
B. Oscillator
C. Filter
D. Phase inverter

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T6D06
What component changes 120 V AC power to a lower AC voltage for other uses?
A. Variable capacitor
B. Transformer
C. Transistor
D. Diode

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T6D07
Which of the following is commonly used as a visual indicator?
A. LED
B. FET
C. Zener diode
D. Bipolar transistor

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T6D08
Which of the following is combined with an inductor to make a resonant circuit?
A. Resistor
B. Zener diode
C. Potentiometer
D. Capacitor

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T6D09
What is the name of a device that combines several semiconductors and other components into one package?
A. Transducer
B. Multi-pole relay
C. Integrated circuit
D. Transformer

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T6D11
Which of the following is a resonant or tuned circuit?
A. An inductor and a capacitor in series or parallel
B. A linear voltage regulator
C. A resistor circuit used for reducing standing wave ratio
D. A circuit designed to provide high-fidelity audio

END OF SUB ELEMENT 6
CIRCUIT COMPONENTS & SCHEMATICS