Electrical Engineering

1. The SI unit of electric charge is the:

A) Ampere

B) Volt

C) Ohm

D) Coulomb

Answer: D) Coulomb

Explanation: The Coulomb (C) is the standard unit of electric charge. It is defined as the amount of charge transported by a constant current of one Ampere in one second.

2. The potential difference between two points in an electric circuit is known as:

A) Current

B) Resistance

C) Voltage

D) Power

Answer: C) Voltage

Explanation: Voltage (or electric potential difference) is the work done per unit charge in moving a charge between two points. It is the "push" that causes current to flow and is measured in Volts (V).

3. Ohm's Law states that the current through a conductor is directly proportional to the:

A) Resistance, provided the voltage is constant

B) Voltage across it, provided the temperature and other physical conditions are unchanged

C) Power dissipated, provided the resistance is constant

D) Charge flowing through it

Answer: B) Voltage across it, provided the temperature and other physical conditions are unchanged

Explanation: Ohm's Law is a fundamental relationship in electrical circuits, expressed as V = I * R, where V is voltage, I is current, and R is resistance.

4. The rate at which electrical energy is converted into another form, such as heat or light, is called:

A) Current

B) Voltage

C) Resistance

D) Power

Answer: D) Power

Explanation: Electrical power (P) is the rate of doing work or transferring energy. It is measured in Watts (W) and can be calculated using formulas like P = V * I or P = (I squared) * R.

5. In a series circuit, the total resistance is the:

A) Sum of the individual resistances

B) Reciprocal of the sum of the reciprocals of individual resistances

C) Product of the individual resistances

D) Average of the individual resistances

Answer: A) Sum of the individual resistances

Explanation: For resistors connected in series, the total equivalent resistance (Rt) is found by adding them up: Rt = R1 + R2 + R3 + ... The same current flows through each resistor.

6. For components connected in parallel, which of the following quantities is the same for all components?

A) Current

B) Resistance

C) Power

D) Voltage

Answer: D) Voltage

Explanation: In a parallel circuit, all components are connected across the same two points, so the voltage drop across each component is identical.

7. To find the total resistance of a complex series-parallel circuit, one must:

A) Always start with the components farthest from the source

B) Combine groups of series and parallel resistors into single equivalent resistances step-by-step

C) Add all the resistor values together regardless of their connection

D) Only consider the largest and smallest resistor values

Answer: B) Combine groups of series and parallel resistors into single equivalent resistances step-by-step

Explanation: The analysis of a series-parallel circuit involves systematically simplifying it by identifying simple series or parallel combinations and replacing them with their equivalent resistance until only one total resistance remains.

8. Thevenin's theorem simplifies a complex linear circuit into an equivalent circuit consisting of a:

A) Current source in parallel with a resistor

B) Voltage source in series with a resistor

C) Current source in series with a resistor

D) Voltage source in parallel with a resistor

Answer: B) Voltage source in series with a resistor

Explanation: Thevenin's theorem is a powerful tool for circuit analysis, allowing a complicated part of a circuit to be replaced by a single Thevenin voltage source and a single Thevenin resistance.

9. Kirchhoff's Current Law (KCL) states that the algebraic sum of currents:

A) Around any closed loop is zero

B) Entering and leaving any node (or junction) is zero

C) In any series circuit is zero

D) In any parallel circuit is zero

Answer: B) Entering and leaving any node (or junction) is zero

Explanation: KCL is based on the principle of conservation of charge. It means that the total current flowing into a junction must equal the total current flowing out of that junction.

10. The region around a magnet where its magnetic force can be experienced is called the:

A) Magnetic field

B) Electric field

C) Magnetic pole

D) Magnetic domain

Answer: A) Magnetic field

Explanation: A magnetic field is a vector field that describes the magnetic influence on moving electric charges, electric currents, and magnetic materials. It is typically visualized using magnetic field lines.

11. The effective value of a sinusoidal AC voltage, which produces the same heating effect as an equivalent DC voltage, is known as the:

A) Peak value

B) Average value

C) RMS (Root Mean Square) value

D) Peak-to-peak value

Answer: C) RMS (Root Mean Square) value

Explanation: The RMS value is the most common way to specify an AC voltage or current. For a sinusoidal waveform, the RMS value is the peak value divided by the square root of 2.

12. A capacitor stores energy in the form of a/an:

A) Electric field

B) Magnetic field

C) Electromagnetic field

D) Chemical energy

Answer: A) Electric field

Explanation: A capacitor stores energy in the electrostatic field that is created between its two conductive plates when a voltage is applied across them.

13. The property of an electrical conductor that opposes a change in the current flowing through it is called:

A) Resistance

B) Capacitance

C) Inductance

D) Reactance

Answer: C) Inductance

Explanation: Inductance (L) is the property of a circuit element to store energy in a magnetic field when current flows through it. According to Lenz's law, the induced voltage opposes the change in current. It is measured in Henrys (H).

14. A transformer operates on the principle of:

A) Mutual inductance

B) Self-inductance

C) Static electricity

D) Ohm's law

Answer: A) Mutual inductance

Explanation: A transformer works by having a changing magnetic field, created by the AC current in the primary coil, induce a voltage in the secondary coil. This transfer of energy via a shared magnetic field is called mutual inductance.

15. The time constant of a series RC circuit is given by the product of:

A) R and C

B) R and L

C) L and C

D) V and I

Answer: A) R and C

Explanation: The time constant (tau = R * C) is a measure of how quickly the capacitor charges or discharges in an RC circuit. After one time constant, the capacitor voltage will have reached approximately 63.2% of its final value during charging.

16. In a series RL circuit, the voltage across the inductor:

A) Leads the current by 90 degrees

B) Lags the current by 90 degrees

C) Is in phase with the current

D) Is opposite in phase to the current

Answer: A) Leads the current by 90 degrees

Explanation: The voltage across an ideal inductor is proportional to the rate of change of current. For a sinusoidal current, this results in the voltage waveform leading the current waveform by a phase angle of 90 degrees.

17. The phenomenon that occurs in a series RLC circuit when the inductive reactance and capacitive reactance are equal is called:

A) Damping

B) Attenuation

C) Resonance

D) Saturation

Answer: C) Resonance

Explanation: At the resonant frequency, the reactances cancel each other out. This causes the circuit's total impedance to be at its minimum (equal to R), resulting in maximum current flow.

18. A circuit that allows signals below a certain cutoff frequency to pass while blocking signals above it is a:

A) High-pass filter

B) Low-pass filter

C) Band-pass filter

D) Band-stop filter

Answer: B) Low-pass filter

Explanation: A simple low-pass filter can be made with a resistor in series and a capacitor in parallel with the load. The capacitor's reactance decreases at higher frequencies, effectively shorting them to ground.

19. Superposition theorem can be applied to a circuit containing:

A) Only linear bilateral elements

B) Only non-linear elements

C) Only active elements

D) Both linear and non-linear elements

Answer: A) Only linear bilateral elements

Explanation: The superposition theorem states that in a linear circuit with multiple sources, the total response is the algebraic sum of the responses caused by each independent source acting alone. It is only applicable to linear systems.

20. The final value of the current through an inductor in a DC circuit, after a long time, will be:

A) Zero

B) Infinite

C) Limited only by the circuit's resistance

D) Equal to the source voltage

Answer: C) Limited only by the circuit's resistance

Explanation: In a DC circuit, after the transient phase, a pure inductor behaves like a short circuit because the current is no longer changing. Therefore, the steady-state current is determined solely by Ohm's law (I = V/R).

21. In a balanced three-phase star (Y) connected system, the line voltage is:

A) Equal to the phase voltage

B) The square root of 3 times the phase voltage

C) The phase voltage divided by the square root of 3

D) The sum of the three phase voltages

Answer: B) The square root of 3 times the phase voltage

Explanation: In a star connection, the line voltage is the vector difference between two phase voltages. This results in a magnitude that is sqrt(3) times the phase voltage.

22. A material with a very large number of free electrons is a good:

A) Insulator

B) Conductor

C) Semiconductor

D) Dielectric

Answer: B) Conductor

Explanation: Electrical current is the flow of charge. In metallic conductors like copper and silver, the vast number of free electrons are easily able to move through the material when a voltage is applied.

23. If the voltage across a 10-ohm resistor is 20 V, the current flowing through it is:

A) 200 A

B) 20 A

C) 2 A

D) 0.5 A

Answer: C) 2 A

Explanation: Using Ohm's Law, I = V/R. Given V = 20 V and R = 10 ohms, the current is I = 20 V / 10 ohms = 2 A.

24. A 100-watt light bulb is operated from a 120-volt source. The current flowing through the bulb is approximately:

A) 1.2 A

B) 12 A

C) 0.83 A

D) 12000 A

Answer: C) 0.83 A

Explanation: Using the power formula, P = V * I, the current can be calculated as I = P/V. Given P = 100 W and V = 120 V, the current is I = 100 W / 120 V, which is approximately 0.83 A.

25. Three resistors of 10 ohms, 20 ohms, and 30 ohms are connected in series. The total resistance is:

A) 10 ohms

B) 20 ohms

C) 30 ohms

D) 60 ohms

Answer: D) 60 ohms

Explanation: For resistors in series, the total resistance is the sum of the individual resistances: Rt = 10 + 20 + 30 = 60 ohms.

26. Two resistors of 10 ohms each are connected in parallel. Their total equivalent resistance is:

A) 20 ohms

B) 10 ohms

C) 5 ohms

D) 100 ohms

Answer: C) 5 ohms

Explanation: For two resistors in parallel, the total resistance is Rt = (R1 * R2) / (R1 + R2). So, Rt = (10 * 10) / (10 + 10) = 100 / 20 = 5 ohms.

27. Norton's theorem provides an equivalent circuit consisting of a:

A) Voltage source in series with a resistor

B) Current source in parallel with a resistor

C) Voltage source in parallel with a resistor

D) Current source in series with a resistor

Answer: B) Current source in parallel with a resistor

Explanation: Norton's theorem is the dual of Thevenin's theorem. It simplifies a linear circuit into an equivalent circuit with a single Norton current source and a single Norton resistance in parallel.

28. Kirchhoff's Voltage Law (KVL) is based on the principle of conservation of:

A) Charge

B) Mass

C) Momentum

D) Energy

Answer: D) Energy

Explanation: KVL states that the algebraic sum of the voltage drops and rises around any closed loop in a circuit must be zero. This is a statement of the conservation of energy.

29. The unit of magnetic flux is the:

A) Tesla

B) Henry

C) Weber

D) Ampere-turn

Answer: C) Weber

Explanation: Magnetic flux is a measure of the total magnetic field that passes through a given area. Tesla (T) is the unit of magnetic flux density (Weber per square meter).

30. In a purely capacitive AC circuit, the current:

A) Lags the voltage by 90 degrees

B) Leads the voltage by 90 degrees

C) Is in phase with the voltage

D) Leads the voltage by 45 degrees

Answer: B) Leads the voltage by 90 degrees

Explanation: The current in a capacitor is proportional to the rate of change of voltage. For a sinusoidal voltage, this results in the current waveform leading the voltage waveform by 90 degrees.

31. If the distance between the plates of a parallel plate capacitor is doubled, its capacitance will:

A) Double

B) Halve

C) Remain the same

D) Quadruple

Answer: B) Halve

Explanation: The capacitance of a parallel plate capacitor is inversely proportional to the distance between the plates. Doubling the distance will halve the capacitance.

32. The opposition to the flow of alternating current caused by an inductor is called:

A) Resistance

B) Impedance

C) Capacitive reactance

D) Inductive reactance

Answer: D) Inductive reactance

Explanation: Inductive reactance is the property of an inductor to oppose AC current. It is directly proportional to the frequency and the inductance.

33. An ideal transformer has a primary winding with 100 turns and a secondary winding with 200 turns. If the primary voltage is 120 V, the secondary voltage will be:

A) 60 V

B) 120 V

C) 240 V

D) 480 V

Answer: C) 240 V

Explanation: The voltage ratio of an ideal transformer is equal to its turns ratio: Vs / Vp = Ns / Np. So, Vs = 120 * (200 / 100) = 240 V.

34. The transient response of a circuit is the response that:

A) Is present after a long time

B) Is always a constant value

C) Disappears over time

D) Is caused by the AC component of the source

Answer: C) Disappears over time

Explanation: The transient response is the temporary behavior of a circuit after a sudden change, such as closing a switch. It decays to zero as the circuit reaches its steady-state condition.

35. A band-pass filter is a circuit that:

A) Passes all frequencies

B) Rejects all frequencies

C) Passes frequencies within a certain range and rejects frequencies outside that range

D) Passes only very low frequencies

Answer: C) Passes frequencies within a certain range and rejects frequencies outside that range

Explanation: A band-pass filter has two cutoff frequencies, and it attenuates frequencies both below the lower cutoff and above the upper cutoff.

36. In a three-phase delta connected system, the line current is:

A) Equal to the phase current

B) The square root of 3 times the phase current

C) The phase current divided by the square root of 3

D) Zero

Answer: B) The square root of 3 times the phase current

Explanation: In a delta connection, the line current is the vector difference between two phase currents, resulting in a magnitude that is sqrt(3) times the phase current.

37. The unit of electrical conductance is the:

A) Ohm

B) Henry

C) Farad

D) Siemens

Answer: D) Siemens

Explanation: Conductance (G) is the reciprocal of resistance (G = 1/R) and is a measure of how easily current flows through a material.

38. The energy consumed by a 2 kW heater in 3 hours is:

A) 6 kWh

B) 60 kWh

C) 600 J

D) 2/3 kWh

Answer: A) 6 kWh

Explanation: Energy is the product of power and time. E = 2 kW * 3 h = 6 kilowatt-hours (kWh).

39. The current in a 5 ohm resistor is 4 A. The power dissipated in the resistor is:

A) 20 W

B) 80 W

C) 1.25 W

D) 100 W

Answer: B) 80 W

Explanation: Using the power formula P = (I squared) * R, the power is P = (4 * 4) * 5 = 80 W.

40. When a new resistor is added in parallel with an existing parallel circuit, the total resistance will:

A) Increase

B) Decrease

C) Remain the same

D) Depend on the value of the new resistor

Answer: B) Decrease

Explanation: Adding a new path for the current to flow in parallel always reduces the overall opposition to the flow, thus decreasing the total resistance.

41. Faraday's law of electromagnetic induction states that the induced electromotive force (EMF) is proportional to the:

A) Rate of change of magnetic flux

B) Strength of the magnetic field

C) Current in the conductor

D) Length of the conductor

Answer: A) Rate of change of magnetic flux

Explanation: Faraday's law quantifies the relationship between a changing magnetic field and the electric field it creates.

42. The opposition to AC current caused by a capacitor is known as:

A) Inductive reactance

B) Capacitive reactance

C) Impedance

D) Resistance

Answer: B) Capacitive reactance

Explanation: Capacitive reactance is inversely proportional to the frequency and the capacitance.

43. An inductor is a passive component that stores energy in a/an:

A) Electric field

B) Magnetic field

C) Gravitational field

D) Chemical form

Answer: B) Magnetic field

Explanation: When current flows through an inductor (a coil of wire), it creates a magnetic field in and around the coil, storing energy.

44. A transformer can be used to step up:

A) Only AC voltage

B) Only DC voltage

C) Both AC and DC voltage

D) Only power

Answer: A) Only AC voltage

Explanation: Transformers rely on a changing magnetic field to induce a voltage in the secondary coil. A DC current produces a constant magnetic field, so a transformer will not work.

45. After one time constant, the current in a charging series RL circuit will have reached approximately what percentage of its final steady-state value?

A) 36.8%

B) 50%

C) 63.2%

D) 100%

Answer: C) 63.2%

Explanation: The time constant for an RL circuit is tau = L/R. At time equals one time constant, the current will have reached about 63.2% of its final value.

46. In a resonant RLC circuit, the quality factor (Q) is a measure of the:

A) Circuit's total resistance

B) Sharpness of the resonance peak

C) Power dissipated in the circuit

D) Phase angle between voltage and current

Answer: B) Sharpness of the resonance peak

Explanation: A high Q factor indicates a narrow bandwidth and a sharply peaked resonance curve, meaning the circuit is highly selective to frequencies near its resonant frequency.

47. The frequency of the standard AC power system in Europe is:

A) 50 Hz

B) 60 Hz

C) 100 Hz

D) 120 Hz

Answer: A) 50 Hz

Explanation: Much of the world, including Europe, Asia, and Africa, uses a standard frequency of 50 Hertz for AC power.

48. Millman's theorem is used to find the:

A) Equivalent resistance in a complex network

B) Equivalent current source from a number of parallel sources

C) Common voltage across a number of parallel branches

D) Total power in a series-parallel circuit

Answer: C) Common voltage across a number of parallel branches

Explanation: Millman's theorem provides a formula to calculate the voltage at a common node for a circuit that has several parallel branches.

49. For a three-phase system, the phase difference between each of the three voltages is:

A) 90 degrees

B) 120 degrees

C) 180 degrees

D) 360 degrees

Answer: B) 120 degrees

Explanation: In a balanced three-phase system, the three sinusoidal voltages are equal in magnitude but are out of phase with each other by exactly 120 electrical degrees.

50. The flow of one coulomb per second is equal to one:

A) Volt

B) Ohm

C) Watt

D) Ampere

Answer: D) Ampere

Explanation: The Ampere (A) is the base unit of electric current, defined as the rate of flow of charge (1 Ampere = 1 Coulomb / 1 second).

51. The resistance of a conductor will decrease if the:

A) Length of the conductor is increased

B) Cross-sectional area of the conductor is increased

C) Temperature of the conductor is increased

D) Resistivity of the material is increased

Answer: B) Cross-sectional area of the conductor is increased

Explanation: The resistance of a conductor is inversely proportional to its cross-sectional area. A thicker wire has less resistance.

52. The total power consumed in a series circuit is the sum of the powers consumed by each individual component. This statement is:

A) True

B) False

C) True only for DC circuits

D) True only for AC circuits

Answer: A) True

Explanation: The principle of conservation of energy dictates that the total power delivered by the source must be equal to the total power dissipated by all the components in the circuit.

53. The superposition theorem is not applicable for the calculation of:

A) Voltage

B) Current

C) Power

D) Resistance

Answer: C) Power

Explanation: Superposition applies only to linear quantities like voltage and current. Since power is a non-linear quantity (related to the square of current or voltage), it cannot be calculated by simply summing the power from each source acting alone.

54. The left-hand rule in electromagnetism is used to determine the:

A) Direction of induced current

B) Direction of magnetic flux

C) Direction of force on a current-carrying conductor in a magnetic field

D) Polarity of a magnetic field

Answer: C) Direction of force on a current-carrying conductor in a magnetic field

Explanation: This rule relates the directions of the magnetic Field, the Current, and the resulting Force. It is the principle behind electric motors.

55. For a given AC voltage, the average value over one complete cycle for a pure sinusoidal waveform is:

A) The same as the RMS value

B) The same as the peak value

C) Zero

D) Half the peak value

Answer: C) Zero

Explanation: For a symmetrical waveform like a sine wave, the positive and negative half-cycles are identical in shape but opposite in sign, resulting in an average value of zero.

56. The unit of capacitance, the Farad, is dimensionally equivalent to:

A) Volts per Coulomb

B) Coulombs per Volt

C) Joules per Coulomb

D) Amperes per second

Answer: B) Coulombs per Volt

Explanation: Capacitance is defined as the ratio of the charge stored to the potential difference applied (C = Q/V).

57. An ideal voltage source has:

A) Zero internal resistance

B) Infinite internal resistance

C) A large internal resistance

D) A resistance equal to the load resistance

Answer: A) Zero internal resistance

Explanation: An ideal voltage source can maintain a constant voltage across its terminals regardless of the current drawn from it, which implies it has no internal resistance.

58. In a series resonant circuit, the impedance at frequencies below the resonant frequency is primarily:

A) Resistive

B) Inductive

C) Capacitive

D) Infinite

Answer: C) Capacitive

Explanation: Below the resonant frequency, the capacitive reactance is larger than the inductive reactance. Therefore, the net reactance is capacitive.

59. The time response of a circuit describes its behavior with respect to:

A) Frequency

B) Temperature

C) Time

D) Resistance

Answer: C) Time

Explanation: Time response analysis determines how a circuit's output (voltage or current) changes over time in response to an input that also changes over time.

60. The main advantage of a three-phase power system over a single-phase system is that it:

A) Requires less copper for the same power transmission

B) Can provide a constant amount of power

C) Is simpler to generate

D) Both A and B are correct

Answer: D) Both A and B are correct

Explanation: Three-phase systems are more economical, transmitting more power with less conductor material. Additionally, the total power delivered by a balanced three-phase system is constant, which is ideal for running large electric motors smoothly.