Electrical Engineering

1. The unit of magnetomotive force (MMF) is the:

A) Weber

B) Tesla

C) Ampere-turn

D) Henry

Answer: C) Ampere-turn

Explanation: Magnetomotive force is the magnetic equivalent of electromotive force. It is the product of the current flowing through a coil and the number of turns in the coil (MMF = N * I).

2. An ideal current source has:

A) Zero internal resistance

B) Infinite internal resistance

C) A very small internal resistance

D) A resistance equal to the load resistance

Answer: B) Infinite internal resistance

Explanation: An ideal current source can deliver a constant current to any load, regardless of the voltage across it. To do this, it must have an infinite internal resistance (or more accurately, infinite parallel resistance) to prevent any current from being diverted internally.

3. If the resistance of a circuit is doubled while the voltage remains constant, the power dissipated will:

A) Halve

B) Double

C) Quadruple

D) Be quartered

Answer: A) Halve

Explanation: Power can be calculated as P = (V squared) / R. Since power is inversely proportional to resistance, doubling the resistance will cut the power in half.

4. In a series circuit with two resistors, the voltage drop is greatest across the:

A) Resistor with the smaller resistance

B) Resistor with the larger resistance

C) Same across both resistors

D) First resistor in the circuit

Answer: B) Resistor with the larger resistance

Explanation: In a series circuit, the same current flows through all components. According to Ohm's Law (V = I * R), the voltage drop is directly proportional to the resistance. Therefore, the largest resistor will have the largest voltage drop.

5. The total conductance of a parallel circuit is the:

A) Sum of the individual conductances

B) Reciprocal of the total resistance

C) Sum of the individual resistances

D) Both A and B are correct

Answer: D) Both A and B are correct

Explanation: For parallel circuits, it is often easier to work with conductances (G = 1/R). The total conductance is the sum of the individual conductances (Gt = G1 + G2 + ...), and this total conductance is also the reciprocal of the total equivalent resistance (Gt = 1/Rt).

6. The current-division rule is used to find the current in one branch of a:

A) Series circuit

B) Parallel circuit

C) Series-parallel circuit

D) Bridge circuit

Answer: B) Parallel circuit

Explanation: The current-division rule allows you to calculate the current flowing through one of several parallel branches, using the total current entering the parallel combination and the resistance values.

7. The maximum power transfer theorem states that maximum power is delivered from a source to a load when the load resistance is:

A) Equal to the source resistance

B) Much larger than the source resistance

C) Much smaller than the source resistance

D) Zero

Answer: A) Equal to the source resistance

Explanation: This theorem is crucial for applications like audio amplifiers and communication systems. When the load resistance equals the source resistance, the power transferred to the load is maximized.

8. The algebraic sum of the products of current and resistance in each of the conductors in any closed path in a network plus the algebraic sum of the EMFs in that path is:

A) Zero

B) A positive constant

C) A negative constant

D) Dependent on the number of sources

Answer: A) Zero

Explanation: This is a formal statement of Kirchhoff's Voltage Law (KVL), which expresses the conservation of energy in a closed circuit loop.

9. The ability of a material to retain its magnetism after the magnetizing force is removed is known as:

A) Permeability

B) Reluctance

C) Hysteresis

D) Retentivity

Answer: D) Retentivity

Explanation: Retentivity is a measure of the residual magnetic flux density that remains in a magnetic material after the external magnetic field is removed.

10. The form factor of a sinusoidal AC waveform is the ratio of:

A) Peak value to RMS value

B) RMS value to average value

C) Average value to RMS value

D) Peak value to average value

Answer: B) RMS value to average value

Explanation: For a sine wave, the RMS value is 0.707 times the peak, and the average value (over a half-cycle) is 0.637 times the peak. The ratio of these two, the form factor, is approximately 1.11.

11. A dielectric material is a substance that is a/an:

A) Good conductor

B) Good insulator

C) Semiconductor

D) Superconductor

Answer: B) Good insulator

Explanation: A dielectric is an electrical insulator that can be polarized by an applied electric field. It is the material used between the plates of a capacitor to increase its capacitance.

12. The energy stored in an inductor is proportional to the:

A) Square of the voltage across it

B) Square of the current through it

C) Resistance of the coil

D) Number of turns only

Answer: B) Square of the current through it

Explanation: The energy (E) stored in the magnetic field of an inductor is given by the formula E = 0.5 * L * (I squared), where L is the inductance and I is the current.

13. A transformer that has more turns in the secondary winding than in the primary winding is called a:

A) Step-down transformer

B) Step-up transformer

C) Autotransformer

D) Isolation transformer

Answer: B) Step-up transformer

Explanation: A step-up transformer increases the voltage from primary to secondary because the induced voltage is proportional to the number of turns in the winding.

14. In a purely resistive AC circuit, the phase angle between the voltage and the current is:

A) 90 degrees

B) -90 degrees

C) 180 degrees

D) 0 degrees

Answer: D) 0 degrees

Explanation: In a resistor, the current is always directly proportional to the voltage at every instant in time. Therefore, the voltage and current waveforms are in phase with each other.

15. The impedance of a series RL circuit is calculated as:

A) R + XL

B) The square root of (R squared + XL squared)

C) The square root of (R squared - XL squared)

D) (R * XL) / (R + XL)

Answer: B) The square root of (R squared + XL squared)

Explanation: Impedance (Z) is the vector sum of resistance (R) and inductive reactance (XL). Since they are 90 degrees out of phase, their magnitudes are combined using the Pythagorean theorem.

16. The bandwidth of a resonant circuit is the range of frequencies for which the power is:

A) At its maximum value

B) Zero

C) Above 70.7% of the maximum power

D) Above 50% of the maximum power

Answer: D) Above 50% of the maximum power

Explanation: The bandwidth is measured between the two half-power points on the resonance curve. These are the frequencies at which the circuit power is half its maximum value, which corresponds to the current being 70.7% of its maximum.

17. A filter that rejects frequencies within a certain range and passes all frequencies outside that range is a:

A) Low-pass filter

B) High-pass filter

C) Band-pass filter

D) Band-stop (or notch) filter

Answer: D) Band-stop (or notch) filter

Explanation: A band-stop filter is the opposite of a band-pass filter. It is used to eliminate a specific, unwanted band of frequencies from a signal.

18. To apply Norton's theorem, the Norton equivalent current is found by:

A) Calculating the current flowing through the open-circuited load terminals

B) Calculating the current flowing through the short-circuited load terminals

C) Measuring the total current from the voltage source

D) Dividing the Thevenin voltage by the total resistance

Answer: B) Calculating the current flowing through the short-circuited load terminals

Explanation: The Norton current (IN) is the maximum current that the circuit can deliver to the output, which is found by placing a short circuit across the output terminals a-b and calculating the current through it.

19. A circuit is considered "critically damped" when the:

A) Response oscillates indefinitely

B) Response is very slow and sluggish

C) Response reaches the final value in the fastest possible time without any overshoot

D) Damping factor is zero

Answer: C) The response reaches the final value in the fastest possible time without any overshoot

Explanation: Critical damping is the condition in a second-order system (like an RLC circuit) that provides the quickest response to a step input without oscillating.

20. The phase sequence of a three-phase system refers to the:

A) Order in which the phase voltages reach their peak values

B) Magnitude of the phase voltages

C) Frequency of the phase voltages

D) RMS value of the line currents

Answer: A) Order in which the phase voltages reach their peak values

Explanation: A standard positive phase sequence is ABC, meaning the voltage in phase A peaks first, followed by phase B (120 degrees later), and then phase C (another 120 degrees later).

21. The property of a material that opposes the establishment of a magnetic field is called:

A) Permeability

B) Reluctance

C) Inductance

D) Susceptibility

Answer: B) Reluctance

Explanation: Reluctance in a magnetic circuit is analogous to resistance in an electric circuit. It is the ratio of magnetomotive force (MMF) to the magnetic flux.

22. An electric motor converts:

A) Mechanical energy into electrical energy

B) Electrical energy into mechanical energy

C) Electrical energy into heat energy

D) Kinetic energy into potential energy

Answer: B) Electrical energy into mechanical energy

Explanation: Motors operate on the principle of the motor effect: a force is exerted on a current-carrying conductor when it is placed in a magnetic field, causing it to rotate.

23. The power factor of an AC circuit is the ratio of:

A) True power to apparent power

B) Apparent power to true power

C) Reactive power to true power

D) Impedance to resistance

Answer: A) True power to apparent power

Explanation: The power factor (PF) is a measure of how effectively the current is being converted into useful work. It is also equal to the cosine of the phase angle between the voltage and current. A purely resistive circuit has a PF of 1.

24. If the cross-sectional area of a wire is halved, its resistance will:

A) Halve

B) Double

C) Quadruple

D) Remain the same

Answer: B) Double

Explanation: Resistance is inversely proportional to the cross-sectional area (R = rho * L / A). If the area is halved, the resistance will double.

25. The total voltage in a series circuit is equal to the:

A) Average of the individual voltage drops

B) Voltage across the largest resistor

C) Sum of the individual voltage drops

D) Voltage across the smallest resistor

Answer: C) Sum of the individual voltage drops

Explanation: This is a direct application of Kirchhoff's Voltage Law (KVL). The sum of the voltage drops across all components must equal the total voltage applied by the source.

26. When a new resistor is added in series to an existing series circuit, the total resistance:

A) Decreases

B) Increases

C) Remains the same

D) Becomes zero

Answer: B) Increases

Explanation: In a series circuit, the total resistance is the sum of all individual resistances. Adding another resistor will always increase the total sum and thus the total resistance.

27. A Wheatstone bridge is a circuit used to measure an unknown:

A) Voltage

B) Current

C) Resistance

D) Power

Answer: C) Resistance

Explanation: The Wheatstone bridge is an electrical circuit used to measure an unknown electrical resistance by balancing two legs of a bridge circuit, one leg of which includes the unknown component.

28. Lenz's Law is a consequence of the law of conservation of:

A) Charge

B) Mass

C) Energy

D) Momentum

Answer: C) Energy

Explanation: Lenz's Law states that the direction of an induced current is such that it will oppose the change in magnetic flux that produced it. This opposition ensures that energy is conserved.

29. The peak-to-peak voltage of a sine wave is:

A) Equal to the peak voltage

B) Half the peak voltage

C) Twice the peak voltage

D) The same as the RMS voltage

Answer: C) Twice the peak voltage

Explanation: The peak-to-peak value measures the total voltage swing from the maximum positive peak to the minimum negative peak, which is a span of two times the peak amplitude.

30. The total impedance of a parallel RLC circuit at resonance is:

A) At a minimum

B) At a maximum

C) Equal to the resistance R

D) Both B and C are correct

Answer: D) Both B and C are correct

Explanation: In a parallel resonant circuit, the inductive and capacitive branch currents are equal and opposite, canceling each other out. This results in a minimum total current from the source, which means the total impedance is at its maximum and is purely resistive (equal to R).

31. The dielectric strength of a material is the maximum:

A) Electric field that it can withstand without breaking down

B) Current it can carry

C) Temperature it can tolerate

D) Voltage it can store

Answer: A) Electric field that it can withstand without breaking down

Explanation: Dielectric strength is a measure of the insulating capability of a material. If the voltage across a dielectric creates an electric field that exceeds this value, the material will conduct current (breakdown).

32. Mutual inductance between two coils can be increased by:

A) Increasing the distance between them

B) Placing an iron core inside the coils

C) Decreasing the number of turns on the secondary coil

D) Using a smaller diameter wire

Answer: B) Placing an iron core inside the coils

Explanation: An iron core has high magnetic permeability, which means it can concentrate the magnetic flux lines. This increases the amount of flux from the primary coil that links with the secondary coil, thus increasing the mutual inductance.

33. The efficiency of a transformer is typically in the range of:

A) 50-60%

B) 65-75%

C) 80-90%

D) 95-99%

Answer: D) 95-99%

Explanation: Transformers are highly efficient devices because they have no moving parts. The main losses are copper losses (due to winding resistance) and iron losses (due to hysteresis and eddy currents in the core), which are relatively small.

34. In an RC circuit, the voltage across the capacitor cannot change instantaneously. This statement is:

A) True

B) False

C) True only for AC circuits

D) True only for DC circuits

Answer: A) True

Explanation: The voltage across a capacitor is proportional to the charge stored on its plates. Since it takes a finite amount of time for charge (current) to flow and accumulate, the capacitor voltage must change smoothly and cannot jump instantaneously.

35. The quality factor (Q) of a series RLC circuit can be defined as the ratio of the:

A) Resistance to the reactance

B) Reactance to the resistance

C) Impedance to the resistance

D) Resistance to the impedance

Answer: B) Reactance to the resistance

Explanation: Q factor is a measure of the energy-storing ability of the circuit versus its energy-dissipating ability. It is calculated as Q = XL / R or Q = XC / R at resonance.

36. In a balanced, three-phase, star-connected system, the neutral current is:

A) Equal to the line current

B) Equal to the phase current

C) Three times the phase current

D) Zero

Answer: D) Zero

Explanation: In a perfectly balanced system, the three phase currents are equal in magnitude and 120 degrees apart. The neutral current is the vector sum of these three currents, which mathematically adds up to zero.

37. The unit of electrical resistivity is the:

A) Ohm

B) Siemens

C) Ohm-meter

D) Ohm per meter

Answer: C) Ohm-meter

Explanation: Resistivity (rho) is an intrinsic property of a material that quantifies how strongly it resists electric current. Resistance = Resistivity * (Length / Area).

38. Kirchhoff's laws are applicable to:

A) Only DC circuits

B) Only AC circuits

C) Both DC and AC circuits

D) Only resistive circuits

Answer: C) Both DC and AC circuits

Explanation: Kirchhoff's Current Law and Voltage Law are fundamental laws based on the conservation of charge and energy, respectively. They apply to all electrical circuits, though for AC circuits, phasor quantities (impedances, complex voltages/currents) must be used.

39. The magnetic field lines around a straight, current-carrying wire form:

A) Straight lines parallel to the wire

B) Straight lines perpendicular to the wire

C) Concentric circles around the wire

D) A spiral shape

Answer: C) Concentric circles around the wire

Explanation: This can be visualized using the right-hand grip rule: if you point the thumb of your right hand in the direction of the current, your fingers curl in the direction of the magnetic field lines.

40. The average value of a sinusoidal AC current over a half cycle is:

A) 0.707 times the peak value

B) 0.637 times the peak value

C) 0.5 times the peak value

D) Zero

Answer: B) 0.637 times the peak value

Explanation: While the average over a full cycle is zero, the average over one positive or negative half-cycle is a non-zero value, calculated as (2 * I_peak) / pi, which is approximately 0.637 * I_peak.

41. In a series RC circuit, the angle by which the total current leads the total voltage will:

A) Increase if the frequency increases

B) Decrease if the frequency increases

C) Remain the same if the frequency increases

D) Become 90 degrees

Answer: B) Decrease if the frequency increases

Explanation: As frequency increases, the capacitive reactance (XC) decreases. This makes the circuit more resistive and less capacitive, so the phase angle between voltage and current gets smaller (closer to 0 degrees).

42. The primary and secondary windings of an autotransformer are:

A) Magnetically coupled only

B) Electrically and magnetically coupled

C) Electrically isolated

D) Not coupled at all

Answer: B) Electrically and magnetically coupled

Explanation: An autotransformer uses a single, tapped winding for both the primary and secondary. This means there is a direct electrical connection between the two sides, in addition to the magnetic coupling.

43. A high-pass filter can be constructed using a:

A) Resistor in series and an inductor in parallel

B) Capacitor in series and a resistor in parallel

C) Resistor in series and a capacitor in parallel

D) Inductor in series and a capacitor in parallel

Answer: B) Capacitor in series and a resistor in parallel

Explanation: The capacitor blocks low-frequency DC and has a high reactance at low frequencies. As the frequency increases, its reactance decreases, allowing the signal to pass through to the load resistor.

44. The power in a three-phase system is measured using two wattmeters. If the load is purely resistive, the readings of the two wattmeters will be:

A) Equal and positive

B) Equal and opposite

C) One will be zero

D) Different and positive

Answer: A) Equal and positive

Explanation: For a purely resistive (unity power factor) balanced load, the phase angle is 0 degrees. The two-wattmeter method formulas show that under this condition, both W1 and W2 will have identical, positive readings.

45. The reciprocal of impedance is called:

A) Conductance

B) Susceptance

C) Admittance

D) Reluctance

Answer: C) Admittance

Explanation: Admittance (Y) is the AC equivalent of conductance and is a measure of how easily a circuit allows current to flow. It is a complex quantity with a real part (conductance, G) and an imaginary part (susceptance, B). Y = 1/Z.

46. The time it takes for the current in an RL circuit to decay to approximately 36.8% of its initial value is:

A) One time constant

B) Two time constants

C) Half a time constant

D) The resonant period

Answer: A) One time constant

Explanation: During decay, the current follows the equation I(t) = I_initial * e^(-t/tau). At t = tau, the value is e^(-1), which is approximately 0.368 or 36.8%.

47. The total energy stored in a circuit is 10 joules, and the power dissipated is 2 watts. If this relationship describes a simple decay process, the circuit's time constant is:

A) 5 seconds

B) 0.2 seconds

C) 20 seconds

D) Cannot be determined

Answer: A) 5 seconds

Explanation: In many physical systems, the time constant can be related to the ratio of energy stored to power dissipated. Time = Energy / Power = 10 J / 2 W = 5 seconds. This represents the time it would take for the energy to dissipate at the initial rate.

48. A node in an electrical circuit is a point where:

A) Only two components are connected

B) Two or more components are connected

C) The voltage is always zero

D) The current is always maximum

Answer: B) Two or more components are connected

Explanation: In circuit analysis (like nodal analysis), a "principal" node is a junction where three or more circuit elements meet, but any connection point is technically a node.

49. A generator that produces an AC voltage is also known as a/an:

A) Motor

B) Alternator

C) Rectifier

D) Inverter

Answer: B) Alternator

Explanation: An alternator is an electromechanical device that converts mechanical energy into electrical energy in the form of alternating current.

50. The total number of watts consumed by a circuit is its:

A) Apparent Power

B) Reactive Power

C) True Power

D) Power Factor

Answer: C) True Power

Explanation: True power (or real power) is the power that performs actual work, like creating heat or light. It is measured in watts (W). Apparent power is measured in volt-amperes (VA), and reactive power is measured in volt-amperes reactive (VAR).

51. If two 10 F capacitors are connected in series, the total capacitance is:

A) 20 F

B) 10 F

C) 5 F

D) 100 F

Answer: C) 5 F

Explanation: Capacitors in series combine like resistors in parallel. The total capacitance is Ct = (C1 * C2) / (C1 + C2) = (10 * 10) / (10 + 10) = 100 / 20 = 5 F.

52. The current in an inductor cannot change instantaneously. This statement is:

A) True

B) False

C) True only for AC circuits

D) True only for DC circuits

Answer: A) True

Explanation: The voltage across an inductor is proportional to the rate of change of current (V = L * di/dt). An instantaneous change in current would mean di/dt is infinite, which would require an infinite voltage. Therefore, inductor current must be continuous.

53. The superposition theorem can be used to find the response in a circuit that has:

A) Only one source

B) Two or more independent sources

C) Only dependent sources

D) No sources

Answer: B) Two or more independent sources

Explanation: The very purpose of the superposition theorem is to simplify the analysis of a circuit with multiple sources by considering the effect of each source one at a time.

54. The magnetic field strength of a coil will decrease if the:

A) Current is increased

B) Number of turns is decreased

C) Core material is changed from air to iron

D) Length of the coil is decreased

Answer: B) Number of turns is decreased

Explanation: The magnetic field strength (or MMF) is directly proportional to both the number of turns (N) and the current (I). Decreasing either of these will decrease the field strength.

55. The RMS value of a DC voltage of 10 V is:

A) 10 V

B) 7.07 V

C) 14.14 V

D) 0 V

Answer: A) 10 V

Explanation: The RMS value of any constant (DC) quantity is simply that quantity itself. The RMS calculation (squaring, taking the mean, taking the root) has no effect on a constant value.

56. For a transformer, the ratio of the secondary current to the primary current is called the:

A) Voltage ratio

B) Turns ratio

C) Current ratio

D) Power ratio

Answer: C) Current ratio

Explanation: The current ratio (Ip / Is) is the inverse of the turns ratio (Ns / Np) for an ideal transformer, showing that a step-up transformer (which increases voltage) will step down the current.

57. A reactive circuit's "steady state" is the condition that remains:

A) For the first few moments after a switch is closed

B) Only during the charging phase

C) After the transient response has died out

D) When the power is zero

Answer: C) After the transient response has died out

Explanation: After a switch is flipped in a reactive circuit, there is a temporary transient period. Once this period is over and the currents and voltages reach their final, stable values or waveforms, the circuit is said to be in its steady state.

58. In a series RLC circuit at resonance, the phase angle between voltage and current is:

A) 90 degrees

B) -90 degrees

C) 45 degrees

D) 0 degrees

Answer: D) 0 degrees

Explanation: At resonance, the inductive and capacitive reactances cancel each other out, leaving only the resistance. The circuit behaves as if it were purely resistive, so the voltage and current are in phase.

59. A bridge rectifier uses how many diodes?

A) One

B) Two

C) Three

D) Four

Answer: D) Four

Explanation: A full-wave bridge rectifier uses four diodes arranged in a bridge configuration to steer the current on both the positive and negative half-cycles of the AC input, providing a more efficient rectification than half-wave or center-tapped full-wave rectifiers.

60. The power factor of a purely inductive or purely capacitive circuit is:

A) 1 (Unity)

B) 0 (Zero)

C) 0.5 leading

D) 0.5 lagging

Answer: B) 0 (Zero)

Explanation: In a purely reactive circuit (only L or only C), the phase angle between voltage and current is 90 degrees. The power factor is the cosine of this angle, and the cosine of 90 degrees is zero. This means no true power is consumed; energy is just stored and returned by the reactive component.