

U.S.C.G. Merchant Marine Exam

Assistant Engineer – Limited

Q615 Electrical Electronics and Control Engineering

(Sample Examination)

Choose the best answer to the following Multiple Choice Questions:

1. For the purpose of calculating line current, which of the following procedures should be used to determine the total line current of a three-phase, delta wound, AC generator?
- (A) Divide the total amperage in all phases by three.
 - (B) Divide the total amperage in all phases by the square root of three.
 - (C) Multiply the amperage in one phase by the square root of three.
 - (D) Multiply the amperage in one phase by three.

If choice C is selected set score to 1.

2. Referring to figure "B" of the illustration, what statement is true? Illustration EL-0020
- (A) The order of resistors connected in the series string has no impact on the total resistance. The total resistance of the circuit will be less than any one of the individual resistances.
 - (B) The order of resistors connected in the series string has an impact on the total resistance. If the largest resistance is first in the circuit, the total resistance will be more than if it is not.
 - (C) The order of resistors connected in the series string has an impact on the total resistance. If the largest resistance is last in the circuit, the total resistance will be more than if it is not.
 - (D) The order of resistors connected in the series string has no impact on the total resistance. The sum of the resistances is the total resistance of the circuit.

If choice D is selected set score to 1.

3. What statement is true concerning the total resistance of a parallel circuit?
- (A) The total resistance is equal to the sum of the individual branch resistances.
 - (B) The total resistance is equal to the sum of the individual branch resistances divided by the number of branches.
 - (C) The total resistance is larger than that of the branch with the greatest resistance.
 - (D) The total resistance is less than that of the branch with the lowest resistance.

If choice D is selected set score to 1.

4. What would be the total capacitance of the circuit illustrated in figure "A" if the value of capacitor C_1 was 100 microfarads and capacitor C_2 was 200 microfarads? Illustration EL-0038
- (A) 66.6 microfarads
 - (B) 150 microfarads
 - (C) 166.6 microfarads
 - (D) 300 microfarads

If choice D is selected set score to 1.

5. A resistance is added in series and internally with the analog meter movement of which of the following instruments?

- (A) DC ammeter
- (B) DC voltmeter
- (C) AC ammeter
- (D) AC frequency meter

If choice B is selected set score to 1.

6. In figure "2" of the diagram shown in the illustration, the three-phase step-down power transformer has a turns ratio of four to one. If a three-phase 480 volt supply is connected to terminals "A1-B1-C1", what voltage should develop across terminals "A2-B2-C2"? Illustration EL-0084

- (A) 69 volts
- (B) 120 volts
- (C) 208 volts
- (D) 277 volts

If choice B is selected set score to 1.

7. What type of electrical diagram for the steering control systems is shown in the illustration? Illustration EL-0192

- (A) The diagram is a wiring diagram.
- (B) The diagram is a one-line diagram.
- (C) The diagram is a functional block diagram.
- (D) The diagram is a pictorial drawing.

If choice C is selected set score to 1.

8. What is an ammeter used to measure?

- (A) resistance
- (B) current
- (C) continuity
- (D) voltage

If choice B is selected set score to 1.

9. As shown in figure "A" of the digital multimeter screen shown in the illustration, what would be the significance of the symbol indicated by "1" being illuminated? Illustration EL-0047
- (A) The symbol is illuminated when the meter is in range of a wireless signal.
 - (B) The symbol is illuminated when the meter is subjected to a potentially unsafe voltage.
 - (C) The symbol is illuminated when the selector switch is selected for continuity/diode test and the secondary function push button is toggled for continuity.
 - (D) The symbol is illuminated when the meter test leads are placed in the wrong terminal jacks for the test being performed.

If choice C is selected set score to 1.

10. What is the nominal output voltage of a 6 cell lead-acid battery?

- (A) 6 volts
- (B) 7.5 volts
- (C) 12 volts
- (D) 18 volts

If choice C is selected set score to 1.

11. Which type of AC single phase motor will also operate on direct current?

- (A) Split phase
- (B) Repulsion-start
- (C) Series-wound
- (D) Shaded-pole

If choice C is selected set score to 1.

12. What type of AC motor would use a rheostat in the rotor circuit to vary the speed of the motor?

- (A) synchronous motor
- (B) regenerative braking motor
- (C) wound-rotor induction motor
- (D) squirrel-cage induction motor

If choice C is selected set score to 1.

13. Which of the following is the only known perfect dielectric for the purpose of serving as electrical insulation?

- (A) mica
- (B) vacuum
- (C) ceramic
- (D) glass

If choice B is selected set score to 1.

- 14.** In preparing a battery-operated digital megohmmeter (resistance tester) for use, what statement is true?
- (A) The circuit or circuit component under test must be energized, AND the megohmmeter test voltage must be set to a value less than the equipment exposure voltage.
 - (B) The circuit or circuit component under test must be energized, AND the megohmmeter test voltage must be set to a value equal to or greater than the equipment exposure voltage.
 - (C) The circuit or circuit component under test must be de-energized, AND the megohmmeter test voltage must be set to a value equal to or greater than the equipment exposure voltage.
 - (D) The circuit or circuit component under test must be de-energized, AND the megohmmeter test voltage must be set to a value less than the equipment exposure voltage.

If choice C is selected set score to 1.

- 15.** The leads from an ohmmeter are attached to the leads of the opposite ends of an AC induction motor stator coil. If a reading of infinity (OL) is obtained, what does this indicate?
- (A) grounded stator coil
 - (B) shunted stator coil
 - (C) shorted stator coil
 - (D) open stator coil

If choice D is selected set score to 1.

- 16.** Contact with any energized electrical system conductor is potentially hazardous and precautions should be taken to prevent exposure. With all other factors considered equal (such as voltage, conducting path through the body and the duration of contact), contact with an energized electrical system conductor of which system type would produce the most damaging effect?
- (A) DC systems
 - (B) 60 Hz AC systems
 - (C) 10 kHz AC systems
 - (D) All the above systems would be equally as damaging

If choice B is selected set score to 1.

- 17.** Which of the following devices would be forbidden to use as a primary means of electrical isolation?
- (A) fused disconnect switch
 - (B) start/stop push button station
 - (C) non-fused disconnect switch
 - (D) circuit breaker

If choice B is selected set score to 1.

18. If it becomes absolutely necessary to run an alternator at lower than 5% below its rated frequency, in terms of output voltage, what must be done?

- (A) The alternator output voltage must be maintained at the rated value for the alternator output voltage.
- (B) The alternator output voltage must be increased proportionately upward to compensate for the frequency decrease.
- (C) The alternator output voltage must be decreased proportionately downward with the frequency decrease.
- (D) Under no circumstances is it permissible to run an alternator at a frequency lower than 5% below its rated frequency.

If choice C is selected set score to 1.

19. What can be the cause of excessive heat or burning contacts in an operating motor controller?

- (A) high ambient temperature
- (B) dirty or pitted contacts
- (C) burned out operating coil
- (D) low motor starting torque

If choice B is selected set score to 1.

20. What condition associated with a lead-acid battery cell can cause the plates to partially short-out and cause the cell to fail to hold a charge?

- (A) dirty or acid-wet tops and sides of batteries
- (B) sulfation of the plates due to consistent undercharging or leaving the battery in a discharged state
- (C) accumulation of sediment within the cells due to excessive overcharging and discharging
- (D) lime accumulation on both the positive and negative terminal posts

If choice C is selected set score to 1.

21. If the cooling water system is isolated for repairs, but in an operational emergency, it is still desirable to run the alternator pictured in figure "A" of the illustration, what must be done? Illustration EL-0037

- (A) The emergency air inlet panel and air outlet doors must be opened and only then can the alternator be run, but at reduced load.
- (B) The emergency air inlet panel and air outlet doors must remain closed, which requires the alternator to be run only at reduced loads.
- (C) The alternator may not be run without cooling water under any circumstances.
- (D) The emergency air inlet panel and air outlet doors must be opened, but in doing so allows the alternator to be run at rated load.

If choice A is selected set score to 1.

22. Why should battery rooms be well ventilated during the charging of lead-acid storage batteries?

- (A) highly toxic sulfuric acid gas must not be allowed to accumulate
- (B) highly poisonous chlorine gas must not be allowed to accumulate
- (C) highly flammable oxygen and hydrogen gases must not be allowed to accumulate
- (D) highly toxic lead gas must not be allowed to accumulate

If choice C is selected set score to 1.

23. What is the most reliable and preferred method for determining the state of charge of a wet cell NiCad battery while it is being charged?

- (A) Measuring the battery voltage with a solenoid type voltage tester.
- (B) Measuring the specific gravity of each cell with a hydrometer.
- (C) Measuring the battery voltage with a digital voltmeter.
- (D) Measuring the temperature corrected specific gravity of each cell with a hydrometer and thermometer.

If choice C is selected set score to 1.

24. Which of the illustrated motors has an open, drip-proof (ODP) motor enclosure? Illustration EL-0001

- (A) A
- (B) B
- (C) C
- (D) D

If choice C is selected set score to 1.

25. Which of the listed motors will operate at the highest RPM, assuming that each operates at the same frequency?

- (A) A four-pole synchronous motor under normal load.
- (B) A four-pole induction motor under no load.
- (C) A six-pole synchronous motor under normal load.
- (D) A six-pole induction motor under full load.

If choice A is selected set score to 1.

26. By what means is a synchronous motor started and brought nearly to synchronous speed?

- (A) By the use of compensating windings, also known as starting windings.
- (B) By the use of interpoles, also known as commutating poles.
- (C) By the use of starting capacitors, also known as condensers.
- (D) By the use of a squirrel-cage induction winding, also called an amortisseur winding.

If choice D is selected set score to 1.

- 27.** Which of the following statements represents the main difference between an electromagnetic relay and an electromagnetic contactor as used in motor control and power circuits?
- (A) A relay is series connected and a contactor is parallel connected.
 - (B) Contactor contacts are made from silver and relay contacts are made from copper.
 - (C) Contactor contacts can handle heavier loads than relay contacts.
 - (D) Contactors control current and relays control voltage.

If choice C is selected set score to 1.

- 28.** Which of the following pictures represents a magnetic reversing or two-speed motor starter?
Illustration EL-0179

- (A) A
- (B) B
- (C) C
- (D) D

If choice D is selected set score to 1.

- 29.** What is the name of the device that works in conjunction with an automatic voltage regulator and is used as the source of magnetizing direct current delivered to the rotating field of an AC generator?

- (A) magnetizer
- (B) alternator
- (C) governor
- (D) exciter

If choice D is selected set score to 1.

- 30.** How are fuses usually rated?

- (A) watts only
- (B) amps only
- (C) volts and amps only
- (D) volts, amps, and interrupting capacity

If choice D is selected set score to 1.

- 31.** The arc resulting from the tripping of a circuit breaker is prevented from damaging the contacts. How is this done?

- (A) an inverse timed thermal trip for short circuit currents
- (B) designing the contacts to open slowly
- (C) instantaneous magnetic trip for overload currents
- (D) extinguishing the arc by means of an arc chute

If choice D is selected set score to 1.

32. If the illustrated device in figure "B" has a step-up ratio of 10 to 1 what voltage would be measured at the secondary shortly after the primary of the device is connected to 110 volts DC and the primary current stabilized with a current of 12 amps? Illustration EL-0055

- (A) 0 volts
- (B) 110 volts
- (C) 1000 volts
- (D) 1100 volts

If choice A is selected set score to 1.

33. The timer element of a reverse power relay cannot be energized unless what condition is met?

- (A) the power flow is the opposite to the tripping direction
- (B) the power flow is the same as the tripping direction
- (C) one generator is fully motorized
- (D) the movement of the disk is damped by a permanent magnet

If choice B is selected set score to 1.

34. Which line in figure "B" shown in the illustration represents the trailing edge of the wave? Illustration EL-0088

- (A) 3
- (B) 4
- (C) 5
- (D) 6

If choice B is selected set score to 1.

35. Which of the substances listed can be used to shield sensitive equipment from static magnetic fields?

- (A) Iron
- (B) Bakelite
- (C) Mica
- (D) Glass

If choice A is selected set score to 1.

36. Which of the following statements correctly applies to bipolar junction transistors?

- (A) The collector separates the emitter and base.
- (B) The emitter separates the base and collector.
- (C) LED and LCD are the two basic types of transistors.
- (D) The three terminals are called the emitter, base, and collector.

If choice D is selected set score to 1.

37. What is the functional purpose of the Zener diode "CR1" as shown in section "D" of the regulated DC power supply? Illustration EL-0085

- (A) prevents excessive currents
- (B) corrects power factor
- (C) is a temperature compensator
- (D) aids in output voltage regulation

If choice D is selected set score to 1.

38. In referring to figure "A" of the illustration, what type of active filter circuit is shown? Illustration EL-0077

- (A) Bandpass filter circuit
- (B) Low-pass filter circuit
- (C) High-pass filter circuit
- (D) Notch filter circuit

If choice B is selected set score to 1.

39. A voltage amplifier has a calculated voltage gain of 5. Which statement is true concerning input and output voltages?

- (A) If the input changes 5 volts, the output changes 10 volts.
- (B) If the input changes 10 volts, the output changes 5 volts.
- (C) If the input changes 2 volts, the output changes 10 volts.
- (D) If the input changes 10 volts, the output changes 2 volts.

If choice C is selected set score to 1.

40. As shown in all three diagrams included in the illustration, what type of logic circuit is represented? Illustration EL-0231

- (A) NOR gate
- (B) NOT gate
- (C) XOR gate
- (D) OR gate

If choice C is selected set score to 1.

41. As shown in all four diagrams included in the illustration, what type of logic circuit is represented? Illustration EL-0227

- (A) NAND gate
- (B) AND gate
- (C) NOR gate
- (D) OR gate

If choice D is selected set score to 1.

- 42.** Ships requiring extremely rapid maneuvering response using propeller shaft speed and direction as the sole means of controlling propeller thrust are most likely to use what type of drive system?
- (A) Gas turbine geared drive
 - (B) Steam turbine geared drive
 - (C) Diesel-electric drive
 - (D) Direct or geared diesel drive

If choice C is selected set score to 1.

- 43.** An electric propulsion drive system in which the propulsion generator supplies power to both the propulsion motor and ship service loads is referred to as what type of system?
- (A) a multi-purpose system
 - (B) a dedicated system
 - (C) an integrated system
 - (D) a composite system

If choice C is selected set score to 1.

- 44.** By what common means is the speed of an AC propulsion motor on a diesel-electric propulsion ship controlled?
- (A) by varying the input voltage to the motor, but not the frequency
 - (B) by varying the input frequency to the motor, but not the voltage
 - (C) by varying either the input voltage or frequency to the motor, but not both
 - (D) by varying both the input frequency and voltage to the motor

If choice D is selected set score to 1.

- 45.** How is the main shaft rotation on an AC diesel-electric propulsion vessel normally reversed?
- (A) reversing the phase sequence supplied to the motor
 - (B) increasing the generator frequency
 - (C) reversing the prime mover rotation
 - (D) decreasing the generator frequency

If choice A is selected set score to 1.

- 46.** What statement is TRUE concerning podded azimuthing propulsors?
- (A) It is an electric drive system in which the motor drives a controllable-pitch propeller (CPP).
 - (B) It is an electric drive system where the propulsion motor is installed in a submerged housing capable of swiveling.
 - (C) It is an electric drive system that incorporates a DC motor.
 - (D) It is an electric drive system using water jets.

If choice B is selected set score to 1.

47. In addition to high voltage circuit grounding with ground-connecting switching devices, for additional operator safety and confidence, portable grounding straps may be used. What is the proper procedure for connecting these portable grounding straps?

- (A) Connect the phase connections to common first, then connect the common connection to hull ground.
- (B) Connect the common connection to hull ground first, then connect the phase connections to common.
- (C) The common to hull ground connection and the phase connections to common can be made in any sequence.
- (D) The common to hull ground connection and the phase connections to common should all be made simultaneously.

If choice B is selected set score to 1.

48. In order for a live-line tester to be used to test and prove dead a high voltage circuit, what must be done to verify the ability of the tester to detect a voltage?

- (A) The live-line tester should be checked by connecting to a known high voltage source only after testing the circuit to be worked upon.
- (B) The live-line tester should be checked by connecting to a known high voltage source before and after the circuit to be worked upon is tested.
- (C) The live-line tester should be checked by connecting to a known high voltage source only before testing the circuit to be worked upon.
- (D) The live-line tester need not be checked prior to testing the circuit to be worked upon as long as it has not been declared inoperative.

If choice B is selected set score to 1.

49. A bearing temperature monitoring system such as that used for measuring selected propulsion plant bearings uses what technology?

- (A) self-powered thermocouples (TC)
- (B) self-powered resistance temperature detectors (RTD)
- (C) externally powered thermocouples (TC)
- (D) externally powered resistance temperature detectors (RTD)

If choice D is selected set score to 1.

50. Of the following, what shipboard system is MOST likely to use the synchronous transmission system featuring a transmitter and receiver?

- (A) Rudder angle indicator system
- (B) Centrifuge RPM indicator system
- (C) Turbocharger RPM indicator system
- (D) Shaft revolution indicator system

If choice A is selected set score to 1.

51. As shown in the illustrated block diagram for a distributed automation system, what statement is true concerning the workstations labeled "LOS" associated with the port power management system?
Illustration EL-0096

- (A) These are local operating system workstations that allow local control of processes related to the operation and control of all functions within the engineering plant.
- (B) These are local operating system workstations that allow local control of processes related to the operation and control of the port generator.
- (C) These are lube oil system workstations that allow local control of processes related to the lubrication of the port generators.
- (D) These are lube oil system workstations that allow local control of processes related to the lubrication of all machinery within the engineering plant.

If choice B is selected set score to 1.

52. Modern ships use multiple computers arranged in a client/server network to perform various shipboard functions. What type of computer network would most likely be used aboard ship?

- (A) Wireless wide area network
- (B) Wired local area network
- (C) Wireless local area network
- (D) Wired wide area network

If choice B is selected set score to 1.

53. What would be the indication of a grounded switch or cable as measured by a megohmmeter?

- (A) being unsteady in the high range
- (B) being unsteady in the low range
- (C) infinity
- (D) "zero"

If choice D is selected set score to 1.

54. When testing insulation resistance of electric equipment and machinery, ideally when should the insulation resistance be tested for the lowest normal insulation values?

- (A) immediately after starting up the machine
- (B) every 30 days whether the machine is in use or not
- (C) every time the brush rigging is adjusted
- (D) immediately after shutting down the machine

If choice D is selected set score to 1.

55. Referring to the illustration pertaining to an alternator protection and alarm system, what statement is true concerning the component labeled "LO"? Illustration EL-0067

- (A) LO is an alternator phase loss safety shutdown and alarming device.
- (B) LO is an alternator bearing low lube oil pressure safety shutdown and alarming device.
- (C) LO is an alternator prime mover low lube oil pressure safety shutdown and alarming device.
- (D) LO is an alternator electrical fault trip master lock-out and alarm device.

If choice D is selected set score to 1.

56. In an impressed current cathodic hull protection system, what statement is true concerning the composition and arrangement of the anodes?

- (A) The protective anodes are made of zinc and are electrically insulated from the hull.
- (B) The protective anodes are made of lead or platinized titanium and are electrically insulated from the hull.
- (C) The protective anodes are made of lead or platinized titanium and are electrically bonded to the hull.
- (D) The protective anodes are made of zinc and are electrically bonded to the hull.

If choice B is selected set score to 1.

57. The electrical energy necessary to power a sound-powered telephone's small vibrating bell is obtained from what power source?

- (A) the emergency batteries for the general alarm
- (B) the emergency switchboard
- (C) normal 115-volt DC supplies
- (D) each station's hand-cranked generator

If choice D is selected set score to 1.

58. In the event of a power failure during cargo loading operations, the movement of an electric powered cargo winch will be stopped by what means?

- (A) a spring set brake
- (B) the weight of the load on the boom
- (C) a hand-operated band brake
- (D) a manual override switch

If choice A is selected set score to 1.

59. As shown in the illustration, what is responsible for maintaining the "UV" relay energized when the master switch handle is moved away from the "off" position? Illustration EL-0102

- (A) "MS 1" contact
- (B) normally open "UV" sealing contact
- (C) "MS 2" contact
- (D) normally closed "OL" contact

If choice B is selected set score to 1.

60. In figure "1" of the illustration, what type of circuit breaker trip element is featured? Illustration EL-0033

- (A) shunt trip
- (B) magnetic trip
- (C) thermal trip
- (D) ambient compensated trip

If choice C is selected set score to 1.

61. What is the shape of the schematic symbol for an operational amplifier used in an analog circuit?

- (A) trapezoid
- (B) circle
- (C) square
- (D) triangle

If choice D is selected set score to 1.

62. Which of the following activities occurs during the charging process of a lead-acid storage battery?

- (A) Both plates change chemically to lead sulfate.
- (B) Oxygen gas is absorbed.
- (C) Hydrogen gas is absorbed.
- (D) The specific gravity of the acid increases.

If choice D is selected set score to 1.

63. What is the best method of determining the state of charge of a flooded lead-acid storage battery?

- (A) ampere-hour capacity of the battery
- (B) testing of the individual cell voltages
- (C) total cell voltages
- (D) specific gravity of the electrolyte

If choice D is selected set score to 1.

64. When an alternator is to remain idle for even a few days, what should be ensured or manually accomplished?

- (A) ensure energization the space heater circuit (usually automatic)
- (B) manually lift the brushes and disconnect the pigtailed if applicable
- (C) manually open the equalizing bus disconnect switch as required
- (D) insulate the collector rings with strips of cardboard if applicable

If choice A is selected set score to 1.

65. In performing routine maintenance of a ship's service alternator, what should be included?

- (A) megger testing of all rectifying diodes
- (B) changing the pedestal bearing insulation yearly
- (C) periodic cleaning of the air filters or screens
- (D) lubricating exciter slip rings

If choice C is selected set score to 1.

66. Which of the following methods should be used to dress the face of silver-plated contacts?

- (A) Sanding with 400 grit sandpaper
- (B) Burnishing with a burnishing tool
- (C) Filing with a mill file
- (D) Knurling with a knurling tool

If choice A is selected set score to 1.

67. When a fluorescent lamp has reached the end of its useful life, it should be replaced immediately. If not, what condition could the resultant flashing cause?

- (A) damaging the lamp's ballast circuit
- (B) short circuiting of adjacent lighting circuits
- (C) exploding of the lamp, causing glass to fly in all directions
- (D) tripping of the lamp's circuit breaker

If choice A is selected set score to 1.

68. When you are making a high potential test (insulation resistance) on the motor coils of repaired electrical machinery to ground, what would a low resistance reading indicate?

- (A) good insulation
- (B) bad insulation
- (C) a high slot discharge factor
- (D) high insulation power factor

If choice B is selected set score to 1.

69. Large machines undergoing a resistance insulation testing using a megohmmeter should be discharged to remove any accumulated electrostatic/capacitive/dielectric-absorption charge stored. When should this discharge be performed?

- (A) after conducting the insulation resistance check only
- (B) while performing the insulation resistance check only
- (C) prior to conducting the insulation resistance check only
- (D) prior to and after conducting the insulation resistance check

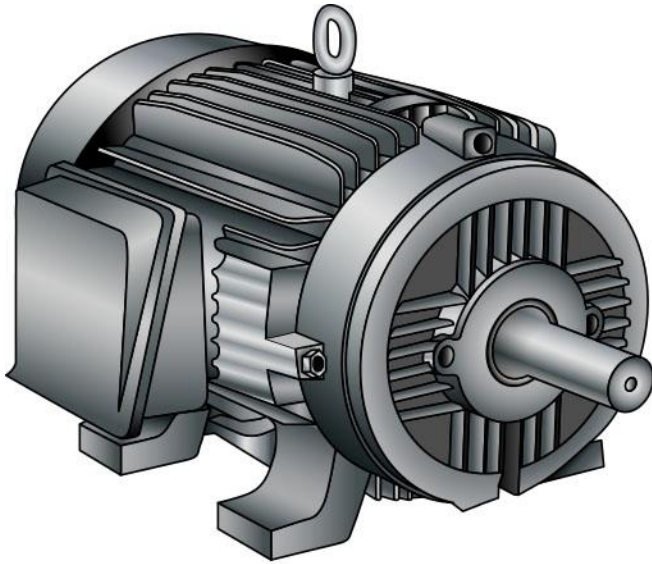
If choice D is selected set score to 1.

70. Referring to the containership one-line distribution diagram shown in the illustration, what is the purpose of the transformers providing power to the refrigerated container feeder bus? Illustration EL-0014

- (A) Step up the voltage from the 450 VAC main bus to the voltage required for the refrigerated container feeder bus.
- (B) Prevent any unintentional grounds in the refrigerated container distribution system from affecting the 450 VAC main distribution system.
- (C) Reduce the kVA loading on the 450 VAC main distribution system main switchboard.
- (D) Step down the voltage from the 450 VAC main bus to the voltage required for the refrigerated container feeder bus.

If choice B is selected set score to 1.

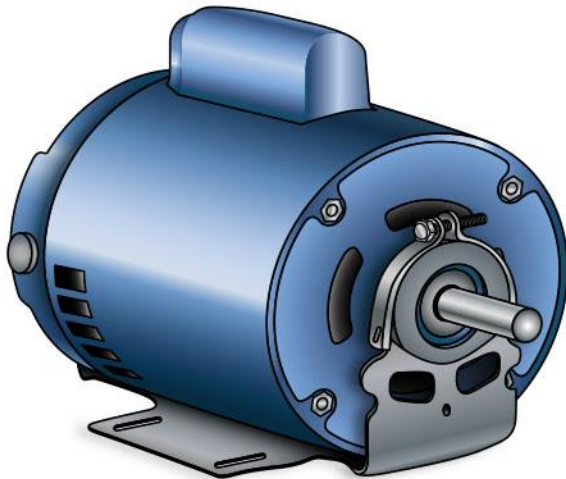
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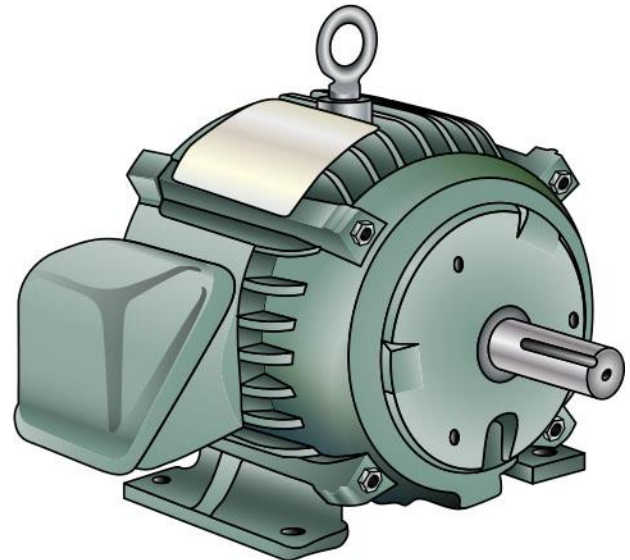
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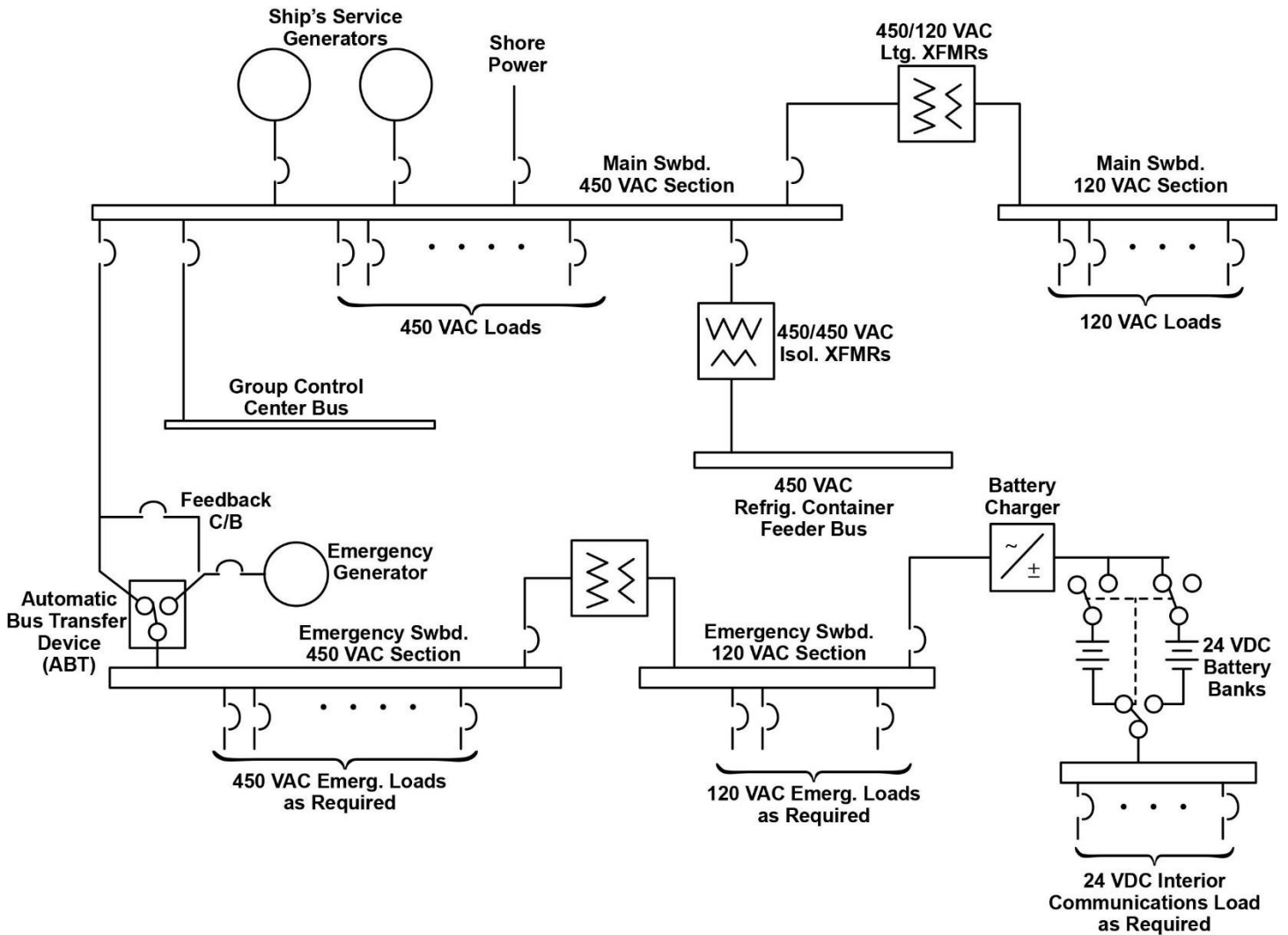
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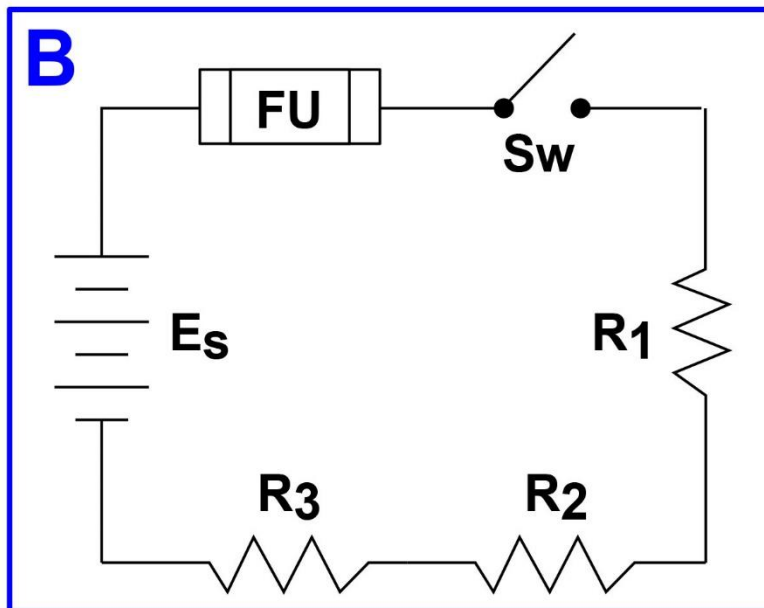
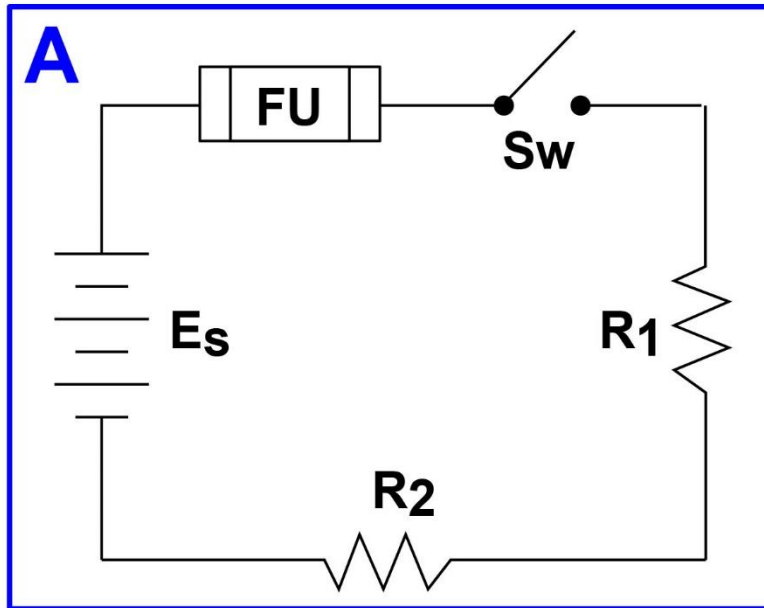


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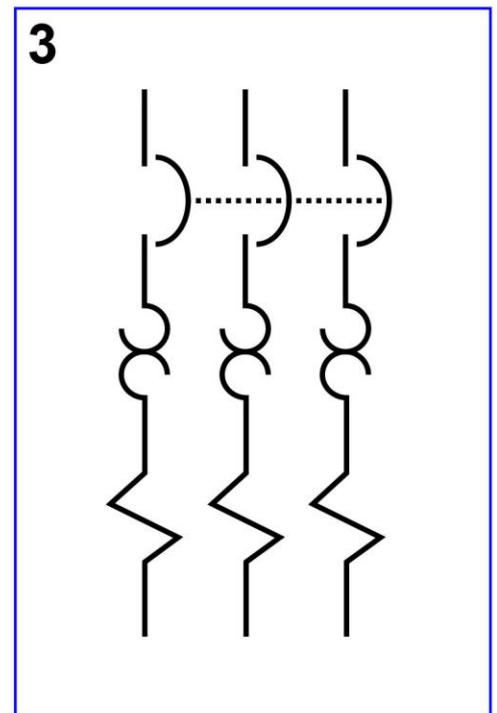
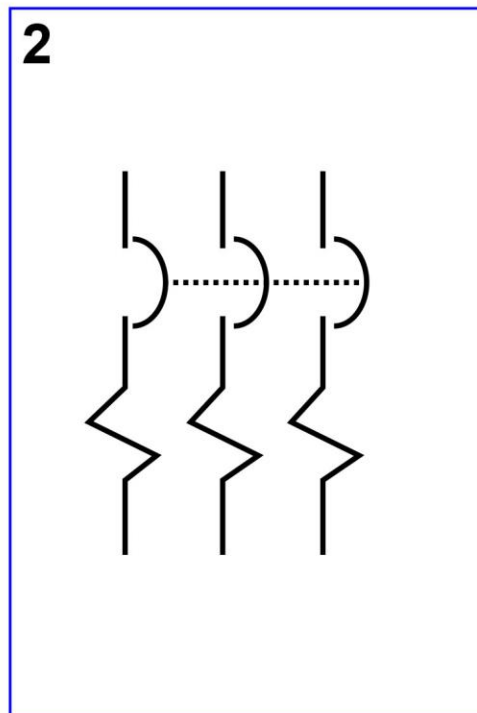
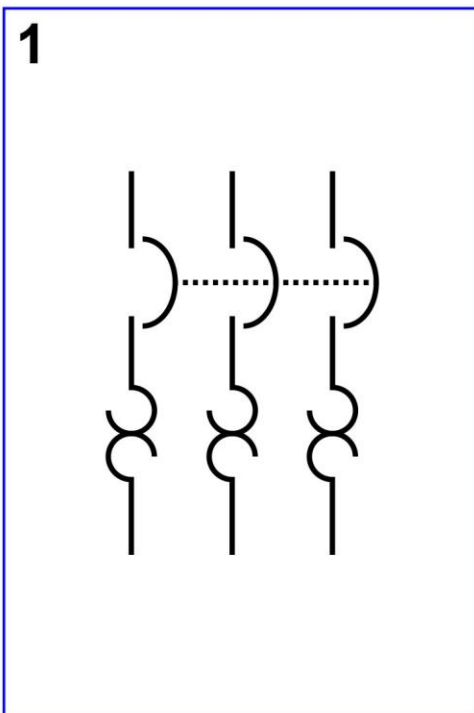


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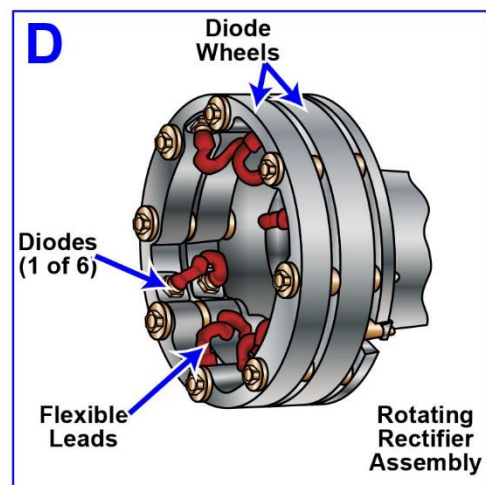
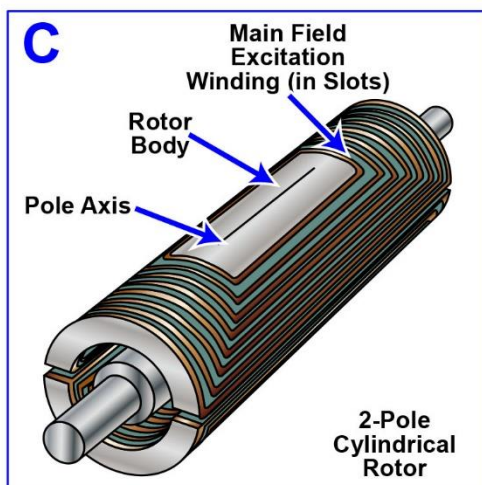
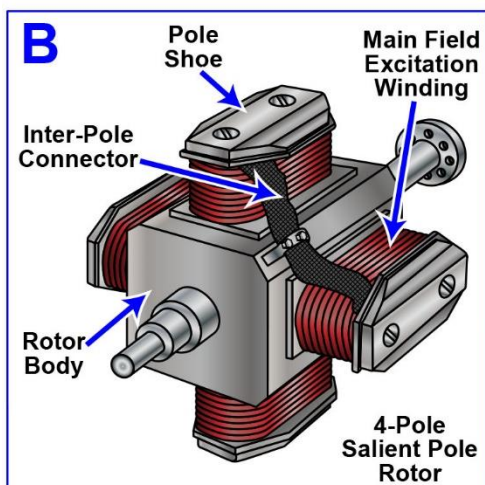
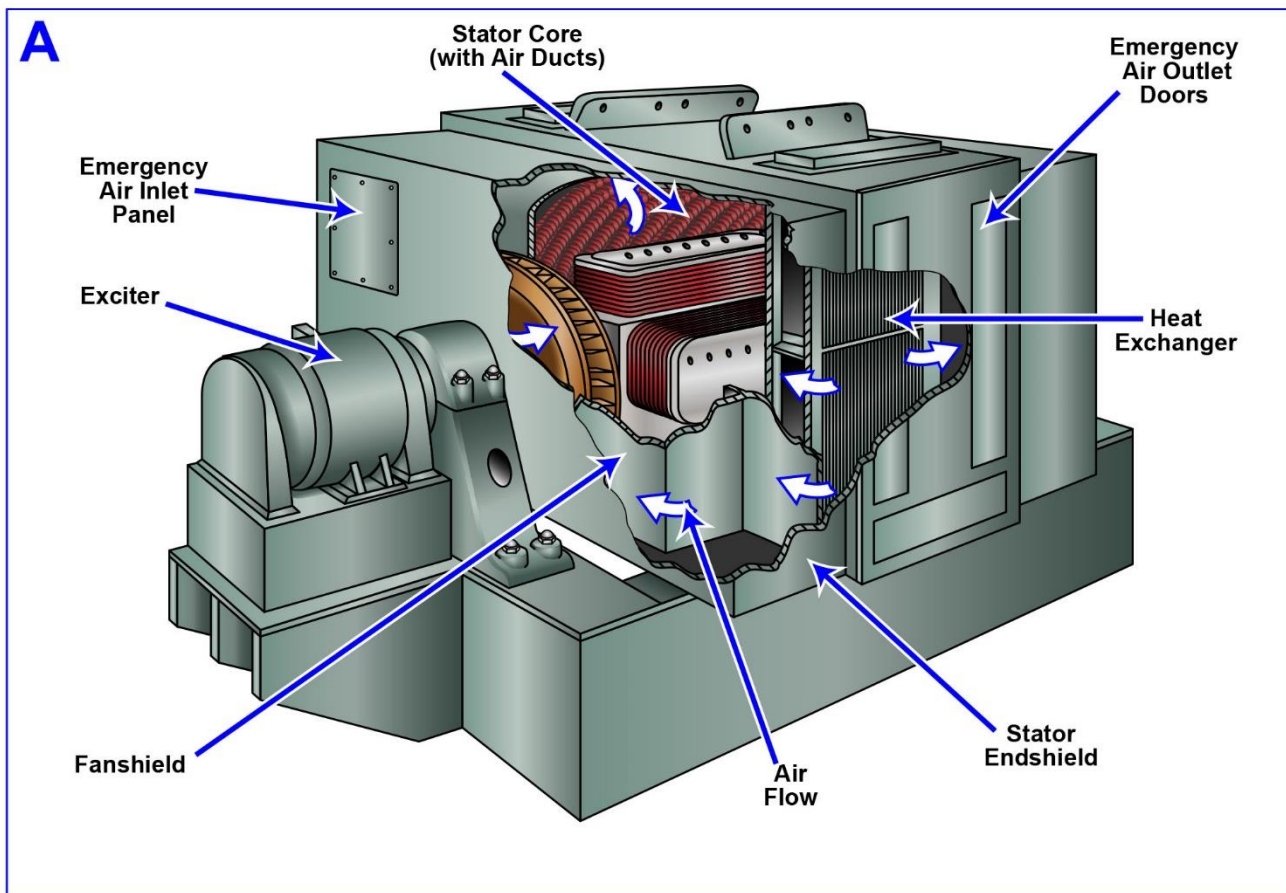


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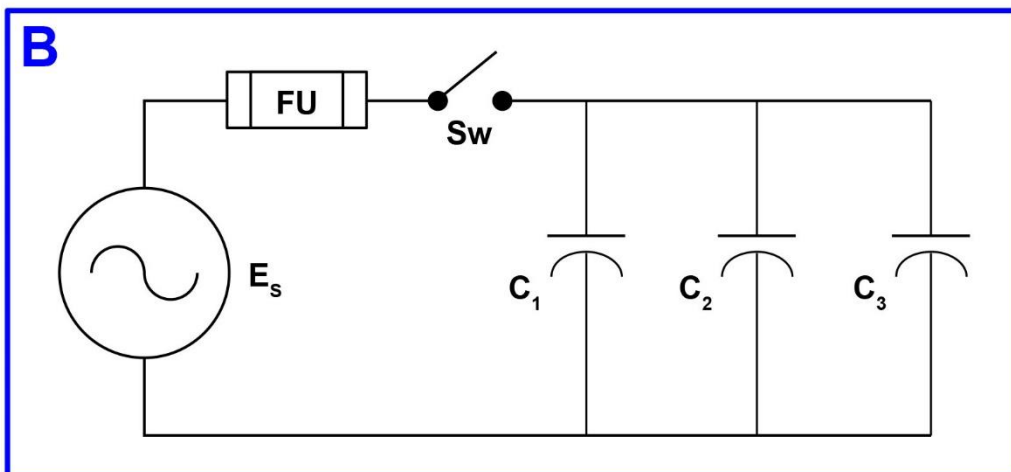
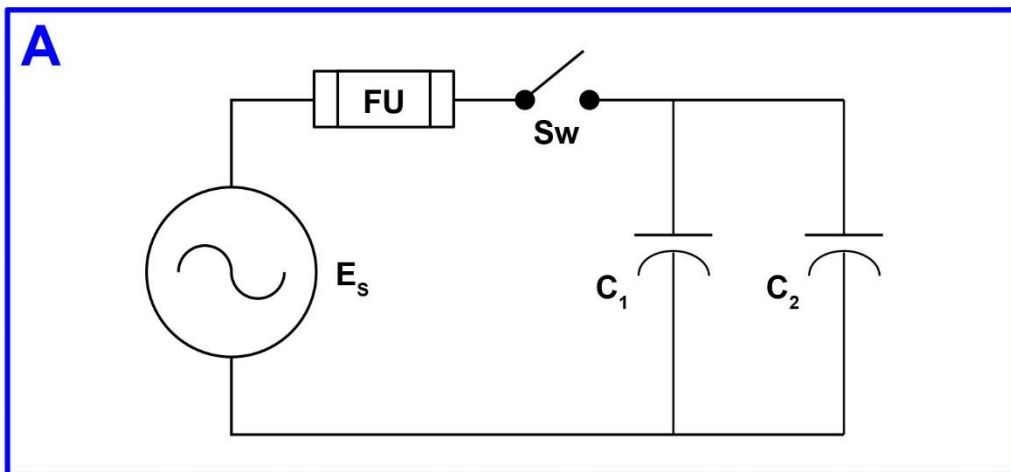
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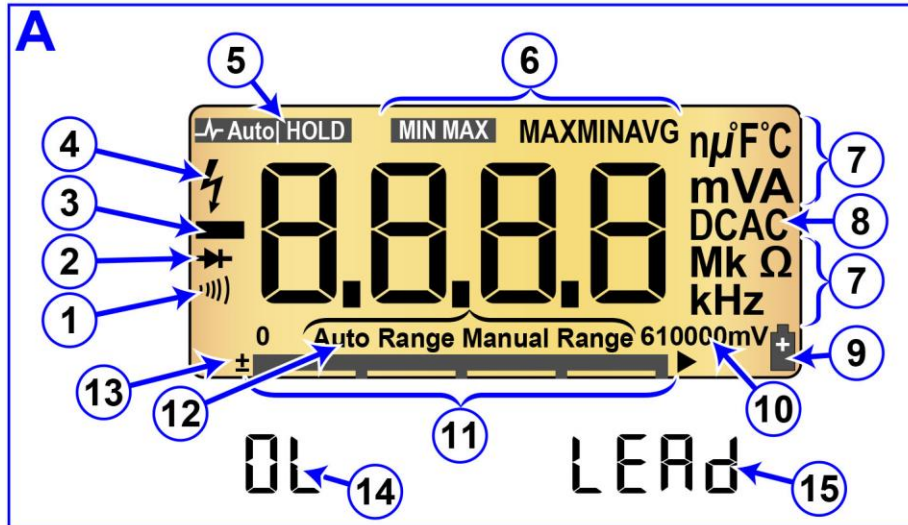
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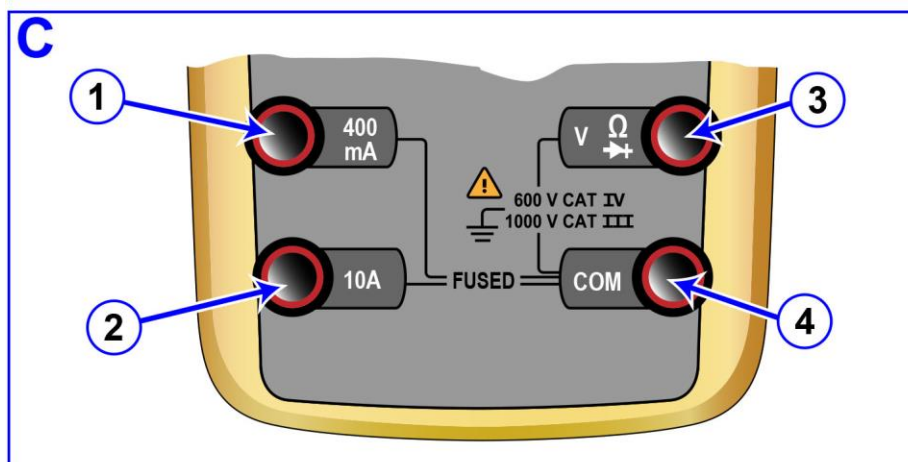
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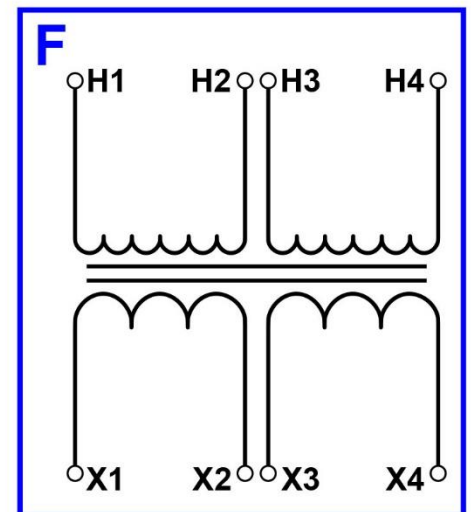
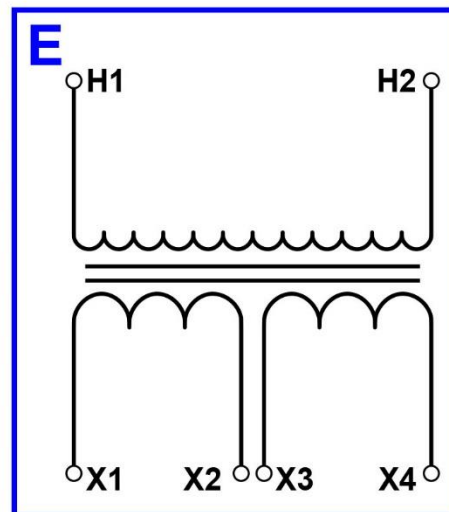
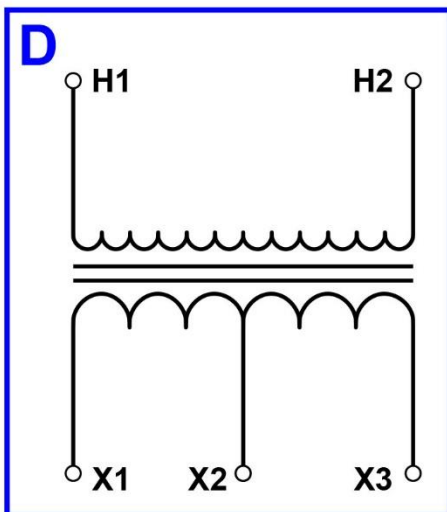
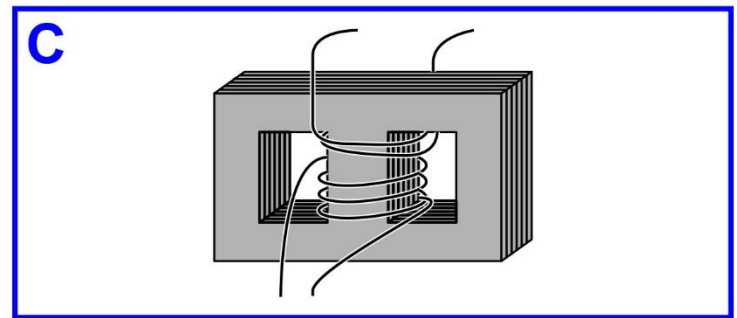
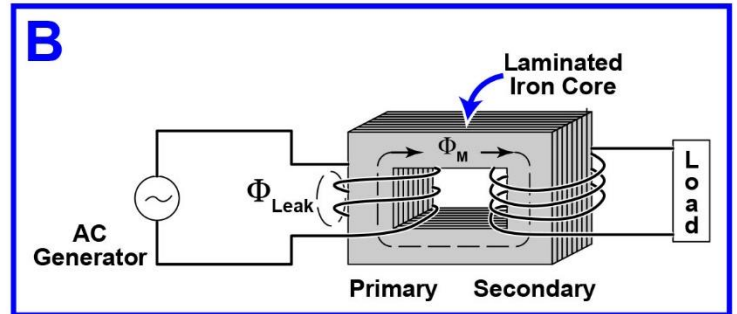
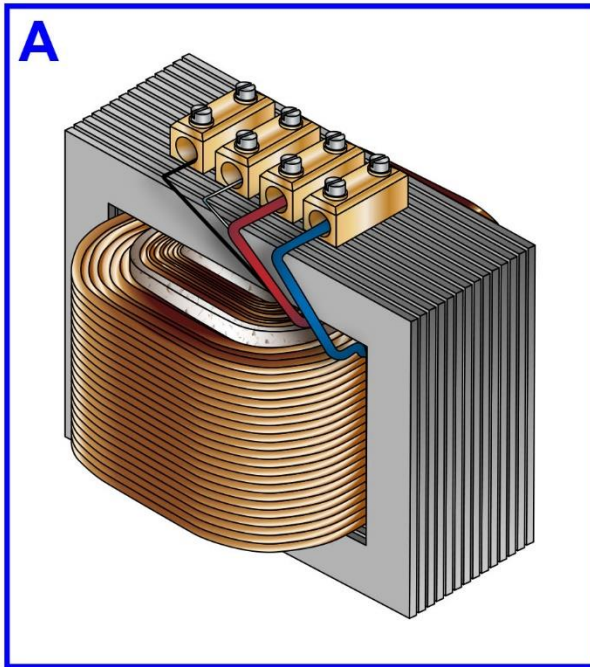
B

Switch Position	Measurement Function
\bar{V} Hz	1
\bar{V}	2
m \bar{V}	3
Ω + \leftarrow	4
\leftarrow)	5
\sim mA	6
\sim A	7



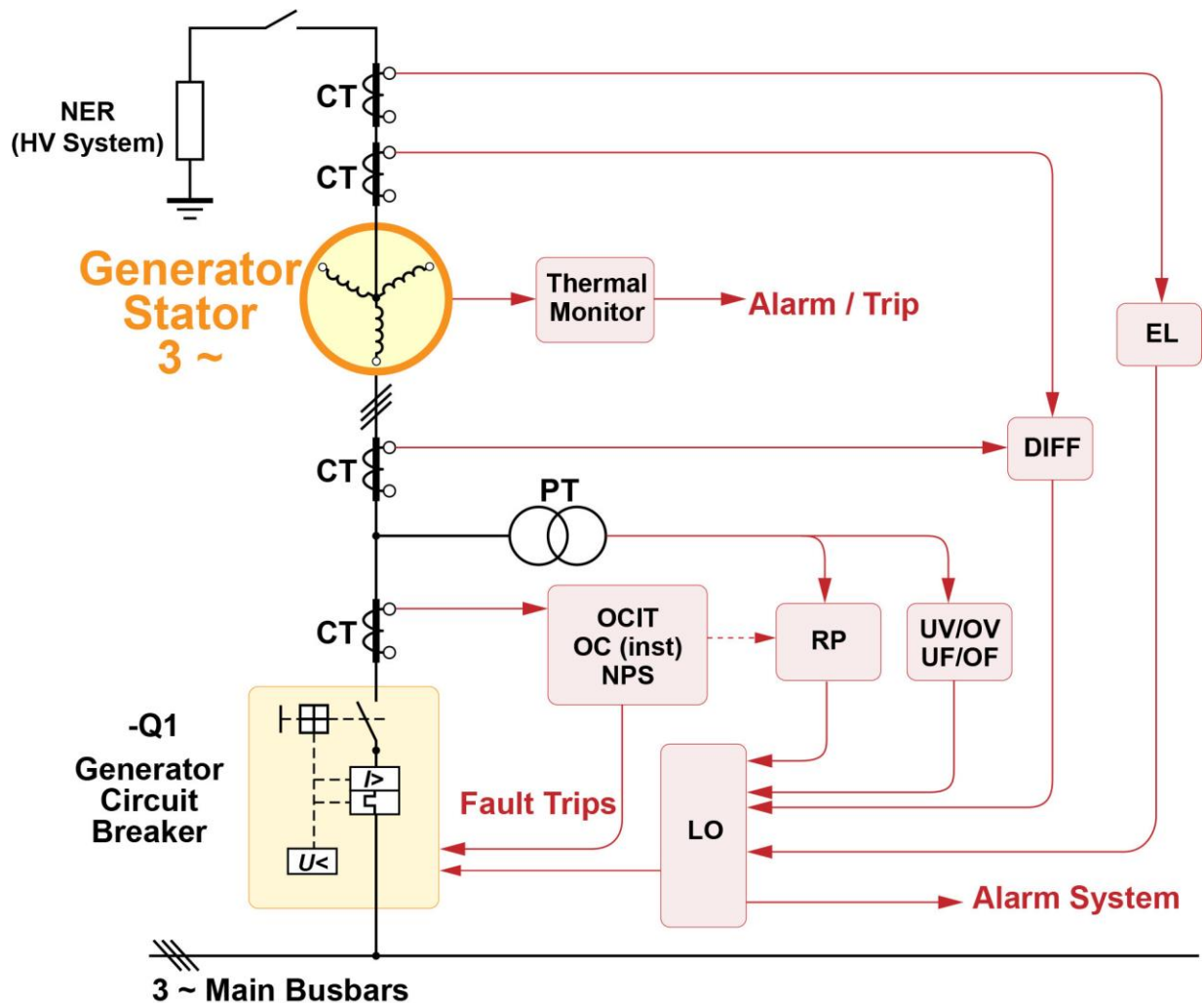
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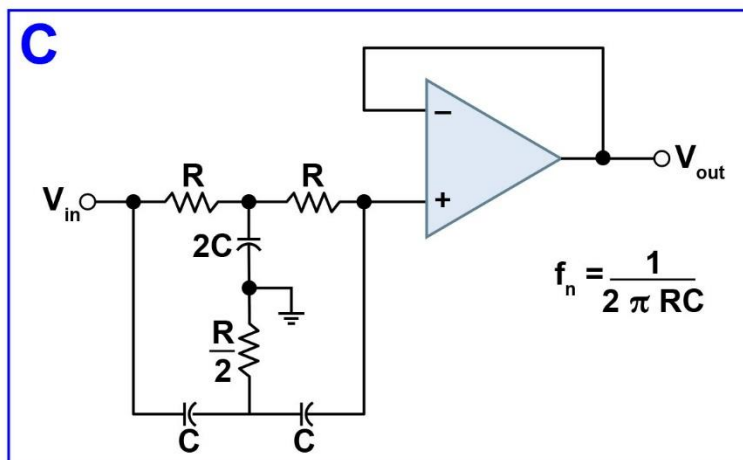
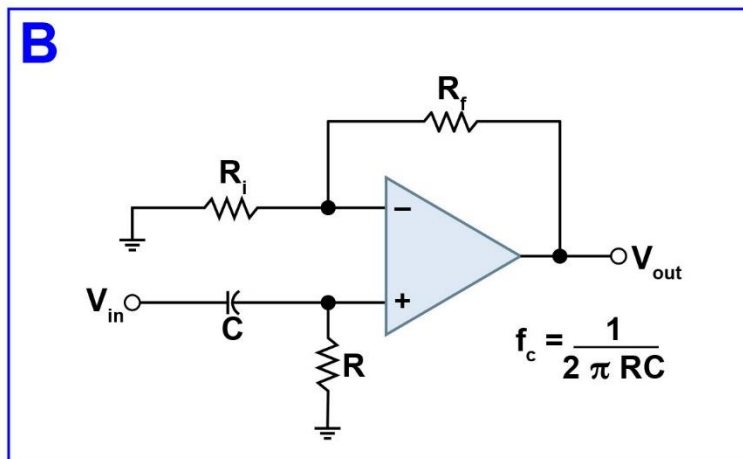
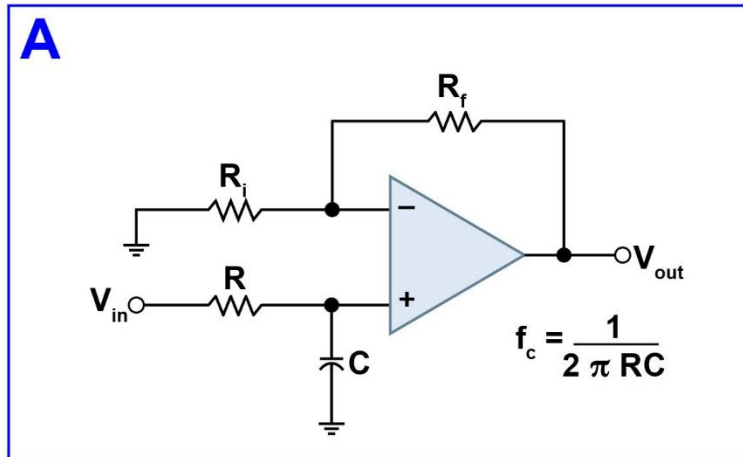


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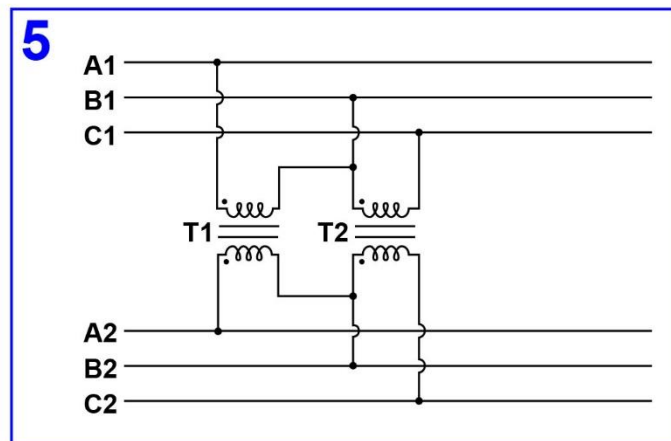
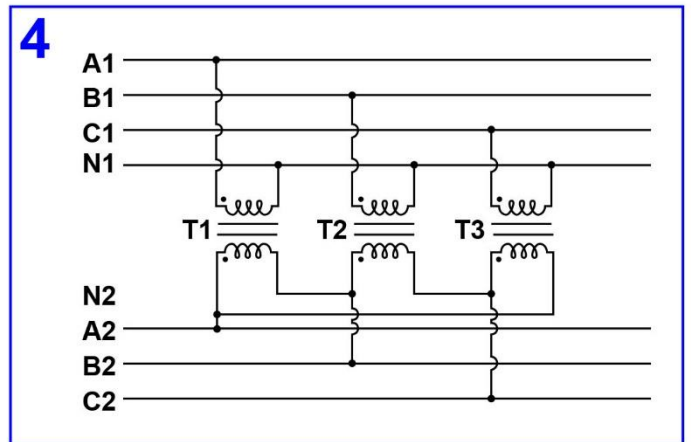
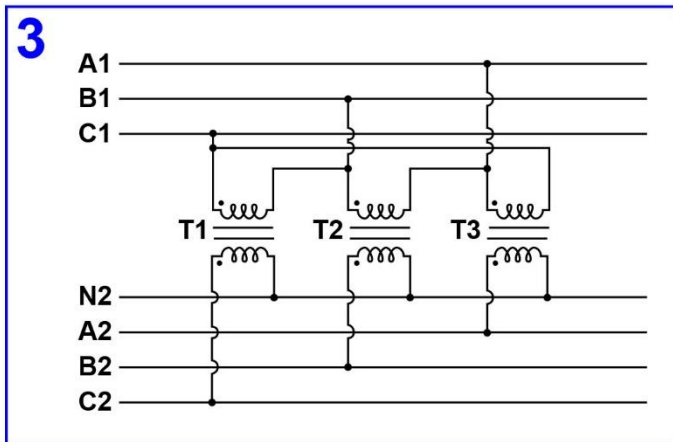
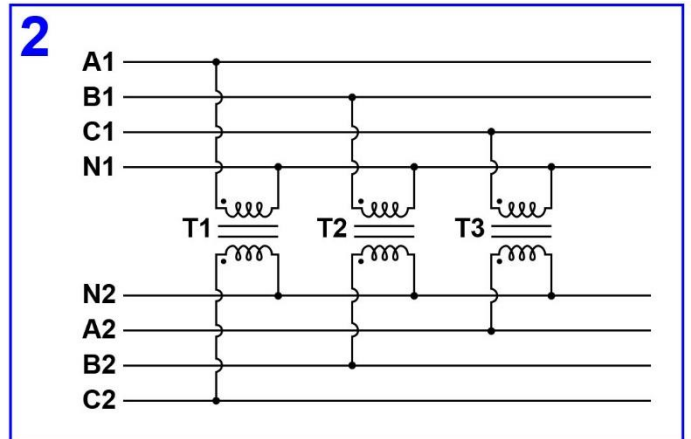
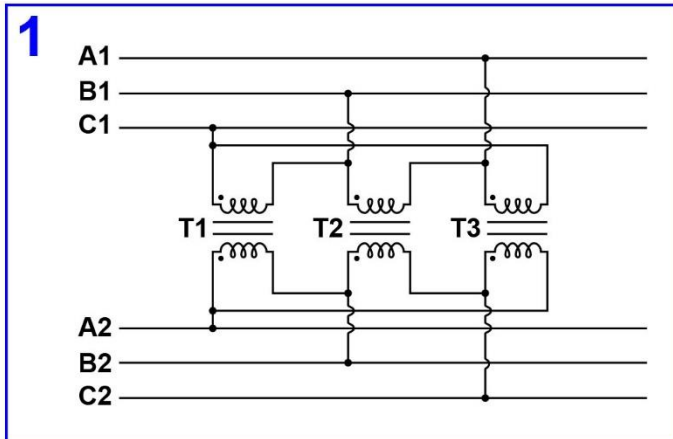
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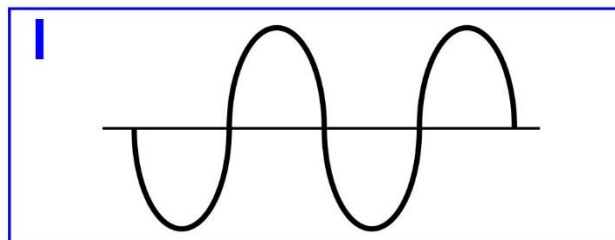
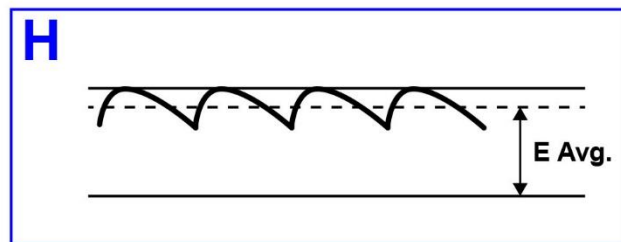
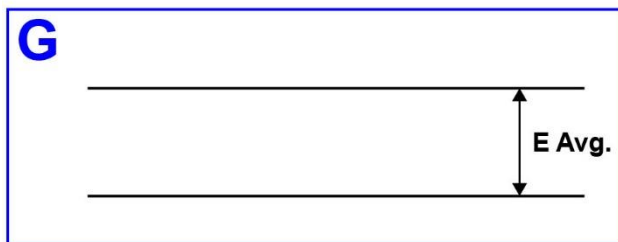
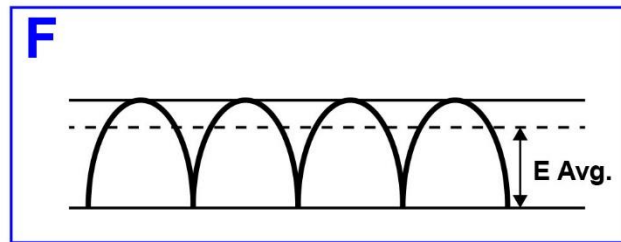
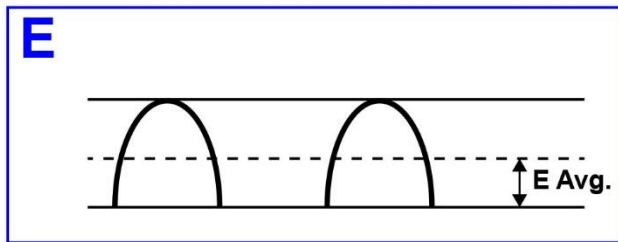
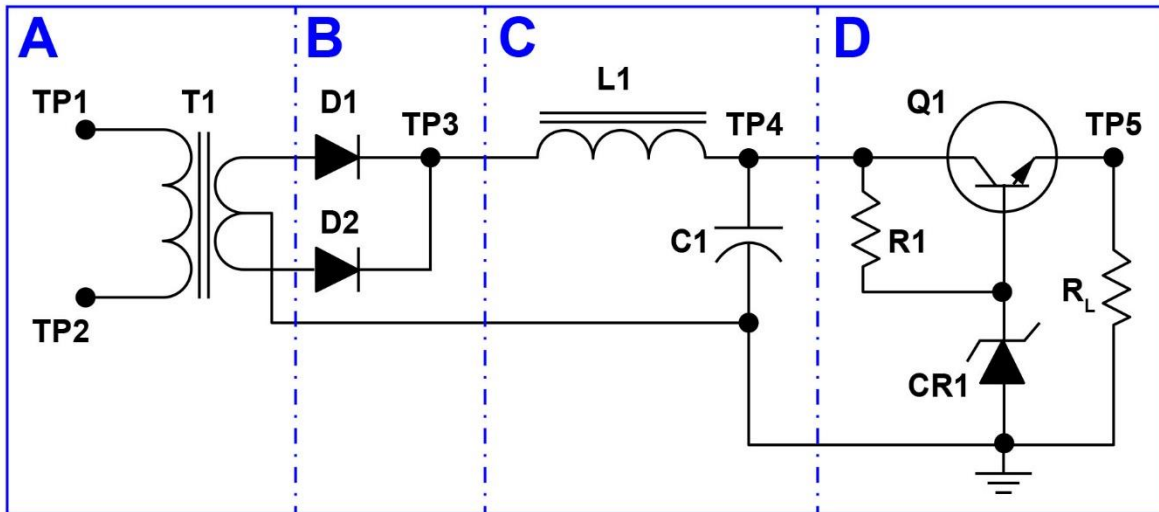
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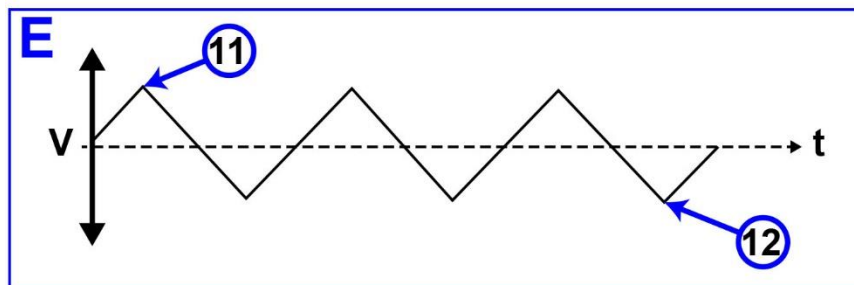
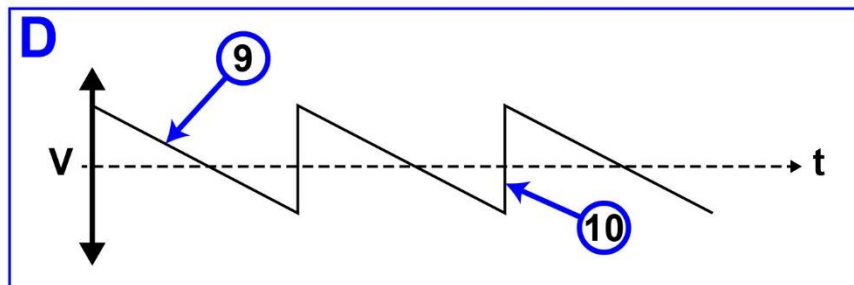
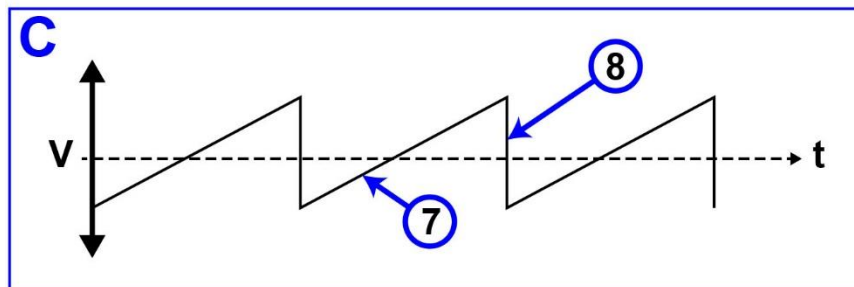
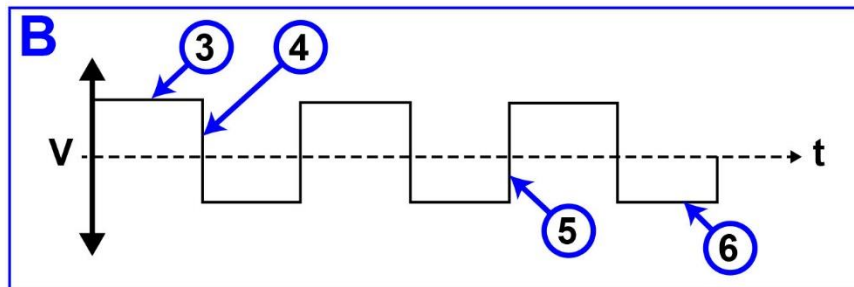
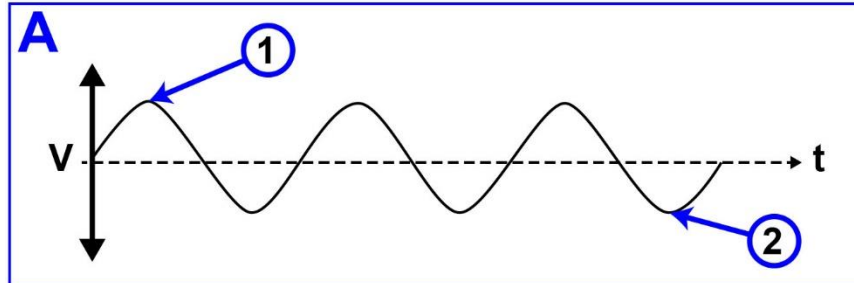
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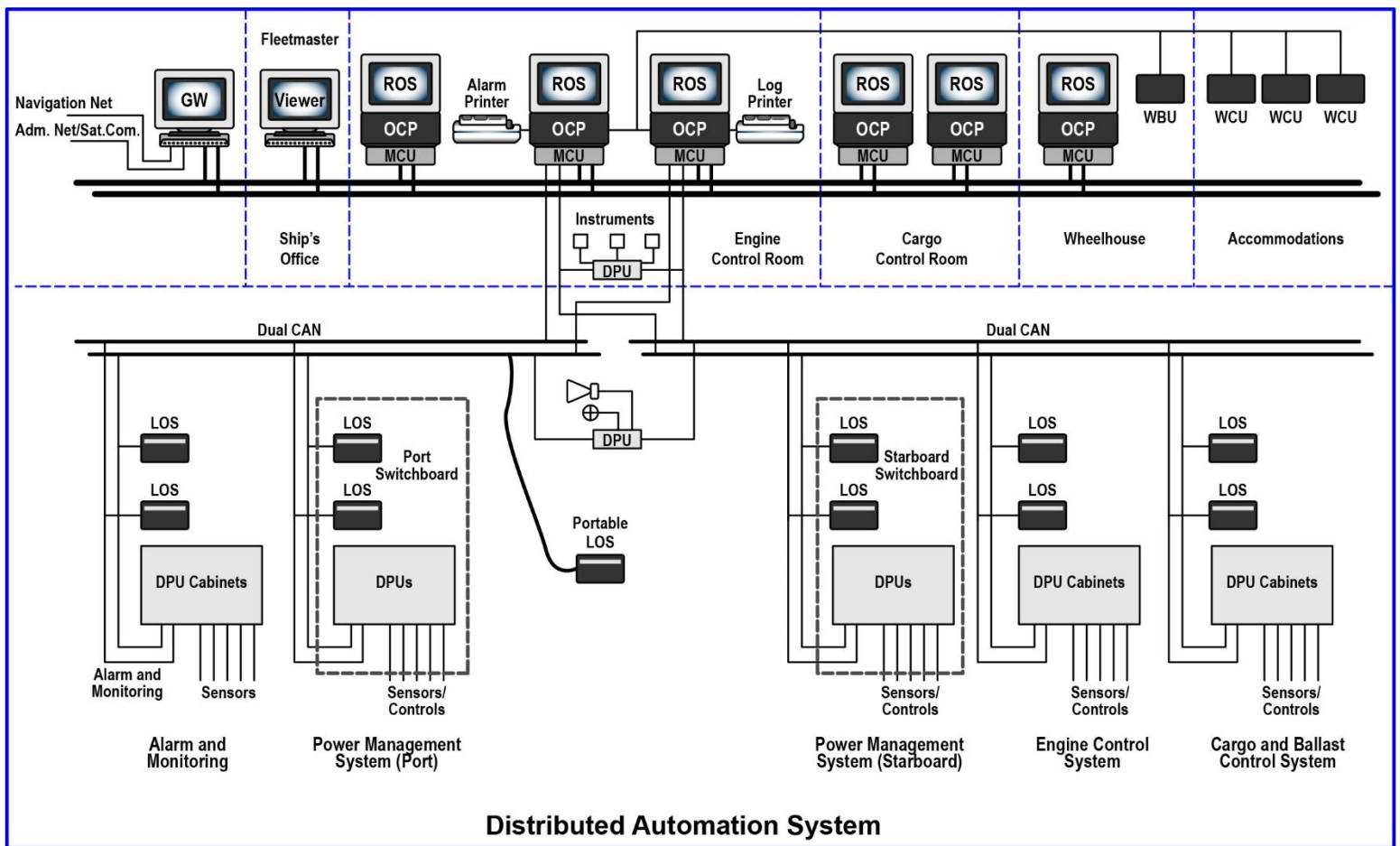
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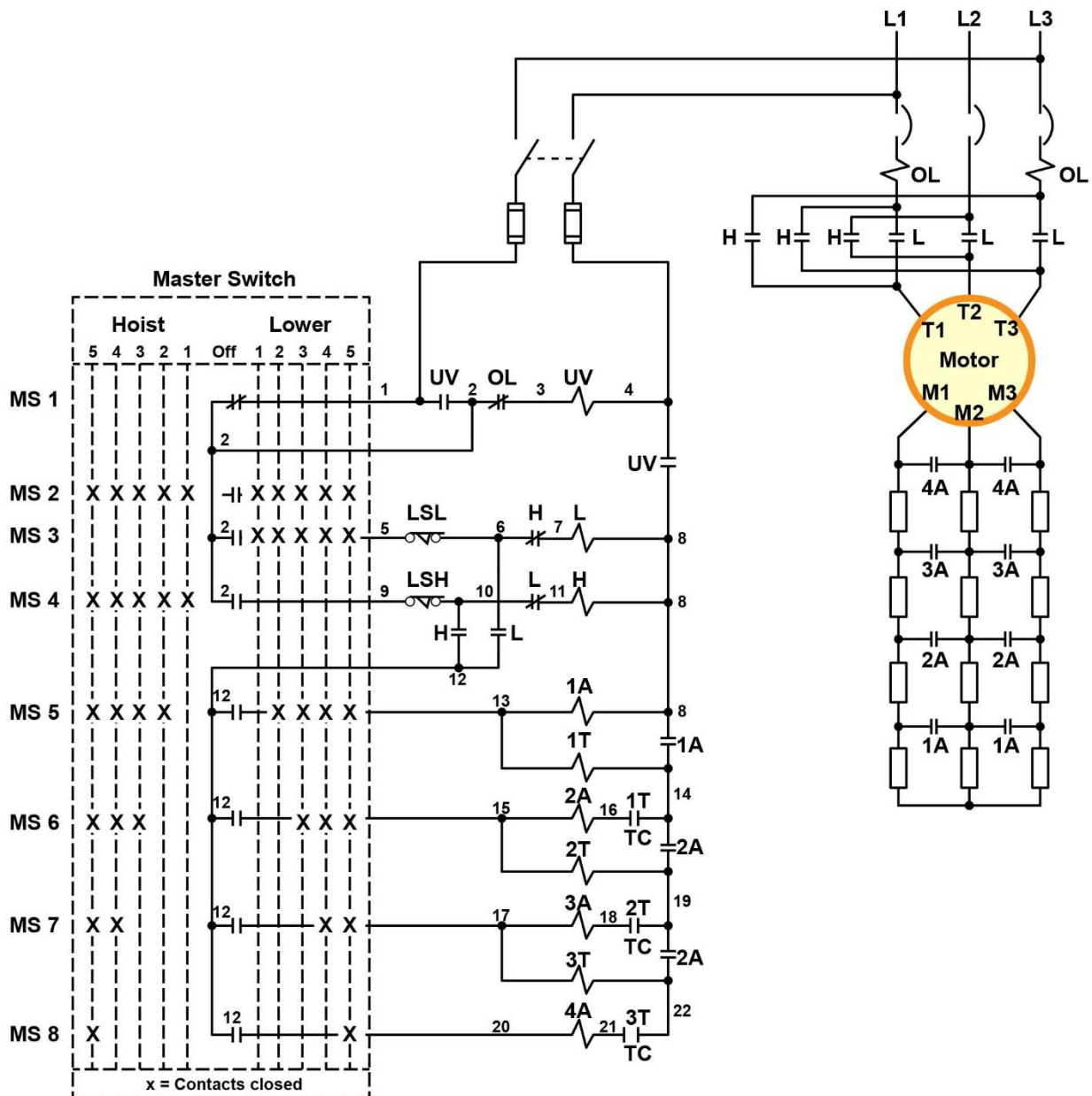
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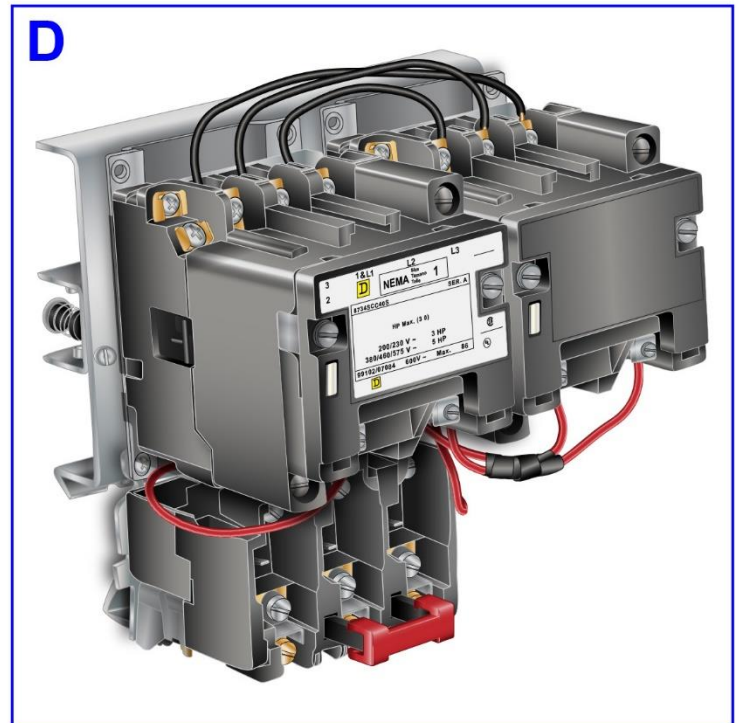
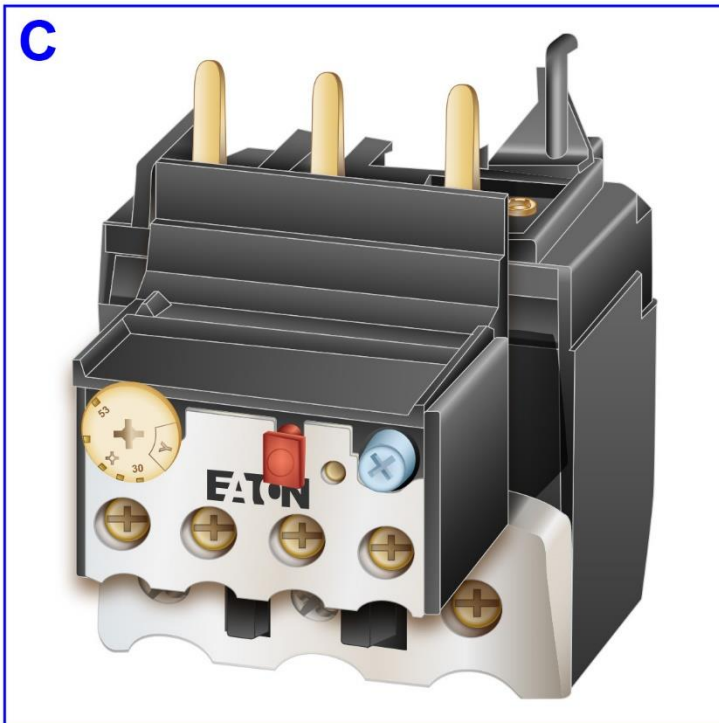
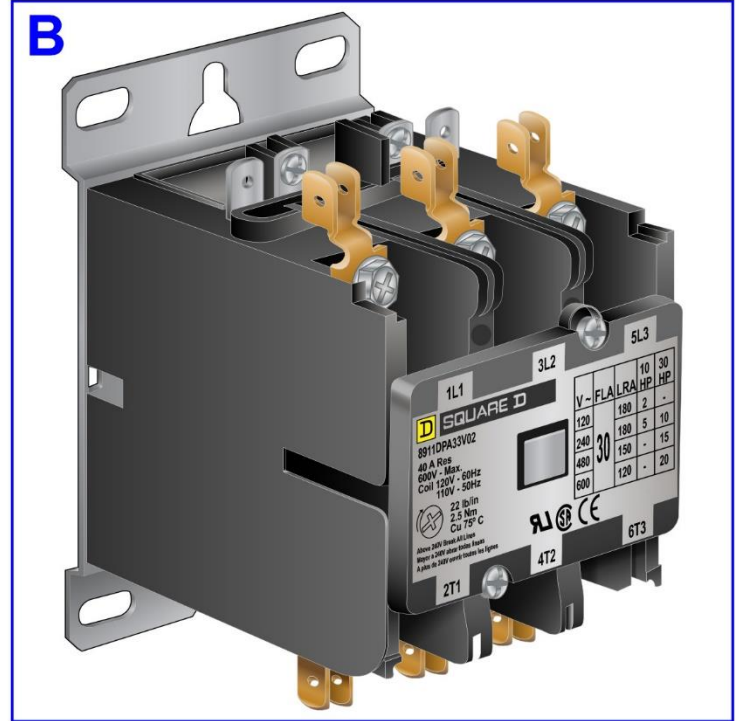
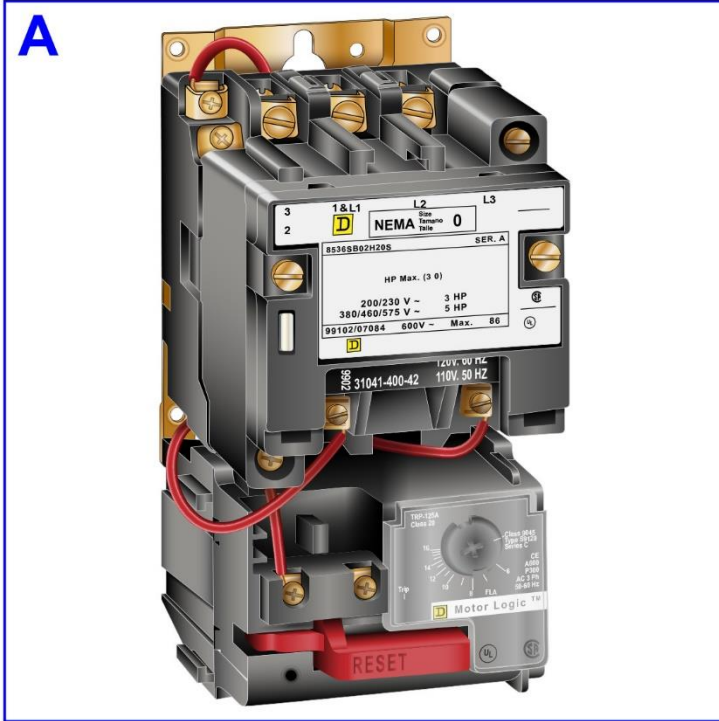


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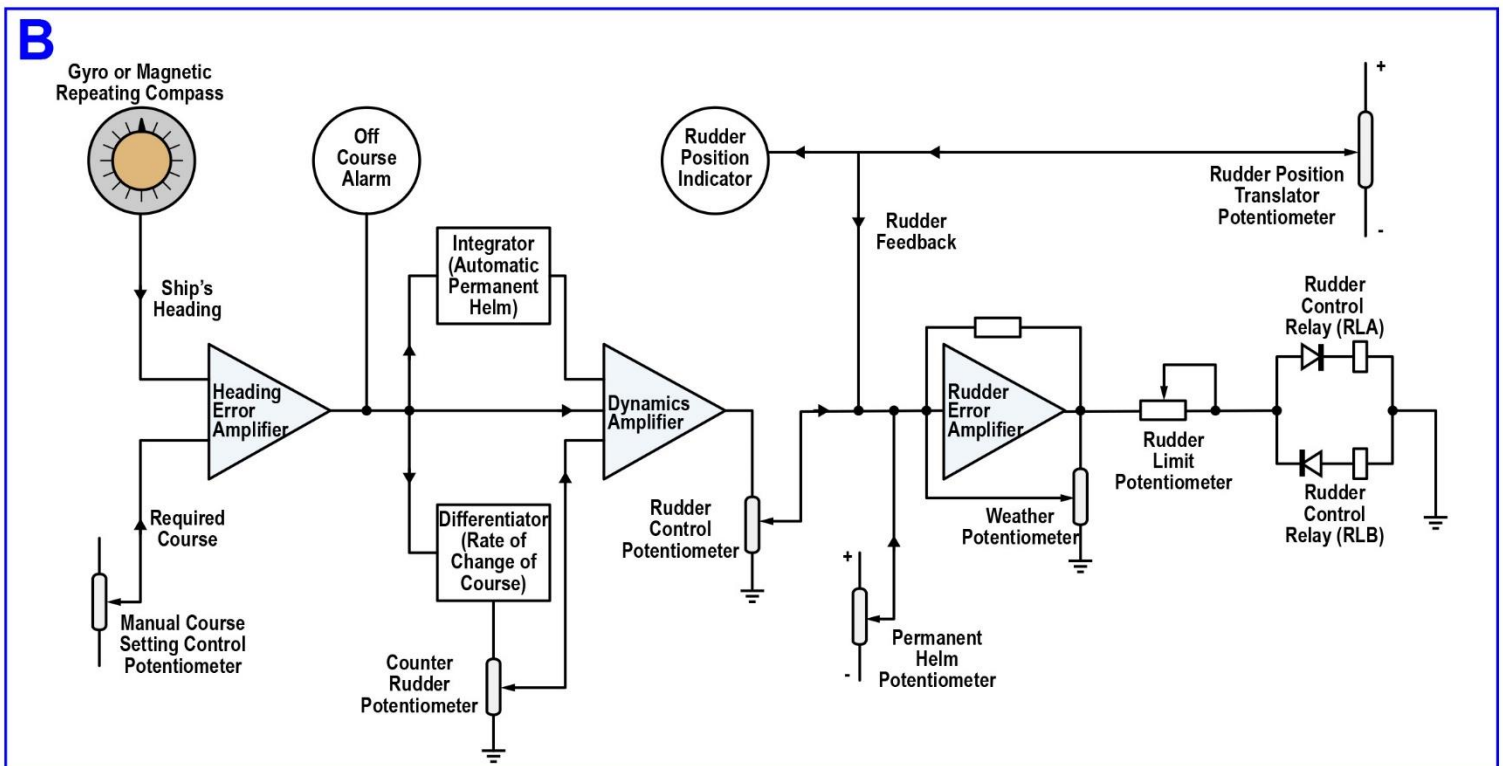
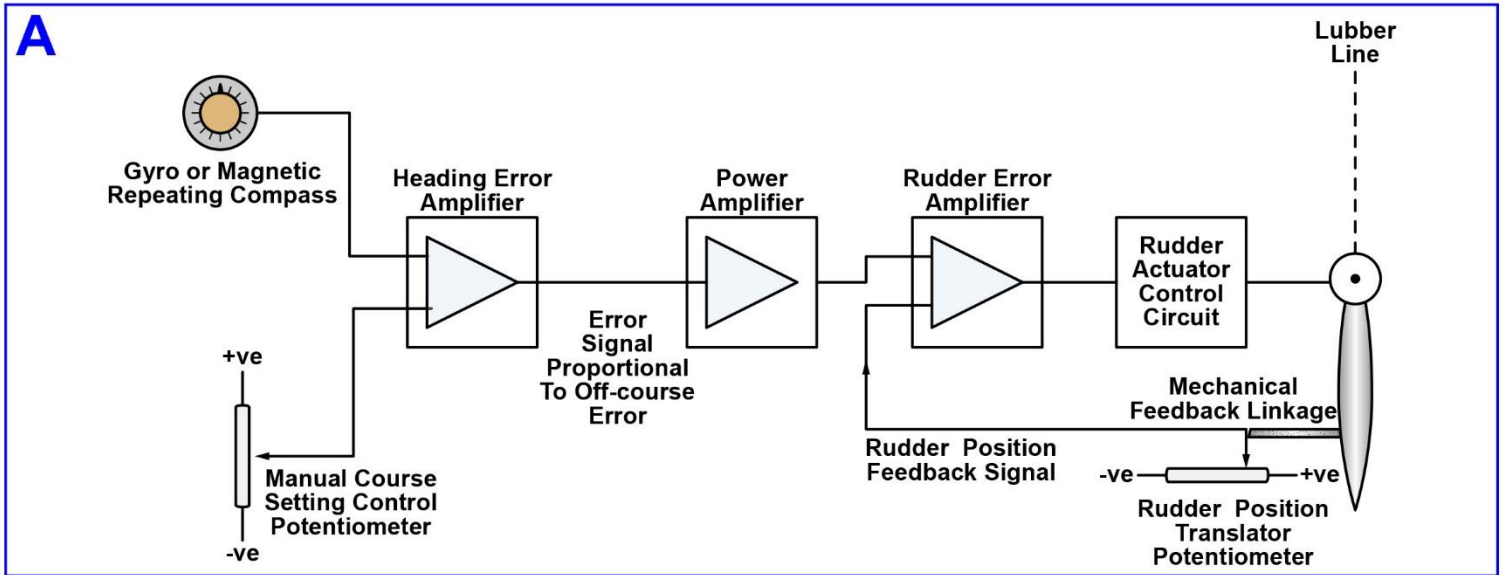
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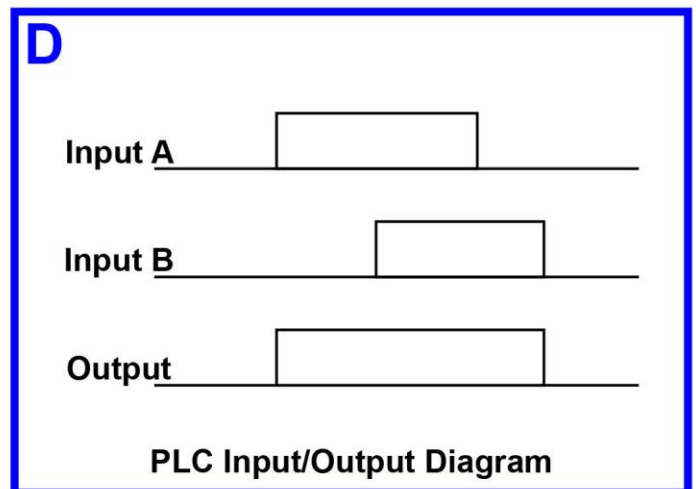
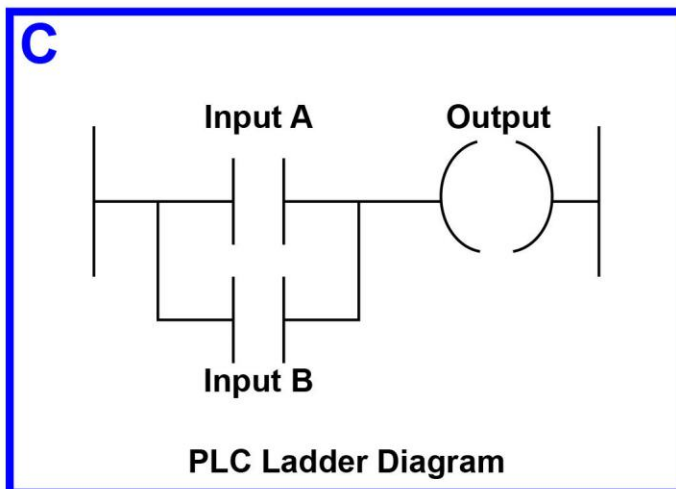
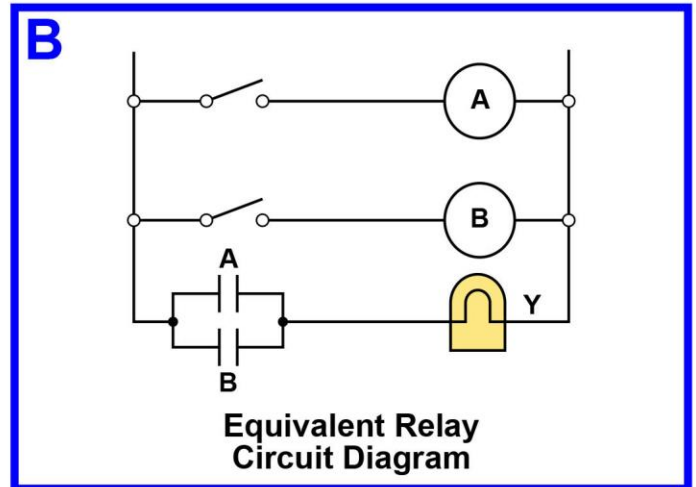
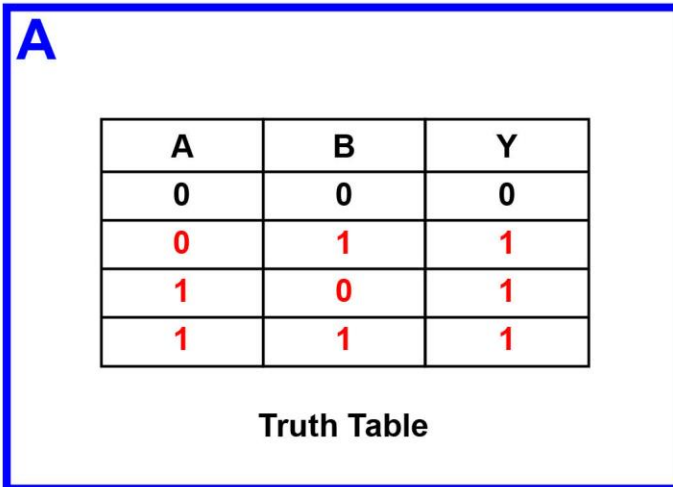


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EL-0231 Relay and PLC Logic Compared

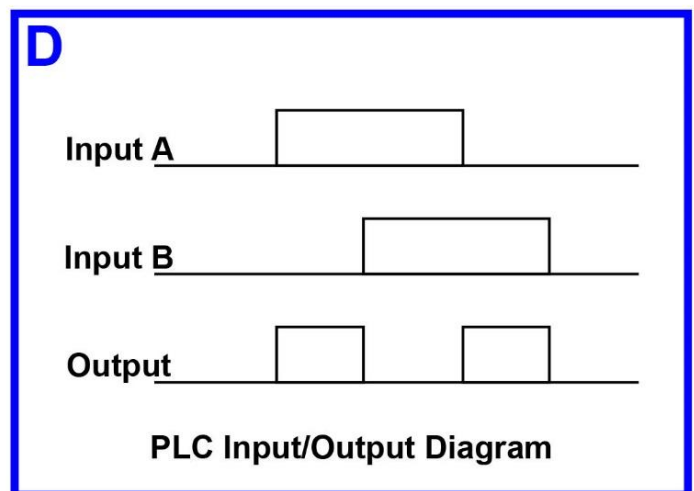
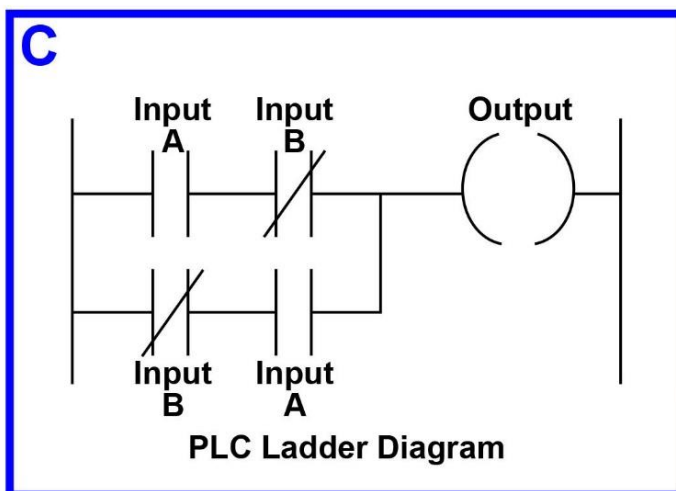
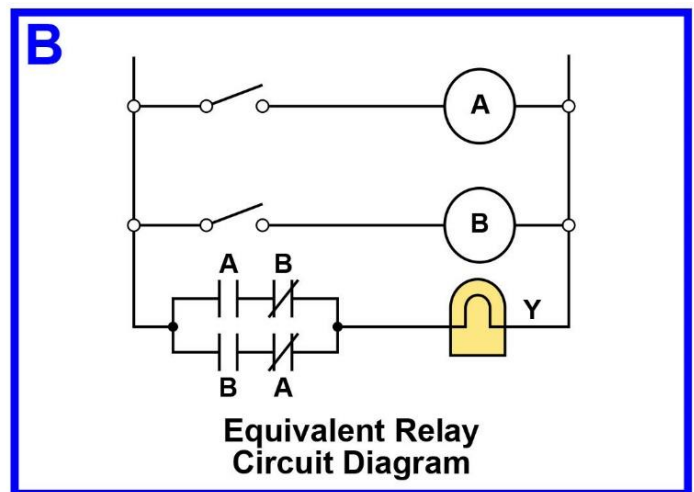
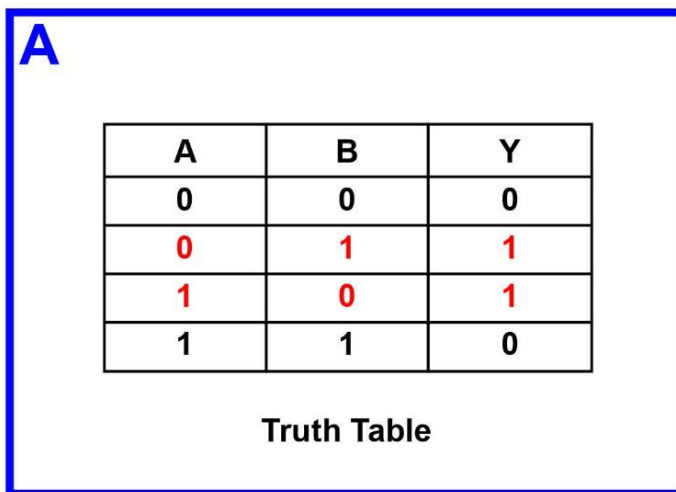


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