Past Examination Questions for Certificate of Competency as a Chargeman L1

Structure of Theory Examination Paper:

PART A: 30 Objective Questions (1 Mark for Each Question)
PART B: 5 Short Answer Questions (5 Marks for Each Question)
PART C: 3 Essay Type Questions (15 Marks for Each Question)

Duration:3 Hours

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Electrical Inspectorate Unit, Ministry of Public UtilitiesSarawak (2016)

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

A Voltmeter
B Ammeter
C Watt-meter
D Ohm-meter

2 What is the purpose to install the gear box on an electric motor coupled with a load?

A Form high torque at low speed
B Form low torque at high speed
C Produce low speed without change to the torque
D Produce high speed without changing the torque

3 Which of the following statement **BEST** describe the CT having a ratio of 200/5A?

A If primary current 100A, secondary current will be 1A
B If primary current 100A, secondary current will be 5A
C If primary current 100A, secondary current will be 4kA
D If primary current 100A, secondary current will be 2.5A

4 Which of the followings affect the speed-torque characteristics of an induction motor?

I Applied voltage
II Rotor resistance
III Supply frequency

A I and II only
B I and III only
C II and III only
D I, II and III only

5 How to improve low power factor where the induction motors has a capacitive effect?

A Connect capacitor
B Connect inductor
C Connect resistor
D Non of the above

6 Given a CT ratio of 900/5A and the approved load is 720A. Calculate the percentage of new setting value.

A 125%
B 111%
C 97%
D 76%

7 In a three-phase system, the voltage measured between the red phase and neutral reads 240V. What is the reading if we put the probe between yellow phase and blue phase?

A 120V
B 240V
C 415V
D 480V

8 A 3.5hp air-conditioner unit is installed at a single phase 240V supply system. What is the minimum over-current protection rating for this air-conditioner unit?

A 6A MCB
B 10A MCB
C 16A MCB
D 20A MCB

9 An electrical equipment is drawing 80A of current when connected to a single phase 240V supply. Find the real power consumed by the electrical circuit.

A 19.2kW
B 1920W
C 0.33W
D 3W

10 Choose the appropriate type of fire extinguisher to put out fire on an electrical equipment.

I Foam
II Water
III Dry powder
IV Carbon dioxide

A I, II and III
B II, III and IV
C I, III and IV
D III and IV

11 Which of the main switchboard installations requiremment listed below is **FALSE**?

A Meter panel shall be sealable from the outside
B Size of the panel shall be 500 x 600 x 270mm (H X W X D)
C Panel shall be made of mild steel of minimum 1.5mm thickness
D Seperate energy meter panel is required to be installed outside the MSB

12 Given a 1400/5A current transformer, the maximum current flow from the secondary side is _____.

A 3 A
B 5 A
C 15 A
D 1400 A

13 Name the voltage labelled D in Diagram 1 below.

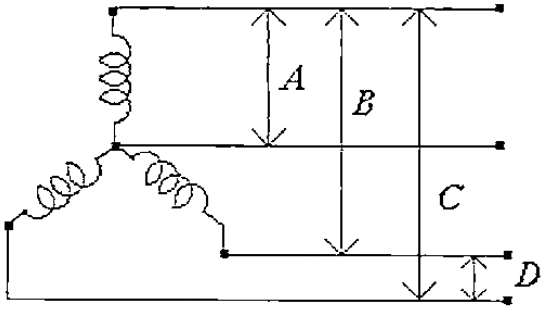


Diagram 1

A Line voltage
B Earth voltage
C Phase voltage
D Floating voltage

14 Which of the followings is **NOT** a general requirement of earthing conductor and protective conductor?

A Sufficiently low impedence to meet the need to carry any earth fault currents
B Strong enough to withstand mechanical damage
C All mechanical joints are to be kept concealed
D Conductor used must be of sufficient size

15 Which of the following can predict the direction for the motion from the electric current and magnetic field which exist in an electric motor?

A Fleming's left hand rule
B Fleming's right hand rule
C Fleming's Thumb Rule
D Fleming rules of hand

16 Which of the following fault may occur in an electrical circuit?

A Low resistance between live conductor and earthed metalwork
B Loss of continuity
C Bad joint
D All of the above

17 Which of the followings best describe the breaking capacity of an overcurrent protective device?

A More than the amount of prospective short circuit current in the circuit
B Equivalent to the amount of prospective short circuit current in the circuit
C Less than possible amount of short circuit current in the circuit
D 50% of the amount of prospective current in the circuit

18 Identify four refrigeration cycle basic components in the correctorder.

A Compressor, condenser, receiver tank and evaporator
B Compressor, evaporator, condensor and receiver tank
C Compressor, condenser, metering devices and evaporator
D Compressor, condenser, metering devices and hand valve

19 What is the purpose of a current transformer in an electrical installation?

A Measure current at busbars
B Increase current flow into ammeter
C Prevent short circuit current at installation
D Limit and minimize current flowing into ammeter for metering and protection

20 Which of the following test is to be carried out after temporary supply is connected during testing of an electrical installation?

A Continuity of ring final circuit conductors
B Earth electrode resistance
C Insulation resistance

D Polarity

21 Which of the following is **NOT** true?

A I_b is the design current
B I_c is the operating current for protection devices
C I_n is the nominal current or rating of the protection devices
D I_z is the current carrying capacity of the cable in situation where it is installed

22 Fault currents can discharge enormous quantities of energy causing excessive temperatures or mechanical forces. Which of the following is **TRUE**?

A The above can cause catastrophic damage to property
B The above can cause injury to persons or livestocks
C The above can cause system collapse
D All of the above

23 Which of the following is not an electric discharge lamp?

A Low-pressure sodium lamp
B Fluorescent lamp
C Neon lamp
D LED

24 Which of the following sentence **BEST** describes a primary cell?

A A cell that can be recharged
B A cell that cannot be recharged
C Usually combined to form a battery
D Lead acid is one of the common type

25 If a battery of 1.5V and a battery 6.5V are connected in series, what is the output voltage obtained?

A 1.5V
B 6.5V
C 8.0V
D 12.0V

26 If the cross-sectional area of the phase conductor is 50 mm^2, what is minimum cross-sectional area of the corresponding protective conductor?

A 5 mm^2
B 25 mm^2
C 50 mm^2
D 100 mm^2

27 What is the common ratio for an isolation transformer?

A 1:1
B 2:1
C 1:2
D 10:1

28 In a main switchboard room, what is the minimum clearance from the back of the MSB to the wall?

A 600mm
B 750mm
C 900mm
D 1000mm

29 Which of the following is commonly use as the core material of a low frequency transformers which operates at 50Hz?

A Zinc
B Copper
C Ceramic
D Silicon steel

30 Which of the following does **NOT** require a reduced-voltage starting method motor control starting?

A Primary-resistance
B Auto-transformer
C Direct-on-line
D Star-delta

31 When two resistors, R_1 and R_2 are connected in series, the total resistance value would be calculated as _____.

A. $R_1 + R_2$
B. $R_1 - R_2$
C. $R_1 \times R_2$
D. $R_1 \div R_2$

32 Given that the line voltage, V_L in a 3-phase system is 415V and the line current I_L is 80A, find apparent power.

A. 24
B. 33
C. 46
D. 57

33 Which of the following mathematical function is used to find power factor?

A. sin
B. cos
C. tan
D. log

34 An AC circuit is loaded with inductive load (such as motor) will cause the power factor to _____.

A. Leading
B. Lagging
C. Lead-lag
D. Lag-lead

35 Which of the following transformer formula is **FALSE**?

A. $V_p/V_s=N_p/N_s$
B. $Z_p/Z_s=(N_p)^2/(N_s)^2$
C. $I_p/I_s = N_s/N_p$

D. $\mathbf{I_p/V_p=N_s/N_p}$

36 Which of the following symbol is used to represent the factor of "The current carrying capacity of the cable in the situation where it is installed"?

A. Ib
B. Iz
C. In
D. Ci

37 According to IEE 16th Wiring Regulations, what is the maximum allowable voltage drop for a three phase supply?

A. 4%
B. 6%
C. 10%
D. 25%

38 What is the configuration of the primary winding (incoming) of a three phase transformer commonly found in a substation*?*

A. star winding
B. delta winding
C. star-star winding
D. delta-delta winding

39 According to the IEE Regulation 16th edition, what is the minimum resistance value in an **INSULATION TEST** for a three phase system?

A. 0.25 mega ohm
B. 0.5 mega ohm
C. 1.0 mega ohm or more
D. Less than 1.0 mega ohm

40 Given that the cable voltage drop property of a cable is 18 mili volt per meter per Ampere. Calculate the voltage drop for this circuit if the length of the cable is 8 meter and carries a current of 16 Ampere.

A. 1.15 volt
B. 1.36 volt
C. 1.64 volt
D. 2.30 volt

41 What are the three components in the fire pyramid?

A. Fire, earth, and water
B. Oxygen, fuel, and heat
C. Oxygen, gas, and heat
D. Fuel, heat, and petrol

42 There are four (4) stages in the process of combustion of fire. Which stage of the combustion has no visible smoke, flame or significant heat?

A. Incipient stage
B. Smoldering stage
C. Flame stage
D. Heat stage

43 What is the ratio for an isolation transformer?

A. 2:1
B. 1:1
C. 1:2
D. 10:1

44 Which of the following can be found in a main switch board?

A. Ballast
B. Overcurrent Relay
C. Switch Socket Outlet
D. Choke

45 Which of the following component is to receive low pressure, low temperature fluid from the expansion valve and bring it close thermal contact with the load?

A. Condenser
B. Compressor
C. Evaporate
D. Blower

46 Which of the following condition is **TRUE** when selecting a protective device for a cable?

A. $I_z \leq I_n$
B. $I_n \geq I_b$
C. $I_n \leq I_b$
D. $I_z \leq I_b$

47 Which of the following battery is **NOT** re-chargeable?

A. primary cell
B. secondary cell
C. third cell
D. lower cell

48 What type of system (earthing) is adapted by SESCo?

A. TN system
B. TN-C system
C. TN-C-S system
D. TT system

49 Which of the following is **NOT** a method of joining two cables?

A. Britannia joint
B. Tee twist joint
C. Married joint
D. American joint

50 Why is it important to perform battery maintenance?

A. To improve the lifespan of the battery.
B. To increase the voltage of the battery.
C. To fulfill the company requirements.
D. To get appraisal from the company.

51 Define “bonding conductor”.

A. The conductive mass of earth, whose electric potential at any point is conventionally taken as zero.
B. The resistance of an earth electrode to earth.
C. A protective conductor providing equipotential bonding.
D. A conductor combining the function of both protective conductor an neutral conductor.

52 According the BS 7671, what is the minimum size of the main protective earth conductor?

A. 3 mm^2
B. 6 mm^2
C. 16 mm^2
D. 25 mm^2

53 The coil of an electrical measuring instrument is connected to the terminal of the instrument through two spiral springs. What is the purpose of these springs?

A. Supply a reacting force proportional to the deflection
B. Supply an acting force proportional to the deflection
C. Supply additional force to the meter
D. Reduce force to the meter

54 What type of force is developed around the conductor when an electric current flows through it?

A. Electric
B. Electro-dynamic
C. Magnetic
D. Rotation

55 How many mode of operation does a HBC fuse have?

A. One
B. Two
C. Three
D. Four

56 What does I∆n denotes in an RCD or RCCB?

A. Delta current
B. Fusing current
C. Current rating
D. Rated residual current

57 Which of the following device will provide overload protection?

A. Linked switch
B. Residual current device
C. Disconnector
D. Circuit breaker

58 What are the advantages of lead acid cell type?

A. Lower cost

B. Lower internal resistance
C. Does not need special battery charger
D. All of the above

59 A complete DC power supply is made up from the following, **EXCEPT**

A. Transformer
B. Bridge rectifier
C. Capacitor
D. Voltmeter

60 Which of the following is **NOT** a Reduced-Voltage Starter for motor?

A. Direct
B. Star
C. Auto
D. Primary

61 An electric kettle rated at 1780 watt is being plug into a 13A socket outlet. Calculate the current consumption for this circuit.

A 0.74 A
B 7.41 A
C 17.4 A
D 174.1 A

62 Which equipment in distribution board will break the circuit when excess current flows, thus protecting circuit conductors from damage?

A Fuses or Circuit Breaker
B Kilo watt meter
C Amp meter
D Isolator

63 What is power?

A The opposite to current flow
B Flow of free electrons in one definite direction
C Electrical pressure and always occurs between two point
D Amount of work that can be done in some standard amount of time, usually one second

64 Cable PVC or rubber-insulated non sheathed can be used _____.

A in conduit, cable ducting or trunking, but not in such conduits etc, buried underground
B in general indoor use other than embedding and underground in conduit or pipes
D in overhead wiring between buildings and underground in conduits or pipes.
C in general indoor use and on exterior surface walls and the like

65 Under SESCO Fire Safety Rules, which of the followings is **FALSE**?

A Portable CO_2 extinguishers may be used in the vicinity of Live equipment provided that safety clearances are maintained.
B Portable firefighting equipment of water type may be used on any electrical equipment if it has been isolated from the power supply.
C There are no safety clearances to be maintained when handling a portable dry

chemical extinguisher in the vicinity of Live equipment.

D Before any works are to be carried out in any enclosure protected by automatic CO_2, the automatic control should be set into manual control with a Caution notice to this effect attached.

66 Where incoming service cables are connected to un-shrouded busbar terminals, a suitable cover made of insulating materials shall be provided such that no "live" parts are exposed after the switchboard access panels are removed. Such exposure shall be marked indelibly with the _____ sign.

A DANGER
B CAUTION
C MAN AT WORK
D WORK IN PROGRESS

67 According to IEE 16th Wiring Regulations, what is the maximum allowable voltage drop for a three phase supply?

A 4%
B 6%
C 10%
D 25%

68 What is the acceptable value for an insulation test?

A Less than 1Ω
B Less than 100Ω
C More than 1000Ω
D More than 1 MΩ

69 A 3.6 HP air-conditioner unit is installed at a single phase 240V supply system. What is the minimum over-current protection device rating for this air-conditioning unit?

A 6A MCB
B 16A MCB
C 20A MCB
D 32A MCB

70 Which component of an air-conditioner unit is capable of changing hot liquid to cold liquid?

A Expansion valve
B Condenser coil
C Compressor
D Thermistor

71 Choose the appropriate type of fire extinguisher to put out fire caused by electrical equipment.

A Dry soda
B Foam base
C Water base
D Dry powder

72 In controlling street lighting, which component can help to trigger the circuit, when timer clock is defective?

A DC supply

B Photocell
C Contactor
D Amplifier

73 What is the component name inside a rectifier device that is able to transform AC to DC supply?

A LED
B Diode
C Resistor
D Capacitor

74 In lead acid type battery, the container is normally filled with _____.

A 35% sulphuric acid and 65% of water solution
B 25% sulphuric acid and 75% of water solution
C 55% electrolyte and 45% of water solution
D 35% mercury and 65% of water solution

75 Which type of battery is suitable to be used on vehicle?

A Lithium
B Mercury
C Alkaline
D Lead acid

76 The power factor is very important in determining the _____.

A current demand
B actual true power usage
C the cable size for the incoming side
D the ratio of the real power flowing to the load over apparent power

77 What happen to the conductor when power factor value drops to below 0.6?

A The current is smaller
B The cable may explode
C The conductor get hot
D The insulation is not affected

78 What is the solution to increase the power factor value if it is low?

A Increase the conductor size on the incoming side
B Reduce the use of inductive load
C Install more resistive load
D Install capacitor bank

79 What is total resistance of the 4 numbers of 10 ohm resistor connected in series?

A 40 mΩ
B 4 Ω
C 40 Ω
D 400 ohm

80 According to IEE wiring Regulation, the tripping time for RCD to operate shall not be _____.

A More than 50 mili-second
B More than 100 mili-second
C More than 250 mili-second
D More than 500 mili-second

81 Which of the followings **BEST** describe continuity test on consumer circuit?

A To measure the power factor
B To measure the current value
C To ensure the insulation cable is good
D To ensure the conductor connection on terminal in secure

82 Earth fault loop impedance value should be _____.

A < 1 Ω
B < 4 Ω
C < 10 Ω
D < 100 Ω

83 A step down transformer has 2400 turns on the primary and 1200 turns on the secondary. Calculate the turn ratio.

A 1:2
B 2:1
C 2:2
D 1:3

84 What is the setting on earth fault relay if the incoming value is 1600A?

A 5A
B 16A
C 160A
D 260A

85 Current transformer is a device found inside a main switchboard to _____.

A measure voltage
B measure current
C measure resistance
D measure power factor

86 In photovoltaic installation, the information is required as listed below **EXCEPT** _____.

A substation source
B LT feeder connected
C the brand of product used
D location of the consumer's PV systems.

87 In grid-connected photovoltaic system, the public electricity grid functions as an _____.

A energy store
B power factor
C solar cell
D battery

88 The speed of a motor is commonly referred to as _____.

A revolution per minute
B rounds per magnet
C reverse per minute
D revolution per mark

89 The electric motor which uses induction principle will always produce eddy current effect. How to minimize this effect?

A Replace a new electric motor
B Put up signage on the affected motor
C Apply additional safety feature to the motor
D Apply lamination to the armature and stator winding

90 The Fleming's Rule is applied to determine the properties of an electric motor, which of the Fleming's rule tell us the generation of energy in a generator?

A Right hand
B Left hand
C Both hand
D No answer

91 Which of the followings is an instrument used to measure very high values of resistance?

A Ammeter
B Voltmeter
C Ohm-meter
D Mega-ohmmeter

92 Which of the following cables has the properties to withstand high temperature?

A PVC cable
B XLPE cable
C Armour cable
D Coaxial cable

93 Which type of sprinkler system is under water pressure at all times so that water will discharge immediately when an automatic sprinkler operates?

A Deluge
B Wet-pipe
C Dry-action
D Limited water supply system

94 Given a CT ratio of 400/5A, the approved load is 360A. Calculate the percentage of new setting value.

A 124%
B 111%
C 97%
D 76%

95 What is power factor?

A Power factor is cable rating.
B Power factor is current demand of an installation.

C Power factor is equal to voltage multiplied by current.
D Power factor is the ratio of true power over apparent power.

96 What is the minimum permissible insulation resistance of an installation?

A 0Ω
B Less than 1MΩ
C 1MΩ
D 1000MΩ

97 In a three-phase system, what is the voltage measurement if we put the meter probe between Blue and Red phase?

A 120 volts
B 240 volts
C 390 volts
D 415 volts

98 Which of the followings is **NOT** a factor to approve the use of IDMT earth fault protection in an MSB installation?

A Loads where an interruption of supply can cause chaos.
B Non-essential loads where an interruption of electricity supply can be momentarily tolerated.
C Loads where the sub distribution boards are situated at significant distances from the MSB.
D Commercial loads where an interruption of supply will cause business downtime and inconveniences.

99 How can we improve low power factor of a main switch board?

A Install resistor bank
B Install capacitor bank
C Install inductor regulator
D Install power factor regulator

100 *Transformer Impedance* 2.5%, *500kVA, 11/0.433kV, three phase. Berapakah* nilai *Prospective Short Circuit Current* pada*Secondary*?

A 26.7kA
B 20kA
C 1.1kA
D 1kA

101 Which of the following component transforms alternating current (AC) into direct current (DC)?

A LED
B Resistor
C Capacitor
D Diode

102 What is the ideal value for an earth path resistance?

A 0Ω
B 100Ω
C 1MΩ

D 100MΩ

103 Which of the following method helps to keep eddy current in the transformer core to a minimum?

A Use more windings
B Use laminated core
C Use larger iron core
D Use higher voltage at the primary windings

104 What happens if the power factor value drops too low?

A Nothing happens.
B Higher voltage drop along conductor.
C Less current flowing along conductor.
D Cost saving in the generation of electricity.

105 Given the size of a phase conductor is 95 mm^2, what will be the suitable cable size for the CPC?

A 16 mm^2
B 25 mm^2
C 35 mm^2
D 50 mm^2
A 16 mm^2

106 What happens when two current carrying conductors are close together?

A Nothing happens.
B The magnetic field of the two conductors will overlap.
C If current is in the same direction in both conductors, the conductors repels each other.
D If current is in the same direction in both conductors, the conductors are pulled together.

107 What is the minimum thickness and width of rubber mat to be placed in front of an entire length of a Main Switch Board (MSB) in the MSB room?

A No minimum thickness and width = 600mm
B No minimum thic55kness and width = 60mm
C Thickness =5 mm and width = 600mm
D Thickness =5 mm and width = 60mm

108 Current transformer _____.

A measures the supply voltage
B isolates the instrument or relay from the high voltage
C reduces the voltage to ac motors during starting period
D increases or decreases the supply voltage by a small amount

109 Which of the followings is **TRUE**?

A Resistance is defined as current flow.
B Current is a flow of electrons in one definite direction.
C Current is electrical pressure and always occurs between two points.
D Voltage is caused by two points having the same amount of electrons.

110 What is the purpose of performing continuity test on consumer circuit?

A Measure the current.
B Measure the power factor.
C Ensure the cable insulation is good.
D Ensure there is no break in the circuit.

111 In order for SESCO switching personnel to identify PV customers, approved caution notice must be placed at the following locations **EXCEPT** _____.

A customer's gate post
B substation pillar door
C feeder inside the pillar
D isolator installed outside customer's premise

112 The followings are the factors that determine the capacitance, **EXCEPT**.

A Shape of the dielectric material
B Distance between plates
C Dielectric material
D Effective area

STRUCTURE PART B & PART C

113 List five (5) necessary steps or procedures in order to create a safe working environment.

a. Put up warning or caution signage on the work area.
b. Treat all conductors as LIVE.
c. Perform Lockout tag procedure on the machines where need to be work.
d. Use the correct size of the conductor and suitable type of cables.
e. Isolate LIVE conductor.

114 Explain eddy current loss and hysteresis loss in a transformer.

Hysteresis Loss

- Hysteresis loss is that energy lost during reversing of the magnetic field in the core as the magnetizing AC rises and falls and reverses direction. Each time the direction of magnetization is reversed, some useful energy is wasted in overcoming internal friction.
- Hysteresis loss is minimized by using special alloys known as "perm alloy" for core material.

Eddy Currents

- Eddy current loss is a result of induced currents circulating in the core, which in turn produce heating and therefore reduce the amount of power to the secondary coil.
- In order to avoid eddy currents , the core is laminated, made of thin sheets of soft iron. Each sheet is separated from the next by a layer of insulating varnish.

115 Given the circuit as shown in figure 1, where R1 = 20 Ω, R2 = 20 Ω, R3 = 5 Ω, R4 = 10 Ω, R5 = 15 Ω, R6 = 25 Ω, R7 = 100 Ω and V_{batt} = 120 V.

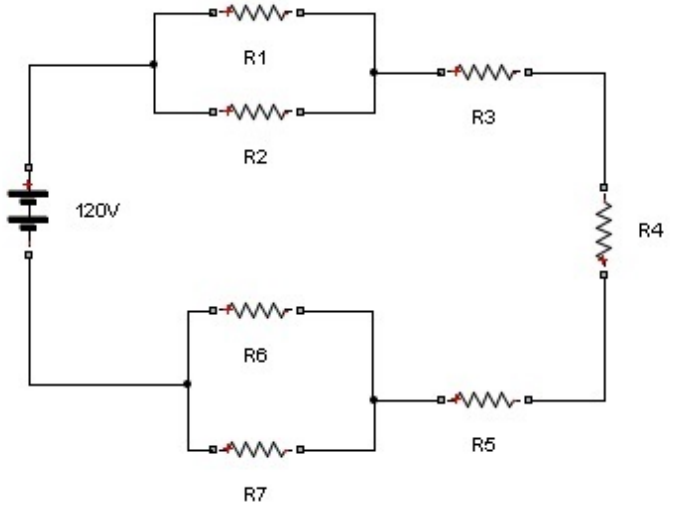


Figure 1

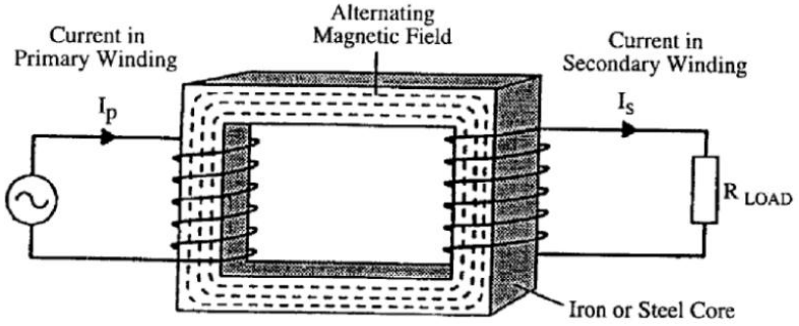
Please find;

a. The total current leaving the battery?
I_T = 2 Amps

b. The power supplied by the battery?
P_{batt} = 240 W

c. The voltage across R5?
V_{R5} = 30 V

116 Briefly explain the operation of an electrical transformer. (Include a basic transformer diagram in your explanation)



When applying an a.c voltage to one side of the coil, it will induce an alternating magnetic field in the core. These alternating magnetic field in the core will then induce an E.M.F in the secondary coil, which causing an A.C current to flow to the secondary circuit.
Electrical transformer used electromagnetism method to create magnetic field in the core from the A.C voltage at primary side. Then, electromagnetic induction occur at the secondary side to create an induced current flow.

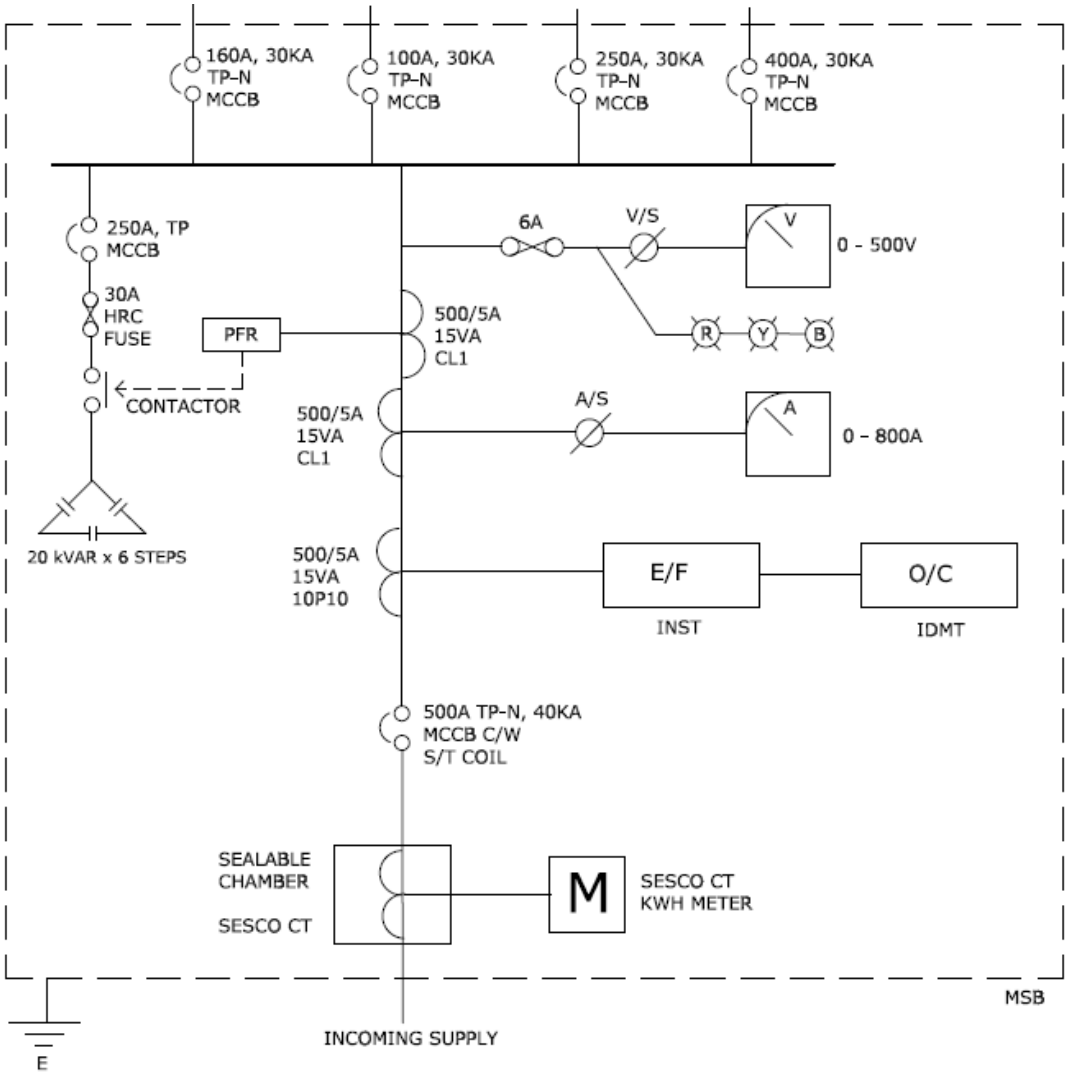
117 List out three common types of faults in a domestic system, and suggest the suitable protective device to be used for each of the faults.

a. Short circuit faults → protective device: fuse, MCB
b. Overloads → protective device: MCB
c. Earth faults → protective device: RCD

118 Draw the schematic diagram of the main switchboard with the following specifications.

- CT ratio: 500/5A, 15VA, 10P10 (protection CT)
- Main breaker: 500A, 40KA, TPN MCCB complete with Shunt Trip
- CT ratio: 500/5A, 15VA, CL.1 (metering CT)
- Over current and earth fault relay
- Indicating lamp (R,Y,B)
- Outgoing feeder breaker 160A, 100A, 250A and 400A, TPN, MCCB
- Voltmeter and ammeter complete with selector switch
- SESCO CT meter complete with CT and sealable chamber
- Capacitor Bank (20 kVAR x 6 STEPS), with CT ratio: 500/5A, 15VA, CL.1 (metering CT), and PFR
- Capacitor Bank: 250A TP MCCB and 30A HRC fuse

[15 marks]



119 List down four (4) tests on a wiring installation which requirend supply to be connected

a. polarity test – using testpen to check on the LIVE terminal
b. earth fault loop impedance
c. protection device tripping time test – RCD test
d. phase sequence test

120 Construct a diagram to explain a three phase TT system

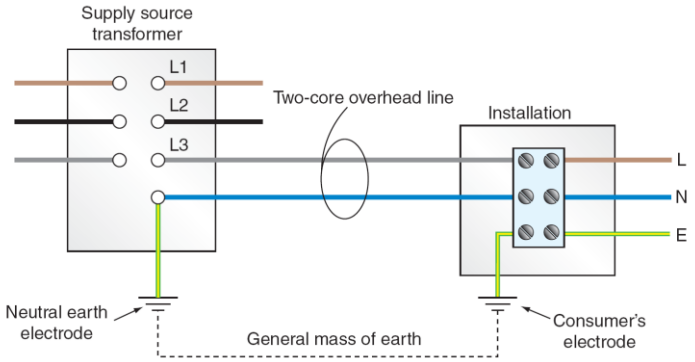


FIGURE 2.7 TT system.

121 a. A three (3) phase 415V furnace rated at 9kW is laid in length of 14 meter from a sub distribution board. The cable size used for this circuit is 10.0mm² PVC and the cable properties is given in the table below.

Type of cable size	Voltage drop (mVA.pm) (3 or 4 cable)
10.0mm² PVC cable	3.8

Find the current and voltage drop for this circuit.

Current, Ib = 21.68A
Voltage drop, Vd = 1.153 Volt

b. Calculate the maximum cable length run if the system is connected to a 415V supply and the cable length is 25 meter and cable voltage drop is 5.6 volt.

Cable length run (max) = 74.10 meter

122 Why aluminium conductor is becoming popular than copper conductor nowadays?

a. Is cheaper than copper
b. Has a larger cross-sectional area for the equivalent current rating than copper

123 What are the **FIVE** (5) components that you can find inside a main switchboard?

a. air circuit breaker (acb) or “main switch”
b. earth fault relay or “EFR”
c. overcurrent protection device or “OC”
d. supply indicator lamp or “phase indicating lamp”
e. current transformer for metering “small CT”

124 a. List down **FOUR** (4) components of refrigeration cycle in an air-conditioning unit.

i. compressor
ii. condenser
iii. expansion valve or metering device
iv. evaporator or cooling coil unit

b. What is the purpose of an expansion valve in an air-conditioning unit?

The expansion valve removes pressure from the liquid refrigerant to allow expansionor change of state from a liquid to a vapor in the evaporator. The high-pressure liquid refrigerant entering the expansion valve is quite warm.

125 a. List **THREE** (3) common types of faults in domestic systems.

a. Short circuit faults / Low resistance fault
b. Overloads / overcurrent
c. Earth faults

b. Based on Figure 1 and Figure 2 below, explain the working principles of a residual current device under normal condition and earth fault condition. Your explanation should include the followings:

i. Current flow in the conductors;
ii. Magnetic fluxes in the toroid (magnetic core); and
iii. Tripping mechanism of the RCCD.

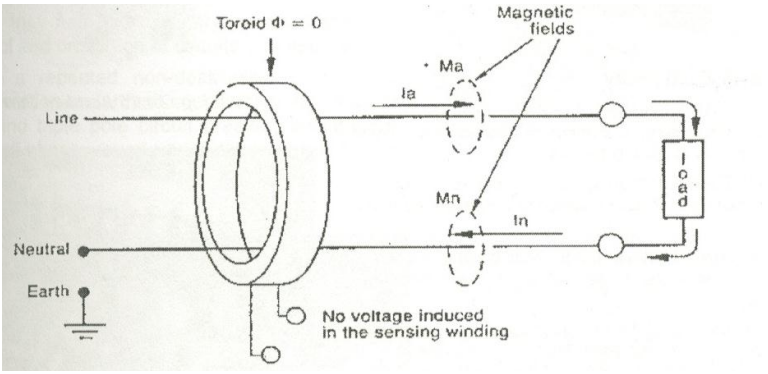


Figure 1: No Earth Fault Condition

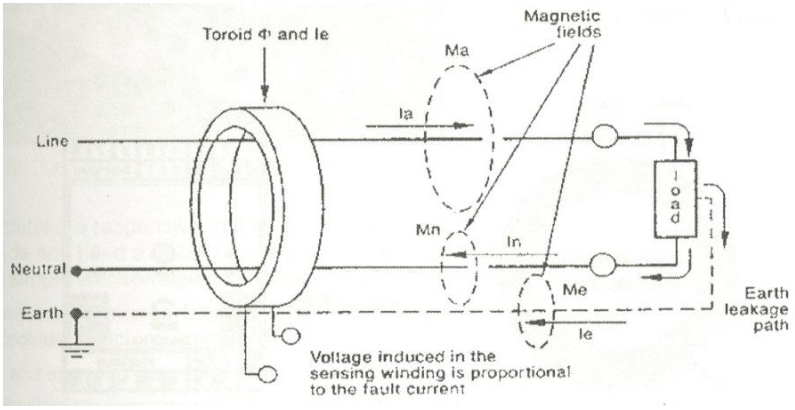


Figure 2: Earth Fault Condition

- Under no earth fault condition, the current flowing in the two conductors LIVE (I_a) and NEUTRAL (I_n) is equal.
- Therefore, since the currents are always in the opposite directions, the magnetic fluxes (M_a and M_n) set up in the toroid (magnetic core) cancel each other.
- Sensing winding wound around toroid and connected to a tripping solenoid does not produce any induced voltage so the RCCB remains “on”.
- Under earth fault condition, a portion of the current flowing in the LIVE conductor escape through Earth instead of returning through the NEUTRAL conductor.
- As a result, I_a will be larger than I_n, making M_a greater than M_n.
- Voltage is induced in the sensing winding and will energize the tripping solenoid if the designed setting is reached.

126 Explain with a digram an TT Earthing system.

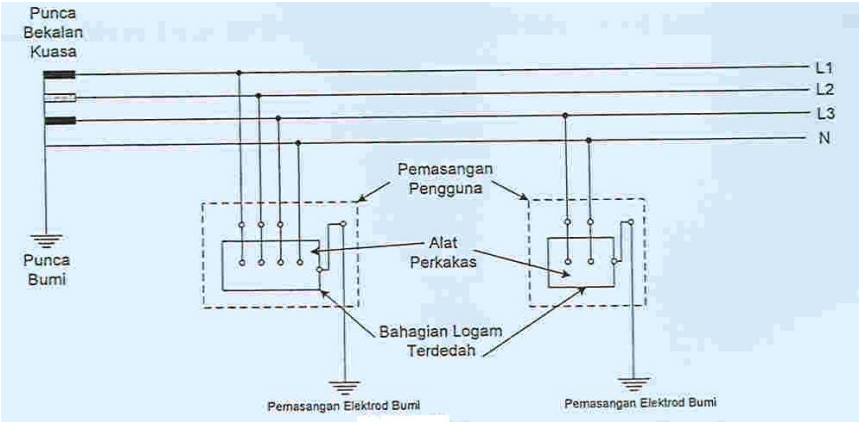


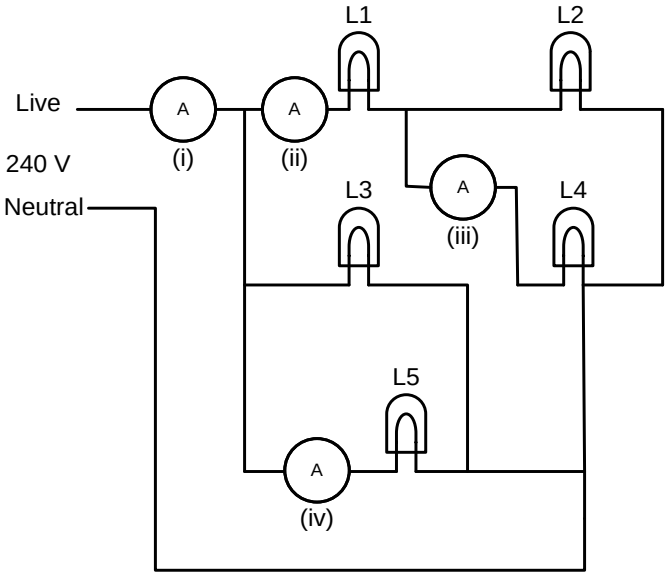
Diagram 2

127 Suggest **FIVE** (5) necessary steps or procedures in order to create a safe working environment.

a. Put up warning or caution signage on the work area.
b. Treat all conductors as LIVE.
c. Perform Lockout tag procedure on the machines where need to be work.
d. Use the correct size of the conductor and suitable type of cables.
e. Isolate LIVE conductor.

128 There are five (5) lamps, L1, L2, L3, L4 and, L5 are connected in a lamp bank as shown in Figure 1. Draw a diagram to show the connection of ammeter(s) to measure the current that flow through:

a. ALL the lamps
b. L1
c. L4
d. L5



129 a. List the minimum clearance requirements for the front, side and back of a Main Switchboard with length of more than 3 meters.

Front: 1000 mm
Side: 600 mm
Back: 900 mm

b. List **THREE** (3) tests that need to be done by a consultant for a newly installed Main Switchboard.

i. Insulation test
ii. Current transformer ratio and polarity check
iii. Stability to external faults

c. What are the two (2) test methods for testing an underground cable? Describe the purpose of each of the test.

i. Continuity test – to ensure the conductor / cable are in good condition
ii. Insulation test – to measure the cable insulation resistance and to ensure the conductor are not short-circuit

d. List one (1) purpose of earthing.

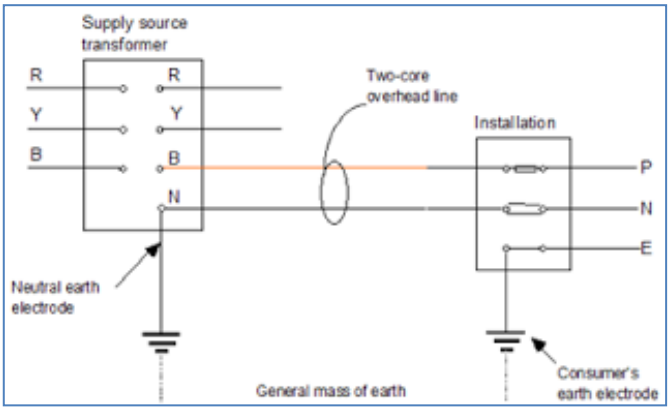
Proper operation of protective devices like residual current device (RCD).

130 a. What is the purpose of Earthing in an electrical installation?

The purpose of Earthing in an electrical installation is to blow the fuse or to trip a miniature circuit breaker (MCB) when the live side of the electric wiring or that of an appliance comes into contact with exposed metalwork such as the casing of an appliance, the body of a kettle, toaster or electric iron.

b. State the Earthing system being adapted by SESCO and draw a diagram of the system with its supply source transformer, consumer installations and its Earthing.

The Earthing system being adapted by SESCO is the TT System.



131 List out five tests that need to be carried out of an electrical installation before the supply is connected.

a. Continuity of protective conductors, main and supplementary bonding
b. Continuity of ring final circuit conductors
c. Insulation resistance
d. Polarity
e. Earth electrode resistance

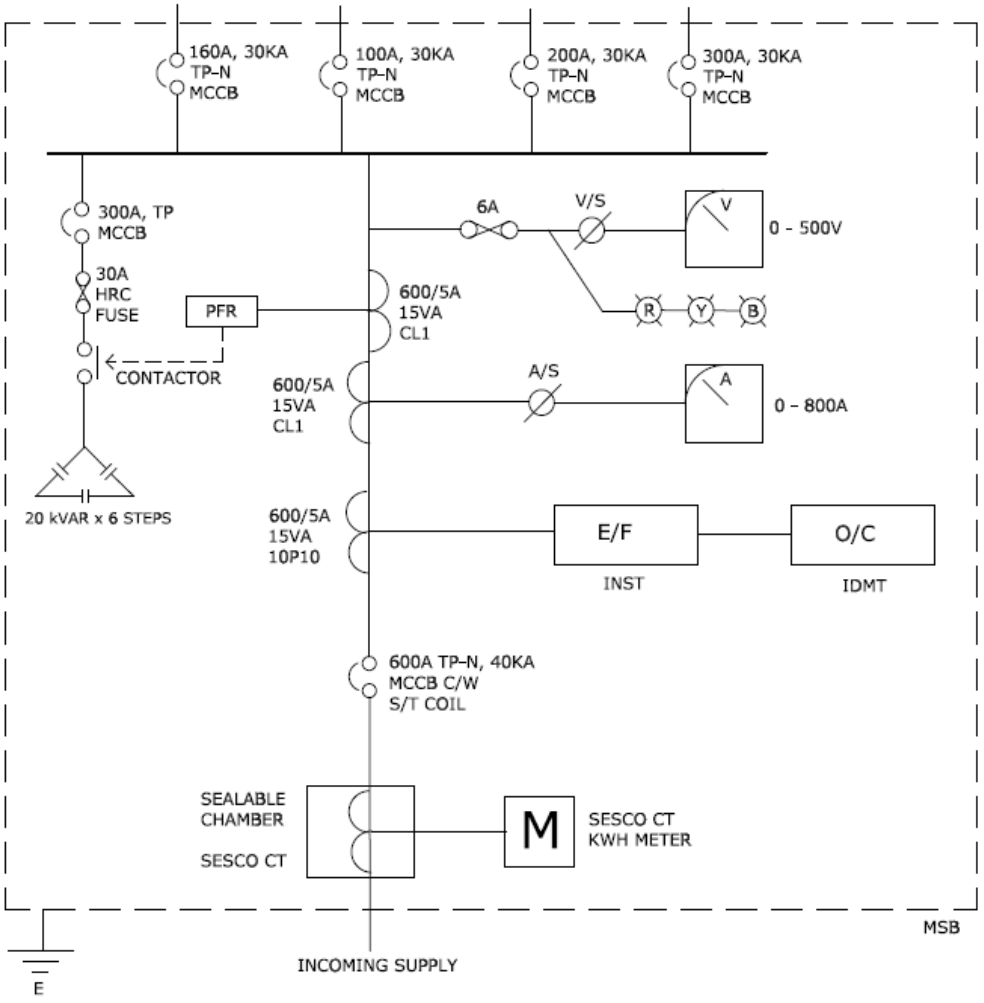
132 What are the necessary maintenances that can be done in order to maintain the maximum service life of a battery?

a. Ensure battery maintenance is clean and tight to give good electrical contact.
b. Ensure connection terminals are of suitable material.
c. Check electrolyte regularly and keep it within the range of required levels.
d. Battery case to be kept clean of electrolyte.
e. Battery must be protected from extreme temperatures.

133 Draw the schematic diagram of the main switchboard showing the followings:

- CT ratio: 600/5A, 15VA, 10P10 (protection CT)
- Main breaker: 600A, 40KA, TPN MCCB complete with Shunt Trip
- CT ratio: 600/5A, 15VA, CL.1 (metering CT)
- Over current and earth fault relay
- Indicating lamp (R,Y,B)
- Outgoing feeder breaker 160A, 100A, 200A and 300A, TPN, MCCB
- Voltmeter and ammeter complete with selector switch

- SESCO CT meter complete with CT and sealable chamber
- Capacitor Bank (20 kVAR x 6 STEPS), with CT ratio: 600/5A, 15VA, CL.1 (metering CT), and PFR
- Capacitor Bank: 300A TP MCCB and 30A HRC fuse



134 What is the objective of earthing a consumer's installation.

Objective of earthing a consumer's installation is to ensure that all exposed conductive parts and extraneous parts associated with electrical installations are at, or near earth potential.

135 List **FOUR** (4) purpose of earthing.

a. Proper operation of protective devices like residual current device (RCD).
b. Quick detection and clearance of earth fault.
c. Protection of workmen from the hazards of electric shock.
d. Controls of voltage rise during system disturbances.

136 Suggest **FIVE** (5) necessary steps or procedures in order to create a safe working environment.

a. Put up warning or caution signage on the work area.
b. Treat all conductors as LIVE.
c. Perform Lockout tag procedure on the machines where need to be work.
d. Use the correct size of the conductor and suitable type of cables.
e. Isolate LIVE conductor.

137 List **FIVE** (5) advantages of three phase induction motor.

a. smaller in size
b. light in weight.
c. less maintenance cost.
d. easy to operate
e. less sparking produced

138 a. Find the voltage across resistor R_1 in Figure 1 below.

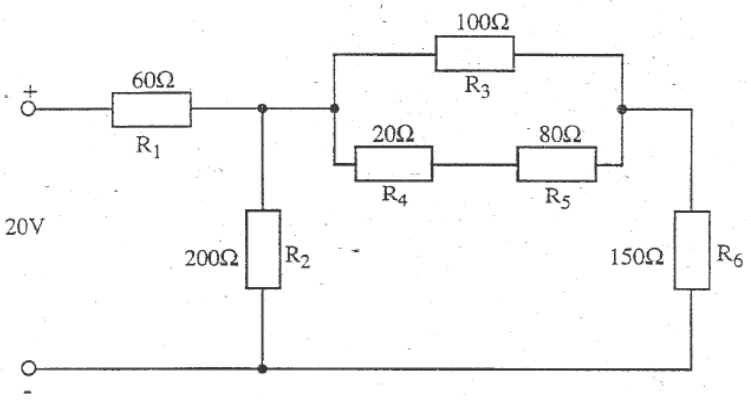


Figure 1

V R_1= 7.5V

b. A nickel cadmium cell is rated at 0.4 ampere-hours. How many such cells must be connected in parallel to supply current to a 10 Ω load for a period of 200 hours?

Total cell $\cong 61 cells$

139 There are two forms of electric shocks known as direct contact and indirect contact. Define direct contact and indirect contact.

Direct contact: which is contact of person or livestock wiwht live parts.
Indirect contact: which is contact of person or livestock with exposed conductive parts made live by a fault.

140 a. The core material has a major effect on a transformer's performance. List **THREE** (3) core materials for transformers.

i. Silicon steel
ii. Alloy
iii. Ferrite

b. Define Eddy Current.

Small, unwanted electric currents induced by alternating magnetic field in core material.

141 List out **FIVE**(5) primary cells commonly used in the market.

a. Carbon Zinc
b. Alkaline
c. Mercury / Silver Oxide
d. Lithium

e. Nickel Cadmium

142 a. How to resolve eddy current loses in a transformer?

The core is laminated, made of thin sheets of soft iron, each sheet is separated from the next by a layer of insulating varnish

b. List THREE (3) types of street lighting control method.

i. direct switch
ii. timer clock
iii. photocell or light sensor

143 What is “secondary cell” in the battery application and give **THREE** (3) examples.

“Secondary cell” refers to the one battery cell that “Can be recharged”, and an assembly of electrodes and electrolytes, which constitutes the basic unit of a battery.

a. Lead Acid Cell
b. Nickel Cadmium Cell
c. Nickel Iron Cell

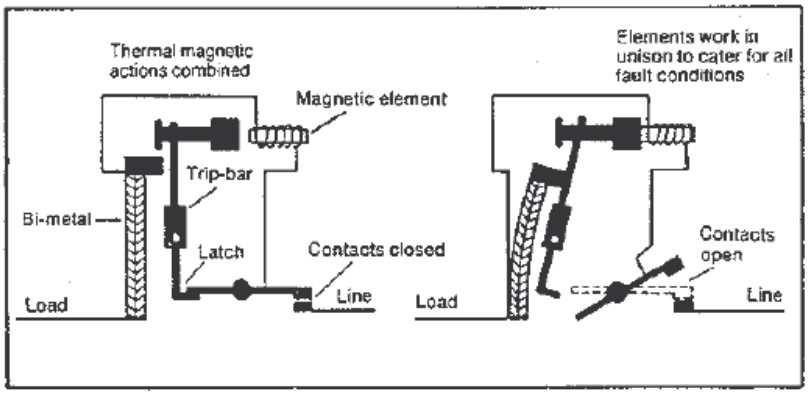
144 a. What is the function of Miniature Circuit Breaker (MCB)?

To make and break a circuit.

b. What are the two elements in a MCB that provide automatic operation?

i. Magnetic
ii. thermal elements

c. Explain the working mechanism of the two elements from part 1(b) above.



When a small sustained overload occurs, the thermal trip will come into operation after a few seconds or even minutes. However, when a heavier overload or short circuit occurs, the magnetic trip coil operates quickly to disconnect the faulty circuit

d. List out **THREE** main types of protective conductor and briefly explain each of them.

Earthing Conductor
This connects the main earthing terminal with the means of earthing which ma be an earth electrode buried in the ground for a TT system, or where a TN system is in use another means of earthing such as the supply authority terminals.
Circuit proctective conductor
These are run for each circuit and may comprise a separate conductor be imported

in the cable for the circuit concerned or the metal conduit or cable sheath in, for example, the case of mineral insulated cables.

The main equipotential bonding conductor

These connect the main earthing terminal with the main service metal pipes such as water and gas, and with any exposed building structural steelwork, ventilation ducting.

145 Draw the 4 line schematic diagram of the following main switchboard:

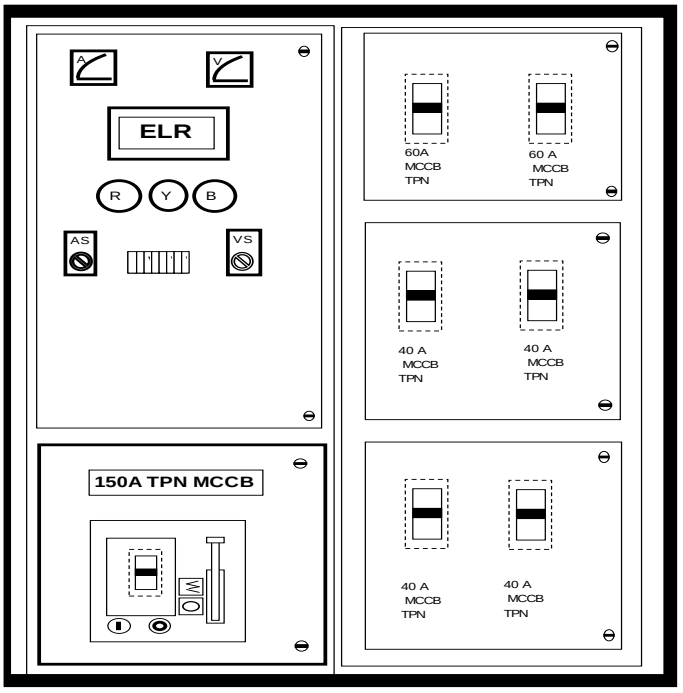
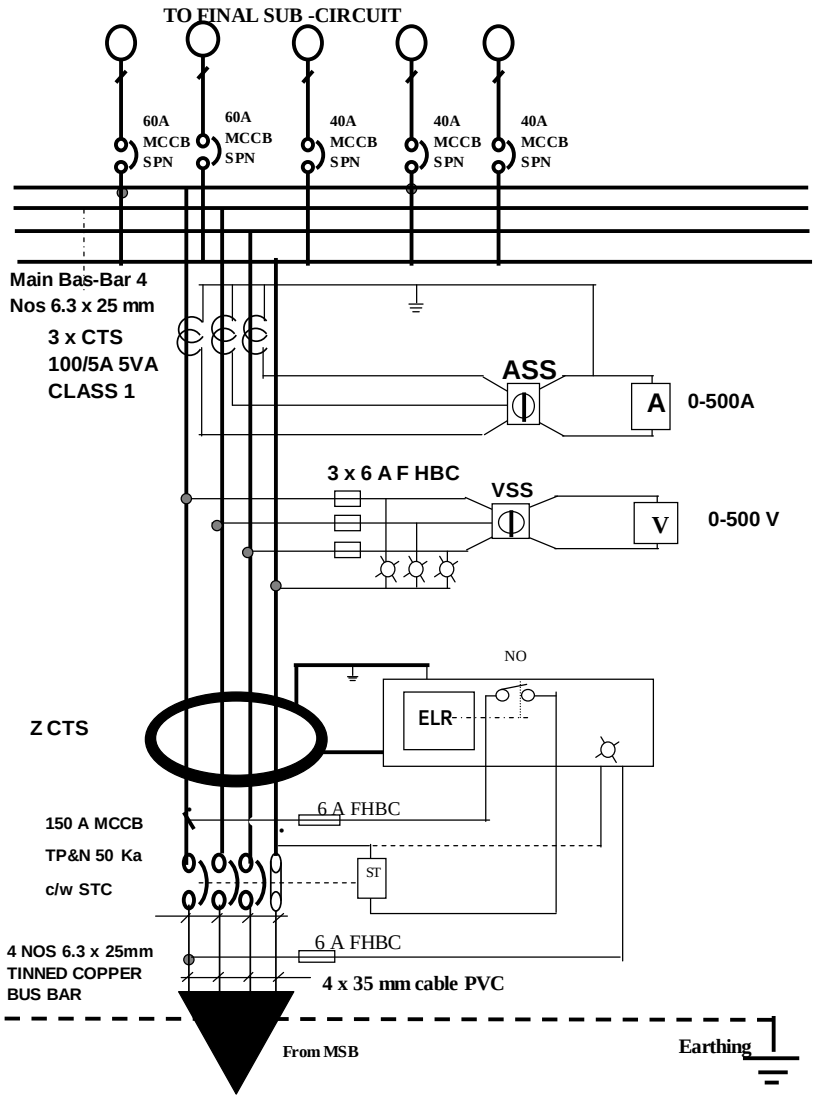


Diagram 1

146



147 What are **THREE** (3) types of protective conductor found in an installation?

a. Earthing conductor
b. Circuit protective conductor
c. The main equipotential bonding conductor

148 An industrial plant draws 200 A at 415V. Given power factor is 0.65, find true power, apparent power and reactive power (VA/kVA, kW, kVAR).

True Power (P) = 93444.14 W
Apparent Power (S) = 143760.22 VA
Reactive Power (Q) = 109248.3066 VAR

149 Fill in the blanks using the words given below:

current transformer	kwh meters	busbar risers	main busbar	incoming supply

Main switchboard installation requirements requires that where current transformer compartment is not yet available, the **current transformer** shall be positioned on **busbar risers** before the switchgear and main switch and shall not to be positioned at the **main busbar**. Voltage supply for the **kwh meters** must be connected at the **incoming supply** before the switchgear or main switch.

150 a. What are the differences between primary cell and secondary cell?
Primary Cell - cannot be recharged**,** must be replaced after used**,** usually of dry type cell.

Secondary Cell -Recharge-able, Secondary cell are usually combined to form a battery

b. Give **THREE** (3) examples of primary cell.

i. Carbon zinc
ii. Alkaline
iii. Mercury

c. Give **TWO** (2) examples of secondary cell.

i. Lead acid cell
ii. Nickel Cadmium (NiCAd)

d. List any **FOUR** (4) applications for secondary cell.

i. Engine starting on car
ii. Lighting on buses
iii. Solar Aplications
iv. Emergency Lighting

e. What instrument is used to measure the voltage of a battery?

Voltmeter

151 List in detail, **FIVE** (5) requirements by SESCO for Main Switchboard (MSB) Rooms.

a. Minimum clearance requirements for the purpose of safety and effective operating and adjusting of equipment mounted on the MSSB are as follows:

Length of MSB	Minimum Clearance (mm)		
	Front	Side	Back
Less than equal to 3 meters	750	600	750
More than 3 meters	1000	600	900

b. Front access type MSB do not require back clearance, but must allow for full frontal access to the busbar, CT Chamber and all ancillary equipment.

c. MSB room doors shall be arranged to open outwards and shall not obstruct the passage way into which they open. All doors shall be fitted with locks to prevent the entry of an unauthorized persons but shall be readily opened from the side without the use of a key.

d. The MSB room shall preferably be provided with an alternative emergency exit door.

e. The MSB room shall either be naturally or forced ventilated depending on the location. Forced ventilation shall be required if the MSB room is located in the basement levels where ducted fresh air and exhaust are to be maintained effectively. The exhaust fan shall be of adequate capacity.

152 List **FIVE** (5) the disadvantages of low power factor.

a. Larger cross-sectional area conductors required

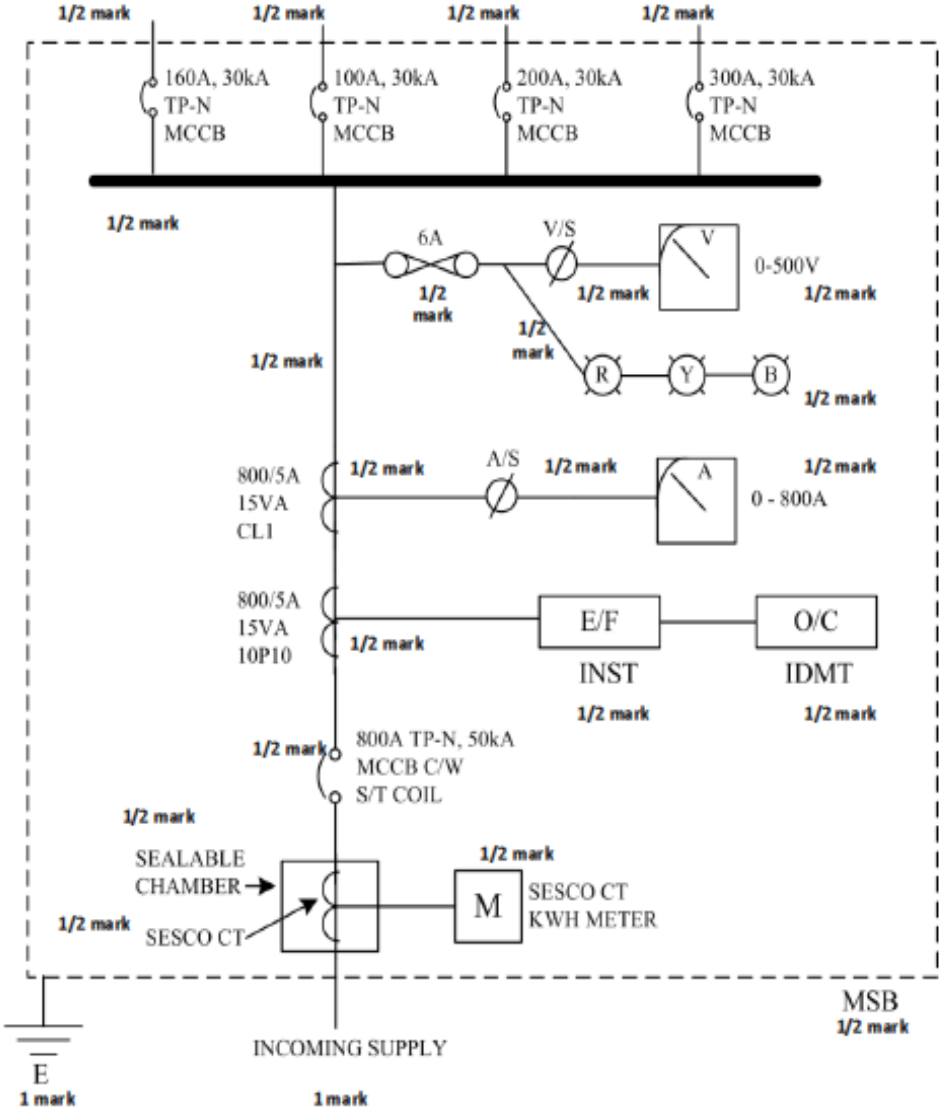
b. Larger transformer
c. Higher rated switch gear
d. Fuses of a higher currrent rating
e. Higher voltage drops along conductors

153 List five (5) components in a main switchboard?

a. air circuit breaker or ACB or “main switch”
b. earth fault relay or “EFR”
c. overcurrent protection device or “OC”
d. supply indicator lamp or “phase indicating lamp”
e. current transformer for metering “small CT”

154 Draw the schematic diagram of the main switchboard showing the followings:

a. CT ration: 800/5A, 15VA, 10P10 (protection CT)
b. Main breaker: 800A, TPN MCCB complete with Shunt Trip
c. Over current and earth fault relay
d. CT ratio: 800/5A, 15VA, CL.1 (metering CT)
e. Indicating lamp (R,Y,B)
f. Voltmeter and ammeter complete with selector switch
g. Outgoing feeder breaker 160A, 100A, 200A and 300A, TPN, MCCB
h. SESCO CT meter complete with CT and sealable chamber



155 a. One of the essential functions of a motor control is starting. List its other **THREE** (3) essential functions.

i. Speed regulation
ii. Stopping
iii. Protection

b. List **TWO** (2) common types of motor starters for reduced voltage starting.

i. Auto transformer
ii. Star-delta

156 a. Will a residual current circuit breaker (RCCB) operates for overloads or short circuits?

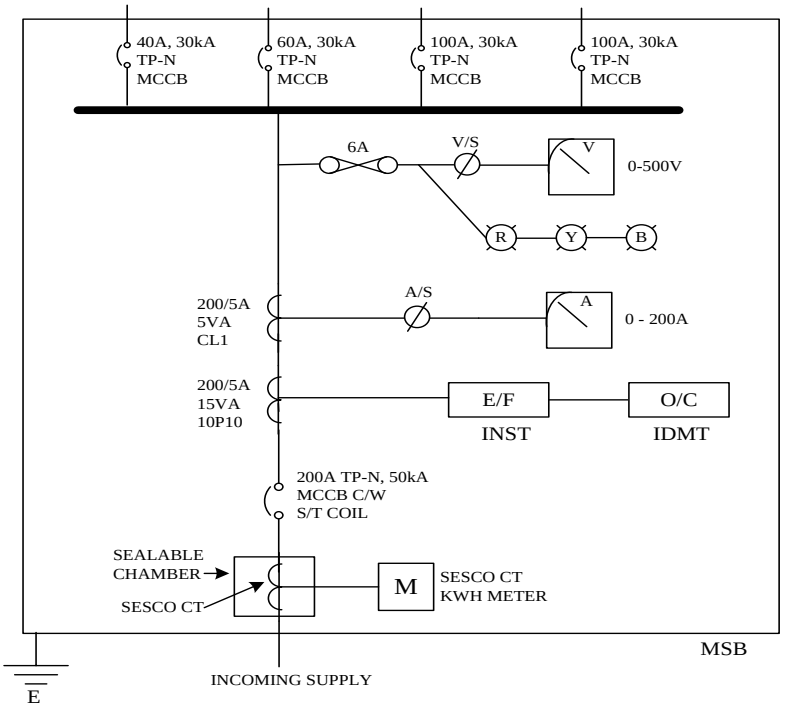
No, RCCB does not operate for overloads or short circuits.

b. List **TWO** (2) means of protection against overcurrent in low voltage installation.

- Fuse
- Overcurrent Relay

157 Provide the schematic diagram of the main switchboard showing the following:

- CT ratio: 200/5A, 15VA, 10P10 (protection CT)
- Main breaker: 200A, 3P MCCB completed with Shunt Trip
- Over current and earth fault relays
- CT ratio: 200/5A, 5VA, CL.1 (metering CT)
- Indicating lamp (R,Y,B)
- Voltmeter and ammeter completed with selector switch
- Outgoing feeder breaker 40A, 60A, 100A and 100A, TP, MCCB
- SESCO CT meter complete with CT and sealable chamber.



158 Calculate the current flowing through resistors R1, R2, R3, R4 and R5 of the circuit in Diagram 3 below:

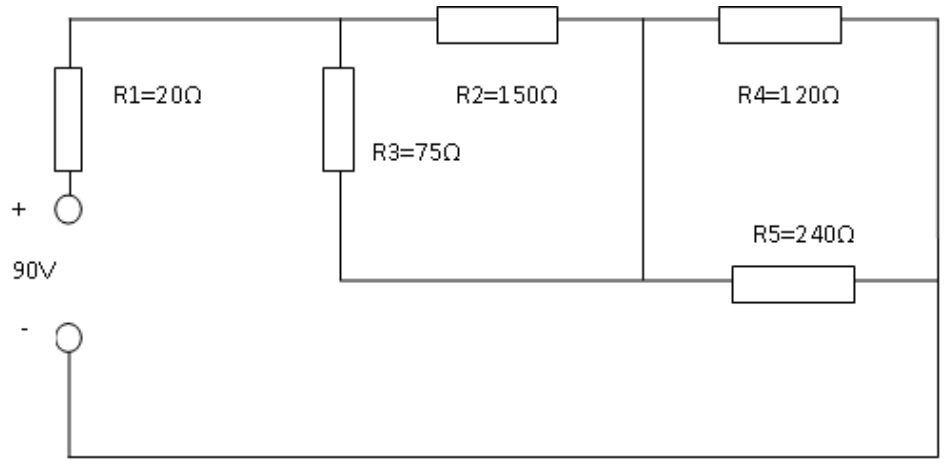


Diagram 1

I1 = IT
= 0.6A
I2 = 0.2A
I3 = 0.4A
I4 = 0.4A
I5 = 0.2A

159 Testing should be carried out on completion of an electrical installation. List and sequence the eight (8) tests listed below into Table 1 accordingly.

List of Test:

- Polarity
- Polarity
- Insulation resistance
- Earth electrode resistance
- Earth fault loop impedance
- Residual current operated devices
- Continuity of protective ring final circuit conductors
- Continuity of protective conductors, main and supplementary bonding

Before the supply is connected		**After the temporary supply is connected**	
1	Continuity of protective conductors, main and supplementary bonding	1	Polarity
2	Continuity of protective ring final circuit conductors	2	Earth fault loop impedance
3	Insulation resistance	3	Residual current operated devices
4	Polarity	4	
5	Earth electrode resistance	5	

160 The open circuit voltage of a lead acid battery is 12V. When a 4 ohms load is connected to the terminal voltage is 9V. Calculate the internal resistance of the battery?

Ri = 1.333Ω

161 List out the FOUR (4) process stages in sequence for a fire to occur, and draw the fire chain reaction pyramid.

a. *Incipient stage*
b. *Smoldering stage*
c. *Flame stage*
d. *Heat stage*

162 Explain with appropriate examples three (3) protective measures to protect against electric shock by direct contact.

a. Protection on insulating of live part
Live part shall be completely covered with insulation which can only be removed by destruction and which is capable of withstanding the electrical mechanical, thermal and chemical stresses to which it may be subjected in service.
Example: Conductors of cables made to British Standard or equivalent standards afford adequate protection against direct contact.

b. Protection by obstacles
An obstacle may be employed as a measure of protection against unintentional contact only with live parts.
Removal of obstacles may be done without the use of key or tool.
Example: Installations in an area accessible only to skilled people.

c. Protective by barrier or enclosure
A barrier is intended to provide protection against contact with live parts from any usual direction of access.
A barrier may also be removable to allow easy access to live parts but requirements by the regulations must be satisfied.
Example: For general public, the use of 3 pin plug
Where removal of barriers and enclosures can only be possible by the use of key or tool, after disconnection of supply to the live part against which the enclosure affords protection. Restoration of supply being possible only after reclose of enclosure.
Explain with appropriate examples three (3) protective measures to protect against electric shock by direct contact.

163 A main switchboard is installed with a current transformer (CT) with ratio of 700/5A.

a. Calculate the load percentage of the CT if the approved load is 650A.

107%

b. Calculate the value of the current that will trigger the earth fault relay based on the setting of 10%.

70A

c. Find the secondary load value if the primary load current reads 650A.

I_s = 4.64 A

d. List **TWO** (2) requirements for the use of IDMT earth fault relay protection.

i. The circuit breaker must be of shunt trip type with sufficient breaking capacity
ii. The earth resistance of the customer's premises must not be more than 1 ohm.

164 Explain how a residual current device works:

a. under normal operations; and
RCD operation
An RCD, under normal operation, the current flowing in the two conductor LIVE and NEUTRAL is equal. Because the currents balance, there is no induced current in the trip coil of the device.

b. when it detects an earth fault in the circuit
Fault detection – Earth fault
When an earth leakage occurs due to a fault in the circuit or an accident with the equipment, an imbalance occurs and this is detected by the RCD which automatically cuts off the power before injury or damage can result . Live and neutral no longer balance.

165 a. **State TWO (2) of the objectives of Occupational Safety and Health Act, 1994 which was gazetted in 1994?**

i. To protect persons at work against risks to safety or health due to activities of other persons at work.
ii. To protect the public at workplaces against risk to safety or health due to activities of other persons at work.

b. Based on the gazetted OSHA Act, 1994, state **ONE** (1) general duty of employees at work.

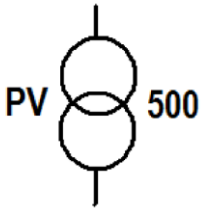
To care for his own safety and health and also others who might be affected by his actions or ommissions.

166 It is required to inform all relevant technical personnel and contractors regarding the location and substation source of PV customer system which has been commissioned.

a. List **THREE** (3) information which is required.

i. Location of customer’s PV system
ii. LT feeder connected
iii. Substation source

b. Draw the symbol used to identify the substation connected to the system where PV customers are also connected.



167 Explain operation of a Residual Current Device under normal and fault conditions.

RCD operation

An RCD, under normal operation, the current flowing in the two conductor LIVE and NEUTRAL is equal. Because the currents balance, there is no induced current in the trip coil of the device.

Fault detection – Earth fault

When an earth leakage occurs due to a fault in the circuit or an accident with the equipment, an imbalance occurs and this is detected by the RCD which automatically cuts off the power before injury or damage can result . Live and neutral no longer balance.

168 An electric motor is connected to a single phase, 240V, 50Hz supply via 70°C single insulated PVC cable, installed in PVC conduit on wall. This motor is drawing 30 amperes from the supply. The cable length for this circuit is 15 meters and assume that all the cable correction factors are one (1). *Refer to Table 1 in Appendix for Current ratings and voltage drops of cable.*

Cross sectional area	In conduit in thermal insulation	In conduit in thermal insulation	In conduit on wall	In conduit on wall	Clipped direct	Clipped direct	Voltage drop	Voltage drop
(mm^2)a	(A)	(A)	(A)	(A)	(A)	(A)	(mV/A/m)	(mV/A/m)
-	2 cables	3 or 4 cables	2 cables	3 or 4 cables	2 cables	3 or 4 cables	2 cables	3 or 4 cables
1.0	11.0	10.5	13.5	12.0	15.5	14.0	44.0	38.0
1.5	14.5	13.5	17.5	15.5	20.0	18.0	29.0	25.0
2.5	19.5	18.0	24.0	21.0	27.0	25.0	18.0	15.0
4.0	26.0	24.0	32.0	28.0	37.0	33.0	11.0	9.5
6.0	34.0	31.0	41.0	36.0	47.0	43.0	7.3	6.4

Table 1: Current ratings and voltage drops for single core p.v.c insulated cables

a. Determine the proper cable size for this circuit.

From the Table 1, cable size for 30A is 4 mm^2.

b. Calculate the cable voltage drop.

From Table 1, the cable voltage drop properties is 11.0mV/A/m.
V_D = 4.95V

c. Calculate the maximum cable length allowed (so voltage drop not more than 4%).

Lmax = 29.09m

169 An immersion heater rated at 240V, 3kW is to be installed using 6mm^2 twin with protective conductor PVC insulated and sheathed cable with voltage drop of 7.3mV/A/m. The length

of run of the cable is 14m from the sub distribution board.

a. Determine the current intended to be carried by the circuit in normal circuit, i.e. design current of the circuit, I_b;

I_b = 12.5A

b. Calculate the voltage drop of the circuit; and
Voltage Drop = 1.28V

c. Calculate the maximum length of cable where the voltage drop does not exceed 4% of the declared supply voltage.

105m

170 a. List out the minimum clearance requirements for the side and back of a main switchboard with length as follows

i. Less than or equal to 3 metres
Side – 600mm
Back – 750mm

ii. More than 3 metres
Side – 600mm
Back – 900mm

b. Protection and automatic tripping (opening) of associated circuit breakers (CBs) has two main functions. List the **TWO (2)** main functions.

i. Isolate faulty equipment so that the remainder of the system can continue to operate successfully.
ii. Limit damage to equipment caused by overheating, mechanical forces etc.

c. The rated current of a circuit breaker is the current that it can carry continuously, generally for duration of more than eight hours. The rated current must not cause a temperature rise in excess of the specified values when the ambient temperature is between -50C to 400C. Define the followings with reference to circuit breakers:

i. Breaking capacity
Breaking capacity of a circuit breaker is the maximum current (in r.m.s) that flows through the breaker and the breaker is capable to interrupt at the instant of initiation of the arc during a breaking operation at a stated voltage under prescribed conditions. The breaking capacity is usually expressed in kA or MVA. Typical values range from 3kA to 43kA.

ii. Making capacity
Making capacity of a circuit breaker is the maximum current that will flow through the breaker and the breaker is capable of withstanding at the instance during a closing operation at a stated voltage under prescribed conditions.

171 a. A main switchboard is installed with current transformer (CT) with ratio of 800/5A. The approved load is 750A

i. Prove that the CT is still within the permissible limit of MSB protection scheme.

The CT still within permissible limit of 5A, since 4.69A<5A

ii. If the secondary of the CT reads 4.8A, what is the primary current?

The primary current is 768A.

b. State the minimum clearance requirements for the front, side and back of a Main Switchboard with length of more than 3 meters.

Front: 1000 mm
Side: 600 mm
Back: 900 mm

c. State three (3) tests that need to be done by a consultant for a newly installed Main Switchboard.

i. Insulation test
ii. Current transformer ratio and polarity check
iii. Stability to external faults
iv. Tripping duration which shall comply the followings:

Overcurrent	***Operating Time***
150% of approved setting	maximum 6 seconds
200% of approved setting	maximum 3 seconds
Earth fault	Operating Time
10% of approved setting	instantaneous

172 List **FIVE** (5) components in a main switchboard?

a. air circuit breaker or ACB or “main switch”
b. earth fault relay or “EFR”
c. overcurrent protection device or “OC”
d. supply indicator lamp or “phase indicating lamp”
e. current transformer for metering “small CT”

Soalan Peperiksaan Bagi Sijil Penjaga Jentera L1

Struktur bagi kertas peperiksaan objektif:

Bahagian A: 30 Soalan Objektif (1 Markah bagi setiap jawapan yang betul)

Bahagian B: 5 Soalan Subjektif Pendek (5 Markahbagi setiap jawapan yang betul)

Bahagian C: 3 Soalan Subjektif Panjang (15 Markah bagi setiap jawapan yang betul)

Masa:3 Jam

The Electrical Inspectorate Unit, Ministry of Public Utilities Sarawak, 11th Floor, Wisma Satok, Jalan Satok, 93400 Kuching.

Tel :082-258258 Fax : 082-259843
http://www.mpu.sarawak.gov.my
http://www.eminds.sarawak.gov.my

173 Berapa lamakah perlu meletakkan jari anda bagi tujuan mengesan denyutan nadi karotid mangsa?

A 5 saat
B 1 minit
C 2 minit
D 5 minit

174 Apakah cara yang betul untuk merawat mangsa renjatan (shock)?

A Berikan oksigen
B Selimutkan mangsa
C Berikan kata-kata semangat
D Semua kenyataan di atas adalah betul

175 Kadar voltan untuk kabel pendawaian voltan rendah ialah 600/1000V. Ini bermaksud kabel tersebut boleh digunakan pada bekalan tiga fasa dimana voltan di antara

A mana-mana fasa dan bumi tidak melebihi 1000 volt.
B mana-mana fasa dan bumi tidak melebihi 1000 volt dan voltan antara fasa tidak melebihi 600 volt.
C fasa merah dan bumi tidak melebihi 600 volt dan voltan antara fasa merah dan fasa biru tidak melebihi 1000 volt.
D mana-mana fasa dan bumi tidak melebihi 600 volt dan voltan di antara fasa tidak melebihi 1000 volt.

176 Berapakah nilai maksima voltan sentuh (touch voltage) yang dihadkan untuk mencegah dari kesan bahaya renjatan elektrik kepada pengguna?

A 10 Volt
B 30 Volt
C 50 Volt
D 100 Volt

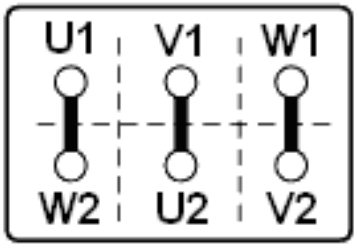
177 Spesifikasi bekalan elektrik yang dibekalkan kepada pengguna-pengguna domestik mengikut standard MS IEC 60038

A Bekalan voltan nominal tiga fasa 400V AU, julat + 6%, -10%;
B Bekalan voltan nominal tiga fasa 400V AU, julat + 6%, -2%;
C Bekalan voltan nominal tiga fasa 400V AU, julat +10%, -6%;
D Bekalan voltan nominal tiga fasa 400V AU, julat +10%, -4%;

178 Nilai rintangan ujian keterusan gelung sebuah motor elektrik tiga fasa adalah seperti berikut:

U1 & U2	=	5Ω
V1 & V2	=	5Ω
W1 & W2	=	5Ω

Berapakah nilai rintangan ujian keterusan di antara terminal U1 dan V1 setelah sambungan motor dibuat seperti Rajah 1?



Rajah 1

A **3.3Ω**
B 5.0Ω
C 7.3Ω
D 10Ω

179 Geganti aruhan (induction relay) kebanyakkannya menggunakan skema perlindungan arus lebih jenis '*time-graded overcurrent protection scheme'*. Di antara keperluan-keperluan asas skema ini ianya mesti mempunyai ciri-ciri masa/arus yang *inversetime/current characteristic*, yang membawa maksud bahawa

I ianya mempunyai masa kendalian yang panjang pada pendarab tatahan arus yang rendah.
II ianya mempunyai masa kendalian yang pendek pada pendarab tatahan arus yang tinggi.
III ianya mempunyai masa kendalian yang pendek pada pendarab tatahan arus yang rendah.
IV ianya mempunyai masa kendalian yang panjang pada pendarab tatahan arus yang tinggi.

A I , II
B **III , IV**
C I, II, III
D I, II, IV

180 Dalam sesuatu pepasangan elektrik hidup, apa akan berlaku pada alatubah arus sekiranya lilitan sekunder di tanggalkan dalam keadaan litar buka?

A Ia bergetar
B Arus tinggi teraruh di sekunder
C **Voltan tinggi teraruh di sekunder**
D Arus dan voltan tinggi teraruh di sekunder

181 What is the purpose of a current transformer in an electrical installation?

A Measure current at busbars
B Increase current flow into ammeter
C Prevent short circuit current at installation
D **Limit and minimize current flowing into ammeter for metering and protection**

182 Ujian *prospective short circuit current (PSC)* adalah 20.5kA,pada*MSB Incoming Busbar.* Pilih nilai *service breaking capacity (Ics)* dan *ultimate breaking capacity (Icu)* untuk *Air Circuit Breaker(ACB).*

A I_{cu} =50kA I_{cs} =16kA

B I_{cu} =20kA I_{cs}=12kA
C I_{cu} =10kA I_{cs} =19kA
D I_{cu} =50kA I_{cs} =50kA

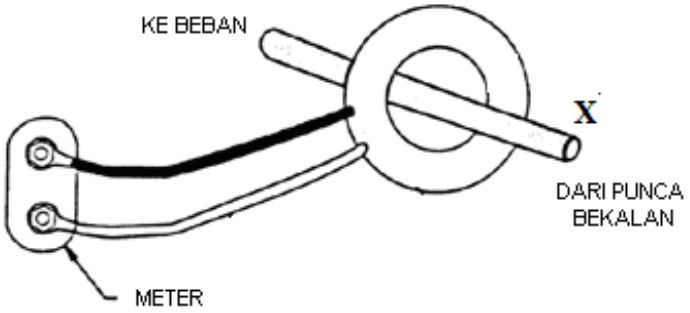
183 Berapakah nilai kelonggaran voltan (Voltage Excursions) ditetapkan *Sarawak Electricity Rules* pada bahagian *Low Voltage Distribution Network*?

A 400/240V +10%,
B 415/240V +5%,
C 433/240V +6%,
D 433/240V +7%,

184 Pilih kenyataan yang **BETUL** mengenai sistem lata (cascade) dalam pemasangan lampu jalan.

A Kawalan suis masa mengawal satu lampu
B Kawalan suis masa digunakan untuk mengawal satu sesentuh
C Kawalan suis masa digunakan untuk mengawal satu atau beberapa lampu
D Kawalan suis masa digunakan untuk mengawal satu atau beberapa sesentuh

185 Merujuk penyambungan pengubah arus pada Rajah 1 di bawah, kenal pasti kekutuban pada 'X'.



Rajah 1

A P1
B P2
C S1
D S2

186 Pilih maklumat-maklumat yang perlu pada plat nama suatu pengubah yang digunakan pada pemasangan papan tanda elektrik.

I Kadaran arus prima
II Kadaran voltan prima
III Nama dan alamat pembuat
IV Sijil kelulusan pihak berkuasa tempatan

A I, II, III
B II, III, IV
C I, III, IV
D I, II, III, IV

187 Nisbah lilitan primer dengan sekunder dalam sebuah transformer ialah 1 : 2. Jika voltan input bernilai 100V dan kuasanya 80W, apakah nilai arus pada gegelung

sekunder jika kecekapan transformer ialah 75%?

A. 0.15 A
B. 0.2 A
C. 0.3 A
D. 0.4 A

188 Pilih spesifikasi punca masukan dan keluaran yang **BETUL** sebuah papan pembahagian voltan rendah (feeder pillar) berkadaran 1000 Ampere.

A. 2 x 800A ; 4 x 400A
B. 2 x 800A ; 5 x 400A
C. 3 x 800A ; 3 x 400A
D. 3 x 800A ; 4 x 400A

189 Pada *Power Factor Regulator* yang mengendalikan bank kapasitor terdapat tatah C / K. Apakah yang di maksudkan dengan 'C'?

A. Nisbah bagi pengubah arus
B. Nilai terendah bagi bank kapsitor
C. Nilai keseluruhan bagi bank kapasitor
D. Nisbah pengubah arus dengan bank kapasitor

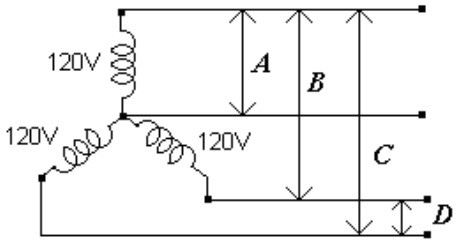
190 Apakah tujuan utama pembetulan faktor kuasa bagi suatu pepasangan elektrik?

A. Menghadkan kos tenaga aktif
B. Menghadkan kos tenaga reaktif
C. Menghadkan voltan litar pengguna
D. Meninggikan kuasa beban motor elektrik

191 Komponen yang berfungsi untuk menyingkirkan haba dalam sistem penyamanan udara

A. Penyejat (Evaporator)
B. Pemampat(Compressor)
C. Pemeluwap (Condensor)
D. Peranti pemeteran (Metering device)

192 Berapakah nilai voltan yang terhasil pada abjad '*C*' dalam Rajah 1 di bawah?



Rajah 1

A. 120V
B. 200V
C. 208V
D. 306V

193 Kenal pasti asas untuk pengiraan *surcaj* faktor kuasa penguna elektrik yang kurang dari 0.80 mengekor.

A. 1.5 % dari bil bulan tersebut
B. 2.0% dari bil bulan tersebut
C. 2.5% dari bil bulan tersebut
D. 3.0% dari bil bulan tersebut

194 Apakah tujuan pemasangan kotak gear (gear box) pada sesebuah motor elektrik yang digandingkan bersama suatu beban?

A. Membentuk daya kilas tinggi pada kelajuan rendah
B. Membentuk daya kilas rendah pada kelajuan tinggi
C. Menghasilkan kelajuan tinggi dengan tidak mengubah daya kilasnya
D. Menghasilkan kelajuan yang rendah dengan tidak berubah daya kilasnya

195 Pilih litar yang tidak memerlukan pemasangan peranti perlindungan arus lebihan.

I Litar sekunder pengubah arus
II Litar yang mengakibatkan bahaya jika diputuskan
III Litar di bahagian beban yang berlaku kenaikan arus
IV Litar dengan beban yang tidak mungkin akan bertambah

A. I, II, III
B. I, II, IV
C. II, III, IV
D. I, II. III, IV

196 Pilih faktor-faktor yang menyebabkan berlakunya tindak balas di dalam stator motor aruhan tiga fasa

I Teras besi stator
II Frekuensi bekalan
III Pengalir lilitan stator
IV Jenis sambungan lilitan stator

A. I, II, III
B. I, II, IV
C. II, III, IV
D. I, II. III, IV

197 Sistem keselamatan pepasangan yang menggunakan suis henti kecemasan (emergency stop button) sesentuh jenis tertutup (normally close) akan disambung pada

A Membentuk daya kilas tinggi pada kelajuan rendah
B Membentuk daya kilas rendah pada kelajuan tinggi
C Menghasilkan kelajuan tinggi dengan tidak mengubah daya kilasnya
D Menghasilkan kelajuan yang rendah dengan tidak berubah daya kilasnya

198 Berapakah nilai máximum *operating voltage* bagi *Low Voltage Armoured Cable*?

A 230VAC/400VAC
B 600VAC/1000VAC
C 800VAC/1.2kVAC

D 800VAC/1.6kVAC

199 Berapakah nilai minimum *insulation resistance* yang dibenarkan untuk *low voltage cable*?

A 1 MΩ
B 0.1MΩ
C 10Ω
D 1Ω

200 Sebuah litar dibekalkan *Voltage* 240V, *Current* 40 A, kirakan nilai *Impedance* dalam litar.

A 6 Ω
B 8 Ω
C 10 Ω
D 15 Ω

201 Motor elektrik beroperasi dengan *Apparent Power* 280kVA,dan*Actual Power* 250kW, kirakan *Power Factor* motor.

A 0.7
B 0.77
C 0.85
D 0.89

202 Kenal pasti faktor yang mungkin menyebabkan motor aruhan tiga fasa jenis rotor berlilit (slip ring motor) gagal beroperasi setelah bekalan disambungkan.

I Lilitan rotor terbuka
II Lilitan pemegun (stator) terbuka
III Sambungan pengubah auto tiada keterusan
IV Sesentuh sambungan bintang penghidup tidak berfungsi

A. I, II, III
B. II, III,IV
C. I, II, IV
D. I, II. III, IV

203 Pilih turutanoperasi komponen sistem penyembur air automatik apabila berlaku sesuatu kebakaran di dalam bangunan.

I Loceng terus berbunyi selepas api dipadamkan
II Kepala penyembur akan mengesan kebakaran
III Haba memecahkan *bulb* di kepala penyembur
IV *Sprinkler* berhenti dengan sendirinya selepas api dipadamkan

A. I, II, III
B. I, II, IV
C. II, III, IV
D. I, II. III, IV

204 Didalam sesuatu bilik suis yang menempatkan sebuah papan suis voltan rendah, apakah perkara-perkara yang perlu dilengkapi?

I Tikar getah
II Alat pemadam api jenis buih

III Lukisan skematik pepasangan
IV Notis 'Bahaya' dan 'Di Larang Masuk' pada pintu bilik
V Kelengkapan topi keselamatan, sarung tangan, alat-alat penguji penebatan, AVO meter dan penguji rintangan bumi

A. I, II, III
B. I, III, IV
C. II, III, IV
D. I, III, IV, V

205 Apakah fungsi *Residual Current Circuit Breaker (RCCB)*?

A Matikan litar secara automatik jika berlaku *overcurrent short circuit.*
B Matikan litar secara automatik jika berlaku *overcurrent overload.*
C Matikan litar secara automatik jika berlaku *earth leakage current.*
D Matikan litar secara automatik jika berlaku *overvoltage.*

206 Dengan mengambilkira *starting current* 1.5 kali, lampu digunakan adalah *High Pressure Sodium 550W, 240VAC, PF=0.85* dan litar lampu dilindungi menggunakan MCCB 30 A.Berapakah bilangan maksimum lampu yangdipasang?

A 7
B 8
C 10
D 12

207 Dengan mengambilkira *starting current* 1.5 kali, lampu digunakan adalah *High Pressure Sodium 550W, 240VAC, PF=0.85* dan litar lampu dilindungi menggunakan MCCB 30 A.Berapakah bilangan maksimum lampu yangdipasang?

A Pulse/Minute: 20
B Pulse/Minute: 60
C Pulse/Minute: 100
D Pulse/Minute: 26

208 *Transformer Impedance* 2.5%, *500kVA, 11/0.433kV, three phase. Berapakah* nilai *Prospective Short Circuit Current* pada *Secondary*?

A 26.7kA
B 20kA
C 1.1kA
D 1kA

209 Pilih skala yang **BETUL**untuk *time multiplier setting(TMS)* dalam *IDMT Protection Relay Induction Disc.*

A 0 hingga 0.5
B 0 hingga 1.0
C 1.0 hingga 5.0
D 1.0 hingga 10

210 Pilih alat uji yang sesuai untuk menguji *Contact Resistance* ACB.

I Mili-volt Meter
II Megger Meter

III Micro-Ohm Meter
IV Inductance Meter

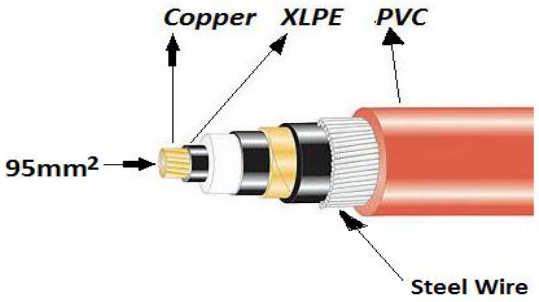
A. I, II
B. I, III
C. I, III, IV
D. I, II, III, IV

211 Pilih turutan langkah yang betul dalam kerja memasang *Local Earth.*

I *supply* di *"OFF"* kan.
II sambungkan *earthing lead* kepada *earth system*.
III sambungkan *earthing lead* kepada *phase conductor* dan *neutral conductor.*
IV uji dan sahkan litar adalah mati menggunakan *voltage Indicator.*

A. I,II,III,IV
B. I,IV,II,III
C. I,III,II,IV
D. II,I,III,IV

212 Pilih nama yang **BETUL** untuk kabel yang ditunjukkan pada Rajah1.



A 95 mm² X 1C/CU/XLPE/SWA/PVC
B 95 mm² X 1C/CU/SWC/AL/PVC
C 95mm² X 1C/CU/AWA/PVC
D 95mm² X 1C/CU/SWA/PVC

213 Pilih jenis beban yang sesuai menggunakan *AC-3 Magnetic Contactor?*

A Three Phase Capacitor
B Three Phase Transformer
C Slip Ring Motor
D Squirrel Cages Motor

SOALAN SUBJEKTIF BAHAGIAN B & C

214 Namakan **LIMA** peralatan perlindungan diri yang digunakan untuk melindungi seseorang daripada bahaya kecederaan dan kemalangan elektrik.

a. Topi keselamatan dan visor
b. Pakaian kalis percikan arka
c. Tali pinggang keselamatan
d. Kasut keselamatan
e. Sarung tangan keselamatan

215 Nyatakan **TIGA** bentuk kerugian yang akan ditanggung oleh pembekal tenaga elektrik jika membekalkan tenaga elektrik kepada pengguna yang mempunyai faktor kuasa yang rendah.

a. Kuasa dijana terbuang.
b. Kuasa kebahagian-bahagian lain akan terjejas.
c. Perbelanjaan menjana berlebihan dan keuntungan bayaran balik sedikit.
d. Arus yang tinggi perlu dibekalkan untuk kuasa yang sama.

216 Berikan **TIGA** langkah yang perlu diambil oleh pihak pembekal terhadap pengguna supaya faktor kuasa yang rendah tidak berlaku lagi.

a. Memasang bank kapasitor pada pepasangan.
b. Mengenakan denda dan membuat pemeriksaan mengejut.
c. Mengenakan tarif yang lebih tinggi untuk faktor kuasa yang rendah.

217 Berikan **TIGA** ciri-ciri bagi motor AU Pemutar Sangkar Tupai. (Squirrel Cage Rotor).

a. Hanya digunakan pada motor aruhan satu fasa dan tiga fasa AU.
b. Teras besi berbentuk lapisan yang dimampatkan untuk mengurangkan arus pusar.
c. Tidak terdapat lilitan pada pemutar.

218 Berikan **EMPAT**(4) tujuan menjalankan senggaraan pada motor-motor elektrik.

a Untuk keselamatan pada pengguna.
b Menentukan motor tersebut akan dikendalikan dengan cekap.
c. Menentukan tidak ada gegaran dan bunyi bising pada motor.
d Mengelakkan kerosakan yang muskil, oleh itu mengurangkan perbelanjaan.

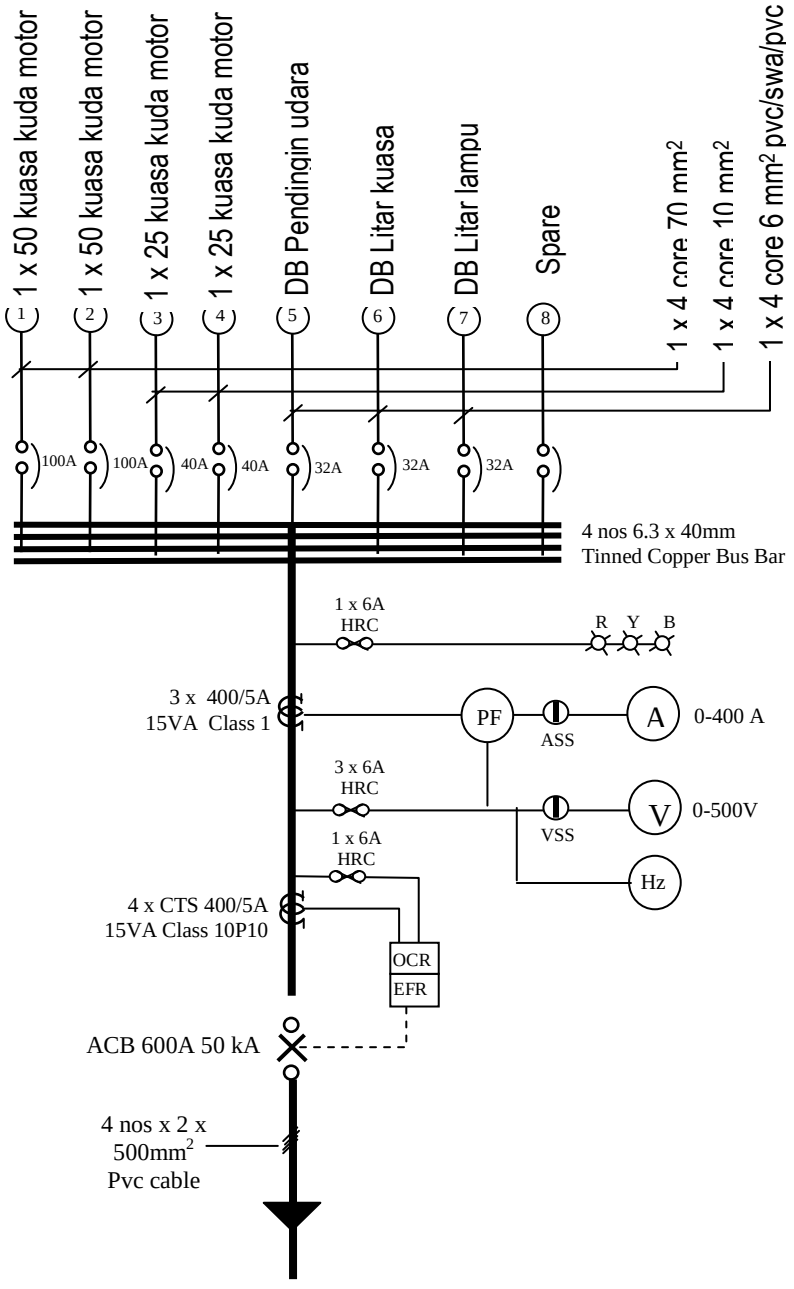
219 Berikan **TIGA** sebab utama sambungan kabel bawah tanah perlu dilakukan.

a. Bagi membuat sistem tamatan kabel dari alatubah kuasa ke alat perkakas suis
b. Dapat memberi kemudahan mensalurkan bekalan ke pengguna dalam sistem pembahagian
c. Menyambungkan kabel yang didapati tidak mencukupi bagi satu drum kabel

220 Senaraikan **TIGA** jenis kabel yang sesuai untuk pepasangan kabel bawah tanah voltan rendah (Low Voltage Underground Cable).

a. PILC Cable (Paper Insulated Lead Covered)
b. XLPE /SWA/PVC
c. XLPE/AWA/PVC

221 Berpandu beban pada Soalan 1, lukiskan litar skematik untuk papan suis utama dengan melabelkan kadaran pemutus litar udara (ACB) masuk, kadaran pemutus litar kotak beracuan (moulded case circuit breaker) di setiap litar keluaran, saiz busbar, saiz kabel disetiap litar keluar, pengubah arus dan jangka pengukuran.



Bekalan Masuk
Dari PE 11/0.433kV

222 Senaraikan **EMPAT** (4)punca menyebabkan kerosakkan kabel bawah tanah.

a. Penyambungan yang tidak baik

b. Bebanan keatas kabel

c. Usia kabel

d. Kecuaian semasa merentang

223 Senaraikan **TIGA** jenis ujian yang perlu dilakukan ke atas Papan Suis Utama bagi pepasangan baru.

a. Ujian penebatan.
b. Ujian Tekanan.
c. Ujian suntikan primer.
d. Ujian suntikan sekunder.
e. Ujian tatahan.

224 Jelaskan prinsip operasi geganti beban lampau jenis sertamerta yang terdapat pada Papan Suis Utama.

Ianya digunakan untuk memutuskan bekalan sebaik sahaja nilai kerosakan telah mencapai tahap yang ditentukan. Apabila gegelung tadi mempunyai kekuatan medan magnet tertentu ia akan bertindak untuk membuka pemutus litar.

225 Terangkan prosidur yang selamat untuk memulihkan bekalan elektrik setelah terputus secara tiba-tiba dan mencari punca kerosakannya.

a. Pergi ke bilik papan suis utama.

b. Kenal pasti sama ada bekalan TNB yang terputus atau pemutus litar yang terpelantik.

c. Sekiranya pemutus litar yang terpelantik, kenal pasti sama ada kerosakan disebabkan oleh kerosakan bocor kebumi atau lebihan arus.

d. Sekiranya pemutus litar litar yang terpelantik disebabkan lebihan arus, pastikan sekiranya tahu beban mana punca kerosakan. Tutup fius-suis/ MCCB beban tersebut. Jika tidak kenal pasti punca lebihan arus tutup bekalan kepada semua litar. Reset geganti lebihan arus. ON beban penting sahaja. Cari punca lebihan arus .

e. Sekiranya pemutus litar terpelantik disebabkan arus bocor kebumi, kenal pasti punca kerosakan. Buat ujian penebatan di papan suis itu dan juga di tiap punca beban keluar. Pastikan tiada kerosakan di papan suis.

f. Sekiranya punca kerosakan telah dikenal pasti di beban dan bukan di papan suis, tutup bekalan kebeban dan reset geganti. ON pemutus litar dan berikan bekalan kepada lain-lain beban.

g. Perbaiki punca kerosakan.

h. Sekiranya kerosakan di papan suis, perbaiki kerosakan sebelum dapat membekalkan bekalan.

226 Ujian peralatan elektrik biasanya dilakukan sebagai ujian tapak (site test) selepas peralatan telah dipasang. Nyatakan tujuan ujian tapak ini dijalankan.

a. Memeriksa dan menentukan sama ada peralatan baru yang dipasang atau yang sedia ada dalam perkhidmatan berada dalam keadaan kehendak piawaian dan mematuhi spesifikasi sebelum mula tugas.

b. Mengenalpasti penyenggaraan, pembetulan atau penggantian peralatan yang perlu.

c. Mengesahkan sama ada peralatan boleh terus melaksanakan fungsi-fungsi rekabentuk dengan selamat atau tidak.

d. Menentukan tahap kemerosotan peralatan sepanjang hayat perkhidmatan.

e. Mewujudkan satu penanda aras untuk ujian akan datang.

227 Berikan **LIMA** tujuan *Earthing System* perlu dibuat dengan berkesan dalam setiap pepasangan elektrik.

a. Perlindungan daripada renjatan elektrik.
b. Meningkatkan kecekapan mengalirkan arus bocor ke bumi.
c. Membolehkan peranti perlindungan arus bocor beroperasi dengan cekap sekiranya berlaku arus bocor.
d. Perlindungan daripada arus pusuan yang disebabkan kilat(Lightning Strike)
e. Mengurangkan kesan arus harmonic (Harmonic Current).

228 Nyatakan **TIGA** tujuan *Motor Starter and Control* diperlukan dalam mengawal dan menghidupkan motor elektrik.

a. Mengurangkan lonjakan arus pada peringkat permulaan (Reduces inrush current).
b. Mengelakan pemutus litar atau peranti arus lebih terpelantik (trip) ketika motor mula dihidupkan.
c. Mengelak sistem tersampuk(Interrupted)/terganggu akibat ketidak stabilan voltan semasa motor mula dihidupkan.

229 Senaraikan **EMPAT** jenis *Electric Motor Starter and Controller.*

a. Star-Delta Starter
b. Star-Delta Forward Reverse Starter and Control
c. Direct On Line (D.O.L)
d. Forward Reverse Starter Control

230 Terangkan dengan ringkassebab ujian Insulation *Polarization Index* perlu dilakukan pada Transformer,Motor,dan Generator.

Untuk menguji **tahap penebatan *(Insulation Level)* gegelung belitan (Winding Coil) sama ada gegelung tersebut kering atau bebas daripada kelembapan *(Moisture Free)* bagi** menentukan sama ada gegelungbelitan **tersebut perlu disenggara atau tidak.**

231 Sebuah premis industri sederhana mendapat bekalan daripada pihak berkuasa bekalan menerusi sebuah pencawang elektrik 11/0.433kV, 50 Hz dan mempunyai tanggungan beban yang disambungkan dari papan suis utama seperti Jadual 1.

Bil	Jenis Beban	Kuantiti
1.	Motor tiga fasa 50 kuasa kuda	2 unit
2.	Motor tiga fasa 25 kuasa kuda	2 unit
3.	Papan Agihan Pendingin Udara - motor satu fasa 2.0 kuasa kuda	10 unit
4.	Papan Agihan Punca Kuasa - Suis soket alir keluar 13A	50 unit
5.	Papan Agihan Lampu	150 mata lampu

Jadual 1

Berpandukan jumlah beban tersebut, tentukan:

i. Kadaran pemutus litar kotak beracuan (MCCB),
ii. Saiz dan jenis kabel untuk setiap litar dan
iii. Kadar pemutus litar udara (ACB) yang sesuai untuk papan suis utama.

Bil	Arus Beban	Kadaran MCCB	Jenis dan Saiz Kabel
1.	***Litar 1 : 1 x Motor 3 fasa 50 kk*** 63.34A	100A	1 x 4 core 70 mm^2 pvc/swa/pvc cable
2.	***Litar 2 : 1 x Motor 3 fasa 50 kk*** 63.34A	100A	1 x 4 core 70 mm^2 pvc/swa/pvc cable
3.	***Litar 3 :1 x Motor 3 fasa 25 kk 31.67A***	40A	1 x 4 core 10 mm^2 pvc/swa/pvc cable
4.	***Litar 4 :1 x Motor 3 fasa 25 kk*** 31.67A	40A	1 x 4 core 10 mm^2 pvc/swa/pvc cable
5.	***Litar 5 : DB Pendingin Udara*** 25.36A	32A	1 x 4 core 6.0 mm^2 pvc/swa/pvc cable
6.	***Litar 6 : DB Kuasa*** 25.47A	32A	1 x 4 core 6.0 mm^2 pvc/swa/pvc cable
7.	***Litar 7: DB Lampu*** 25.47A	32A	1 x 4 core 6.0 mm^2 pvc/swa/pvc cable
Jumlah Arus	266.32	332.90A	Saiz ACB : 600A

232 a. Nyatakan **TIGA (3)** komponen *fire tetrahedron* bagi tindakbalas berantai dalam kebakaran.

i. Haba(Heat)
ii. Bahan api (Fuel)
iii. Oxygen

b. Senarai **DUA** jenis *sensor* atau *detector* dalam *Automatic fire alarm system.*

i. Smoke Detector
ii. Heat Detector