PACIFIC GAS AND ELECTRIC COMPANY

PG and E

245 MARKET STREET • SAN FRANCISCO, CALIFORNIA 94106 • (415) 781-4211 • TWX 910-372-6587

June 3, 1980

Local Union No. 1245
International Brotherhood of
Electrical Workers, AFL-CIO
P. O. Box 4790
Walnut Creek, California 94596

Attention: Mr. Dean Cofer, Business Manager

Gentlemen:

This letter will confirm the understanding arrived at during the meeting to review the revised Electricians' Qualifying Examination.

The understanding is as follows:

Agreement was reached on the attached list of 100 questions. It was agreed that Tests A and B would be drawn from this list and that questions not used could be substituted, at Company discretion to replace questions in either Test A or B. It was also agreed that the math values in the problems could be changed, from time to time, provided the basic concept of the problems is not changed.

If you are in accord with the foregoing and its attachment and agree thereto, please so indicate in the space provided below and return one executed copy of this letter to Company.

Yours very truly,

PACIFIC GAS AND ELECTRIC COMPANY

By _____
Manager of Industrial Relations

The Union is in accord with the foregoing and its attachment and it agrees thereto as of the date hereof.

LOCAL UNION NO. 1245, INTERNATIONAL BROTHERHOOD OF ELECTRICAL WORKERS, AFL-CIO

June 18, 1980

By Dean Cofer
Business Manager

80-58-TQC

This list contains 100 questions from which Test A and Test B for the Electrician's Qualifying Exam have been drawn.

1. Ohm's Law implies that:

   a. $P = E/R$
   b. $P = IR$
   c. $E = PI$
   d. $P = I^2R$

2. If the voltage is doubled and the resistance remains the same, the amperage is:

   a. The same
   b. 2 times as great
   c. ½ times as great
   d. 4 times as great

3. If the voltage is doubled and the resistance remains the same, the power is:

   a. The same
   b. 2 times as great
   c. ½ as great
   d. 4 times as great

4. A 1 mh coil has a resistance of 100 ohms. At what frequency does $X_L = R$?

5. A capacitor in a R-C circuit across 100 volts charges to 63.2 volts in 5 seconds. The resistor is 1 Megohm. What is the value of the capacitor?

6. If a current transformer has a ratio of 600/5 and a primary current of 480 amperes, the secondary current in the relay will be:

7. When making a primary ratio on a set of Wye connected current transformers connected to 3 phase relays and a ground relay, if the primary ratio leads are connected to A & B phases properly, secondary current will be read in:

   a. AØ relay only
   b. A and CØ relays
   c. BØ and ground relays
   d. AØ and ground relays
   e. None of the above

8. Taps on overcurrent relays are used to set the:

   a. Minimum to operate the disc to creep
   b. Adjustment to the curve
   c. Instantaneous setting
   d. Lever

9. Which of the following statements are true concerning PGandE wire designations:

   a. Wire number 3 should be a current circuit wire
   b. Wire number 1 should be a trip wire
   c. Wire number 5, 7 and 9 should be current wires
   d. Wire number 2 should be a close wire

10. Which one of the following conditions is correct for automatic operation of PCB to test the line?

   a. Hot bus and hot line, closed PCB; F.C.O. closed & Dev. 43 on auto.
   b. Dead line and hot bus closed PCB; F.C.O. closed & Dev. 43 on auto
   c. Hot line and dead bus open PCB; F.C.O. closed & Dev. 43 on auto
   d. Hot bus and dead line open PCB; F.C.O. closed & Dev. 43 on auto

11. Eddy current losses in a transformer are reduced by:

   a. Better insulation
   b. Using larger wire
   c. Using a laminated core
   d. Using better iron alloys in the core

12. If the secondary of a station service bank is connected 4-wire Delta, the lighting circuit must be taken from:

   a. Hot leg to hot leg
   b. Power leg to hot leg
   c. Power leg (stinger) to neutral
   d. The secondary voltage is greater than the primary voltage

13. The terms additive and subtractive of a transformer refer to:

   a. Location of $X_1$ Bushing
   b. The primary voltage is greater than the secondary voltage
   c. There are more primary turns than secondary turns
   d. The secondary voltage is greater than the primary voltage

14. A single phase transformer nameplate reads as follows:

| | | |
|---|---|---|
| 12,000/20,800 volts | GRD-Y | 120/240 |
| Impedance 3% | | kva - 25 |

It is connected to a 3 wire 12 kv system. How will the high tension terminals be connected?

a. Phase to phase
b. A phase to B phase only
c. Phase to neutral
d. C phase only

15. In a Wye-Delta transformer bank the primary line current is:

a. 1.73 times the primary coil voltage
b. Equal to the secondary line current
c. 1.73 times the secondary coil current
d. Equal to the primary coil current

16. Which of the following formulas is correct for a three-phase Delta connected transformer bank?

a. 3 phase $W = E_{coil} \times I_{coil} \times$ Power Factor
b. 3 phase $VA = E_{line} \times I_{line}$
c. 3 phase $VA = 1.73 \times E_{coil} \times I_{coil} \times$ Power Factor
d. 3 phase $W = 1.73\ E_{line} \times I_{line} \times$ Power Factor

17. The red close light on a PCB also indicates;

a. The PCB is energized at primary voltage
b. The PCB is at lock-out
c. The integrity of the trip coil
d. None of the above

18. A load-tap changer is primarily used to:

a. Change current under no load
b. Change voltage while carrying load
c. Change voltage under no load
d. Change the customer's load

19. No load-tap changers are used to:

a. Change taps under light load conditions
b. Select the desired HT bushing
c. Change the ratio of primary turns to secondary turns with the transformer de-energized
d. All of the above

20. A three phase Delta, 480 volt transformer is installed to serve a three phase lighting load. The rating of the transformer is 45 KVA. At full load calculate:

The primary line current

The secondary line current

21. On a 230 KV transmission line the meters read 200 MW and 40 M Vars. What is the line current?

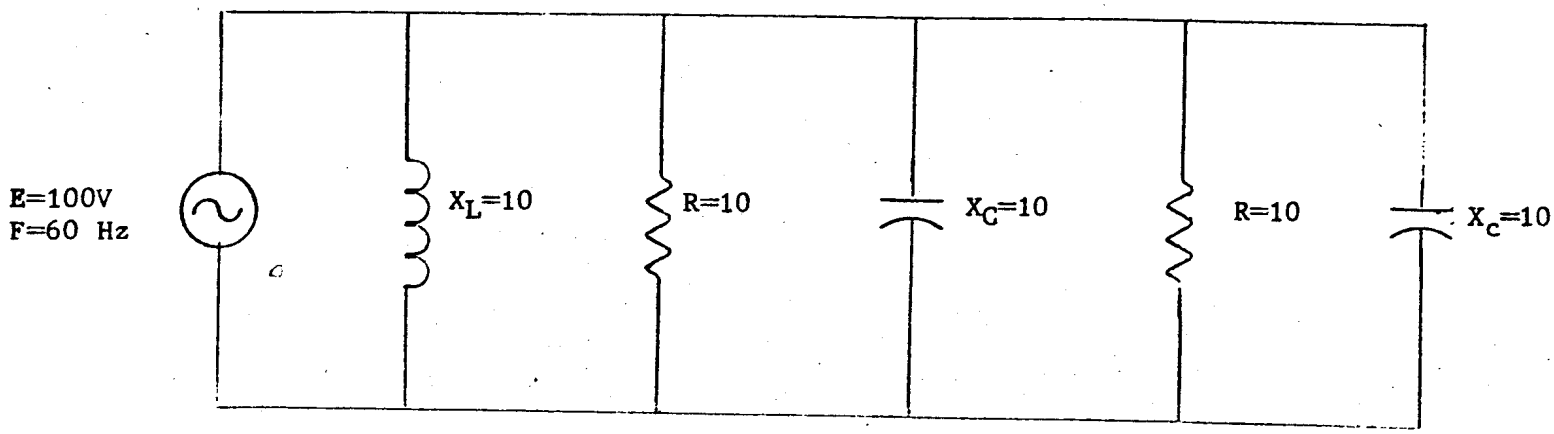
22. On a right triangle, the base is one half the hypotenuse. The altitude is 10. Find the base.

23. In addition to a TTR, the turns ratio of a transformer may be checked by using an AC voltage source and a _____ .

a. Ammeter
b. Megger
c. Voltmeter
d. None of the above

24. Device 80 is:

a. Recloser
b. Overcurrent relay
c. Alarm relay
d. None of the above




25. How much power does the above circuit use?

26. While paralleling two PCBs on the auxiliary bus, you must:

a. Cut out the ground relay on one
b. Cut out the reclosing relay on both
c. Cut out the ground and reclosing relay on both
d. Cut out the phase relay on one

27. A switch designated as SW 55 is normally a:

a. Bypass switch
b. Bus disconnect switch
c. Line disconnect switch
d. PCB

28. When testing an auxiliary bus with a PCB, the _____ must be cut out.

a. Ground relay
b. Phase supply
c. DC supply
d. Reclosing relay

29. When bypassing regulators, it is proper to:

a. Place the tap changer to an output voltage at its base voltage
b. Close the bypass switch at its present tap
c. Set the band width of 2 volts
d. Run the regulator to the neutral position, cut out the motor circuit and tag caution

30. When closing a recloser in the field with the bypass switch closed:

a. Cut out the phase trip of the line recloser
b. Cut out the ground trip of the line recloser
c. Cut out the reclosing and the ground trip switches of the line recloser
d. Cut out the reclosing switch of the line recloser

31. The total voltage in an AC series circuit is :

a. Total voltage times the total current
b. A point of excess and a point of deficiency
c. The vector sum of all of the voltage drops
d. A movement of electrons

32. A Varmeter is used to indicate the _____ of a circuit.

a. Reactive voltamps
b. Apparent power
c. Voltamps
d. Power factor

33. If three diodes in a full wave bridge rectifier open up:

a. There will be no output
b. There will be 3/4 of the full wave output
c. There will be full output
d. There will be 1/2 of the full wave output

34. When an open circuit occurs, the resistance of the circuit approaches:

a. Infinity
b. 50% of its closed circuit value
c. Zero
d. 50% of its open circuit value

35. A fuse is a device that:

a. Melts when current over its rating is passed through it
b. Opens the circuit on overload
c. Is installed in series with the line
d. All of the above

36. The property of a circuit that will cause the current to lag the voltage is called:

a. Inductance
b. Impedance
c. Capacitance
d. Resistance

37. When battery cells are connected in parallel:

a. The output voltage is the sum of all the paralleled batteries
b. The output voltage is the difference of all the paralleled batteries
c. Their rated voltages must be the same
d. None of the above

38. Alternating current is defined as a current that is:

a. Constantly changing in direction and periodically in magnitude
b. Changing only in voltage
c. Constantly changing in magnitude and periodically changing in direction
d. Periodically changing in current and in voltage

39. An electric current flowing through a coil provides:

a. A diaphonous current field
b. An electromagnetic field
c. Turboencabulation
d. A permanent magnetic field

40. A watt meter is used to indicate the _____ of a circuit

a. True power
b. Impedance
c. Reactance
d. Apparent power

41. Voltmeters are connected in _____ with the circuit to be read.

a. Tandem
b. Parallel
c. Series
d. Series and parallel

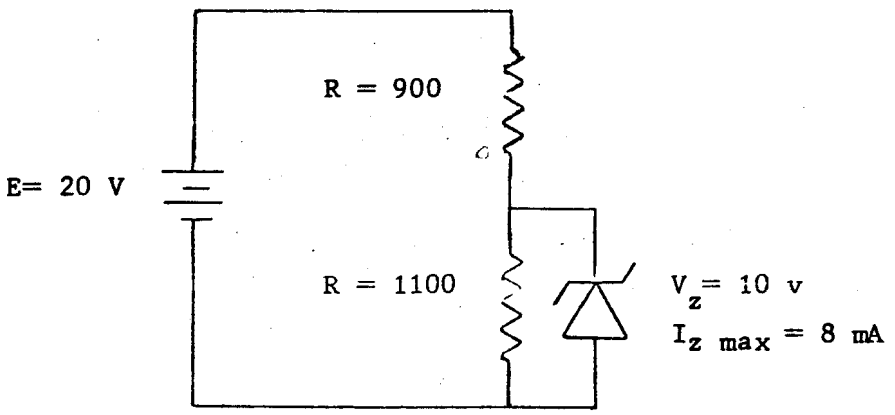
42. A phase sequence indicator:

a. Determines A, B, and C phases
b. Always reads clockwise rotation
c. Reads clockwise or counterclockwise depending upon the connection
d. Determines the hot and power legs

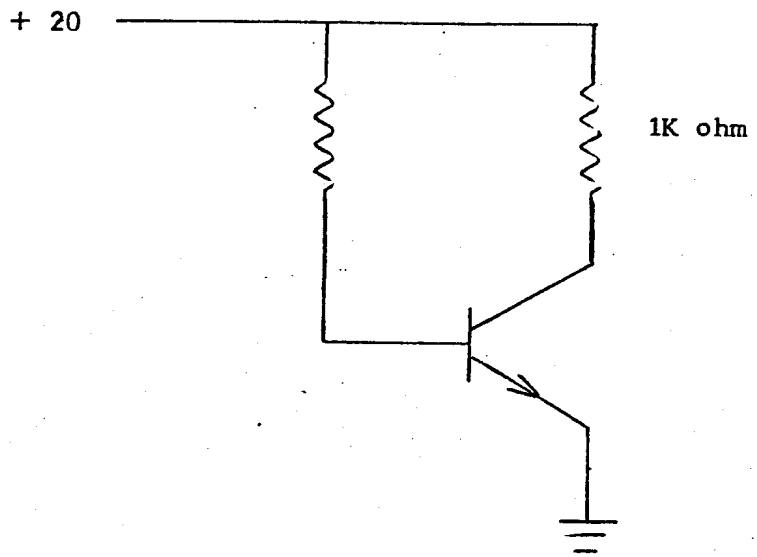
43. When placing portable grounds on de-energized equipment:

a. First check equipment dead with a high voltage detector or by ferral testing
b. Portable ground shall be first connected to a ground bus before being brought into contact with any de-energized conductor or equipment, and shall be readily visible by one member of the crew
c. Ground cables shall not protrude in working or other energized equipment areas
d. All of the above

44. Calculate the zener current




45. A full wave DC power supply uses a 24 V center tapped transformer and two diodes. Draw the circuit. If the output is filtered, what is the output voltage?




46. The voltage drop from the collector to emitter is 10 volts. What is the collector current when the Beta of the transistor is 100?

47. The primary of a transformer is 480 volts. The primary current is 10 amps and the secondary current is .6667 amps. There are 1,200 turns on the primary. What is the secondary voltage?

48. A generator-operating at 70 MW has a P.F. of 80%. How many M Vars must the generator change to increase the P.F. to 90%.

49. What should be the voltage rating of a standard megger used on control wire with a rating of 1,000 V.

50. Transformer oil dielectric testing below _____ volts must be filtered and brought up to at least _____ volts.

51. Give two reasons why the dielectric strength of insulating oil may test below the minimum acceptable value.

52. The purpose of contact resistance measurements on PCBs is to determine

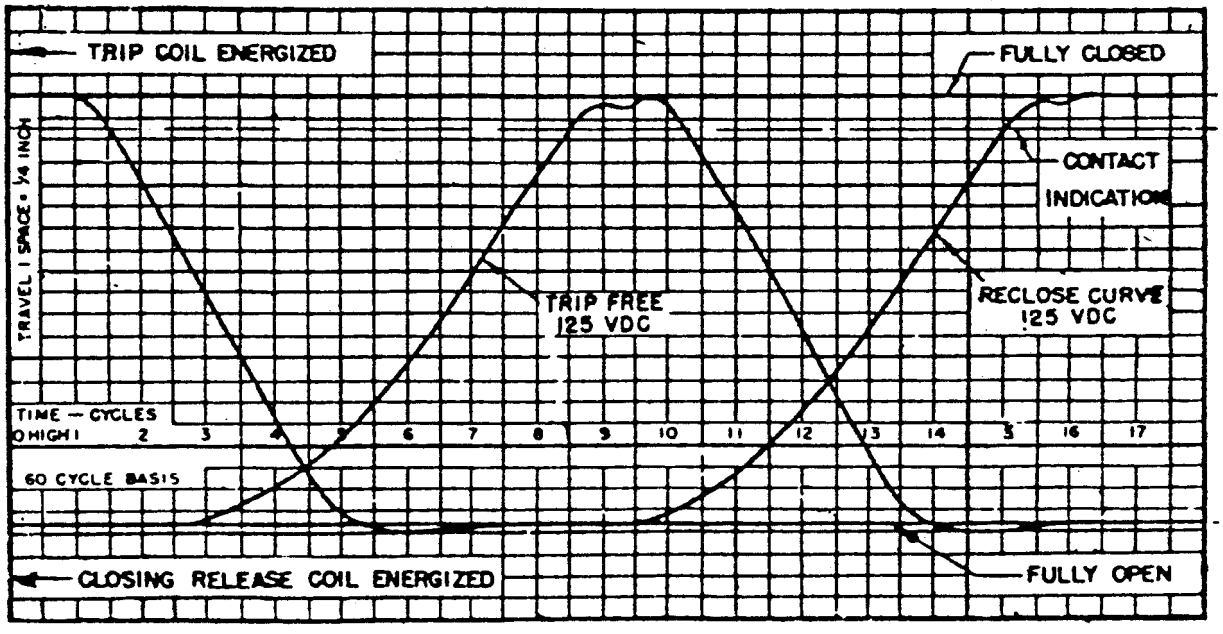
_____

_____

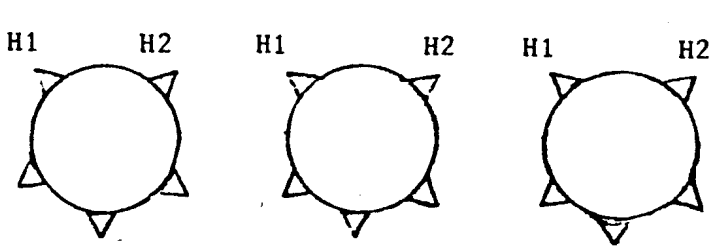
and the difference in contact resistance readings as compared between
53. phases or poles should not exceed _____%.

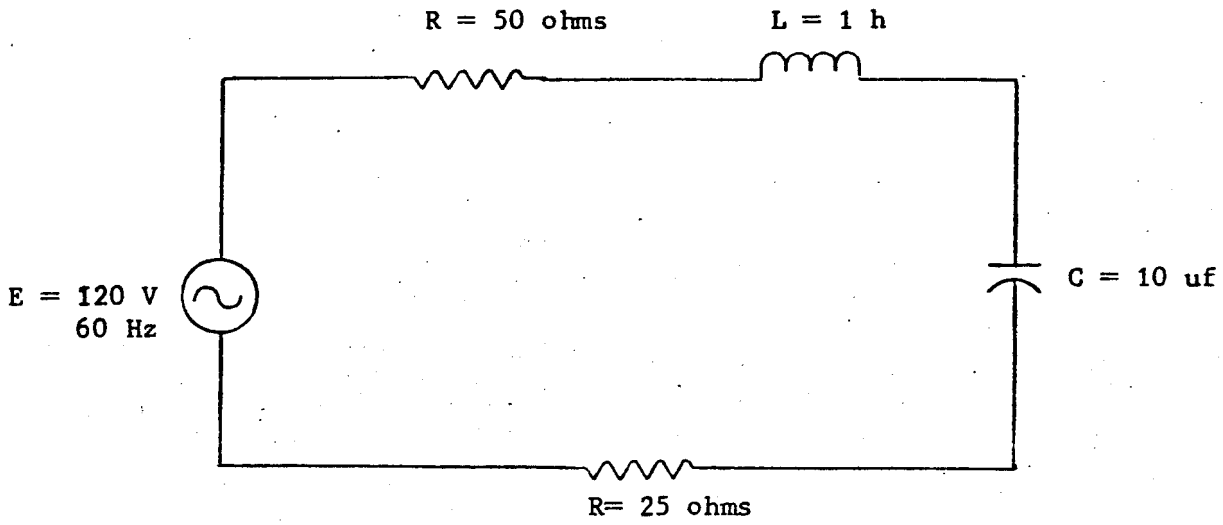
54. Measure and record the following time intervals and travel from the graph below

1. Closing time _____
2. Opening time _____
3. Trip free time _____
4. Contact penetration _____
5. Stroke _____
6. Overtravel _____



55. Vector and connect the following subtractive transformers, Delta-Delta, with the secondary 180° out of phase with the primary. Show power leg, hot legs and neutral.






56. What is the total impedance of the above circuit?

57. Find the true power used by the above circuit.

58. Find the voltage drop across the inductor in the above circuit.

59. A three-phase 480 V motor is drawing 30 AMPS from the line. The P.F. is 72% and the efficiency is 68%. How much horse power does the motor develop?

60. Given - 12 KV distribution feeder with CTs as shown below

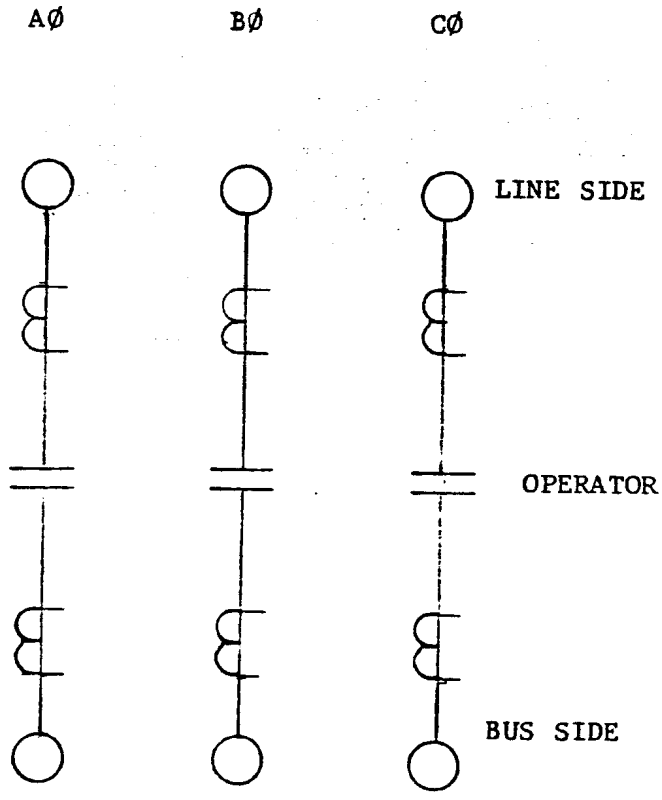
Label the poles numerically

Label the "spots" (polarity marks) of the bus and line CTs.

Connect the proper CTs to a set of phase overcurrents and a ground relay. Label phases on the relays.

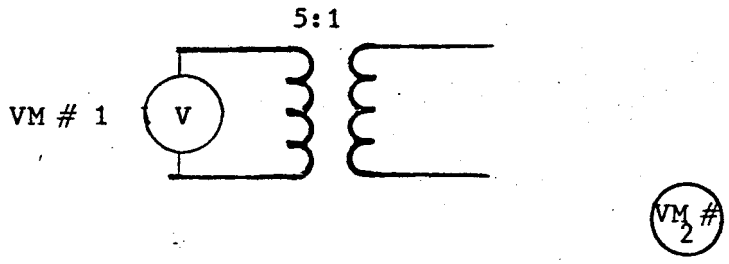
Label the wires connecting the CTs and relays per PGandE standard wire designations.

Make a diagram showing primary test equipment and connection for a ground ratio on A phase. Indicate with arrows the instantaneous relative current flow in the primary and secondary circuits.



61. Can you parallel a Delta-Delta transformer with a Wye-Wye transformer? Explain your answer.

62. The transformer has a ratio of 5 to 1. Show the proper connections to test for polarity. Show the voltage obtained if the polarity is subtractive and voltmeter #1 reads 100 volts.

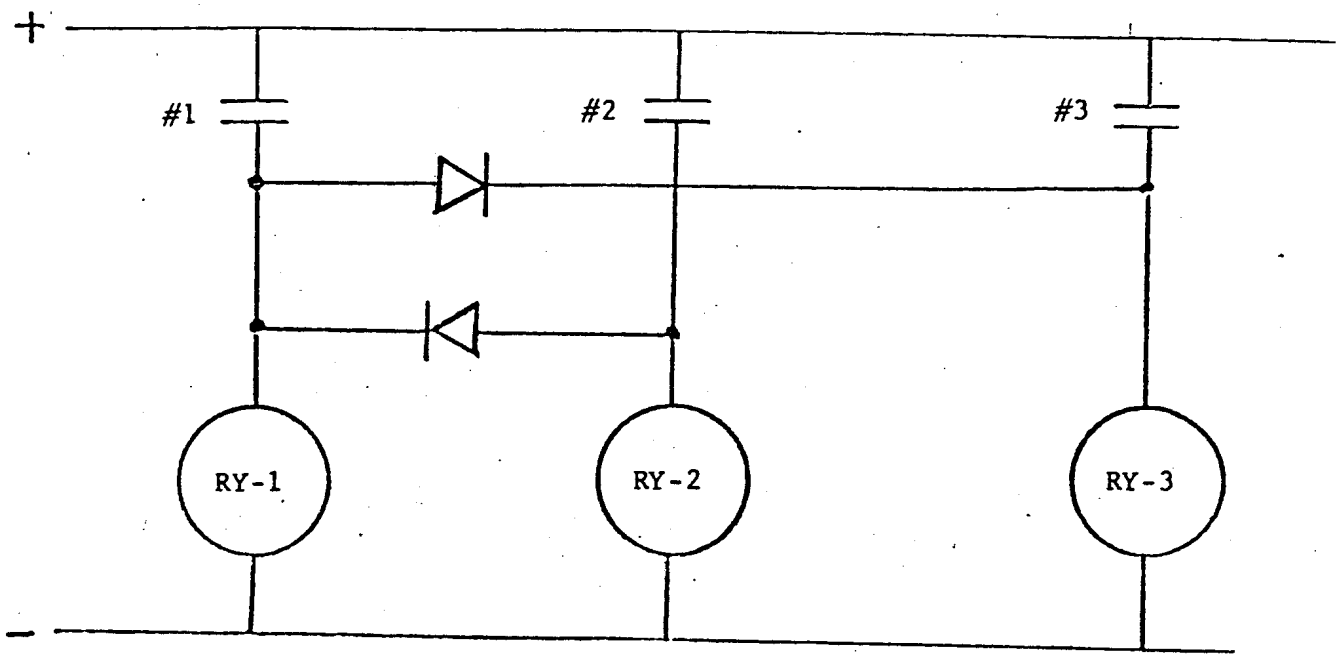



63. The handles on hand reset lockout relays are painted what color?

64. Transmission PCB bypass switch handles are painted what color?

65. Control switch "Slip and 0" contacts are both closed in which switch position?

    a. Close
    b. Trip
    c. After trip
    d. After close




66. Contact #1 is closed:

a. RY-1, RY-2 and RY-3 pick up
b. only RY-1 and RY-2 pick up
c. only RY-1 and RY-3 pick up
d. only RY-1 picks up

67. Contact #2 is closed

a. RY-1, RY-2 and RY3 pick up
b. only RY1 and RY2 pick up
c. only RY2 picks up
d. only RY2 and RY3 pick up

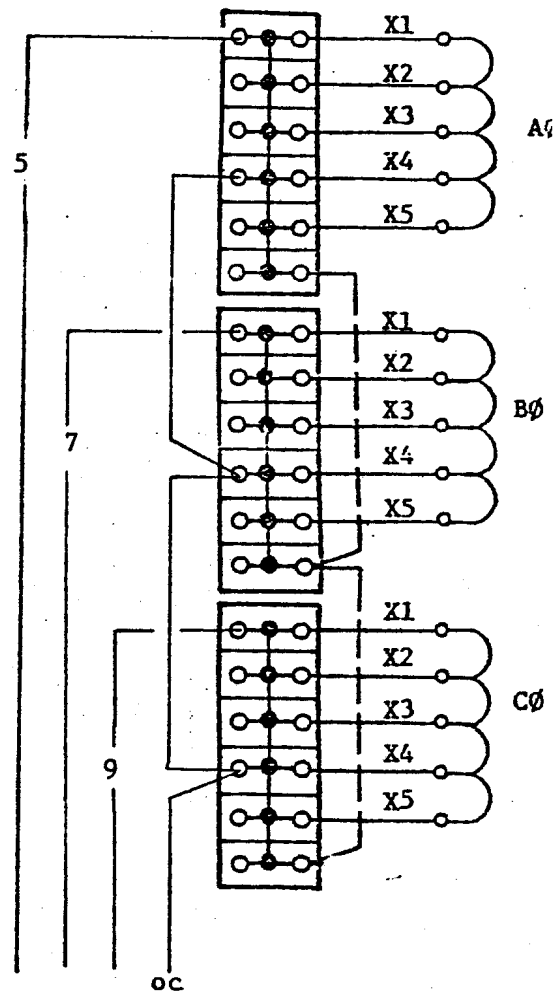
68. Contact #3 is closed

a. only RY3 picks up
b. RY1, RY2 and RY3 pick up
c. only RY1 and RY3 pick up
d. only RY2 and RY3 pick up

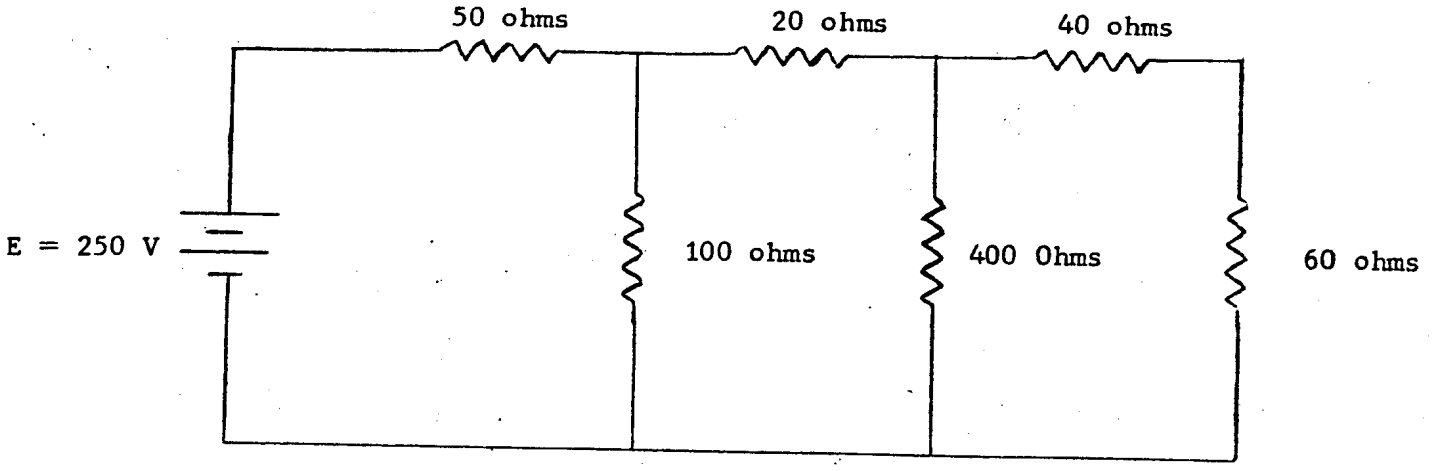
RATIO AND NUMBER OF SECONDARY TURNS BETWEEN TAPS
STANDARD TYPES BR-B AND BR-C ( * ) BUSHING CURRENT TRANSFORMERS

| Nominal Ratio | 600/5 Amps. 120 Turns | | 1200/5 Amps. 240 Turns | | 2000/5 Amps. 400 Turns | | 3000/5 Amps. 600 Turns | |
|---|---|---|---|---|---|---|---|---|
| Taps | Turns | Pri.* Amps. | Turns | Pri.* Amps. | Turns | Pri.* Amps. | Turns | Pri.* Amps. |
| $X_2$-$X_3$ | 10 | 50 | 20 | 100 | 160 | 800 | 300 | 1500 |
| $X_1$-$X_2$ | 20 | 100 | 40 | 200 | 80 | 400 | + | ---- |
| $X_1$-$X_3$ | 30 | 150 | 60 | 300 | 240 | 1200 | + | ---- |
| $X_4$-$X_5$ | 40 | 200 | 80 | 400 | 100 | 500 | | |
| $X_3$-$X_4$ | 50 | 250 | 100 | 500 | 60 | 300 | + | ---- |
| $X_2$-$X_4$ | 60 | 300 | 120 | 600 | 220 | 1100 | 400 | 2000 |
| $X_1$-$X_4$ | 80 | 400 | 160 | 800 | 300 | 1500 | 600 | 3000 |
| $X_3$-$X_5$ | 90 | 450 | 180 | 900 | 160 | 800 | | |
| $X_2$-$X_5$ | 100 | 500 | 200 | 1000 | 320 | 1600 | | |
| $X_1$-$X_5$ | 120 | 600 | 240 | 1200 | 400 | 2000 | | |

MULTI RATIO C.T.




69. This CT is shown wired for a 800/5 ratio. Show changes to make this a 900/5 ratio.




70. What is the current through the 60 ohm resistor?

71. What is the voltage drop across the 50 ohm resistor?

72. What is the total power used by this circuit?

73. A lead acid cell with a low charge will have a:

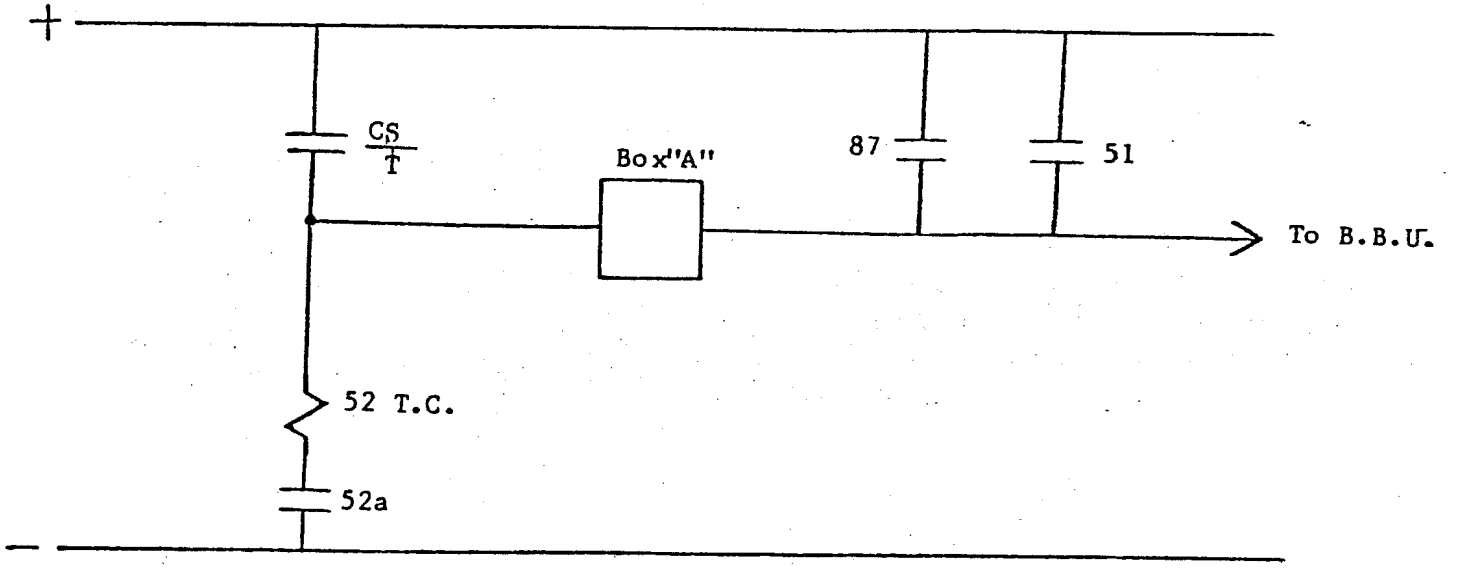
a. High specific gravity reading
b. Zero specific gravity reading
c. Low specific gravity reading
d. Normal specific gravity reading

74. Ohm's Law states that:

a. The resistance is directly proportional to the current and inversely proportional to the voltage.
b. With an increase in voltage, the current will decrease
c. The current is directly proportional to the voltage applied and inversely proportional to the resistance.
d. The current is inversely proportional to the square of the applied voltage

75. A transmission line operating at 230 KV has balanced ammeters reading 200 amperes. The VARMETER indicates zero vars . What should the WATTMETER indicate ?

76. A power line has 5 ohms resistance and 10 ohms reactance. It is operating at 115 KV and 100 amperes. If the amperage is increased to 200 amperes, what is the line's power loss?




77. Correctly insert a tripping diode in box A.

78. If the minimum to "creep" is out of adjustment you must adjust:

a. the drag magent
b. the bias spring
c. the zero index
d. the tap

79. Which of the following would be adjusted in an overcurrent relay so it meets its curve?

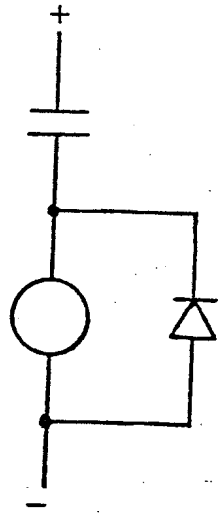
a. The drag magnet
b. The bias spring
c. The zero index
d. None of the above

80. An overcurrent relay has taps of 0.5 - 1.0 - 2.0 - 3.0 - 4.0. In order to make a tap adjustment of 2.5 you would:

a. Put tap screws in the 0.5 and 2.0 positions
b. Put tap screw in the 2.0 position and adjust the bias spring
c. Put tap screw in the 3.0 position and adjust the magnet for maximum drag
d. None of the above

81. On a distribution overcurrent relay scheme, the 51 cut-out switch:

a. bypasses the currents around the relay
b. Opens the trip circuit to the relay
c. Prevents the primary side of the bank from tripping on distribution trouble
d. Removes the ground relay from the trip circuit




82. The purpose of the diode is to:

a. Desensitize the relay pick up
b. Seal in the relay
c. Prevent contact bounce
d. Attenuate the collapsing field of the coil

83. A capacitor in a DC circuit will:

a. Never allow current to pass through the capacitor
b. Allow current to pass when first energized
c. Rectify current to a safe value
d. None of the above

84. A capacitor when used in a DC power supply circuit will:

a. Raise the voltage to $\sqrt{2}$ of the applied AC
b. Prevent third harmonics
c. Utilize third harmonics to raise the voltage to the $\sqrt{3}$ of the applied AC
d. Rectify the AC

85. Grounding a DC control circuit at a switchboard at a PCB:

a. Is acceptable because current is limited by the ground detector lights
b. Is not acceptable as the station battery polarity may be reversed
c. Is not acceptable due to possible false tripping
d. Is acceptable only to test alarms in the station

86. Current transformer secondary circuits:

a. May be opened if the circuit is at full load
b. May be opened if the circuit is at minimum load
c. May be opened if the circuit is energized and not carrying load
d. May be opened only if the circuit is cleared

87. A voltage detector shall never be used on busses of equipment normally energized above 15 KV, phase to ground. What is the line-to-line voltage of this limit? _____

88. A single phase transformer has a nameplate rating of 34642/33775/32910/32044/31178 to 7200 volts. 478 volts is applied to the primary winding. The secondary needs 99.5 V. Volt meter is 1% accurate. What tap is the transformer on?

89. Minimum voltage to close a CB should be _____% or less of nameplate voltage?

90. Minimum voltage to trip a CB should be _____% or less of nameplate voltage.

91. CB lock out switches are set at no more than (starting from a full storage tank pressure):

a. 3 close-open operations
b. 4 close-open operations
c. 5 close-open operations
d. 6 close-open operations

92. CB air compressor cut-in settings should operate after the:

a. 1st close-open operation
b. 2nd close-open operation
c. 3rd close-open operation
d. 4th close-open operation

93. CB air low alarm switches are set to operate after the:

a. 1st close-open operation
b. 2nd close-open operation
c. 3rd close-open operation
d. 4th close-open operation

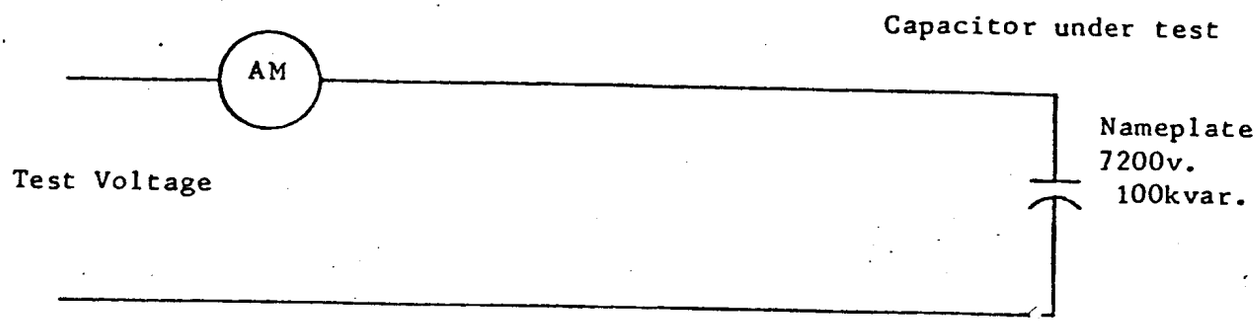
94. A 3 phase transformer is serving a balanced lighting load. The transformer coil ratio is 4 to 1. The primary voltage is 480 volts. Calculate the primary line current when the load is 30 KW.

95. The base of a right triangle is one half the altitude. The hypotensue is 12. Find the base.

96 If you don't have a TTR, what can be used to check the turns ratio of a transformer?

97. When testing an auxiliary bus with a CB, the _____ must be cut out.

98. What must you do before you bypass a regulator?




99. The test voltage is 120 volts. What should the ammeter read?

100. Vector and connect the following subtractive transformers, Wye-Delta, with the secondary lagging the primary by $30^{o}$. Show the power leg, hot legs and neutral.