2394 EXAM PAPER

1. State THREE circumstances that would require a periodic inspection and test to be carried out on an installation (3 marks)

2. There are various documents that are relevant to the Inspection and Testing of an installation. State
   a) one statutory item of documentation (1 mark)
   b) two non-statutory items of documentation. (2 marks)

3. State the meaning of
   a) ADS
   b) Basic protection (2 marks)
   c) one other method of fault protection (1 mark)

4. List THREE areas other than wear and tear and ageing that should be considered when carrying out a periodic inspection and test of an installation (3 marks)

5. State the preferred method of using an approved test lamp to check that a circuit is dead and safe to work on, in accordance with the recommendations of GS38. (3 marks)

6. State the electrical units in which EACH of the following test results would be expressed
   a) Insulation resistance. (1 mark)
   b) External loop impedance. (1 mark)
   c) Tripping time of an r.c.d. (1 mark)

7. Identify the type of circuit that would require the following applied voltages when conducting an insulation resistance test.
   a) 250 V. (1 mark)
   b) 500 V. (1 mark)
   c) 1000 V. (1 mark)

8. List the first three tests that should be carried out during a ***periodic*** inspection and test of an installation (3 marks)

9. Name the protective conductors that connect together the following.
   a) An electrically heated towel rail and exposed metal pipework in a bathroom. (1 mark)
   b) The earthing terminal of a socket outlet and the main earthing terminal. (1 mark)
   c) Main Gas and Water services to the main earthing terminal. (1 mark)

10. State the
    a) essential action to be taken before disconnecting a main protective bonding conductor for test purposes during a periodic inspection and test (2 marks)
    b) dangers that would arise if this action is not taken (1 mark)

11. A ring final circuit continuity test revealed incorrect polarity on three socket outlets. The results were

	L to N	L to c.p.c.
Socket A	open circuit	correct
Socket B	correct	open circuit
Socket C	open circuit	open circuit

    State which conductors have reversed polarity in each case. (3 marks)

12. State the effect on
    a) conductor resistance when conductor length increases (1 mark)
    b) insulation resistance when cable length increases (1 mark)
    c) conductor resistance when conductor c.s.a. increases. (1 mark)

13. Explain briefly the action to be taken if the insulation resistance test of an installation indicates an overall value of 1.25 M-ohms. (3 marks)

14. a) The resistance of a 50 m length of conductor is 0.1 ohms. What would be the resistance of 100 m of the same conductor? (1 mark)
    b) The insulation resistance of 1000 m of twin cable is 50 M-ohms. What would be the insulation resistance of 2000 m of the same conductor? (1 mark)
    c) The resistance of a length of 1.0 mm^2 conductor is 0.2 ohms. What would be the resistance of a 4.0 mm^2 conductor of the same length? (1 mark)

15. State the IP codes for enclosures that protect against a
    a) jointed test finger and a 12.5 mm dia. sphere (1 mark)
    b) jointed test finger only (1 mark)
    c) 1 mm dia. wire. (1 mark)

16. In the formula **Zs = Uo/Ia**, state what is represented by
    a) Z_s
    b) U_o (1 mark)
    c) I_a (1 mark)
    (1 mark)

17. List THREE requirements of GS 38 regarding the construction of an approved test lamp. (3 marks)

18. The maximum tabulated values of Z_s for three circuits are 0.86 Ω, 1.2 Ω and 2.67 Ω respectively. The measured values for the same three circuits are 0.69 Ω, 0.8 Ω and 2.2 Ω. Verify by calculation whether the measured values are acceptable. (3 marks)

19. Construction sites are considered within BS 7671 to be special locations that require special regulations. Give THREE examples of locations on a construction site that are NOT subject to such special requirements (3 marks)

20. State the earth return path for EACH of the following
    a) TT (1 mark)
    b) TN-S (1 mark)
    c) TN-C-S. (1 mark)

Section B - Answer ALL SIX questions. All questions carry equal marks.

All questions in Section B (21-26) refer to Fig. 1 attached.

Fig. 1 attached shows the layout of the new electrical installation in a small workshop. The metalclad TP&N distribution board houses type B and C BS EN 60898 c.b.'s and the wiring system thoughout is single-core p.v.c. insulated cable enclosed in steel conduit and trunking. An initial verification is to be carried out.

21. State the
    a) information that will be required before the verification proceeds (4 marks)
    b) documentation that will need to be completed for this inspection and test (4 marks)
    c) statutory requirements that will govern the verification process (2 marks)
    d) test equipment needed. (5 marks)

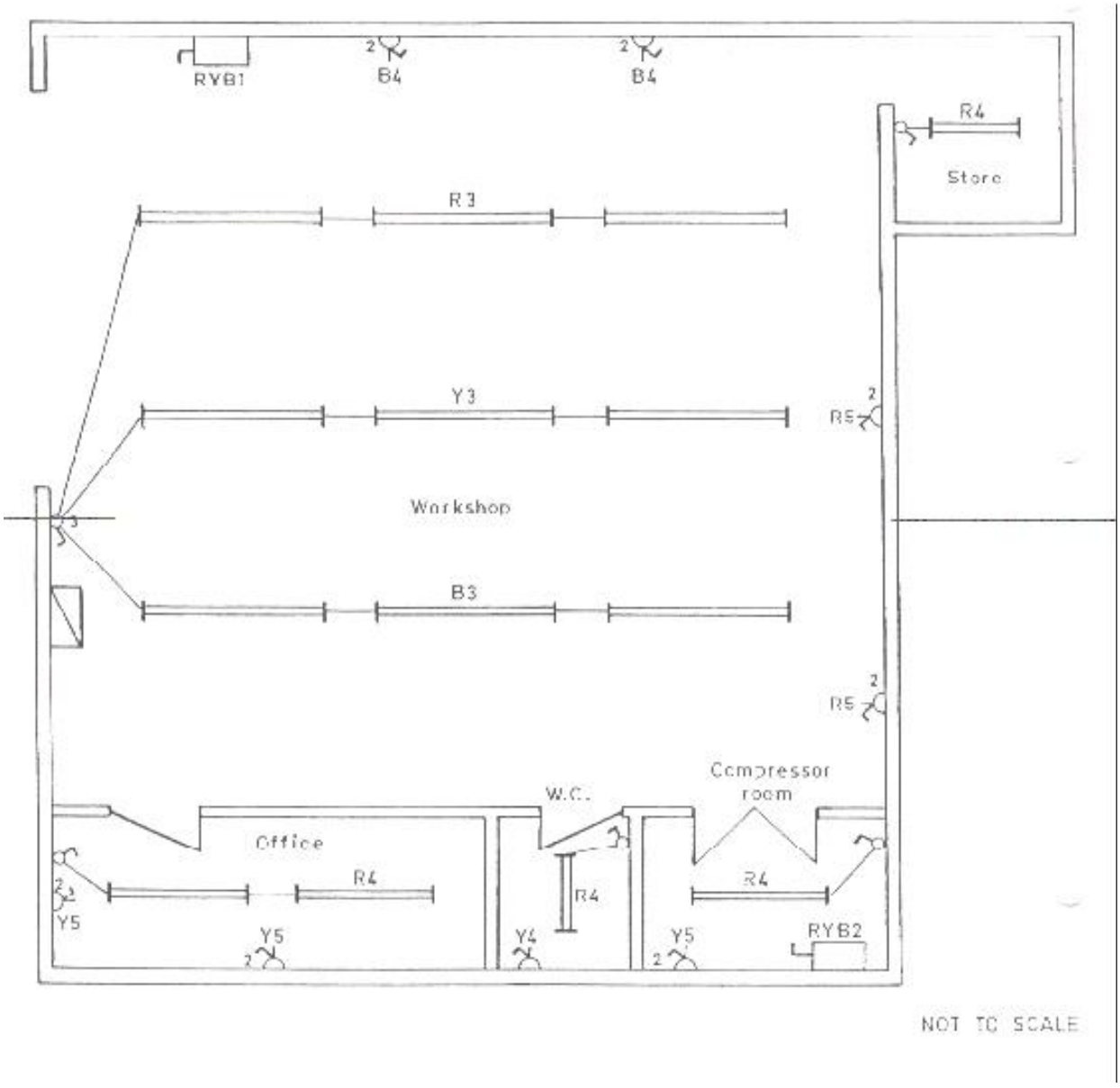
22. List FIVE items from the inspection check list that are relevant to this installation (15 Marks)

23. List, in the correct sequence, the tests to be carried out on this installation including those tests that are required but not included in the BS 7671 sequence (15 Marks)

24. Describe how an insulation resistance test on this installation should be carried out. (15 Marks)

25. The TP&N isolator in the compressor room is wired on its own radial circuit
    a) List ALL the component parts of the earth fault loop path associated with this circuit in the event of a fault to earth. (8 Marks)
    b) If the maximum value of loop impedance for this circuit in 2.4 ohms and an earth fault causes a current of 120 A, show by calculation if this value will disconnect the circuit in the required time. (7 Marks)

26. If the wiring system did not contain separate c.p.c.'s describe the two tests required to verify the continuity of protective conductors formed by the conduit and trunking. (15 Marks)


RYB1
2
B4
2
B4
R4
Store
R3
Y3
2
R5
Workshop
B3
2
R5
Compressor
room
W.C.
Office
R4
R4
R4
2
Y5
Y5
2
Y4
Y5
2
RYB2
NOT TO SCALE

Answers

All fuses/M.C.B.'s in place/on
All equipment vulnerable to test should be removed
Test perform

1 Any three of...
End of licence (Public buildings)
End of insurance period
Change of ownership
End of recommended period since last test

2 a) Electricity At Work act '89 **or** Health & Safety at Work Act '74
b) BS 7671
On Site Guide
Guidance Notes
etc.

3 a) (i) Automatic Disconnection of the Supply
(ii) Protection provided for persons or livestock against contact with live parts.
b) Class II equipment
Non conducting Location
Earth free location
Electrical separation

4 Damage
Corrosion
Use/change of use
Alterations/additions
Loading

5 Select an approved test lamp
Test to prove working condition
Test circuit
Identify isolator & switch off
Remove fuses/break neutral
Put fuses in pocket/tool box
Lock off
Put key to lock in pocket/tool box
Post warning notices
Retest circuit
Check tester to prove still working

6 a) MΩ
b) Ω
c) ms

7 a) SELV/PELV
b) LV up to 500 V
c) LV 500 V to 1000 V

8 Continuity of C.P.C.
Polarity
Earth loop impedance

9 Supplementary protective bonding conductor
Circuit protective conductor
Main protective bonding conductor

10 a) Installation to be disconnected from supply
b) If a fault occurs, exposed & extraneous conductive parts could be raised to a

dangerous level above earth potential.

11 a) L & C.P.C.
b) L & N
c) All **or** N & C.P.C.

12 a) Increases
b) Decreases
c) Decreases

13 Each circuit should be separately tested & its insulation resistance should be greater than 2 MΩ.

14 a) 0.2 Ω (0.1 x 2)
b) 25 MΩ (50) 2)
c) 0.05 Ω

15 a) IP2X
b) IPXXB
c) IP4X

16 a) Z_s = System Impedance
b) U_o = Nominal voltage to earth
c) I_a = Current causing operation of protective device within specified time

17 Fully shrouded
In line fuse (500 mA)
Minimum exposed metal

18 : rule (Rule of thumb)
(i) Max value = 0.86 Ω
Max adjusted = 0.86 x 0.8 = 0.688 Ω
Actual value = 0.69 Ω
Actual value is higher that adjusted value - Not acceptable

(ii) Max value = 1.2 Ω
Max adjusted = 1.2 x 0.8 = 0.96Ω
Actual value = 0.8 Ω
Actual value is lower that adjusted value - Is acceptable

(iii) Max value = 2.67 Ω
Max adjusted = 2.67 x 0.8 = 2.136 Ω
Actual value = 2.2 Ω
Actual value is higher that adjusted value - Not acceptable

19 Any one of...
Site offices
Cloakrooms
Meeting Rooms
Canteens
Restaurants
Dormitories
Toilets
Etc.

20 a) Consumers C.P.C., consumers earth electrode, ground, suppliers earth electrode
b) Consumers C.P.C., suppliers protective conductor
c) Consumers C.P.C., suppliers PEN conductor

21 a) Maximum demand
Arrangement of live conductors & type of earthing
Nature of supply
Distribution schedule
Charts/diagrams/working instructions
Equipment vulnerable to tests

b) Electrical installation certificate
Schedule of Inspections
Schedule of test results

c) Electricity At Work act '89
Health & safety At Work Act '74
Ensure no persons or livestock are in danger when conducting tests.

d) Voltage indicator and proving unit
Continuity tester - Continuity & polarity testing
Insulation resistance tester
Earth loop impedance tester
Prospective short circuit current tester
(Residual current device tester if R.C.D. is fitted)

22 Any five from 712-01-03
Connection of conductors
Polarity
Method of installation
Method of protection against electric shock
Earthing
Identification of conductors
Etc.

23 **Power Off - Dead Tests**
Continuity of CPC including main and supplementary protective bonding conductors
Continuity of ring final circuit conductors
Insulation resistance
Polarity
Power Off- Prove the Supply
Re-check polarity
External loop impedance - with installation earthing conductor disconnected
Prospective short circuit current - with installation earthing conductor connected
Prospective fault current - with installation earthing conductor connected
Power On - Live Tests
Earth Fault loop impedance - for each circuit
Functional testing

24 All switches closed
All current using equipment removed
All fuses/M.C.B.'s in place/on
All equipment vunerable to test should be removed
Test performed at meter tails if possible.

Test between
i) Live Conductors, L1-L2, L2-L3, L1-L3, L1-N, L2-N & L3-N
ii) Live Conductors to Earth. L1-E, L2-E, L3-E & N-E

25 a) The fault current path starts at the point of fault
- Circuit C.P.C from the point of fault back to the M.E.T.
- From the M.E.T. to the suppliers substation transformer
  - ➢ TT system
    - ∴ Consumers earth electrode

∴ Ground
∴ Suppliers earth electrode
➢ TN-S system
∴ Suppliers service cable metallic sheath
➢ TN-C-S system
∴ Suppliers PEN conductor

- Sub-station transformer secondary winding
- Suppliers Line conductor
- Consumers' Line conductor to point of fault.

b) Using the formula in appendix 3 of BS 7671 we can use the fault current to find the actual impedance value

$$Zs = \frac{Uo}{Ia} = \frac{240}{120} = 2\Omega$$

Zs = Uo/Ia =230/120 = 1.92 ohms

The maximum impedance is higher than the calculated value, therefore, based on the information provided, the circuit complies.

26 Perform $R_1 + R_2$ test
Inspect conduit/trunking along its route to verify its integrity
Perform a high current ohmmeter test.
ed at meter tails if possible.

Test between
i) Live Conductors, L1-L2, L2-L3, L1-L3, L1-N, L2-N & L3-N
ii) Live Conductors to Earth. L1-E, L2-E, L3-E & N-E

25 a) The fault current path starts at the point of fault

- Circuit C.P.C from the point of fault back to the M.E.T.
- From the M.E.T. to the suppliers substation transformer
- TT system
- Consumers earth electrode
- Ground
- Suppliers earth electrode
- TN-S system
- Suppliers service cable metallic sheath
- TN-C-S system
- Suppliers PEN conductor
- Sub-station transformer secondary winding
- Suppliers Line conductor
- Consumers' Line conductor to point of fault.

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