C&G 2394/2395 Past Exam Paper

Section A All questions carry equal marks. Answer all 20 questions.

1. State the 3 main areas to be verified during the initial inspection of a new installation, as detailed in Guidance Note 3. (3 marks)

2. State what, in addition to compliance with BS 7671, the designer must ensure when carrying out an alteration or addition to an existing electrical installation. (3 marks)

3. State 3 types of installation in which electrical work may need to comply with specific statutory regulations, in addition to the EAWR 1989. (3 marks)

4. Give one example of a situation where each of the following would need to be included on a Schedule of Inspections.
a) Limitation of discharge of energy. (1 mark)
b) Placing out of reach. (1 mark)
c) Presence of under voltage protective devices. (1 mark)

5. State:
a) which statutory document places a duty on persons carrying out inspection and testing of electrical installations (1 mark)
b) the 2 groups of people for whom the Inspector has a duty to ensure safety under a) above. (2 marks)

6. State the:
a) instrument used to test for continuity of protective conductors (1 mark)
b) unit of measurement for the test in a) (1 mark)
c) reasons for the choice of instrument and scale. (1 mark)

7. List the first 3 live tests for a new installation which forms part of a TT system. (3 marks)

8. State, using the correct terminology, 3 protective conductors which may be connected to the main earthing terminal of an electrical installation. (3 marks)

9. A 25m length of a conductor has a resistance of 0.183Ω. Determine the resistance, in ohms, of
a) 50m of the same conductor (1 mark)
b) 25m of the same conductor with twice the original cross sectional area (1 mark)
c) 25m of the same conductor with half the original cross sectional area. (1 mark)

10. State the 3 objectives of a ring final circuit continuity test, as given in Guidance Note 3. (3 marks)

11. State 3 checks that would need to be carried out before performing an insulation resistance test on an existing circuit which has been safely isolated from the supply (3 marks)

12. State 3 special locations identified in B57671, in addition to bathrooms, saunas and swimming pools. (3 marks)

13. State, in relation to an IP code, the significance of the,
a) first number.
b) second number.
c) X, where it replaces either number.

14. State, when carrying out polarity testing as part of the initial inspection and testing process, the,
a) 2 stages in the process when the tests should be carried out.
b) test equipment used for the second stage in a) above.

15. State 3 component parts of the earth fault loop impedance path external to the electrical installation forming part of a TT system. (Total marks 3)

16. A value of Zs may need to be calculated when no supply is available to the installation. State the,
a) test value to be used.
b) additional information to be obtained.
c) formula used to calculate the earth fault loop impedance.

17. An inspector must ensure that a measured value of Zs is within the maximum acceptable value in BS7671. State the,
a) 2 methods used to determine compliance.
b) maximum acceptable test value for the following BS 7671 tabulated values
i) O.35Ω
ii) 14.1Ω

18. State the 3 instrument tests to be applied, together with the test current used, to determine compliance of a 30 mA RCD installed to provide additional protection against direct contact.

19. State,
a) the 2 types of fault current that should be measured at the origin of a new single phase electrical installation.
b) which value should be recorded as the overall prospective fault current on the electrical installation certificate.

20. Explain briefly the significance of prospective fault current on the selection of protective devices.
(3 marks).

Section B All questions carry equal marks. Answer all six questions. Show all calculations. Questions 21 to 26 all refer to following scenario.

A new, detached building has been added to a 10 year-old public house. The existing electrical installation forms part of a 400/230 V 50 Hz TN-C-S system with a measured Ze of 0.1Ω and incoming supply conductors of 35mm². The new building comprises a small bar, toilets and a function room. The electrical installation is supplied via a single phase isolator located at the existing main intake position. The distribution circuit comprises 30m of steel wire armoured, thermoplastic (pvc) insulated and sheathed, three core cable with 25mm² copper conductors and a new 18 way distribution board located at the rear of the bar. One core of the distribution cable is used as a circuit protector conductor. The installation is constructed using thermoplastic (pvc) insulated and sheathed multicore cables concealed within the building fabric. Protection to the final circuits is provided by BS EN 60898, type B circuit breakers. A BS EN 61009, 30 mA RCBO is installed to each of the stage power circuits. The electrical installation has been completed and the final inspection, test and certification is to be undertaken.

The new installation details are shown in Figure 1, attached.

21. State,
a) the documentation to be issued to the client on completion of the electrical installation. (3 marks)
b) who is responsible for determining the date of the first periodic inspection. (2 marks)
c) two factors which may need to be considered when determining the date of the first periodic inspection. (2 marks)
d) one statutory document and one non-statutory document which relate to the inspection and testing of the installation. (2 marks)
e) two objectives of the initial verification process (2 marks)
f) four items of essential information relating to the supply which are to be recorded on the certificate. (4 marks)
(Total marks 15)

22. a) State, giving reasons, whether the copper cpc incorporated in the distribution cable is suitable as part of the main equipotential bonding to the gas and water services installed to the new building from the public supply. (3 marks)
b) Describe a suitable test to confirm the continuity of the cpc in the distribution cable. (5 marks)
c) Using the information contained in Figure 2 attached, calculate the expected value for the test described in b). Show all calculations, (4 marks)
d) State why Zs, when measured at the new distribution board, may be different from the calculated value. (3 marks)
(Total marks 15)

23. The continuity of ring final circuits is to be carried out before the installation is energised. Describe with the aid of sketches, the test for Circuit 1, giving the expected values for each stage of the test. Show all calculations. (15 marks)
(Total marks 15)

24. An insulation resistance test is to be carried out on the new installation.
a) State what precautions need to be taken with regard to connected electrical equipment, in order to fully test the installation. (2 marks)
b) State the factors which will affect the total value at the distribution board for the new installation when measured. (4 marks)
c) State the test voltage to be applied, the minimum acceptable value as given in BS 7671 and any additional requirements from Guidance Note 3. (5 marks)
d) Calculate the expected overall value for the new installation if the test values for each of the individual circuits prior to connection to the distribution board was 200 MΩ, show all calculations. (4 marks)
(Total marks 15)

25. An earth fault loop impedance test for Circuit 10, General Lights Left, is to be carried out.
a) Calculate the expected value that will be obtained, using the information provided, (3 marks)
b) Determine whether the value obtained in a) is acceptable. Show all calculations. (3 marks)
c) Describe the procedure for carrying out a direct measurement test. (9 marks)
(Total marks 15)

26.
a) Describe, with the aid of a fully labelled diagram, the earth fault path for Circuit 7. (9 marks)
b) Calculate the prospective earth fault current at the origin of the installation. (2 marks)
c) State, giving reasons, whether the prospective earth fault current at the new distribution board will be higher or lower than that at the origin. (2 marks)
d) State the importance of the prospective fault current in relation to the installed protective devices. (2 marks)
(Total marks 15)

Function Room Distribution Board					
Circuit	Designation	CB RCBO*	Cable details	Cable Length	BS 7671 Maximum Z_s
1	Bar Power Left (Ring)	32A	Phase 2.5mm² CPC 1.5mm²	40m	1.5 Ω
2	Bar Power Right (Ring)	32A	Phase 2.5mm² CPC 1.5mm²	30m	1.5 Ω
3	General Power (Ring)	32A	Phase 2.5mm² CPC 1.5mm²	85m	1.5 Ω
4	Stage Power Left (Ring)	32A*	Phase 2.5mm² CPC 1.5mm²	75m	1.5 Ω
5	Stage Power Right (Ring)	32A*	Phase 2.5mm² CPC 1.5mm²	70m	1.5 Ω
6	Toilet and Corridor Power	20A	Phase 2.5mm² CPC 1.5mm²	20m	2.4 Ω
7	Air Curtain	20A	Phase 2.5mm² CPC 1.5mm²	60m	2.4 Ω
8	Bar Lights Front	6A	Phase1.5mm² CPC 1.0mm²	40m	8.0 Ω
9	Bar Lights Rear	6A	Phase1.5mm² CPC 1.0mm²	40m	8.0 Ω
10	General Lights Left	10A	Phase1.5mm² CPC 1.0mm²	80m	4.8 Ω
11	General Lights Right	10A	Phase1.5mm² CPC 1.0mm²	80m	4.8 Ω
12	Stage Lights Left	10A	Phase1.5mm² CPC 1.0mm²	70m	4.8 Ω
13	Stage Lights Right	10A	Phase1.5mm² CPC 1.0mm²	70m	4.8 Ω
14	Toilet and Corridor Lights	6A	Phase1.5mm² CPC 1.0mm²	25m	8.0 Ω
15	Spare				
16	Spare				
17	Spare				
18	Spare				

Figure 1

CSA in mm²	Resistance in mΩ/m
1.0	18.1
1.5	12.1
2.5	7.41
4.0	4.61
6.0	3.08
10.0	1.83
25.0	0.727

Figure 2

Answers:

1. Compliance with relevant standards, BS or harmonised
   All materials correctly selected and erected
   No visible damage. **GN3, p17**

2. The safety of the existing installation is not impaired. **GN3, p15**

3. Offshore, Petrol stations, Mines and Quarries. **BS7671, scope.**

4. a) Electric fences. b) Overhead lines. c) Motor circuits.

5. a) EAWR 1989. b) Other employees and the general public. (his own safety and that of others) **GN3 p13**

6. a) Low reading ohmmeter.
   b) Ω.
   c) The expected reading will be low ohms, which will be R1+R2 when using method 1 and Method 2 should give reading of less than 0.05Ω for bonding conductors.

7. Polarity, Earth Electrode, Zs. **GN3, p33**

8. Main earthing conductor, Main protective bonding conductor, CPC.
   O.S.G.

9. a) 0.366
   b) 0.0915
   c) 0.366

10. Verify continuity of Line, Neutral and CPC loops.
    Verify the correct wiring of the sockets.
    Check for the existence of spurs and interconnections. **GN3, p36**

11. Pilot or indicator lamps and capacitors disconnected
    Voltage-Sensitive electronic equipment disconnected.
    There is no electrical connection between any line or neutral conductor and earth. **GN3, p37**

12. Agricultural sites, Construction sites, caravan parks. **BS7671.**

13. a) Protection from solid objects.
    b) Protection from water.
    c) The level of protection is not specified.

14. a) Dead and live.
    b) Approved voltage tester.

15. Supply Line conductor, Earth electrode, Supply transformer winding. **GN3, p49**

16. a) R1 + R2
    b) Ze by enquiry
    c) Zs = Ze + (R1 + R2) **GN3, p49**

17. a) Rule of thumb, Comparison with O.S.G values. **GN3, p51**
    b) (i) 0.35 x 0.8 = 0.28
    (ii) 14.1 x 0.8 = 11.28

18. 50% 15mA 100% 30mA 500% 150mA.
    All on both sides of the ac sine wave. **GN3, p52**

19. a) Prospective earth fault current and prospective short circuit fault current.
    b) The higher of the 2. **GN3, p53**

20. The protective device must be able to safely carry and clear the prospective fault current without sustaining damage. **GN3, p53**

21. a) Electrical Installation Certificate, Schedule of test Results, Schedule of Inspections. **GN3, p85.**
    b) The person carrying out the Inspection and Test. **GN3, p62**
    c) Type of installation and any external influences. **GN3, p62**
    d) EAWR 1989, BS7671.
    e) Compliance with standards, no visible damage. **GN3, p17**
    f) Ze, Nominal Voltage, Prospective fault current, Frequency of supply. **GN3, p18, 19**

22. a) *Strange question!!*
    The spare core would have been suitable for use as main equipotential bonding as tab 54H of BS7671 states that where the supply Neutral is less than 35mm then the bonding must be 10mm. Would you get it in the clamp though??
    Unfortunately the scenario states that this spare core has been used as the cpc. Perhaps it would have made life easier if the s.w.a had been used as the cpc.
    For more information read this:
    http://www2.theiet.org/publish/wireregs/wiringmatters/documents/Issue16/2005_16_autumn_wiring_matters_electrical_installations_outdoors.pdf

    b) Isolate the circuit, link Line and cpc at 1 end of the distribution cable and measure the open end resistance at the other end using a low reading ohmmeter. As well as confirming continuity of the cpc this will also give a value of R1 + R2.

    c) $\frac{30m \times 2 \times 0.727}{1000} = 0.04362$

    This is the value of R1 + R2 where R1 = 0.02181 and R2 = 0.02181

d) A live Zs reading will be lower than a calculated value due to parallel earth paths present when live testing

23. **Step 1:**

$\frac{40 \times 7.41}{1000} = 0.2964$ Open ends L-L = 0.2964 N-N = 0.2964

$\frac{40 \times 12.1}{1000} = 0.484$ Open ends cpc-cpc = 0.484

Step 2:
Cross connect L1 to N2 and L2 to N1 expected reading at each socket L to N is:

$\frac{0.2964}{2} = 0.1482$

Step 3:
Cross connect L1 to cpc 2 and L2 to cpc1 expected reading at each socket L to cpc is:

$\frac{0.2964 + 0.484}{4} = 0.1951$ This represents the R1+R2 for the circuit.

24. a) Disconnect all loads
b) Length and csa of cables and the number of circuits.
c) 500v dc, 2MΩ when all circuits tested together. If a lower value is obtained then circuits must be tested individually and a min reading of 1MΩ is acceptable. **GN3, p38**
d) 200 / 14 = 14.29 MΩ

25. a) Zs = Ze + (R1+R2 sub main) = (R1+R2 circuit)

= 0.1 + 0.04362 + (R1 + R2)

R1 = $\frac{80 \times 12.1}{1000} = 0.968$ R2 = $\frac{80 \times 18.1}{1000} = 1.448$ R1+R2 = 2.416

Zs = 0.1 + 0.04362 + 2.416 = 2.56

b) 4.8 x 0.8 = 3.84 2.56 < 3.84 so it is acceptable.

c) Live test with ELI tester at each point of the circuit. The test instrument must have a calibration certificate and test leads compliant with GS38. The furthest point should be the highest value obtained and is the value of Zs for the circuit.

26. a) TN-C-S ELIP drawing.
b) 230/0.1 = 2.3kA
c)Lower, more resistance (sub main) means less current.

d) The protective devices must be able to clear the high fault current. Pfc must not be higher than the breaking capacity.