C&G 2394/2395 Past Exam Paper

1 One of the competence requirements, identified in Guidance Note 3 (GN3), is for the Inspector to have sound knowledge and experience relevant to the nature of the installation being inspected and tested. List three other competence requirements given in GN3. (3 marks)

2 List three items related to the nature of the supply which should be made available to an inspector. (3 marks)

3 Explain briefly when inspection and testing of a new electrical installation should be carried out. (3 marks)

4 State three items that would need to be inspected during the first fix construction of a PVC conduit installation for lighting in a general purpose workshop. (3 marks)

5 State the most appropriate human sense to be used to identify
a) terminals are correctly tightened. (1 mark)
b) conductors are correctly identified. (1 mark)
c) that a motor has been overloaded. (1 mark) (Total marks 3)

6 List the first three tests, together with the appropriate instrument for each, to be carried out on a new lighting installation. (3 marks)

7 State two points connected electrically by the
a) circuit protective conductor. (1 mark)
b) main equipotent bonding conductor. (1 mark)
c) earthing conductor. (1 mark) (Total marks 3)

8 Three additional lighting points are added to extend an existing circuit. State the effect this will have on
a) the measured cpc continuity value for the circuit. (1 mark)
b) the insulation resistance value of the circuit. (1 mark)
c) the earth fault loop impedance value at the furthest point. (1 mark)
(Total marks 3)

9 Explain briefly, why the measurement obtained at each socket outlet, when carrying out Stage 2 of the continuity of ring final circuit conductor test, is expected to be

$$\frac{\text{Phase loop + Neutral loop}}{4}$$

(3 marks)

10 State the unit value used for
a) recording continuity of cpc. (1 mark)
b) recording insulation resistance. (1 mark)
c) tabulated R1 +R2 values given Guidance Note 3. (1 mark) (Total marks 3)

11 State the three checks related to an electrical installation that need to be made before carrying out an insulation resistance test, between live conductors, for an entire lighting circuit. The circuit has been securely isolated. (3 marks)

12 A test for electrical separation of a circuit is to be undertaken. State
a) between which conductors the test should be undertaken. (1 mark)
b) the test voltage which should be applied. (1 mark)
c) the minimum acceptable value. (1 mark) (Total marks 3)

13 State the maximum disconnection time for
a) socket outlets part of a TN system where livestock is to be kept (1 mark)
b) 230 V fixed equipment on a construction site (1 mark)
c) general socket outlets (1 mark) (Total marks 3)

14 State the advice given in GN3 regarding confirmation of polarity, to socket outlets, where the test is carried out to the terminals and not the socket tubes (3 marks)

15 a) Determine the maximum theoretical value of earth electrode resistance for
i) 30mA RCD protection for normal locations. (1 mark)
ii) 1OOmA RCD protection on a construction site. (1 mark)

b) State the value of earth electrode resistance above which GN3 recommends further investigation. (1 mark)
(Total marks 3)

16 The earth fault loop impedance value of an additional lighting circuit is to be established. The protective device is a 6 A BS EN 60898 type B circuit breaker. State
a) one reason why it may not be possible to obtain a result when conducting a direct measurement test. (1 mark)
b) two methods by which Zs may be determined as a result of a). (2 marks)
(Total marks 3)

17 State all the supply systems which incorporate each of the following
a) a PEN conductor (1 mark)
b) a source earth electrode (1 mark)
c) an installation electrode (1 mark) (Total marks 3)

18 The Rule of Thumb method may be applied to the maximum tabulated values of earth fault loop impedance to determine compliance. State
a) the two conditions this makes allowance for. (2 marks)
b) the significance of the measured earth fault loop impedance value. (1 mark)
(Total marks 3)

19 State
a) the purpose of a
i) 100mA RCD fitted at the origin of a TT installation. (1 mark)
ii) 30mA RCD fitted to a socket outlet used for equipment outdoors. (1 mark)

b) the maximum test current used to confirm the operation of the device in a) ii).(1 mark)

(Total marks 3)

20 Explain briefly, the significance of the value obtained for a test of prospective fault current on the selection of protective devices. (3 marks)

Section B -All questions carry equal marks. Answer all six questions.
Questions 21 to 26 all refer to the following scenario.
An electrical contractor has completed an electrical installation for a small private caravan site. The site comprises 15 dedicated caravan pitches, a toilet and shower block and a combined reception office and small shop. The buildings on the site form part of a TN-C-S system supplied at 400/230 V with a Ze of 0.2Ω. At the origin of the installation the distribution circuit to the pitch supplies is separated to form a TT system, having an earth electrode resistance of 48Ω and a 500mA RCD as the main isolator. The installation is to be inspected and tested before being placed into service.

21 a) List all the certification documents that must be completed for the inspection and test for the entire site. (5 marks)
b) State the
i) statutory document which particularly relates to the inspection and testing process. (1 mark)
ii) title given to the person carrying out the inspection and test as stated in b) i) above. (1 mark)
iii) status of person carrying out the inspection and test. (1 mark)
iv) four responsibilities of the person carrying out the inspection and test as Defined in GN3. (4 marks)
c) List three items of information that should be available to the person carrying out the inspection and test (3 marks) (Total marks 15)

22 The insulation resistance of the lighting circuits in the shower and toilet block is to be tested. The fluorescent luminaire circuits are controlled using a timer, local time delay switches and a photocell.
a) State what action needs to be taken before a full insulation resistance test of the lighting circuits can be carried out. (5 marks)
b) Describe the procedure for carrying out the insulation resistance test on one lighting circuit. (5 marks)
c) If the values obtained for the five lighting circuits are 100MΩ, 100MΩ, 200MΩ, 50MΩ and 50MΩ. Calculate the insulation resistance of the five circuits when connected together at the distribution board. Show all calculations. (5 marks)
(Total marks 15)

23 The earth electrode, which is installed at the origin to separate the caravan pitch sockets from the TN-C-S system, has an earth electrode resistance of 48Ω.

a) State which document states that caravan pitch sockets would not be connected to a TN-C-S system. (1 mark)
b) Determine the maximum permissible residual operating current for the RCD protecting this TT system. Show all calculations. (2 marks)
c) State the maximum permissible rating for the RCDs protecting the individual pitch supply sockets, as given in BS7671. (1 mark)
d) The RCDs protecting the pitch socket outlets are to be tested. List
i) the range of tests to be carried out. (3 marks)
ii) the value of the test current used in each case. (3 marks)
iii) the maximum permitted disconnection time in each case. (2 marks)
e) State why a 500mA RCD is used at the origin of these circuits. (2 marks)
(Total marks 15)

24 Describe, with the aid of a fully labelled diagram, the earth fault loop path for one of the pitch supply sockets. (15 marks)

25 The ring circuit supplying the general purpose socket outlets in the shop/office area is being tested to confirm ring final circuit continuity. All the socket outlets are connected to the same circuit. The test results obtained are given in **Figure 1**. State
a) whether the values obtained are as expected in each case. (7 marks)
b) for any value which is not as expected, one reason for the reading obtained. (8 marks) (Total marks 15)

Test 1	P-P	N-N	CPC-CPC
	0.6Ω	0.62 Ω	1.0 Ω

Test 2	Reading at Sockets P+N	Test 3	Reading at Sockets P+cpc
Socket A	0.3		0.41
Socket B	0.29		0.6
Socket C	No Reading		0.4
Socket D	0.48		0.64
Socket E	0.3		No Reading
Socket F	No reading		No reading
Socket G	0.31		0.41

Figure 1

26 **Figure 2** shows the measured and maximum tabulated values of earth fault loop impedance for all the circuits supplying the office and shop area. The single phase distribution for this area is located adjacent to the origin of the electrical installation.
a) Determine whether the measured results are acceptable in each case. (6 marks)
b) State three methods which may be used to rectify any circuits(s) which do not comply. (6 marks)
c) Determine the minimum acceptable breaking capacity for the circuit breakers installed in this distribution board. Show all calculations. (1 mark)
d) Explain briefly the importance of the rated breaking capacity of the circuit

Circuit	Rating/Type	BS 7671 max Zs	Measured Zs
1Ring Circuit	32A B	1.5Ω	0.7Ω
2 Boiler	16A B	3.0Ω	0.9Ω
3 Fridge/Freezer	10A C	2.4Ω	1.2Ω
4 Shop lights	10A B	4.8Ω	3.9Ω
5 Office Lights	6A B	8.0Ω	4.1Ω
6 Outside Lights	6A D	2.0Ω	1.9Ω

Figure 2

Answers:

1. Knowledge of relevant regulations, BS7671
   Fully versed in Inspection and Test procedures.
   Knowledge and experience to use suitable test equipment. **GN3 p14**

2. Nominal Voltage
   Frequency.
   Ze. **GN3 p18, 19**

3. Progressively throughout the different stages of the erection and before being put into service. **GN3 p19**

4. Single pole switches in line conductor only.
   Capacity of conduits for cables to be installed later
   Mechanical protection of conduit where damage is likely
   Correct mechanical support of conduits to bear loading by cable. **GN3 p27, --**

5. a. Touch
   b. Sight
   c. Smell

6. Continuity of protective conductors, with a low reading ohm meter.
   Insulation resistance, with an insulation resistance tester.
   Polarity, with a low resistance ohm meter. **GN3 p33**

7. a. The MET and exposed conductive parts of accessories.
   b. The MET and extraneous conductive parts.
   c. The MET and the means of earthing. **OSG**

8. a. Increase
   b. Decrease
   c. Increase

9. The Line end to end should be the same resistance as the neutral end to end. By cross connecting you are effectively putting 2 resistors of the same value in parallel with each other. This means the combined resistance will be half of 1 or the 2 added together divided by 4. **GN3 p36**

10. a. Ohms
    b. Megohms
    c. Ohms

11. Lamps and/capacitors removed from the circuit.
    Dimmer switches disconnected.
    No electrical connection between L and N.
    All barriers/enclosures in place. **GN3 p37**

12. a. Between live conductors on SELV circuit.
    b. 250vdc.
    c. 0.5M ohm.

A further test between the live SELV conductors and the cpc of the primary circuit should be carried out at 500vdc with a min result of 1M ohm. **GN3 p41**

13. a. 0.2 seconds
    b. 5 seconds
    c. 0.4 seconds

14. Visual inspection of correct connections is required. **GN3 p45**

15. a. *This is an ohms law question.*
    i) Max allowed touch voltage is 50v. Ra = 50 / 0.03 = 1666.67 ohms
    ii) Max allowed touch voltage is 50v. Ra = 50 / 0.1 = 500 ohms

    b. 200 ohms. **GN3 p48**

16. a. The test current may trip the mcb preventing a reading from being taken.
    b. Zs can be calculated by Ze + (R1+R2).
    Use a tester with built in facility to avoid tripping the mcb. **GN3 p51, 52**

17. a. TNC-S
    b. TNC-S, TNS and TT *(source electrode is at the supply transformer).*

18. a. It allows for the fact that the conductor temperature will be lower at time of test than the max operating temp which is used to derive max Zs values qutoted in BS7671.
    It also allows for reduced csa for protective conductors. **GN3 p51**
    b. The measured value is significant because if it exceeds max allowed values the circuit will not disconnect in the required times under fault conditions.

19. a. Max values of Zs will not be achieved on a TT system therefore a 100mA rcd is required at the origin to provide protection from shock.
    A 30mA rcd is required to provide supplementary protection for equipment used outside of the equipotential zone.

    b. 150mA

20. The protective device must be able to clear the prospective fault current without sustaining damage. The breaking capacity must not be less than the pfc. **GN3 p53**

21. a. For the TNC-S supplied circuits, Electrical installation certificate, Schedule of Inspections. Schedule of test results.
For the TT supplied caravan pitches, Electrical installation certificate, Schedule of Inspections, Schedule of test results.

b. i) Electricity at work regulations.
ii)The Duty holder
iii)The Duty holder will be a Competent person.
iv)Ensuring no danger to persons livestock or property, to compare the test results with design criteria, to form a view on the state of the installation and advise on remedial works, to immediately inform the installation owner (and other interested parties) if a dangerous situation exists.

c. Nominal supply voltage, Frequency, Ze.

22. a. The electronic control equipment needs to be disconnected and linked out so that they are not subject to the test voltage. All electrical connections between phase and neutral need disconnecting, this includes lamps and capacitors. **GN3 p37**
All barriers and enclosures must be in place before applying the test voltage.

b. The steps mentioned in part a. of this question will have been adhered to. This is a dead test and should be carried out before energising the installation. The supply should be checked to ensure isolation from the mains supply. Disconnect the neutral conductor from the neutral bar and switch off / remove the local protective device. With a test voltage of 500vdc test between live conductors and live conductors and earth. It is imperative that any switch wires and/or strappers are bought into the test by testing with all combination of switching of light switches. Record the reading on the schedule of test results.

c. *This is a simple resistors in parallel question.*

$1/Rt = 1/R1 + 1/R2 + 1/R3 + 1/R4 + 1/R5$

$= 13/200$

Therefore $Rt = 200/13 = 15.38$ Meg ohms.

23. a. BS7671
b. *This caused a lot of concern to students who sat the exam, but again it is simply a case of applying ohms law.*
The touch voltage on a caravan site must be less than 50V and the resistance of the electrode is 48 ohms, so current is found by:
$I = V/R \quad = 50 / 48$

GN3 p48

$= 1.042$ A

c. 30mA.

d. i) 50%, 100% and 500% of the rated trip current (all 3 tests are done on both sides of the sine wave). The manual test button must also be operated.
ii) The test currents are 15mA, 30mA and 150mA.
iii) At 50% the rcd should not disconnect. At 100% less than 200mS (BS number or 300mS for a BSEN number). At 500% less than 40mS.

e. A 500mA meets the requirements for shock protection as in part b. of this question. It will also give a good level of discrimination between itself and the 30mA rcds. This will avoid disruption to the whole installation in the event of a fault on one of the 30mA protected circuits.

24. This needs to be a labelled drawing of a TT earth system. Your labels should show the supply transformer winding, the supply phase conductor, the protective device, R1 (circuit phase conductor), the load (pitch socket in this case), point of fault to the exposed conductive part, R2 (the circuit cpc), the Main Earthing Terminal, earthing conductor connecting to local earth electrode, general mass of earth, earth electrode connected to star point of supply transformer.

25. a. The expected reading between L and N at each socket following cross connection at the C/U is:

(0.6 + 0.62) / 4 = 0.305 ohms (this should be within 0.5 ohms)

The expected reading between L and N at each socket following cross connection at the C/U is:

(0.6 + 1) / 4 = 0.4 ohms (this should be within 0.5 ohms)

b. Skt B cpcs twisted together but not securely tightened at socket termination.
Skt C phase and cpc reverse polarity.
Skt D is most likely a spur.
Skt E N and L reverse polarity.
Skt F N and cpc reverse polarity.

26. a. Rule of thumb, reduce max values to 80% then compare with measured values. The only ones which are not acceptable are circuits 4 and 6.

b. Larger csa cables. Shorter cable runs. Alternative protective device which allows for a bigger value of Zs. Use of supplementary bonding to lower the circuit Zs.

c. *Another simple ohms law question*
Pfc = Suply Voltage / Ze
= 230 / 0.2 = 1.15kA

The breaking capacity of the protective device must not be less than 1.15kA.

d. The protective device must be able to safely clear the prospective fault current without sustaining damage.