

C&G 2394/2395 Past Exam Paper

Section A- All questions carry equal marks. Answer all twenty questions.

- 1 A new three phase circuit supplying an electric kiln has been installed in an existing installation. State the three documents that must be completed and issued to the client on completion of the work. (3 marks)
- 2 State three items of information that an inspector must have, which may be recorded on diagrams and charts, before carrying out an initial inspection. (3 marks)
- 3 State three documents on which the value of prospective fault current must be recorded. (3 marks)
- 4 State three different examples of a limitation that may be agreed with a client which is not already stated on the Periodic Inspection Report. (3 marks)
- 5 State three situations where the human sense of touch could be used by an inspector. (3 marks)
- 6 State from the test results shown below, the most likely instrument to have been used.
 - a) 0.03Ω (1 mark)
 - b) $125M\Omega$. (1 mark)
 - c) 125ms. (1 mark)
- 7 List the first three tests to be carried out on a newly installed radial circuit. (3 marks)
- 8 State the effect on conductor resistance when the
 - a) temperature is decreased (1 mark)
 - b) length is increased (1 mark)
 - c) csa is increased. (1 mark)
- 9 List three different protective conductors that may be installed in most electrical installations. (3 marks)
- 10 State
 - a) the relevant document to be referred to when considering the use of test leads to carry out an insulation resistance test (1 mark)
 - b) two characteristics of these test leads or probes. (2 marks)
- 11 A ring final circuit has been installed and the continuity of its conductors successfully verified. State three outcomes and/or results to be recorded on the Schedule of Test Results. (3 marks)
- 12 A test for the continuity of a protective conductor connecting the metallic gas service to the main earthing terminal during an initial verification is to be carried out. State the
 - a) instrument to be used (1 mark)
 - b) action to be taken regarding the conductors (1 mark)
 - c) action to be taken regarding the resistance of the test leads. (1 mark)
- 13 State the earth return path, external to the installation, for each of the following systems.
 - a) TN-C-S. (1 mark)
 - b) TN-S. (1 mark)
 - c) TT. (1 mark)

- 14 State what happens to the value of insulation resistance when
- a) the circuit length is increased (1 mark)
 - b) the circuit length is decreased (1 mark)
 - c) an installation is measured as a whole instead of the individual circuits. (1 mark)
- 15 List three different items of equipment which will require special consideration when carrying out insulation resistance testing, excluding dimmer switches. (3 marks)
- 16 State, from the formula $Z_s = Z_e + (R_1 + R_2)$, what is represented by
- a) Z_s (1 mark)
 - b) Z_e (1 mark)
 - c) $R_1 + R_2$ (1 mark)
- 17 State the
- a) purpose of the IP coding system (1 mark)
 - b) level of protection provided by
 - i) IPXXB (2 marks)
 - ii) IP4X.
- 18 State three practical situations where BS 7671 requires the use of an RCD with a maximum residual operating current of 30mA. (3 marks)
- 19 When using an RCD in a circuit forming part of a TT system, the following condition must be fulfilled; $Z_s \times I_{\Delta n} \leq 50V$.
- a) State what is represented by $I_{\Delta n}$ (1 mark)
 - b) Calculate the maximum permitted earth fault loop impedance for a circuit incorporating a 100 mA RCD. (2 marks)
- 20 A test to establish prospective fault current is to be carried out on a single phase installation. State the
- a) two tests to be carried out at the origin of the installation in order to determine the prospective fault current (2 marks)
 - b) condition which **must** be verified once the value from a) above is obtained. (1 mark)

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

A seven year old 400/230 V three-phase electrical installation within a small commercial unit forms part of a TN-S system with a measured value of external earth loop impedance (Z_e) Of 0.22 Ω

The existing metal-clad TP-N distribution board contains BS EN 60898 type B & C circuit breakers. The existing wiring system is 70°C thermoplastic insulated single core cables installed in surface mounted metal conduit and trunking.

Due to the expansion of the business the office requires a new ring final circuit, and the lighting in the toilet area requires the inclusion of motion detectors to help with energy efficiency. On completion of the work and all inspection and testing the client requires a complete set of documentation for the installation for insurance purposes.

The existing lighting circuit live and protective conductors are wired using 1.5 mm² single core 70°C thermoplastic insulated cables, the circuit is 28 m in length, and the intended alteration will add two extra metres to the circuit.

The resistance per metre of a 1.5 mm² single conductor is 12.10 m Ω /m at 20°C.

- 21 a) State, giving reasons, the documentation to be completed for all of the work stated above, (11 marks)
- b) List
- i) two statutory documents
 - ii) and two non-statutory documents
- that may need to be consulted during the inspection and testing process. (4 marks)
- 22 a) State
- i) two checks that need to be carried out following safe isolation, to avoid damage to equipment before an insulation resistance test is conducted
 - ii) the test voltage to be applied for the insulation resistance test
 - iii) the effect on the overall value of insulation resistance after connecting the new circuit to the installation. (5 marks)
- b) Calculate the overall value of insulation resistance if the following circuit values were recorded between live and earth; 200 M Ω , 200 M Ω , 150 M Ω , 50 M Ω , 25M Ω , 100M Ω , 2M Ω . (6 marks)
- c) The toilet lights are controlled via a motion detector which cannot be removed during testing. State two alternative methods of preparing this circuit for the insulation resistance test. (4 marks)
- 23 a) Determine the expected value for Z_s for the altered toilet lighting, showing all calculations. (4 marks)
- b) State a likely condition that may have an effect on the value. In a). (2 marks)
- c) State the simple method that can be used to compensate for the effect identified in b). (4 marks)
- d) Determine if the value in a) is acceptable if the max Z_s value of a 10 A BS EN 60898 cbis 4.80 Ω . (5 marks)

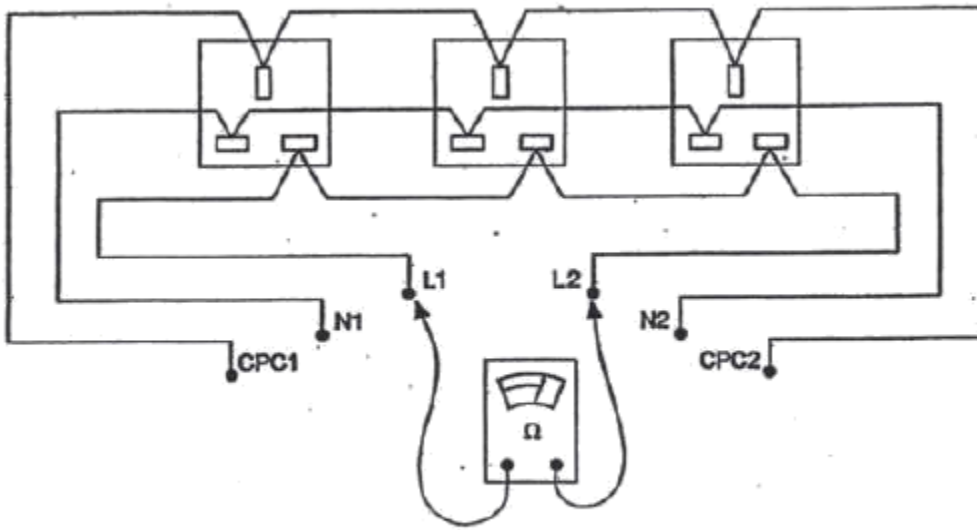
- 24 Describe, with the aid of diagrams, how a continuity of ring final circuit conductor test would be conducted on the new ring final circuit in the office. Show all stages in the correct order. (15 marks)
- 25 Describe in detail how a direct measurement of PFC can be carried out. Diagrams may be used. (15 marks)
- 26 Draw a fully labeled diagram showing the complete earth fault loop path for the altered lighting circuit in the toilets. The diagram should identify the correct system, the complete fault path and all the component parts of the earth fault loop. (15 marks)

Answers:

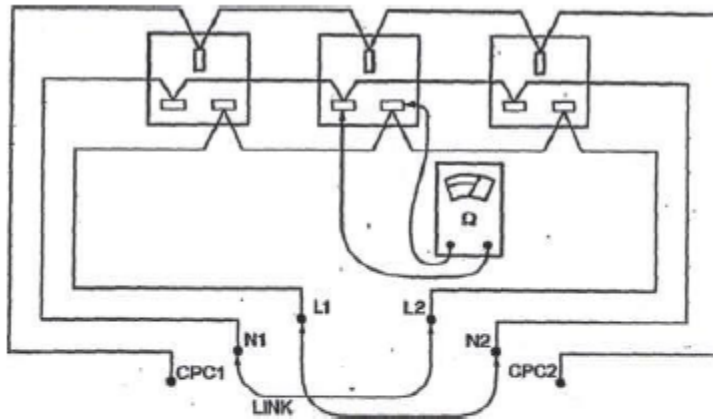
ANSWERS

1.
 - a. Electrical installation certificate.
 - b. schedule of inspection.
 - c. Schedule of test results.
2.
 - a. The number of points, size and type of cables for each circuit.
 - b. The method used for basic and fault protection.
 - c. Any circuit or equipment vulnerable to a particular test.
3.
 - a. Electrical installation certificate.
 - b. Periodic inspection report.
 - c. Schedule of test results.
4.
 - a. IT equipment.
 - b. emergency fire alarm.
 - c. safety circuit.
5.
 - a. Loose connections.
 - b. Overheating.
 - c. sharp edges.
6.
 - a. Low resistance ohmmeter.
 - b. Insulation Resistance Tester.
 - c. RCD Tester.
7.
 - a. Continuity of CPC
 - b. Insulation Resistance
 - c. Polarity.
8.
 - a. Decreased.
 - b. Increased.
 - c. Decreased.
9.
 - a. Earthing Conductor.
 - b. Circuit Protective Conductors.
 - c. Main Protective Bonding Conductors.
10.
 - a. GS38.
 - b. 1) the leads should be fused 500mA.
2) The probes should have finger guards.
11.
 - a. R1+R2.
 - b. R2.
 - c. Polarity.
12.
 - a. Low Resistance Ohmmeter.
 - b. Disconnect one end of conductor before test.
 - c. Null leads or note resistance of the leads to deduct from test results.
13.
 - a. PEN Conductor.
 - b. Cable Sheath.
 - c. General mass of earth.
14.
 - a. Decreased.
 - b. Increased.
 - c. Decreased.
15.
 - a. Touch switches.
 - b. Delay Timers.
 - c. Emergency Lighting
16.
 - a. Earth loop fault impedance.
 - b. External earth loop fault impedance.
 - c. R1 resistance of circuit line conductor.
R2 resistance of CPC.

17. a. Indicates degree of protection given by enclosure for specific environment.
b. IPXXB - Finger protection.
IP4X – Protection against solid object with diameter more than 1mm.
18. a. For socket outlet used to supply portable equipment outside the equipotential zone.
b. for fixed equipment in bathroom.
c. for cable concealed under the plaster.
19. a. Rated Residual operating current of the protective device in Amper.
b. $Z_s=50/0.1=500 \Omega$
20. a. Prospective Short circuit current.
Prospective Earth Fault Current.
b. Highest of the 2 above.
21. a. Periodic Inspection Report. For existing installations.
Schedule of inspections and Schedule of the Test Results.
Electrical Installation Certificate. For new ring final circuit. Schedule of Inspections and Schedule of Test Results. Minor Electrical Installation Works Certificate.
b. Electricity At Work Regulations 1989. and Health and Safety at Work Act 1974 BS7671 and IEE Guidance Note 3.
22. a. 1) The Pilot or indicator lamps and capacitors should be removed.
Any voltage-sensitive or electronic devices should be disconnected.
2) 500V d.c
3) Decrease.
b. $1/R_t=1/200+1/200+1/150+1/50+1/25+1/100+1/2=0.59$
 $R_t=1/0.59=1.7M\Omega$
c. Using test2 measurement between earth and the line and neutral joined together.
Test voltage should be reduced to 250V d.c but insulation resistance must be at least 1MQ
23. a. $Z_s=Z_e+(R_1+R_2)$
 $R_1+R_2=12.1 \times 2 \times 30/1000=0.726\Omega$
 $Z_s=0.22 + 0.726 = 0.95\Omega$
b. Increase the resistance of conductors with the increase of temperature.
c. Rule of Thumb.
d. $4.8 \times 0.8 = 3.84$ more than 0.95 Acceptable.
24. a. **Step 1**
- safety isolate and lock off.
 - Identify and disconnect the L,N and CPC at the d.b
 - select the low resistance tester.
 - Check the calibration is current. The leads are in good condition. The batteries are OK and instrument is functioning.
 - Measure the end to end resistance of each conductors. If the conductor size is same, the readings must be to within 0.05. any difference could be wiring defect, loose connection, or incorrect identification of the ring conductors.
 - Record the results the L-L R1, N-N Rn, CPC-CPC R2.

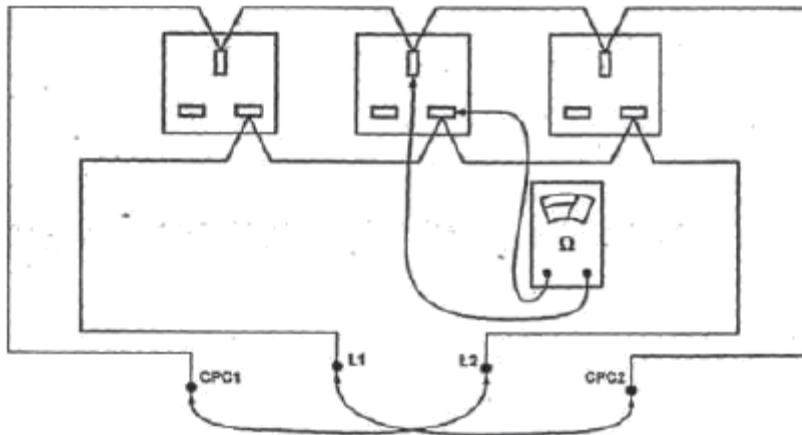


Step 2



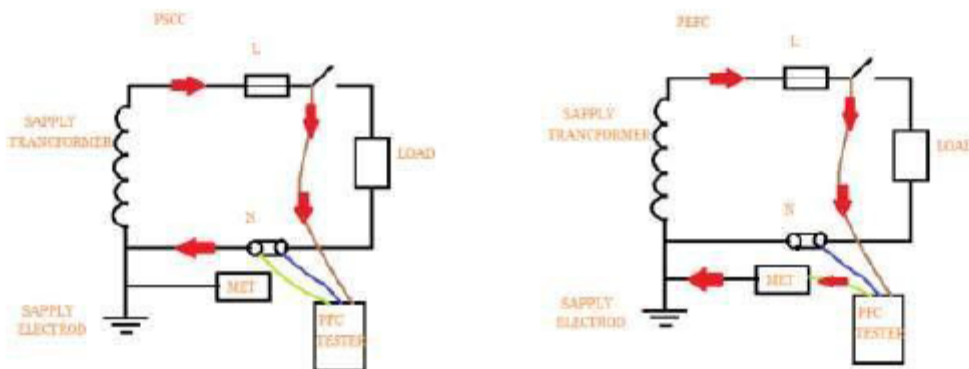
- Join the opposite ends of L and N at the d.b and measure between L and N at every outlet or point on the circuit.
- The value must be $(R1+R2)/4$
- any socket wired as spurs will have a higher reading in proportion to the length of the spur.

Step 3 $R1+R2$



- Join opposite ends of CPC and L at the d.b and measure between L and CPC at every outlet or point on the circuit.
- The value obtained must be $(R1+R2)/4$
- record the Max value of $(R1+R2)$ on the schedule of test results.
- Reconnect all conductors.

25.



- Ensure isolation.
- Select an earth loop impedance tester.
- Check the instrument and leads, probes and clips are in good order and suitable for purpose.
- Set the instrument (KA).
- Observe the polarity indication on the instrument for correct connection
- The test must be conducted at the main switch.
- **PSCC**
- Connect the instrument to the incoming live supply to measure the L to N value of PFC. The Earth lead is connected to the N terminal(3 leads)
- **PEFC**
- Connect the instrument to measure the phase to earth value of PFC. N to N(3 leads)
- Carry out the test and record the readings.
- Switch of the circuit disconnect the instrument.
- Restore the supply.
- **Determination of 3 phase PSCC**
- **Highest single phase value measured an approximation multiply by 2**

