

This **examination consists** of two sections.

Section A - Twenty short answer questions worth three marks each. Candidates must answer **ALL TWENTY** questions. It is recommended that candidates allow approximately one *hour* for this section.

Section B—Six structured questions worth 15 marks each. Candidates must **answer ALL SIX** questions. It is recommended that **candidates** allow **approximately** 1<sup>1</sup>/<sub>2</sub> hours for this section.

Section A - Answer **ALL TWENTY** questions in this section.

- 1 An installation has been seriously overloaded and needs investigation.  
State the
  - a) type of inspection and test that would be required (1 mark)
  - b) certificate that will need to be completed (1 mark)
  - c) documentation that must accompany the certificate in b) (1 mark)
  
- 2 State the
  - a) statutory document that is relevant to electrical systems (1 mark)
  - b) non-statutory document that details the use of electrical test equipment (1 mark)
  - c) non-statutory document that sets out the requirements for electrical installations (1 mark)
  
- 3 State who
  - a) should decide when the first periodic test on an installation should be carried out (1 mark)
  - b) should decide when further periodic tests on an installation should be carried out (1 mark)
  - c) the extent and limitations of a periodic inspection and test should be agreed with. (1 mark)
  
- 4 State the form of shock protection offered by the following
  - a) placing out of reach (1 mark)
  - b) EEBADS (1 mark)
  - c) class II equipment (1 mark)
  
- 5 State the instruments required for the following tests
  - a) continuity of ring final circuit conductors (1 mark)
  - b) insulation resistance (1 mark)
  - c) live polarity (1 mark)

- 6 State, apart from loose connections, **three** circumstances that would result in an increase in conductor resistance (3 marks)
- 7 The c.p.c. continuity of a radial circuit comprising four socket outlets is to be tested. If the test method uses a temporary link between phase and earth in the distribution board, state
- a) at which points in the circuit the test should be conducted (1 mark)
  - b) the conductors between which the test should be made (1 mark)
  - c) the significance of the reading at the farthest point (1 mark)
- 8 State THREE wiring systems that would not normally require a separate thermoplastic (p.v.c.) insulated conductor as a CPC (3 marks)
- 9 For a ring final circuit, state
- a) why the test between P and N is conducted (1 mark)
  - b) the reason why phase to neutral readings at each socket would increase towards the mid point of the ring then decrease again (1 mark)
  - c) the other test that is automatically conducted (1 mark)
- 10 For the insulation resistance test on a 230 V installation, state the
- a) test voltage to be applied (1 mark)
  - b) minimum value of resistance acceptable (1 mark)
  - c) value below which further investigation is required (1 mark)
- 11 The insulation resistance of 600 V discharge lighting installation is to be tested, state the
- a) test instrument to be used (1 mark)
  - b) test voltage to be applied (1 mark)
  - c) minimum value of insulation resistance (1 mark)
- 12 For an installation in a bathroom, state the
- a) type of socket outlet permitted, excluding shaver sockets (1 mark)
  - b) location of zone 0 (1 mark)
  - c) rating of an r.c.d. protecting an item of equipment in zone 1 (1 mark)
- 13 To what IP codes should the following comply?
- a) Accessible horizontal top surfaces of enclosures. (1 mark)
  - b) An intermediate barrier inside an enclosure (2 marks)

- 14 For the testing of polarity, state why
- a) single pole devices should be in the phase conductor only (1 mark)
  - b) certain modern E14 and E27 lamholders do not require testing (1 mark)
  - c) a live polarity test is required (1 mark)
- 15 The total loop impedance of a circuit may be calculated using the following fomula
- $$Z_s = Z_e + \frac{(R_1 + R_2) \times L \times 1.2}{1000}$$
- a)  $Z_e$  (1 mark)
  - b)  $R_2$  (1 mark)
  - c) 1.2 (1 mark)
- 16 State the
- a) important check to be made regarding equipotential bonding carrying out a loop impedance test on a circuit (1 mark)
  - b) action to be taken regarding the earthing conductor prior to conducting an external loop impedance test (1 mark)
  - c) precaution that should be taken before conduction the test in b). (1 mark)
- 17 A test is to be conducted on a lighting conductor earth electrode. State the
- a) instrument to be used (1 mark)
  - b) other **two** electrodes used in the test (2 marks)
- 18 State **three** circumstances under which an r.c.d. having an operating current of 30 mA, or less, **must** be used in an installation (3 marks)
- 19 State
- a) why a test on an r.c.d. must not be conducted before a loop impedance test (1 mark)
  - b) the reason for a functional test on an r.c.d. (1 mark)
  - c) the maximum test current that needs to be applied to a 100mA r.c.d. (1 mark)
- 20 A single-phase T.N.C-S installation has a measured value of external loop impedance of 0.015 ohms. Show by calculation the expected value of the prospective fault current. (3 marks)

**Section B** Questions 21 to 26 refer to the following scenario. Answer ALL SIX questions. All questions carry equal marks.

A 15-year-old dry-powder coating factory is situated adjacent to an 11kV/415/240V Regional Electricity Company substation. The earthing system is T.N-C-S with an external earth fault loop impedance ( $Z_e$ ) of  $0.012\Omega$  and a prospective fault current of 20 kA.

The dry-powder coating process involves cleaning metallic components in an acid bath, washing off with water sprays, drying with hot air blowers, spraying with electrostatically charged powder and finally baking in a tunnel oven.

The existing installation, which are all radial circuits, is wired with (p.v.c.) conductors in metal conduit and trunking. Six new lighting circuits supplying high-bay 300W SON luminaires have been installed using a similar wiring system to the existing installation. The new circuit breakers are fed from a metal clad distribution board housing BS EN 60898 circuit breakers.

An inspection and test of the whole installation is to be carried out.

21 State

- a) the type/s of **overall** inspection and test required (4 marks)
- b) the certification/documentation that needs to be completed by the inspector (4 marks)
- c) who should receive the originals of these documents (1 mark)
- d) who decides when the first periodic test should be conducted on the new lighting (1 mark)
- e) **One** statutory and **two** non-statutory documents relevant to this inspection and testing process (3 marks)
- f) the status of the inspector (2 marks)

22 State

- a) apart from wear, tear and safety, **five** installation conditions that would need to be considered during the inspection process (5 marks)
- b) **Five** items from the BS 7671 schedule of inspections that would need to be considered (5 marks)
- c) Three human senses that would be used in the inspection process (3 marks)
- d) with whom the extent and limitations of an inspection should be agreed (2 marks)

23 List

- a) the first four relevant tests, in sequence, to be conducted on the new lighting installation (7 marks)
- b) All relevant test equipment needed for a) (8 marks)

24 a) Describe how an Insulation Resistance test would be carried out on the new lighting circuits (5 marks)

- b) If an Insulation Resistance test between live conductors and earth on the whole installation resulted in a test value of  $1.6\Omega$ , explain, giving reasons, any actions to be taken. (3 marks)

- c) Describe how an external loop impedance test should be conducted. (4 marks)
- d) Describe how a prospective fault current test should be conducted at the origin of the installation (3 marks)

25 The Maximum and measured values of loop impedance for four circuits are as follows

Max values	Measured values
3.43Ω	2.7Ω
2.29Ω	1.7Ω
2.4Ω	1.9Ω
3.75Ω	3.2Ω

- a) Explain the reasons for the use of the 'rule of thumb' (3 marks)
- b) Using the above method, determine if the measured values are acceptable. (Show all calculations). (4 marks)
- c) For any circuit that fails to comply, indicate **two** methods of overcoming the problem. (6 marks)
- 26 a) Draw a labeled diagram of the earth fault loop path for any circuit in the installation. (8 marks)
- b) Explain why it would be appropriate to use BS 3036 fuses in a distribution board at the origin of this installation (4 marks)
- c) Most standard PSCC testers are designed for single-phase use. How could an appropriate value of short circuit current between phases be determined? (3 marks)