City&Gulids 2394 Mock Exam

1 State
   a) TWO circumstances under which an Electrical Installation Certificate would be required. (2 marks)
   b) The documentation that must accompany such a certificate (1 mark)

2 State THREE non-statutory documents in common use, that are relevant to the inspection and testing of an installation. (2 marks)

3 BS 7671 requires that an inspector has available charts, diagrams or similar information, relating to the installation. State THREE items that should be included in such information. **(Do not include details of the incoming supply).** (3 marks)

4 State the form of protection against electric shock provided by each of the following
   a) Class II equipment (1 mark)
   b) Placing out of reach (1 mark)
   c) ADS. (1 mark)

5 State the documentation that must be completed for EACH of the following
   a) The addition of a socket outlet to a ring final circuit (1 mark)
   b) The inspection and testing of a domestic installation which is ten years old (1 mark)
   c) A shower circuit added to an existing installation. (1 mark)

6 State who should be signatories to an electrical installation certificate. (3 marks)

7 State
   a) The legal status of those who authenticate certificates (1 mark)
   b) TWO human senses used during the inspection and testing process. (2 marks)

8 State the
   a) Colour identification for the 'strappers' on a two way lighting circuit wired with three-core + c.p.c. p.v.c. /p.v.c. cable. (1 mark)
   b) Wording required on a label at the connection of a main equipotential bonding conductor to a water service (1 mark)
   c) IP rating of an accessible horizontal top surface of an enclosure. (1 mark)

9 For a construction site, state the
   a) Electrical supply to be used for portable hand held tools (1 mark)
   b) Maximum disconnection time for the system in a) above (1 mark)
   c) Two areas on the site that are NOT covered by SECTION 704 (1 mark)

10 The end-to-end resistance of two separate 2.5 sq. mm protective conductors were measured (at 20ºC) as 0.0371 Ohms and 0.1631 Ohms. Determine, showing all calculations the
   a) Length of EACH conductor (2.5 sq. mm is 7.41 mΩ/m at 20ºC). (2 mark)
   b) Overall resistance of two conductors wired in parallel and each measuring 0.071 Ohms. (1 mark)

11 When testing the continuity of protective conductors, state the
   a) Instrument to be used (1 mark)
   b) Precautions to be taken (according to GN3) if the test is part of a periodic inspection and testing process. (2 marks)

12 Give THREE examples of a ferrous material or enclosure that may be used as a protective conductor. (3 marks)

13 Identify the protective conductor that connects together EACH of the following
   a) A buried earth electrode and the main earth terminal (1 mark)
   b) Exposed and extraneous conductive parts in zones A, B and C in a swimming pool. (1 mark)
   c) Structural steel work and the main earth terminal. (1 mark)

14 State the THREE MAIN technical reasons for conducting a ring final circuit test. (3 marks)

15 For an insulation resistance test on a domestic installation, state the (1 mark)
   a) Instrument to be used (1 mark)
   b) Resistance range at which this instrument should be set (1 mark)
   c) Measured value, below which each circuit would need to be tested separately.

16 A live polarity test is to be conducted, State
   a) Why such a test is necessary (1 mark)
   b) The instrument to be used (1 mark)
   c) How neutral-earth polarity is checked. (1 mark)

17 Earth fault loop impedance is to be conducted on a radial circuit during an initial verification. State
   a) Where on the circuit the test should be conducted (1 mark)
   b) Which value, measured or corrected, should be recorded on the schedule of test results (1 mark)
   c) Why the value in b) may not be the same as $Z_e + (R_1 + R_2)$. (1 mark)

18 The measured value of earth fault loop impedance for three circuits are; 1.1 Ohms, 2.4 Ohms and 3.3 Ohms. If the maximum permissible value for these circuits are 1.5 Ohms, 3.45 Ohms and 4.0 Ohms, determine (showing all calculations) if the measured values are acceptable. (3 marks)

19 With reference to residual current devices state
   a) ONE application for a 300 mA device (1 mark)
   b) The maximum rating of a device when used for additional protection against direct contact. (1 mark)
   c) Maximum test current to be applied to a 10 mA device. (1 mark)

20 State the
   a) Type of earthing system that would enable prospective short circuit current to be calculated from values of U_o and Z_e (3 marks)
   b) Meaning of Z_e
   c) Accepted value of U_o.

Section B

Questions 21 to 26 refer to Fig 1a, 1b and 1c (attached) and the following scenario.

A consumer has acquired four antique cast iron lamp posts and has converted them to accommodate Edison screw tungsten filament lamps and installed them at various points in the garden. A PIR controlled tungsten halogen security light has also been installed on the side of the house. The posts and security light have been supplied from a standard metal clad, one-gang, one-way grid switch externally mounted. The feed to all the lights are in 1.0 sq. mm PVC/PVC twin with c.p.c. cable, clipped direct to the external brickwork and also laid in 25 mm of sand under the patio slabs to each post in the form of a radial circuit. The metal clad switch is fed from a socket outlet [protected by a 30A BS3036 fuse] on the downstairs ring final circuit using 1.5 sq. mm PVC/PVC twin with c.p.c. cable which passes through the wall and is clipped with the 1.0 sq. mm cable on their edges up to the switch. Each Edison screw lamp fitting together with a terminal block is mounted on a plastic base and secured in the head of each post. An inspection and test of this installation is to be carried out. The earthing arrangement is TN-S.

21 State for this installation
   a) The type/s of verification that would need to be undertaken (3 marks)
   b) The status of the person carrying out the verification (2 marks)
   c) The legislation that would apply (2 marks)
   d) The documentation that would need completing (2 marks)
   e) THREE items from BS 7671 or GN3 checklist that would need to be considered. (6 marks)

22 a) List SIX departures from BS 7671 that should be revealed during the inspection process. (12 marks)
b) State where should such departures be recorded (3 marks)

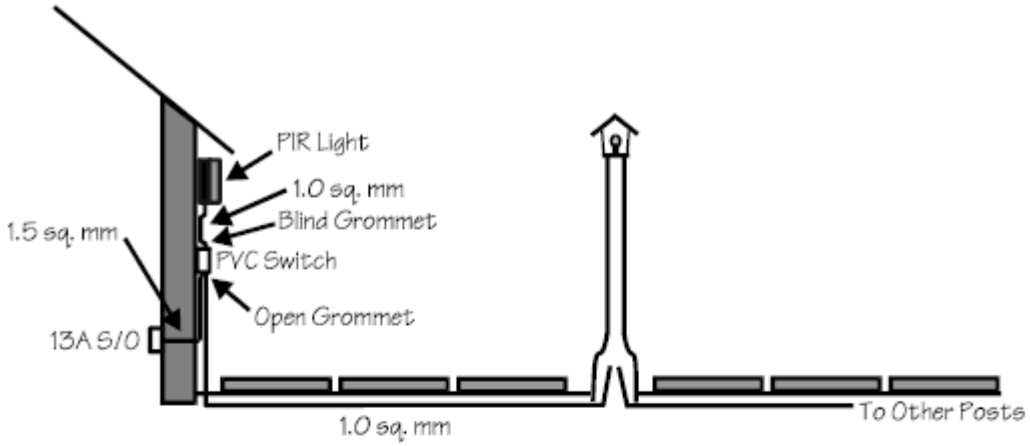
23 List the
a) RELEVANT instrument tests in the correct sequence to be carried out on this new installation. (Only tests relevant to this installation will be considered). (11 marks)
b) Instruments to be used for EACH of the tests in (a) above (4 marks)

24 Describe, in detail, how an insulation resistance test on the new lighting circuit would be carried out. (15 marks)

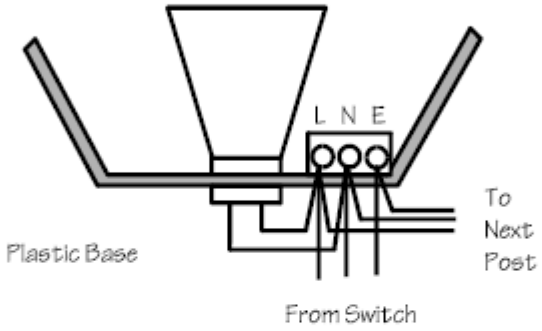
25 If, before any remedial work is undertaken, the measured value of;
$(R_1 + R_2)$ for the ring circuit is 0.35 ohms
Z_e at the intake is 0.09 ohms
$(R_1 + R_2)$ for the new circuit is 0.4 ohms

a) Determine a value for Z_s for the lamp post circuit (3 marks)
b) State TWO conditions that would influence the value (4 marks)
c) Explain the simplified method used, if factors for the conditions in (b) are not known (4 marks)
d) State whether the value in (a) is acceptable if the 30 A BS 3036 ring circuit fuse has a maximum Z_s value of 1.14 ohms (show all calculations). (4 marks)

26 The consumer energised this installation before inspection and testing and a fault developed between a line conductor and the casing of one of the posts.
a) State
i) What risk this situation poses (2 marks)
ii) Why the BS 3036 fuse may not operate (4 marks)
b) List the earth fault loop path for the lamp posts. (9 marks)

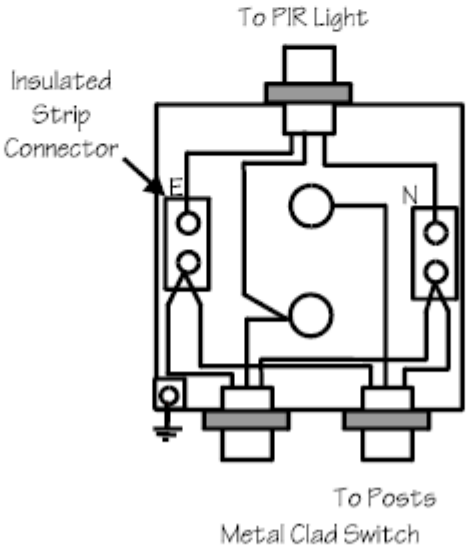


(a)



Lamphead

(b)



(c)

Answers

1 a) i) Where an existing installation has been altered so as to provide a new circuit
ii) On completion of all new installations.
b) Schedule of test results complete with a schedule of inspections.

2 i) BS 7671:2008
ii) Guidance Note 3
iii) The On Site Guide.

3 Any three of…
Connected load
Type of circuit protection provided
Any equipment vulnerable to tests
Type and composition of circuits
Number of circuits and outlets supplied
Type of cables installed

4 a) Basic & Fault protection
b) Basic protection
c) Fault protection

5 a) Minor electrical installation works certificate
b) Periodic inspection report. Schedule of inspection, schedule of test results
c) Electrical installation certificate, Schedule of inspection, schedule of test results

6 Designer
Installer
Tester

7 a) Responsible person/duty holder
b) Smell, touch, sight or hearing

8 a) The GREY is used to link the common conductors, and the BLACK & BROWN to link the strapper terminals L1 and L2. All Line conductors to be clearly marked with brown tape or sleeving.
b) Safety Electrical Connection Do Not Remove.
c) IP4X or IPXXD

9 a) Reduced low voltage system 110 V centre tapped to earth 55V
b) 5 seconds
c) Restaurants, offices, cloakrooms, meeting rooms, toilets etc.

10 7.41mΩ = 0.00741 Ω

a) i) $\frac{0.0371}{0.00741} = 5\text{m}$ ii) $\frac{0.1631}{0.00741} = 22\text{m}$

b) $\frac{1}{R_T} = \frac{1}{0.071} + \frac{1}{0.071}$

$\frac{1}{R_T} = \frac{1+1}{0.071} = \frac{2}{0.071}$

$R_T = \frac{0.071}{2} = 0.0355\Omega$

Or take one reading and divide by two: 0.071/2 = 0.0355Ω

11 a) Low resistance Ohmmeter
b) The circuit should be disconnected from the source of supply prior to disconnecting CPC's and bonding conductors.

12 Trunking/tray
Steel conduit
Metallic cable management system
Cable ladder system if electrically continuous.

13 a) Earthing conductor
b) Supplementary protective bonding conductor
c) Main protective bonding conductor

14 i) To ensure that the circuits being tested form a ring
ii) To ensure no cross connections are located on the circuit
iii) To ensure continuity of the Line, Neutral and cpc conductors.
iv) To ensure that the polarity at each point is connected correctly

15 a) Insulation resistance tester
b) 500V d.c.
c) 2 MΩ

16 a) To prove the correct polarity of the incoming supply
b) approved voltage indicator
c) i) Test across the line and neutral, voltage should be present,
ii) Test across the line and earth, voltage should be present
iii) Test across the neutral and earth conductors, no voltage should be present.

17 a) The remote end of the circuit (point furthest away from the source of supply)
b) Measured value
c) The $R_1 + R_2$ value is obtained using a d.c. test and does not take into account the impedance (a.c. resistance) of the circuit conductors. Also, when taking a reading of Z_s parallel paths may be present which would lead to a lower reading than may otherwise be calculated using true values of Z_e and $R_1 + R_2$.

18 Using the 0.8 factor, the test reading should be less than 0.8 of the max reading.

	Max. Value (Ω)	Max. Value × 0.8 (Ω)	Test Reading (Ω)	Acceptable (Y/N)
a)	1.5	1.2	1.1	Y
b)	3.45	2.76	2.4	Y
c)	4.0	3.2	3.3	N

19 a) Fire protection or any circuits not incorporating S/O in agricultural and horticultural premises
b) 30 mA
c) 10 mA (If used as supplementary protection against direct contact the maximum test current will be $5 \times I_{\Delta N} = 5 \times 10mA = 50mA$)

20 a) TN-C-S
b) The impedance of the earth fault path external to the consumer's installation, i.e. the suppliers Line conductor, the return earth path and the substation transformers secondary winding.
c) 230V

21 a) From the description the installation work has been performed by others therefore installation methods cannot be verified. As this work is an extension of an existing circuit, a minor electrical installation certificate should be the correct certificate, however as the installation methods cannot be verified, only a periodic inspection report complete with schedules of inspections and test results may be completed.
b) Competent person

c) Health & Safety at Work Act 1974
Electricity At Work Regulations 1989
d) As stated in a) above, a Periodic Inspection Report complete with
a Schedule of Inspections and
a Schedule of Test Results
e) Any three from the Chapter 61 checklist relevant to this installation…
IP ratings of accessories
Suitability of cable types
Identification of conductors
Methods of protection against electric shock
etc.

22 a) - Circuit supplied via 1.5mm^2 and 1.0mm^2 cable from a ring final circuit potentially protected by a 30/32 A protective device
- Additional protection not provided
- Open grommet used externally, does it meet required IP rating?
- Metal clad switch used externally, does it meet required IP rating?
- No mechanical protection to PVC cables clipped externally
- PVC cables inappropriately fixed (on their edges)
- No mechanical protection to buried PVC cable
- Possibility that voltage drop constraints cannot be met at the remote end of cable
- Lamppost may not be earthed

b) Within the recommendations section of the certificate or on a separate sheet appended to the report

23 a) Continuity of Circuit Protective Conductors
Insulation resistance
Polarity (dead test)
Polarity (Live test)
Earth Fault Loop impedance
Functional tests

b)

Continuity of CPC	-	Low resistance ohmmeter
Insulation resistance	-	Insulation resistance tester
Polarity (dead test)	-	Low resistance ohmmeter
Polarity (Live test)	-	GS 38 approved voltage indicator or Test lamp
Earth Fault Loop impedance	-	Earth fault loop impedance tester

24
- Installation should be isolated from the source of supply.
- PIR detector to be disconnected to prevent components becoming damaged.
- All lamps should be removed switches closed and sensitive items such as PIR movement detectors should be disconnected from the circuit.
- At the supply source connect the Line and Neutral conductors of the circuit together and with the tester set to 500V, test between the joined Line and Neutral conductors to the CPC.
- Note reading
- Separate the Line and Neutral conductors
- Apply the test between the Line and Neutral Conductors
- Note reading
- All readings obtained should exceed 1.0 MΩ; however any reading above 1.0 MΩ and less than 2 MΩ should be investigated for a possible latent defect.

25 $Z_s = Z_e + (R_1 + R_2)_{ring} + (R_1 + R_2)_{radial}$

a) $Z_s = 0.09 + .035 + 0.4$

$Z_s = 0.84\,\Omega$

b) Conductor temperature rise due to normal operating current
conductor temperature rise due to fault currents

c) Using 0.8 factor

d) Using the 0.8 factor:
Maximum Zs Value = 1.14 Ω
1.14 x 0.8 = 0.912 Ω

As the value in a) (0.84 Ω) is less than 0.8 of the maximum acceptable value (0.912Ω), the value give in a) is acceptable.

26 a) (i) There would be a risk of electric shock due to the possibility of the post's becoming live

(ii) It is not clear from the diagrams provided the actual length of the cable between the ring and the furthest lamppost. This fault current will be dependant on the impedance of the circuit, which may be high, and therefore the fault current may not be of sufficient magnitude to cause the BS3036 protective device to operate.

b) During a fault on a circuit, the earth fault path is from the point of fault on the lamp post, along the

1. Consumers CPC conductor for the lamppost circuit
2. Consumers CPC conductor for the ring final circuit
3. Supply authority's supply Earthing conductor cables metallic cable sheath.
4. Secondary winding of the supply authority's substation transformer.
5. Supply authority's Line conductor.
6. Consumer's Line conductor ring final circuit.
7. Consumer's Line conductor lamppost circuit to the point of fault.