Section A

1. Type of inspection
    a. On demand Periodic Inspection and Test
    b. Periodic Inspection Report
    c. Inspection Schedule & Schedule of Test Results

2. Documents.
    a. Electricity at Work Regulations 1989
    b. Health and Safety Executive Guidance Note GS38
    c. BS7671 – Requirements for Electrical Installations

3. Personnel
    a. First periodic test – designer/installer
    b. Further periodic tests – Tester/Inspector
    c. Extent & Limitations agreed with – person ordering the work

4. Type of contact
    a. Placing out of reach – direct
    b. EEBADS – indirect
    c. Class II equipment – indirect

5. Instruments
    a. Continuity ring final circuit – low reading ohmmeter
    b. Insulation resistance – insulation resistance tester
    c. Live polarity – GS38 compliant voltmeter or test lamp.

6. Increase in conductor resistance
    a. Increase in ambient temperature
    b. Increased circuit length - additions
    c. Decreased conductor cross section - modifications

7. CPC continuity
    a. At every socket
    b. Phase and CPC
    c. Highest value, therefore circuit value, for ($R_1 + R_2$)

8. Wiring systems not requiring separate CPC
    a. PVC-PVC insulated flat cable with CPC (twin & earth)
    b. MICC
    c. SWA

9. Ring final circuit test
    a. P & N tested to ensure a valid ring circuit
    b. If an interconnection existed
    c. Depends on interpretation of word ‘automatic’
        i. CPC continuity, Figure-of-eight, ($R_1 + R_2$) measurement. Or
        ii. Polarity

10. Insulation resistance, 600V discharge lighting
    a. Insulation resistance tester
    b. 1000V d.c.
    c. 1.0 MΩ

11. Insulation Resistance 230V Installation
    a. 500V
    b. 0.5 MΩ
    c. 2 MΩ

12. Bathroom Installation
    a. Socket outlets – SELV only
    b. Within the bath or shower tray itself
    c. 30mA

13. IP Codes
    a. Horizontal top surfaces – IP4X (Reg. 412-03-02)
    b. Intermediate barriers – IP2X or IPXXB (Reg. 412-03-04-(iii))

14. Polarity testing
    a. So that operating the device cuts line potential from the accessory protected.
    b. Because live parts are only energised when lamp is in place.
    c. To ensure supply is connected correctly at source.

15. Loop impedance
    a. Z_e = External Loop Impedance
    b. R_2 = Resistance of circuit protective conductor
    c. 1.2 = Operating temperature correction factor. (1.2 is for bunched 70^{o}C thermoplastic cables used at maximum operating temperature)

16. Bonding
    a. That equipotential bonding **is** in place
    b. Provided installation can be isolated, disconnect main earthing conductor from equipotential bonding and all CPC's
    c. Isolate installation circuits. That is, main isolator must be open.

17. Lightning conductor earth electrode
    a. Instrument – earth electrode resistance tester
    b. Two other electrodes:
        i. Current electrode
        ii. Potential electrode

18. Use of 30mA RCD
    a. For socket outlets reasonable expected to supply portable equipment outside the equipotential zone.
    b. To supply fixed equipment in special locations such as bathroom zone 1
    c. When the loop impedance of a circuit is too high to meet required disconnection times in the event of a fault.

19. RCD tests
    a. Loop impedance test determines that an earth fault loop path exists
    b. Functional test determines that the RCD will actually operate in the event of a fault – electro-mechanical test using the 'T' button.
    c. Max test current for 100mA RCD is 100mA

20. Single phase TN-C-S installation has a Z_e of 0.015 ohms. Calculate Prospective fault current:

Trick question: Appendix 3 of BS7671 (P.193 of latest edition) gives this relationship:

$Z_S = \frac{U_o c}{I_a}$ Where U_{oc} = open circuit voltage at transformer, and is taken as 240V (not 230!)

So the calculation is: $I_a = \frac{U_{oc}}{Z_s} = \frac{240}{0.015} = 16kA$

Section B – Scenario

Main features – high ambient temperatures, water sprays, dust

21. Testing
    a. Periodic Inspection and Test, plus an Initial Inspection and Test, for the new part of the installation.
    b. Periodic Inspection Report, Electrical Installation Certificate, plus Schedules of Test Results and Schedules of Inspections
    c. The person ordering the work gets the originals
    d. First periodic test determined either by statute or by the designer
    e. Statutory document = Electricity at Work Regulations 1989
       Non-statutory = BS7671, HSE Guidance Note 38
    f. Status of inspector = Competent Person

22. Inspection
    a. Installation conditions
        i. High ambient temperatures – effect on cable rating
        ii. Presence of water sprays - IP
        iii. Dusty environment - IP
        iv. Presence of corrosive chemicals – degradation of insulation
        v. ?
    b. BS7671 Inspection Schedule – main areas:
        i. Protection against Direct & Indirect Contact
        ii. Protection against Direct Contact
        iii. Protection against Indirect Contact
        iv. Prevention of Mutual Detrimental Influence
        v. Identification
        vi. Cables and Conductors
    c. Human senses
        i. Sight
        ii. Smell
        iii. Hearing
    d. Limitations of the inspection should be agreed with the person ordering the work

23. Testing
    a. First Four Tests
        i. Continuity of protective conductors
        ii. Insulation resistance
        iii. Polarity (although this can be checked at same time as (a))
        iv. Earth fault loop impedance
    b. Test equipment
        i. Low-reading ohmmeter – continuity/polarity
        ii. Insulation resistance tester
        iii. Loop impedance tester
        iv. GS38 compliant test leads for the above

24. Insulation Resistance test
    a. Disconnect all lamps and sensitive equipment, close all switches, test between phase/neutral, phase/cpc and cpc/neutral for a reading in excess of 0.5 MΩ for each circuit. Or, connect all the circuits together and test en masse.[1]
    b. Lower than 2 MΩ requires further investigation – check each circuit in turn
    c. With installation isolated disconnect all equipotential bonding then, with loop tester test between main earth terminal and incoming supply at the main switch. Repeat for each phase and record maximum value.
    d. Connect together flying earth lead and neutral at supply origin. Set loop tester to PSCC and test between each phase and neutral. For a three-phase supply the phase-phase fault current can be obtained by doubling the largest value.

25. Loop impedance values
    a. Rule of thumb of ¾ of allowable maximum is used as a safe way of incorporating correction factors.
    b. Acceptable values?

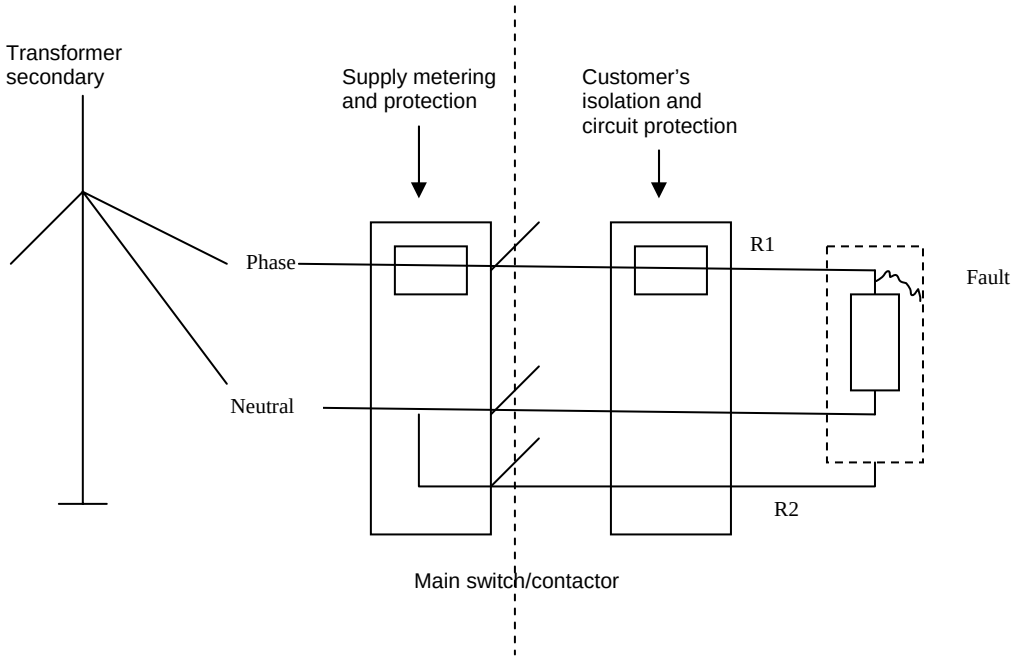
Max Value	¾ Max	Measured Value	Pass/Fail
3.43	2.57	2.7	Fail
2.29	1.72	1.7	Pass
2.4	1.8	1.9	Fail
3.75	2.81	3.2	Fail

    c. Overcoming problem
        i. Increase size of CPC, if possible
        ii. Use RCD

[1] Although the circuit is single phase, 230V, discharge lamps generate much higher voltages when striking. Should the insulation resistance tests, therefore, be carried out at 1000V, with a minimum acceptable value of 1 MΩ? Personally, I'd say, no – we're testing the wiring and switchgear, but it's a debatable point.

26. Earth fault loop

a. Diagram



b. BS3036 Fuses will not carry the large fault current. (They have a safe breaking capacity of either 1 or 4 kA)
c. PSCC between phases can be taken as twice the maximum measured value between any phase and neutral.