|  |  |
| --- | --- |
| **NO** | S O L U T I O N |
| **1(a)**  1(b) | **Power = 1750kW, pf = 0.85**  **Therefore kVA S = 1750/0.85 = 2059kVA**  **22kV, 3phases 3-wires and 50Hz**  **TNS earthing system**  **Max I = 2059,000/(1.732x22000) = 54A** |
| **2** | SOA is also applicable to festive lighting, trade-fairs, mini-fairs and exhibition sites.  SOA must be totally enclosed with all the live parts totally protected from direct contact.  Socket outlets must be equipped with: MCB and RCCB  **230V - Blue colour 110V - Yellow colour**  Inspection Freq for construction sites not less than once a month |
| **3** | |  |  |  |  | | --- | --- | --- | --- | | **No. & Types of Ccts** | **No. of cables** | **Cable Factor** | **Total cable factor** | | 3 nos single phase circuits of 1.5mm2 | 3 x 3 | 22 | 198 | | 1 nos. 3-phase 4-wire circuits of 2.5mm2 with  1.5mm2 CPC | 1 x 4  1 x 1 | 30  22 | 120  22 | |  |  |  | **340** | | **Hence select conduit with factor 404, one bend 7 m (6.6m) i.e. 25mm diameter-** | | | | |  | | | | |
|  |  |

|  |  |
| --- | --- |
| **NO** | S O L U T I O N |
| **4(a)**  **4(b)** | |  | | --- | |  | |  | |
| 5 | 1. **25A MCB Type C approx. 35 to 40s, 63A Type C MCB no tripping**   **Hence there is discrimination**   1. **30A Type B: tripping time approx. 0.1s, 63A Type C tripping time approx. 70s, hence there is discrimination.** 2. **The thermal mechanism or bimetallic strip mechanism operates to clear the fault.** |
| 6 | 1. Equivalent Insulation Resistance = 16//16//8//4 =2.0Mohms   As it is > than 0.5Mohms hence acceptable.   1. e.g. the hotel shaver unit in the washroom or any acceptable item   main equipment used is isolation transformer and neutral is separated from the earth.  (c) Earth electrode resistance under test = 10V/5A = 2.0 ohms  Any two: earth tape, earth rod, earth plate, |

|  |  |
| --- | --- |
| **NO** | S O L U T I O N |
| **B1**  **(a)** | |  |  |  |  | | --- | --- | --- | --- | | **Loads** |  | **DF** | Current Demand | | **10 nos. fluorescent lamps, each rated at 2x32W** | **(10x2x32x1.8)/230**  **= 5.0A** | **0.66** | **3.3** | | **13A SSO circuits**  **Largest cct 3.5kW**  **Remainder cct= (2 x 3.5kW)** | **15.22A**  **30.44A** | **1.0**  **0.4** | **15.22**  **12.18** | | **2 nos. instantaneous water heater, each rated at 3 kW**  **1 no storage heater 1.5kW** | **(3000x2)/230=26A**  **1500/230= 6.52A** | **1.0**  **1.0** | **26**  **6.2** | | **7.8 kW cooker w SSO** | **7800/230 = 33.91A**  **1st 10A**  **Excess 30% of 23.91**  **SSO 5A** | **1.0**  **0.3** | **10.00**  **7.17**  **5** | |  | **Total 1 phase demand** |  | **85.07 (1Ф)** | | **1 nos. air-conditioner, each rated at 9 kW with p.f. of 0.85 and efficiency of 88%** | 8000/(1.732x400x0.88x0.88) | **1.0** | **14.91(3Ф)** | |  |  |  |  |   **1500W audio video system taking supply from 13A S/S/O already accounted for in S/S/O circuits**  **Maximum three phase current demand = 85.07/3 + 14.91 =43.27A**  **10% spare capacity = 1.1 x 43.27A = 47.59A**  **Size of main breaker = 50A Three phase** |
|  |  |

|  |  |
| --- | --- |
| **NO** | S O L U T I O N |
| B2(a) | 1. **Design current Ib = 30000/(1.732x400x0.88) = 49.21A**   **(ii)**  **Select In = 50A Type C**  **(iii) From Table 4C1 Ca(30oC) = 1.0**  **From Table 4B1 Cg(2 circuits) = 0.80 ;**  **No thermal insulation Ci = 1**  **It ≥ In /(CaxCgxCi) =50/(1x0.8) = 61.51 A**  **Select cable size of 16.0 mm2 which can carry 62A (Table 4D2A**  **column 5).**   1. **calculate the voltage drop :**     = (2.4 x 49.21 x 70)/1000 = 8.27V **< 16V (4% of 400V)**  **Therefore Acceptable** |
| **B2**  **(b)** | Earth fault loop impedance ZS = ZE + (R1 + R2)  With 4.0mm2 phase conductor minimum cpc is 1.5mm2  ZE = 0.75 , ZS = 0.75 + (16.71 x 12 x1.38)/1000 = 1.03 Ω  For 32A Type B MCB, from Table 41B2(L) (0.4 secs) Zsmax = 1.43 Ω,  Hence size of cpc of 1.5mm2 is **acceptable** for shock protection    Earth fault current = 230/1.03= 223A  Operating time of 32A Type B MCB at 223A ≤ 0.1s  Using K2S2 ≥ I2t and t of 0.1  K = 115, I =223A, t = 0.1s    ≥0.61mm2  Hence 1.5mm2 cpc meet thermal constraint. |