TABULATION

Table 08: Observation data for the earth electrode test

Length (m)	Resistance (Ω)
0	1.2
1.5	1.8
3.0	1.9
4.5	2.5
6.0	3.0
7.5	3.5
9.0	4.0
10.5	4.5
12.0	6.0
13.5	9.5
15.0	200

CALCULATIONS

Resistances of different sizes of wires at 20 °C are:

1 mm^2 = 18 $m\Omega/m$

1.5 mm^2 = 12 $m\Omega/m$

2.5 mm^2 = 7 $m\Omega/m$

Inside the building is 30 °C:

$R_t = [1 + 0.004(t-20)] \times R_{20}$

Resistances of different sizes of wires at 30 °C are:

1 mm^2 wire; $R_{30} = [1 + 0.004(30-20)] \times 18\ m\Omega/m$

$R_{30} = 18.72\ m\Omega/m$

1.5 mm^2 wire; $R_{30} = [1 + 0.004(30-20)] \times 12\ m\Omega/m$

$R_{30} = 12.48\ m\Omega/m$

2.5 mm^2 wire; $R_{30} = [1 + 0.004(30-20)] \times 7\ m\Omega/m$

$R_{30} = 7.28\ m\Omega/m$

Part 2.1

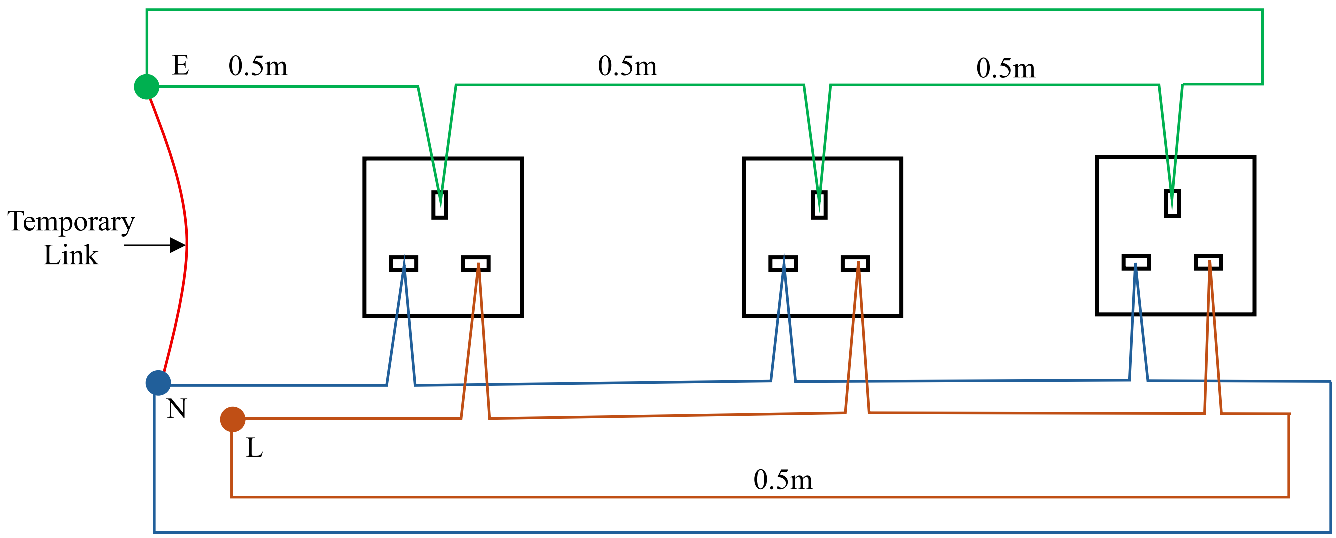

Figure 05 : Circuit 2 with a temporary link between neutral and earth

Since all wires are 2.5mm^2 and 0.5 m ;

$R_L = R_N = R_E = 7.28\ m\Omega/m \times 0.5\ m$

$= 3.64\ m\Omega$

Resistance between earth(E) and neutral(N);

At the socket outlet 1 $= (R_N + R_E) \mathbin{//} (3\times R_N + 3\times R_E)$

$= 2\times 3.64\ m\Omega \mathbin{//} 6\times 3.64\ m\Omega$

$= \frac{6}{(3+1)} \times 3.64\ m\Omega$

$= \underline{5.46\ m\Omega}$

At the socket outlet 2 $= (2\times R_N + 2\times R_E) \mathbin{//} (2\times R_N + 2\times R_E)$

$= 4\times 3.64\ m\Omega \mathbin{//} 4\times 3.64\ m\Omega$

$= \frac{4\times 4}{(4+4)} \times 3.64\ m\Omega$

$= \underline{7.28\ m\Omega}$

At the socket outlet 3 $= (3\times R_N + 3\times R_E) \mathbin{//} (R_N + R_E)$

$= 6\times 3.64\ m\Omega \mathbin{//} 2\times 3.64\ m\Omega$

$= \frac{6}{(3+1)} \times 3.64\ m\Omega$

$= \underline{5.46\ m\Omega}$

Part 2.2

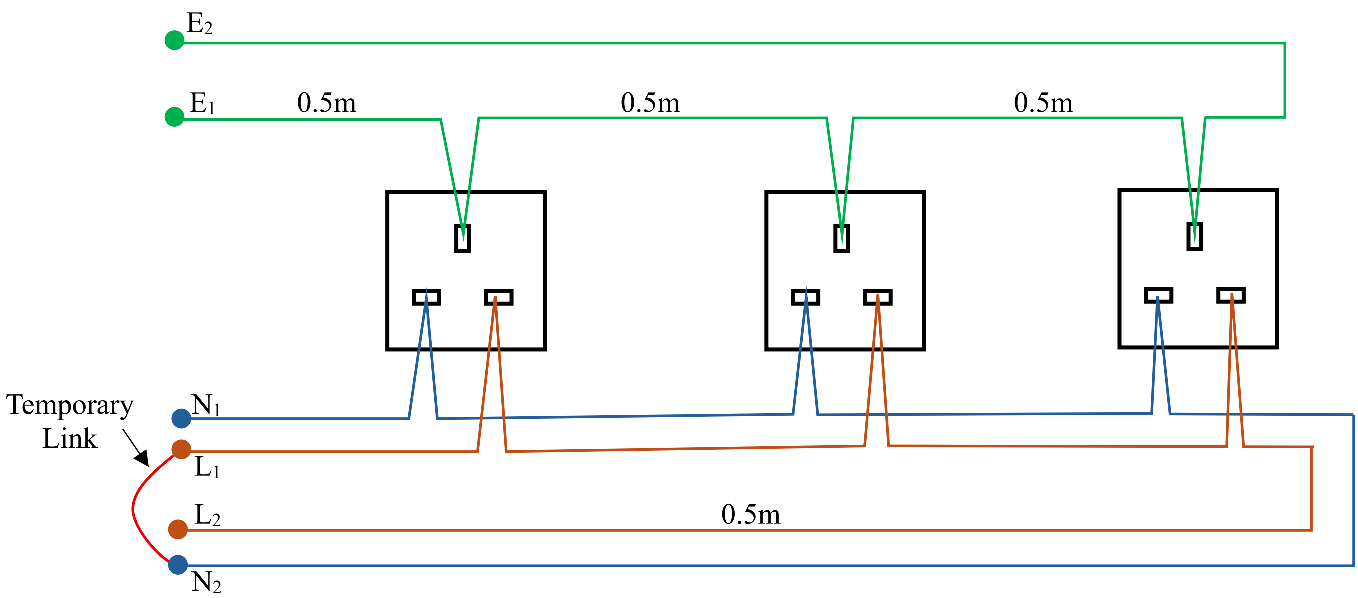

Figure 06 : Disconnected circuit 2 with a temporary link between L_1 and N_2

Resistance between N_1 and L_2 $= 4\times R_N + 4\times R_L$

$= 8 \times 3.64\ m\Omega$

$= \underline{29.12\ m\Omega}$

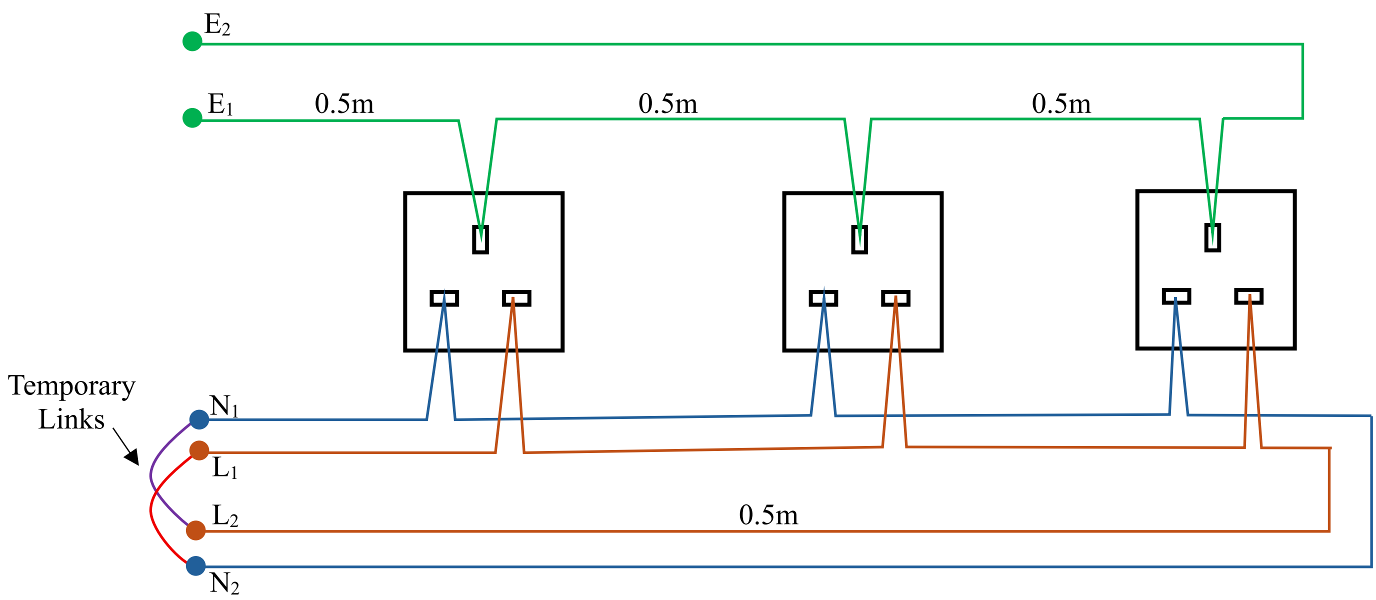

Figure 07 : Disconnected circuit 2 with temporary links between L_1 N_2 and L_2 N_1

Resistance between live(L) and neutral(N);

At the socket outlet 1 $= (1\times R_L + 3\times R_N) \,//\, (1\times R_N + 3\times R_L)$

$= 4\times 3.64\ \text{m}\Omega \,//\, 4\times 3.64\ \text{m}\Omega$

$= \frac{4\times 4}{(4+4)} \times 3.64\ \text{m}\Omega$

$= \underline{\underline{7.28\ \text{m}\Omega}}$

At the socket outlet 2 $= (2\times R_L + 2\times R_N) \,//\, (2\times R_N + 2\times R_L)$

$= 4\times 3.64\ \text{m}\Omega \,//\, 4\times 3.64\ \text{m}\Omega$

$= \frac{4\times 4}{(4+4)} \times 3.64\ \text{m}\Omega$

$= \underline{\underline{7.28\ \text{m}\Omega}}$

At the socket outlet 3 $= (1\times R_L + 3\times R_N) \,//\, (1\times R_N + 3\times R_L)$

$= 4\times 3.64\ \text{m}\Omega \,//\, 4\times 3.64\ \text{m}\Omega$

$= \frac{4\times 4}{(4+4)} \times 3.64\ \text{m}\Omega$

$= \underline{\underline{7.28\ \text{m}\Omega}}$

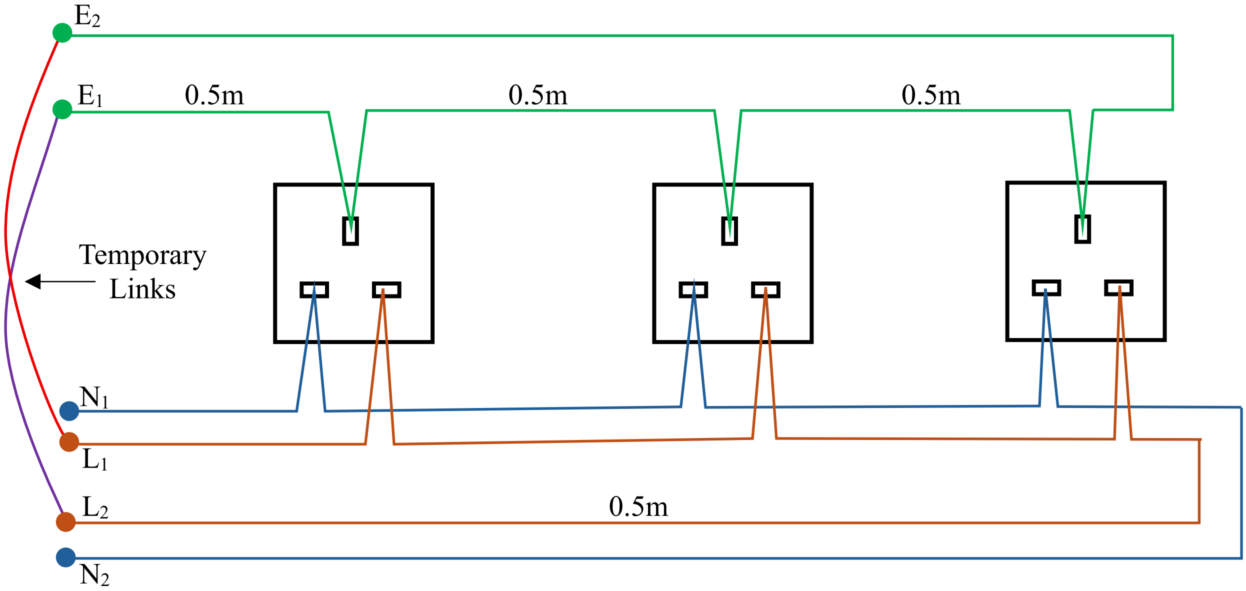

Figure 08 : Disconnected circuit 2 with temporary links between L_1 E_2 and L_2 E_1

Resistance between live(L) and earth(E);

At the socket outlet 1 $= (1\times R_L + 3\times R_E) \,//\, (1\times R_E + 3\times R_L)$

$= 4\times 3.64\ \text{m}\Omega \,//\, 4\times 3.64\ \text{m}\Omega$

$= \frac{4\times 4}{(4+4)} \times 3.64\ \text{m}\Omega$

$= \underline{7.28\ \text{m}\Omega}$

At the socket outlet 2 $= (2\times R_L + 2\times R_E) \,//\, (2\times R_E + 2\times R_L)$

$= 4\times 3.64\ \text{m}\Omega \,//\, 4\times 3.64\ \text{m}\Omega$

$= \frac{4\times 4}{(4+4)} \times 3.64\ \text{m}\Omega$

$= \underline{7.28\ \text{m}\Omega}$

At the socket outlet 3 $= (1\times R_L + 3\times R_E) \,//\, (1\times R_E + 3\times R_L)$

$= 4\times 3.64\ \text{m}\Omega \,//\, 4\times 3.64\ \text{m}\Omega$

$= \frac{4\times 4}{(4+4)} \times 3.64\ \text{m}\Omega$

$= \underline{7.28\ \text{m}\Omega}$

<u>Part 3.1</u>

62% of 15 m $= 15\times 0.62\ \text{m} = 9.3\ \text{m}$

Resistance at 9.3 m $= \frac{(9.3-4.5)}{(10\cdot 5-4\cdot 5)} \times (4.5 - 2.5) + 2.5\ \Omega$ (considering the linear region)

$= \underline{4.1\ \Omega}$

REFERENCES