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Course Electric Power Distribution.

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Question (1)

1

Given data:

Total length of DC distributed 2-wired is = 500 m

Voltage at both end V = 230 V

Various load, 10 A, 40 A, 30 A, 40 A

distance at various load is from end (X) 100 m, 250 m, 350 m, and 450 m

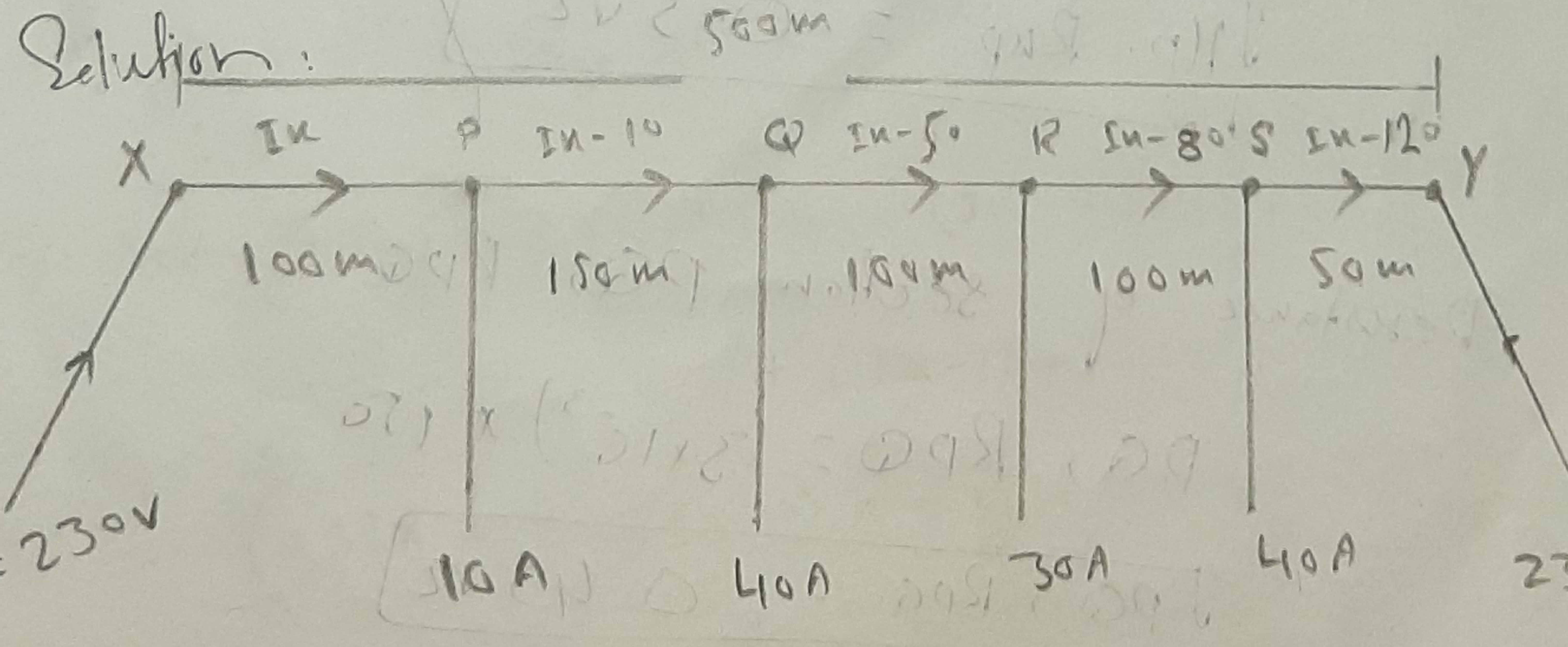
Cross sectional area of Conductor = 2 cm

Resistivity = 1.5×10^{-5} Ωcm

Required data:

Minimum Consumer Voltage = ?

Solution:



In the above figure the distributed (2) with its tapped current.

Let I_n amperes be the current supplied from the feeding end (X). then current current in the various section of the distributor are show in the figure.

Resistance of 1m length of distributer

$= 2 \times \frac{1.5 \times 10^{-5} \times 100}{1}$

$= 2 \times 1.5 \times 10^{-3} \Omega$ or $3 \times 10^{-3} \Omega$

Resistance of section XP. R_{XP}

$XP \cdot R_{XP} = (3 \times 10^{-3}) \times 100$

$XP \cdot R_{XP} = 0.3 \Omega$

Resistance of section PQ, R_{PQ}

$PQ, R_{PQ} = (3 \times 10^{-3}) \times 150$

$PQ, R_{PQ} = 0.45 \Omega$

(3)

Resistance of section QR, R_{QR}

$QR; R_{QR} = (3 \times 10^{-3}) \times 100$

$QR. R_{QR} = 0.3\,\Omega$

Resistance of section RS, R_{RS}

$RS, R_{RS} = (3 \times 10^{-3}) \times 100$

$RS. R_{RS} = 0.3\,\Omega$

Resistance of section SY, R_{SY}

$SY, R_{SY} = (3 \times 10^{-3}) \times 50$

$SY. R_{SY} = 0.15\,\Omega$

Now

voltage at Y = Voltage At X − Drop over length XY

$$V_Y = V_X - \big(I_K R_{XP} + (I_K - 10) R_{PQ} + (I_K - 50) R_{QR} + (I_K - 80) R_{RS} + (I_K - 120) R_{SY}\big) \quad - (1)$$

$$V_Y = 230 - \big(0.3 I_K + 0.45(I_K - 10) + 0.3(I_K - 50) + 0.3(I_K - 80) + 0.15(I_K - 120)\big)$$

(4)

$V = 230 - (0.3I_N + 0.45I_N - 4.5 + 0.3I_N - 15 + 0.3I_N - 24$
$+ 0.15I_N - 18)$

$= 230 - (1.65I_N - 61.5$

$230 = 230 - 1.65I_N + 61.5$

$1.65I_N = 61.5$

$I_N = \frac{61.5}{1.65}$

$I_N = 37.27A$

Knowing the value of I_N, current in any section can be determined.
Thus current in section PQ

$I_{PQ} = I_N - 10 \Rightarrow 37.27 - 10$

$I_{PQ} = 27.27A$

Section QR

$I_{QR} = I_N - 50$
$= 37.27 - 50$

$I_{QR} = -12.73A$

from Q to R = -12.73
and
from R to Q = 12.73

Section I_{RS} = ?

$I_{RS} = I_K - 80$ — from R to S = −42.73 (S…) and from S to R = 42.73

$= 37.27 - 80$

$\boxed{I_{RS} = -42.73\ A}$

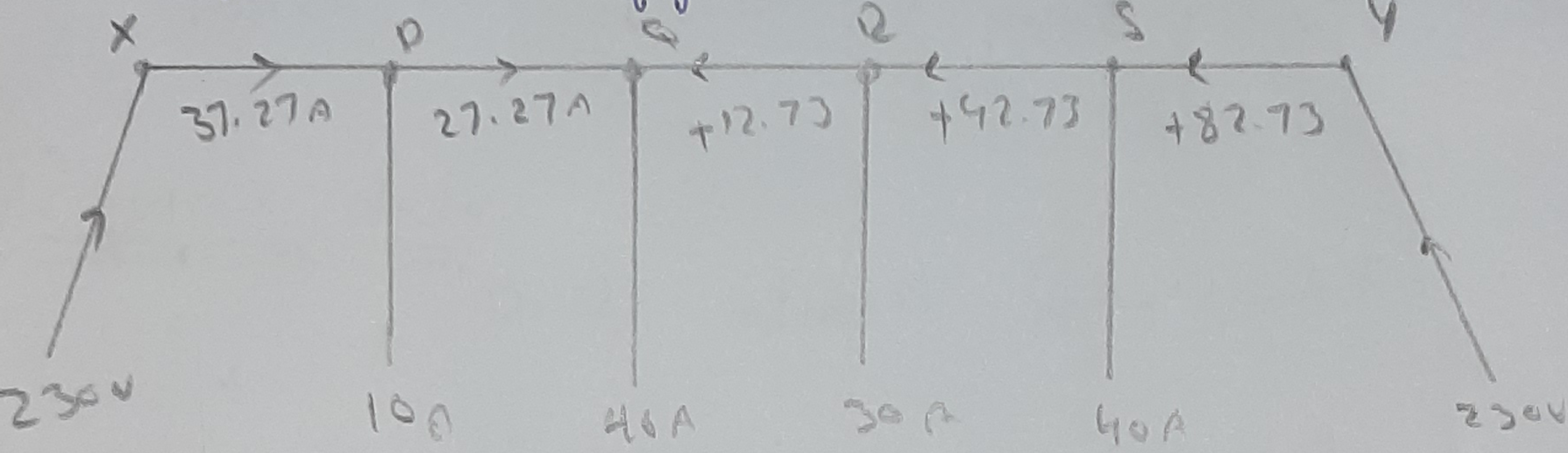
Section I_{SY} = ?

$I_{SY} = I_K - 120$ — from S to Y is = −82.73 and from Y to S = 82.73

$= 37.27 - 120$

$\boxed{I_{SY} = -82.73\ A}$

The actual current distribution of various section is shown in figure.



From the figure its clear that current are coming to load point "Q" from both end.

Hence 'Q' is the point of minimum p.d.

$V_Q = V_K - (I_{KP} \cdot R_{KP} + I_{PQ} \cdot R_{PQ})$ — (I)

$= 230 - (37.27 \times 0.3 + 27.27 \times 0.45)$

$= 230 - (11.181 + 12.2715)$

$= 230 - 23.4525$

$\boxed{V_Q = 206.54V}$ Ans.

Question (2)

Given data:

Supply load is 150 A, 200 A

250 A, 100 A.

distance of 500 m, 1300 m

2300 m, 3000 m

the Resistance of each conductor

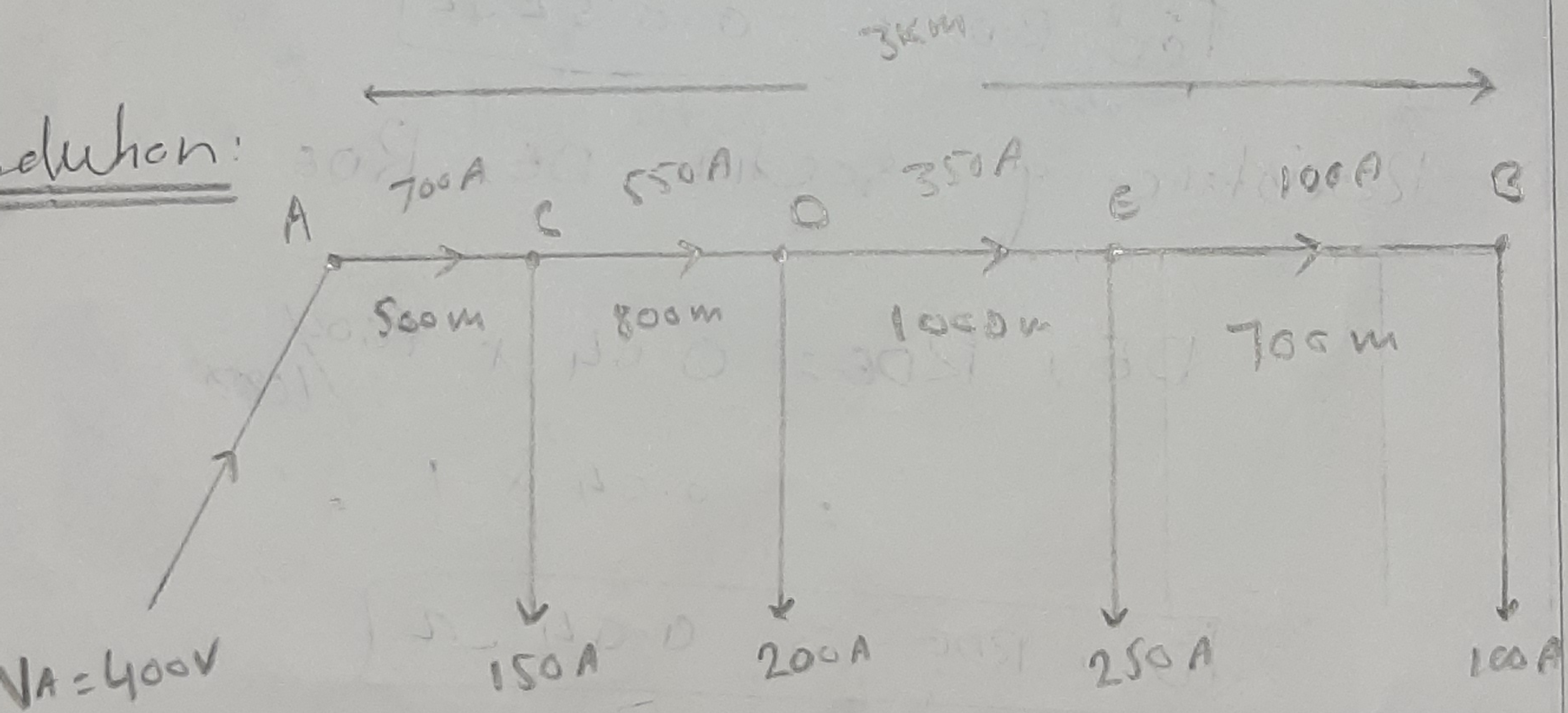
is R = 0.02 per 1000 m

Potential difference at point A = 400 V

Required data:

P.d at each load point = ?

Solution:



→ The single line diagrame of the distributor with its tapped currents,

Resistance per 1000m distributor is $= 2 \times 0.02 = 0.04\,\Omega$

Resistance of section AC, R_{AC}

AC, $R_{AC} = 0.04 \times 500/1000$

$= 0.04 \times 0.5$

AC, $R_{AC} = 0.02\,\Omega$

Resistance of section CD, R_{CD}

CD, $R_{CD} = 0.04 \times 800/1000$

$= 0.04 \times 0.8$

CD, $R_{CD} = 0.032\,\Omega$

Resistance of section DE, R_{DE}

DE, $R_{DE} = 0.04 \times 1000/1000$

$= 0.04 \times 1$

DE, $R_{DE} = 0.04\,\Omega$

Resistance of section EB, R_{EB}.

EB, $R_{EB} = 0.04 \times 700/1000$

$= 0.04 \times 0.7$

$\boxed{EB, R_{EB} = 0.028\,\Omega}$

The current in the various section of distributer are:-

$I_{EB} = 100\,A$, $\quad I_{DE} = 100 + 250 = 350\,A$

$I_{CD} = 350 + 200 = 550\,A$

$I_{AC} = 550 + 150 = 700\,A$

Potential difference at point C; = ?

V_C = Voltage at A − voltage drop in AC

$= V_A - I_{AC} \cdot R_{AC}$ from ohm (law) $\therefore V_{AC} = I_{AC} \cdot R_{AC}$

$= 400 - 700 \times 0.02$

$= 400 - 14$

$\boxed{V_C = 386\,V}$

* P.D at point D = ?

$V_D = V_C - I_{CD} \cdot R_{CD}$

$= 386 - 550 \times 0.032$

$= 386 - 17.6$

$V_D = 368.4\ V$

* P.D at point E = ?

$V_E = V_D - I_{DE} \cdot R_{DE}$

$= 368.4 - 350 \times 0.04$

$= 368.4 - 14$

$V_E = 354.4\ V$

* P.d at load point B

$V_B = V_E - I_{EB} \cdot R_{EB}$

$= 354.4 - 100 \times 0.028$

$= 354.4 - 2.8$

$V_B = 351.6\ V$

Question (3)

(10)

Given data:

Resistance of load across the positive outer ; $= 7\Omega$

Resistance of load across the negative outer is ; $= 9\Omega$

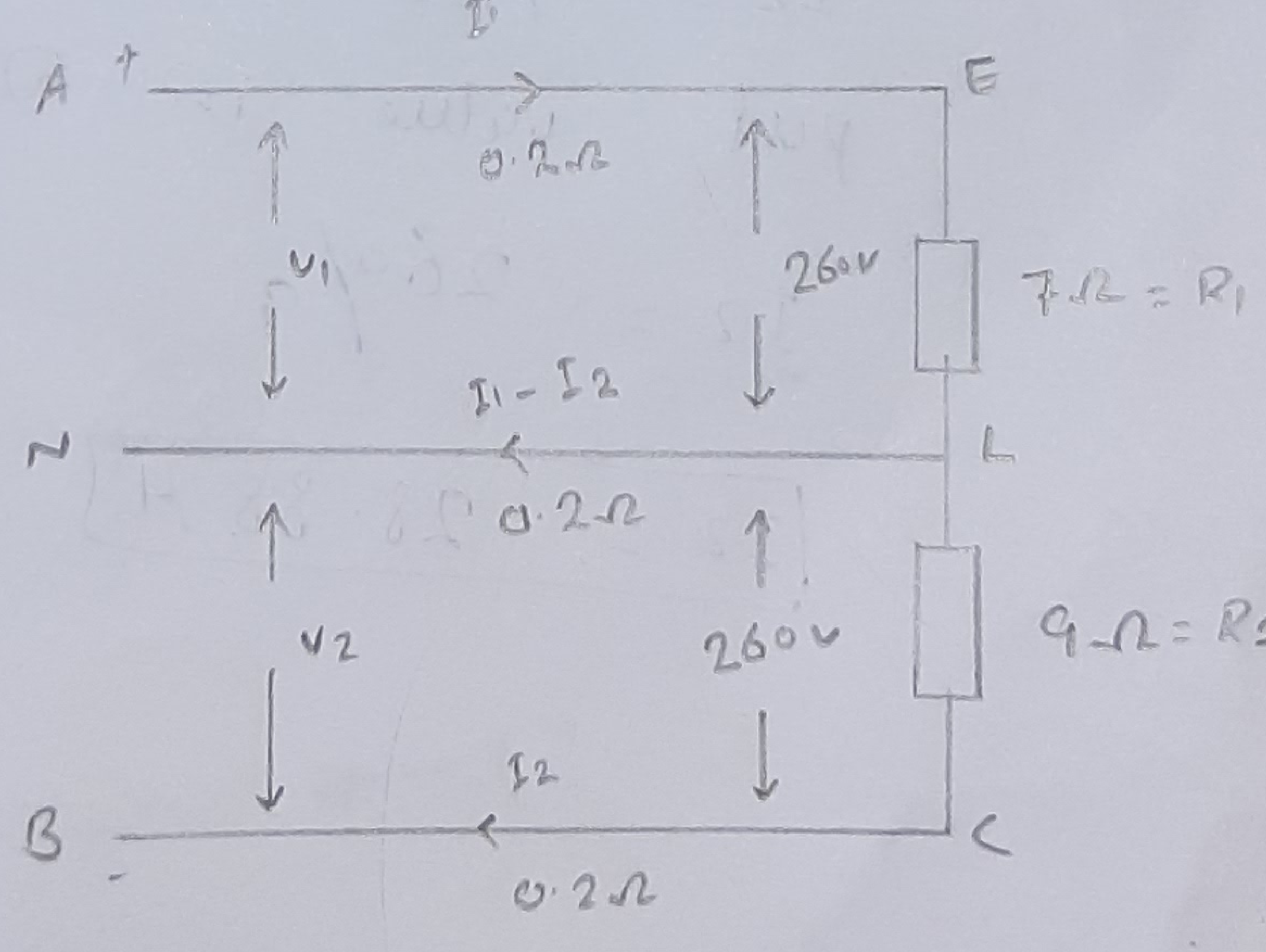
Resistance of each Conductor is $= 0.2\Omega$

Voltage between any outer and neutral is ; $V = 260V$

Required data:

feeding end voltages ; = ?

Solution:



→ The 3- wire distribution system is shown in the above figure.

Now first we find

* Current on the +ve outer so we know that from ohm law

$$I_1 = V_1/R_1 \quad -(1)$$

put value in equation (1)

$$I_1 = 260/7$$

$$\boxed{I_1 = 37.14\ A}$$

* Current on -ve outer $I_2 = ?$ So we know that

$$I_2 = V_2/R_2 \quad -(2)$$

put value in (2)

$$I_2 = 260/9$$

$$\boxed{I_2 = 28.88\ A}$$

* Current in neutral is = $I_1 - I_2$ - (3) (12)

put value in equation (3)

$= 37.14 - 28.88$

$(I_1 - I_2) = \boxed{8.26\ A}$

Now

Voltage b/w +ve outer and neutral at feeding end is

$V_1 = V_{EL} + I_1 R_{AE} + (I_1 - I_2) R_{NL}$ - (4)

put value in equal (4)

$V_1 = 260 + 37.14 \times 0.2 + (8.26) \times 0.2$

$V_1 = 260 + 7.428 + 1.652$

$\boxed{V_2 = 269.08\ V}$

Now

voltage b/w -ve outer and neutral is

$V_2 = V_{LC} - (I_1 - I_2) R_{NL} + I_2 R_{BC}$ - (5)

$V_2 = V_{LC} - (I_1 - I_2) R_{NL} + I_2 R_{BC}$ - (4) ((3))

put value in (4)

$V_2 = 260 - (8.26)(0.2) + 28.88 \times 0.2$

$V_2 = 260 - 1.652 + 5.776$

$V_2 = 265.776 - 1.652$

$\boxed{V_2 = 264.124 \checkmark}$ Ans.

Question 4 part (14)

Answer: If the insulating material used for underground is hygroscopic:

In this case it must be enclosed in a waterproof covering and like lead sheath.

To protect cable from moisture and the breakdown cable.

Because the moisture tend to decrease the insulation resistance.

* If the low dielectric strength is used for underground cable. It can not avoid electrical breakdown of the cable.

Question 4 part (2)

Answer: pure rubber cannot used an an insulating material for underground cable because:

-> Pure rubber has reasonably high insulating properties, it suffers from some major drawbacks

-> Readily absorbs moistures.

-> Maximum safe temperature is low of about 38°C.

-> Soft and liable to damage due to rough handelling ange and ages when exposed to light.

Therefore pure rubber cannot be used as an insulating material.

Q5 part (A). (8)

Answer:

-> the Cable is laid over the Sand bed.

-> in direct laying method of underground cable the maintainance cost is high

Because.

-> In Case of fault occur in this system it is more difficult to locate the fault and maintainance of fault is also difficult. the fault require high cost equipment.

->

Question (5) part (B) (i7)

Answer:

The solid system used for laying of underground cable is expensive as compare to as compare to direct laid system

Because.

-> It requires skilled labour.

-> And favourable weather conditions.