# Syllabus

18 June 2024 14:27

EEEE-syllabus

| Course Code | Name of the Course | | | |
|---|---|---|---|---|
| 216U06C106 | Elements of Electrical and Electronics Engineering | | | |
| | EIEE | | | |
| Teaching Scheme (Hrs./Week) | TH | P | TUT | Total |
| | 03 | -- | -- | 03 |
| Credits Assigned | 03 | -- | -- | 03 |

| Evaluation Scheme | Marks | | | | |
|---|---|---|---|---|---|
| | LAB/TUT CA | CA (TH) | | ESE | Total |
| | | IA | ISE | | |
| | -- | 20 | 30 | 50 | 100 |

IA1 IA2 → 50

**Course pre-requisites:**
Knowledge of Basic Electrical parameters: Resistance, Inductance, Capacitance, Frequency, Voltage, Current and Power and Energy, basic laws of magnetism

**Course Objectives:** It is difficult to imagine life without electricity and electronics. Electricity plays a major role in the working of all minor and major devices used in our day to day life. In this course students acquire fundamental knowledge to understand the design of electrical and electronics systems.

**Course Outcomes (CO):**

- **CO1.** Analyse resistive networks excited by DC sources using various network theorems
- **CO2.** Demonstrate and analyse steady state response of single phase and three phase circuits
- **CO3.** Understand principles and working of AC and DC machines with their applications.
- **CO4.** Explain rectifier-filter circuits using PN junction diode and voltage regulator circuits using Zener diode
- **CO5.** Understand Bipolar Junction transistor and its applications

| Module No. | Unit No. | Contents | No of Hrs. | CO |
|---|---|---|---|---|
| 1 | **DC circuits** | | 12 | CO1 |
| 100% Concept | 1.1 | Concept of dependent and independent sources, ideal and practical voltage and current sources, Kirchhoff's Laws, source transformation and network terminology. | | |
| 90% | 1.2 | Resistive network simplification, Series, parallel connection and Star-Delta transformations | | |
| Numericals | 1.3 | Mesh and nodal analysis, concept of super mesh and super node (Analysis only with independent sources ) | | |
| 10% Theory | 1.4 | Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem (Analysis only with independent sources) | | |
| | | | | |
| 2 | **AC circuits** | | 15 | CO2 |
| 100% concept | 2.1 | Generation of alternating voltage, average value, RMS value, form factor, crest factor, phasor representation in rectangular and polar form. | | |
| 80 % | 2.2 | Steady state behaviour of single phase AC circuits with pure R, L, and C, concept of inductive and capacitive reactance, phasor diagram of impedance, phase relationship in voltage and current. | | |
| Numericals 10 % Th. | 2.3 | RL, RC and RLC series and parallel circuits, concept of impedance and admittance, power triangle, power factor, active, reactive and apparent power, concept of power factor improvement. | | |
| | 2.4 | Series and parallel resonance, Q-factor and bandwidth | | |
| | 2.5 | Three-phase balanced circuits, voltage and current relations in star and delta connections. | | |
| | 2.6 | Measurement of power in 3-phase system using two wattmeter method | | |
| | | | | |
| 3 | **Electrical Machines** | | 12 | CO3 |
| | 3.1 | Single phase transformer construction and principle of working, emf equation of a transformer, losses in transformer, equivalent circuit of Ideal and practical transformer, voltage regulation and efficiency of transformer, phasor diagram at various loading condition (No numerical expected) | | |
| | 3.2 | Construction and working principle of DC motors such as series, shunt and compound, torque-speed characteristics, selection criteria and applications (no derivations and numerical expected) | | |
| 100% | 3.3 | Single phase induction motor: Construction, working principle, double field revolving theory, split phase, capacitor start and shaded pole motor. applications (no derivations and numerical expected) | | |
| Theory | 3.4 | Three phase induction motor: Construction, working principle, Generation of rotating magnetic field, applications. (no derivations and numerical expected) | | |
| | | | | |
| 4 | **Diodes and their applications** | | 04 | CO4 |
| 100% concept 90% Numerica | 4.1 | **P-N Junction diode:** Construction and working of PN junction diode, current voltage characteristics. Application as Rectifier: Half wave rectifiers with resistive load, | 10% Th. | |

| | | | | |
|---|---|---|---|---|
| | | full wave center tap and bridge rectifier with resistive load with their parameters such as ripple factor, rectification efficiency, transformer utilization factor. Filter circuits | | |
| | 4.2 | **Zener Diode:**<br>Construction and working, current voltage characteristics.<br>**Application of Zener diode:** Voltage regulator | | |
| | 4.3 | **Light emitting diode (LED) and Photo Diode:**<br>Construction and working, current voltage characteristics and applications | | |
| | | | | |
| 5 | **Bipolar Junction Transistor and their applications** | | 03 | CO5 |
| 100% Theory | 5.1 | **Bipolar Junction Transistor (BJT):**<br>BJT construction and operation, Common-Base (CB), Common-Emitter (CE) and Common-Collector (CC) configurations and input and output characteristics, operating point, DC biasing (No Numerical expected) | | |
| | 5.2 | Application of BJT-CE configuration: Voltage amplifier, Electronic Switch (No Numerical expected) | | |
| | | | | |
| | Self-learning topics# | | -- | -- |
| | | Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB<br>Types of Wires and Cables, Earthing<br>Types of Batteries, Important Characteristics for Batteries, Elementary calculations for energy consumption, power factor improvement and battery backup<br>Lamps- fluorescent, CFL, LED<br>Electrical measuring instruments principle and applications- energy meter, megger, tong tester. | | |
| | | **Total** | **45** | -- |

# Students should prepare all self-learning topics on their own. Self-learning topics will enable students to gain extended knowledge of the topic. Assessment of these topics may be included in IA.

## References



| Sr. No | Name/s of Author/s | Title of Book | Publisher | Edition/ Year |
|---|---|---|---|---|
| ② 1 | B. L. Thereja | Electrical Technology Vol-1 and Vol-II | S. Chand | 25th Edition 2014 |
| 2 | Mittle and Mittle | Basic Electrical Engineering | Tata McGraw Hill, India | 2nd edition (New) 2001 |
| ① 3 | Singh Ravish R. | Basic Electrical Engineering 80%. | S. Chand | 1st Edition, 2023 |
| 4 | B.R. Patil | Basic Electrical Engineering | Oxford University Press | 2nd Edition, 2022 |
| 5 | Donald Neamen Module 4 | Microelectronics: Circuit Analysis and Design | Tata McGraw Hill India | 4th Edition 2021 |

# IA

18 June 2024 14:30

Lecture 1 →
18 June 2024 14:33

Voltage → unit → V → Potential difference between any two points in electric N/w.

$1V = \frac{1J}{1C} = \frac{\text{1 J of energy (workdone)}}{\text{unit charge}}$

Electric charge → Value of electrons
↳ $1.062 \times 10^{-19} C$

2) Electric current → unit → Amp → I

Rate of flow of electrons in conductor or Semiconductor.

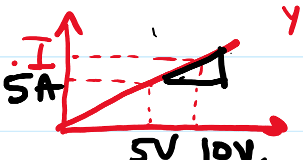
$1A = \frac{1C}{1 sec}$

3): ohms law

Potential difference between any two points on a conductor is directly proportional to current flowing through it.

$(V \propto I)$

$\boxed{V = IR}$




y = mx + c → = 0.

( Provided materials length, crossection area is const)

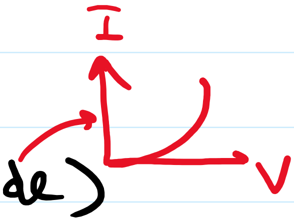
Where R is the resistance between two points

Limitations of ohms law :-

1) Not applicable to non metalic conductor.

1) Not applicable to non metallic conductor.

2) Not applicable for nonlinear devices. (BJT, MOSFET, diode)




3) Resistance $R \rightarrow$  $(\Omega)$.

$R = 10\,\Omega$

$10K \rightarrow 10 \times 10^3$

$\rightarrow$ It is the property of a material due to which it opposes current flowing through it.

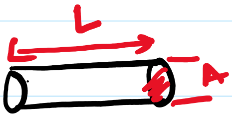
eg $\rightarrow$ Conductors

↳ opposes very low Resistance

Insulators

↳ opposes very high Resistance

$R \propto L_{conductor}$




$\propto \frac{1}{A}$ $A \rightarrow$ area of crossection of conductor

depends on nature of conductor

↳ on temprature of conductor

$R = \rho \frac{L}{A}$

rho

$\rho \rightarrow$ Resistivity of material.

PTC NTC

$T \uparrow R \uparrow$ $T \uparrow R \downarrow$

# Electric Power (P) $\rightarrow$ (DC)

(W) $\rightarrow$ unit

$P = V \cdot I$ — ①

$= I^2 R$ — ②

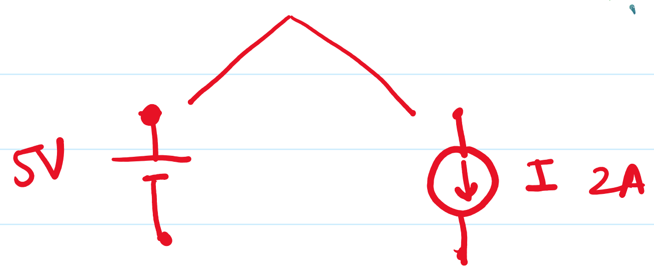
$V^2$ ③

$= I^2R$ — (2)

$= \dfrac{V^2}{R}$ — (3)

# Types of sources

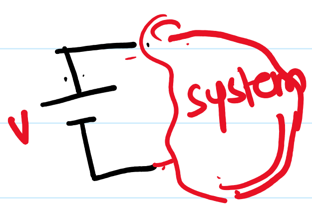
↳ supplies energy to electric N/W



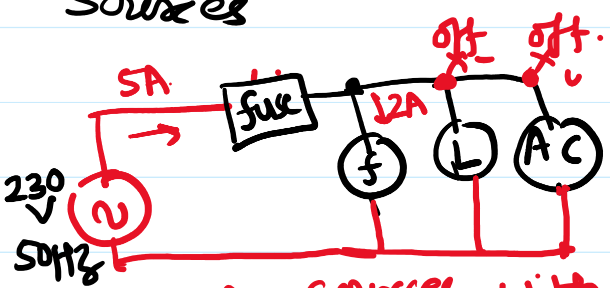

Sources

- × Dependent
  - VCVS
  - CCCS
  - VCCS
  - CCVS
- ✓ Independent
  - o/p of sources is not dependent on any n/w variable (time varying)

AC & DC Sources

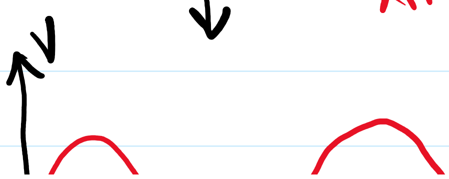



DC sources




AC sources with Appliences At home.

↓




$f = 50Hz$

1sec
↳ 50 cycles

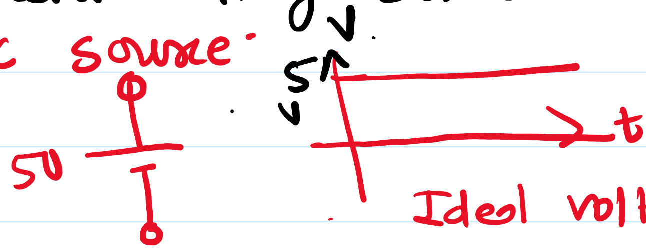
$f = 50\,Hz$


$T = \frac{1}{f}$

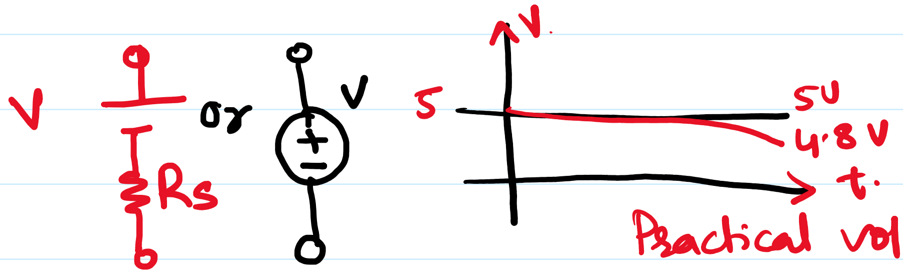
$T = \frac{1}{50}$

# Independent voltage source.

DC source.




Ideal voltage source

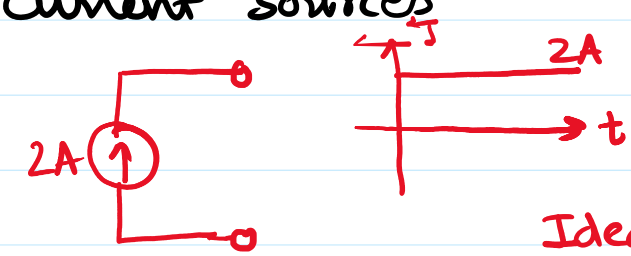



$f = 0$

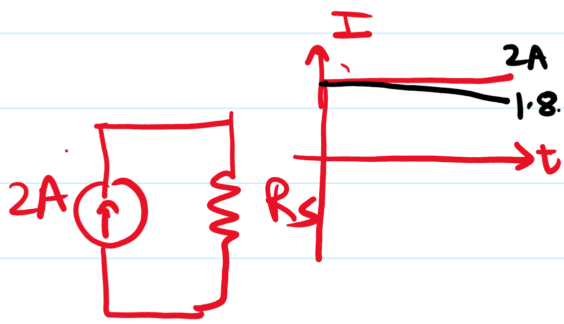
Practical voltage source

( due to voltage drop)
as current flows.

Current sources



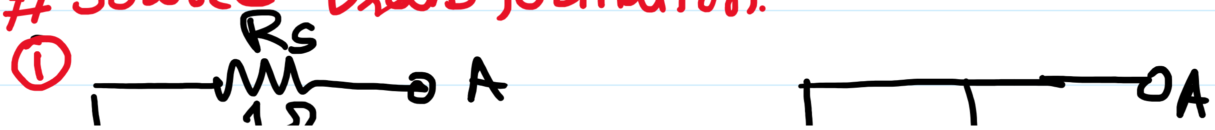

Ideal



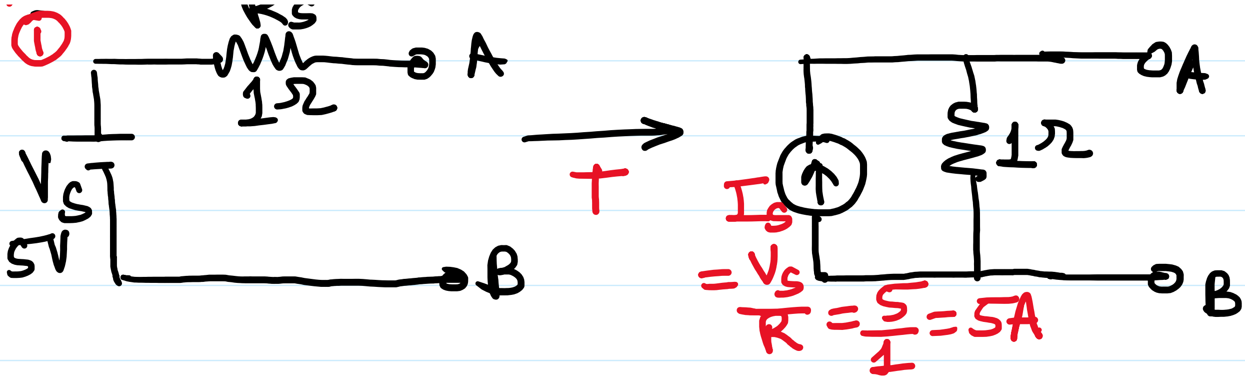

Practical current source.

Summary till now
→ Voltage, current, power, sources

# source transformation.

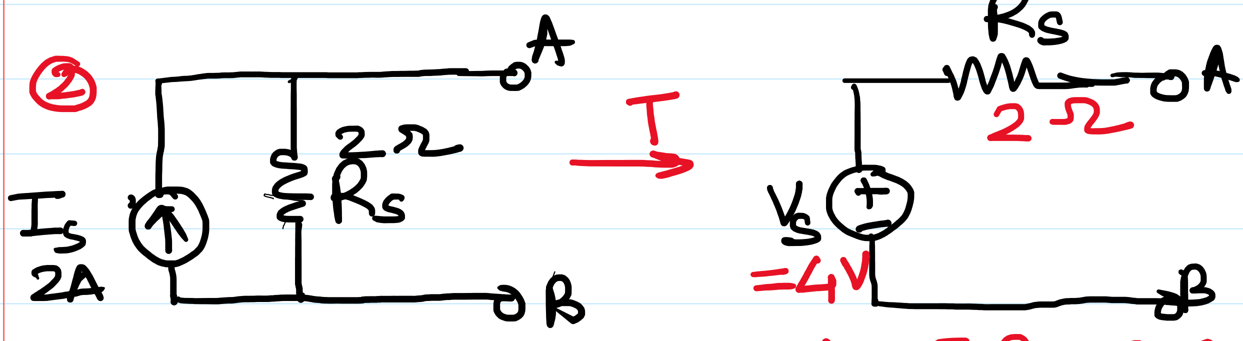


①




$I_s = \frac{V_s}{R} = \frac{5}{1} = 5A$

②




$V_s = I_s R_s = 2 \times 2 = 4 V$

1.2

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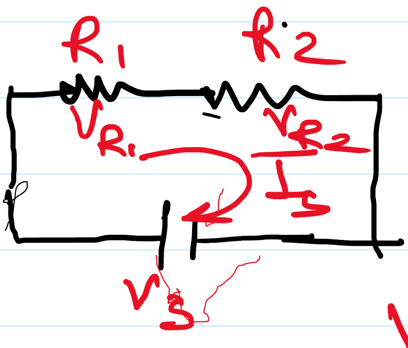
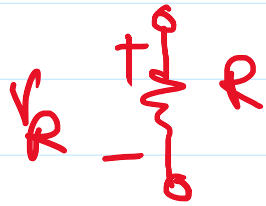
# Resistive N/W simplification




$$V_S = V_{R_1} + V_{R_2} \qquad = IR$$

$$V_{R_1} = I_S R_1$$

$$V_{R_2} = I_S R_2$$

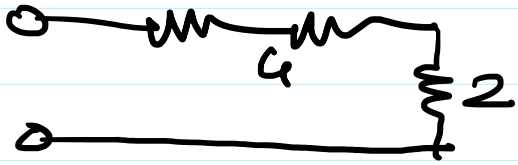
$$V_S = I_S R_1 + I_S R_2 = I_S \underbrace{(R_1 + R_2)}_{R_T}$$

$$V_S = I_S R_T$$

observations

→ Same current flows through both R

R → inseries → V D → additive



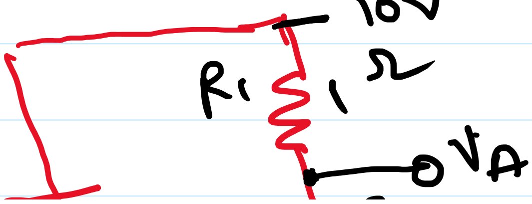

$R_T = 6 + 4 + 2 = 12\Omega$

$$I_S = \frac{V_S}{R_1 + R_2} \quad -(1)$$

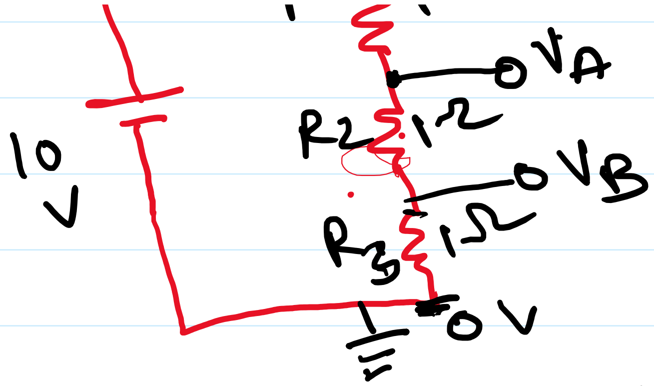
$$V_{R_1} = I_S R_1 = \left(\frac{V_S}{R_1 + R_2}\right) R_1$$

$$V_{R_2} = I_S R_2 = \left(\frac{V_S}{R_1 + R_2}\right) R_2$$

voltage division Rule




$$V_A = \frac{R_2 + R_3}{R_1 + R_2 + R_3} \, 10V$$




$$V_A = \frac{\quad}{R_1+R_2+R_3}$$

$$V_A = \frac{2}{3} \times 10 = \frac{20}{3} V$$

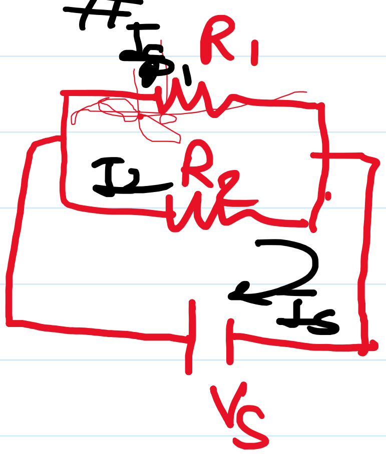
$$= 6.66 V$$

$$V_B = \frac{R_3}{R_1+R_2+R_3} 10V$$

$$= \frac{1}{3} \times 10V = \frac{10}{3}$$

$$= 3.33 V$$

# Parallel circuit




$$\cancel{V_S = I_1R_1 + I_2R_2}$$

$$V_S = I_S R_T$$

$$V_S = I_S(R_1 || R_2)$$

$$V_S = I_S\left(\frac{R_1R_2}{R_1+R_2}\right)$$

$$V_S = I_1R_1 = I_2R_2$$

$$\frac{1}{R_1} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\cancel{\boxed{R_1 || R_2 || R_3 = \frac{R_1R_2R_3}{R_1+R_2+R_3}}}$$

$$R_1 || R_2 || R_3$$

$$\frac{R_1R_2}{R_1+R_2} || R_3$$

$$\frac{R_1R_2}{R_1+R_2} \parallel R_3$$

$$10 \parallel 10 \parallel 10 \rightarrow \underline{10 \parallel 10} \parallel 10$$

$$\frac{100}{20} \parallel 10$$

$$5 \parallel 10$$

$$\frac{1}{R_1} = \frac{1}{3.05} \qquad \frac{50}{15} = 3.05\,\Omega$$

# current division Rule

$$V_s = I_1R_1 = I_2R_2$$

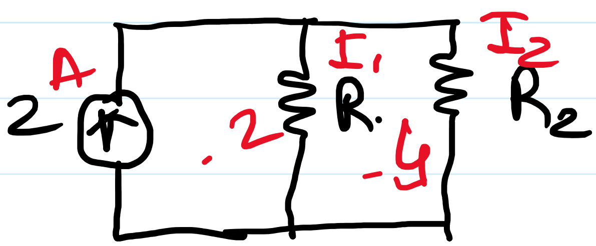
$$I_1 = \frac{V_s}{R_1} = \left(\frac{1}{\cancel{R_1}} \times \frac{\cancel{R_1}R_2}{R_1+R_2}\right)I_s$$

$$I_1 = \left(\frac{I_s}{R_1+R_2}\right)R_2$$

$$I_2 = \left(\frac{I_s}{R_1+R_2}\right)R_1$$

CDR

Numerical 1

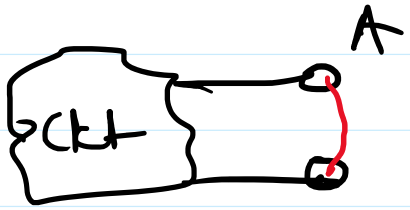



$$I_1 = \left(\frac{R_2}{R_1+R_2}\right)2 = \frac{1}{2} \times 2\,A$$

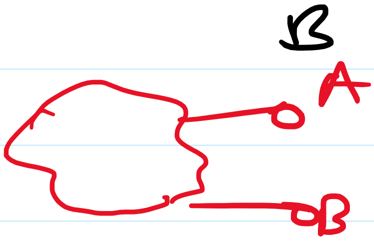
$$I_2 = \left(\frac{R_1}{R_1+R_2}\right)2 = \frac{1}{2} \times 2\,A = 1$$

$$I_1 = \frac{4}{3}\,A, \quad I_2 = \frac{2}{3}\,A$$

# open ckt & short ckt.



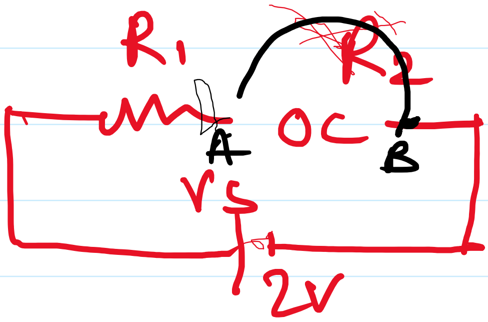

$$R_{AB_{SC}} = 0 \qquad V_{AB_{SC}} = 0 \qquad I_{AB_{SC}} = \infty$$




$R_{AB} = \infty$

$V_{AB} \neq 0$

$I_{AB} = 0$

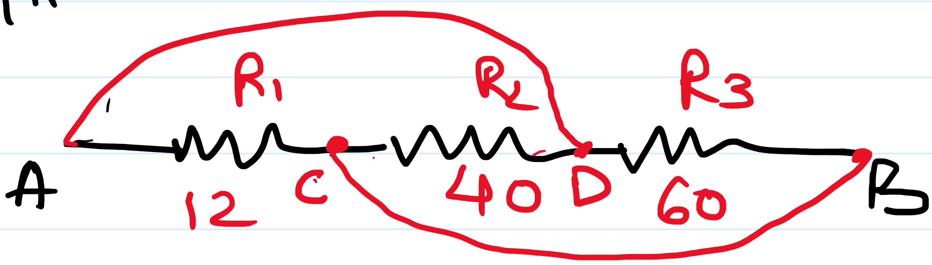


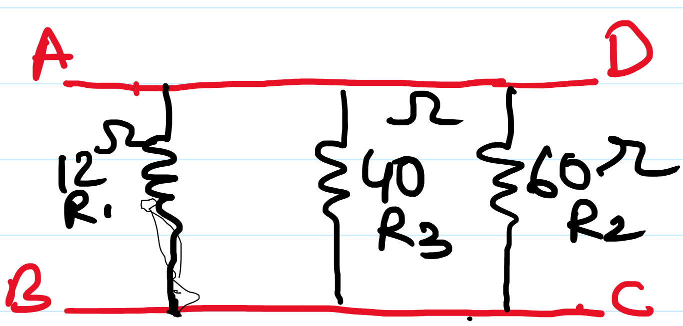

$V_{AB} =$

$I_S = \dfrac{V_S}{R_1 + R_2}$ $\quad R_{AB} =$

Numerical → find equivalent Resistance between A & B.

1.10



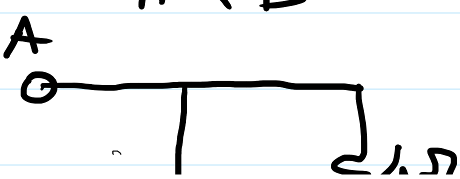

$R_1 \parallel R_2 \parallel R_3$

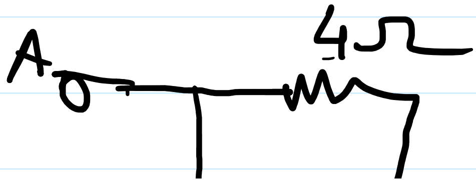
$12 \parallel 40 \parallel 60$

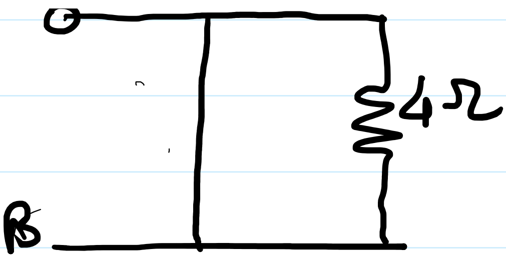
$\dfrac{480}{52} \parallel 60$

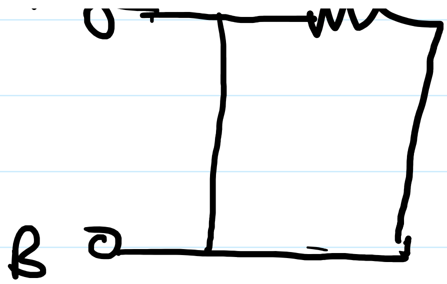
$= 8\,\Omega$

1.11 → What is equivalent Resist in A & B

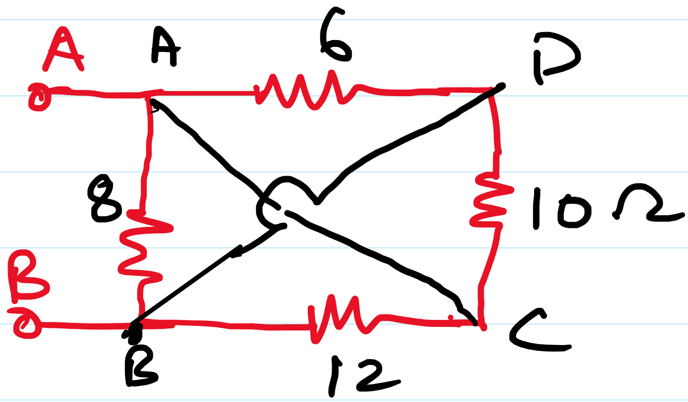


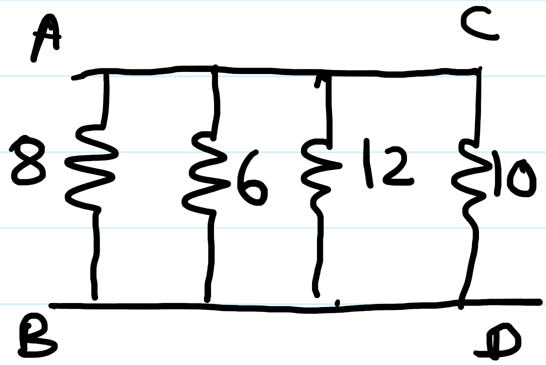






# Numerical 4 → find $R_{AB}$




$$\frac{1}{R_T} = \frac{1}{8} + \frac{1}{6} + \frac{1}{12} + \frac{1}{10}$$

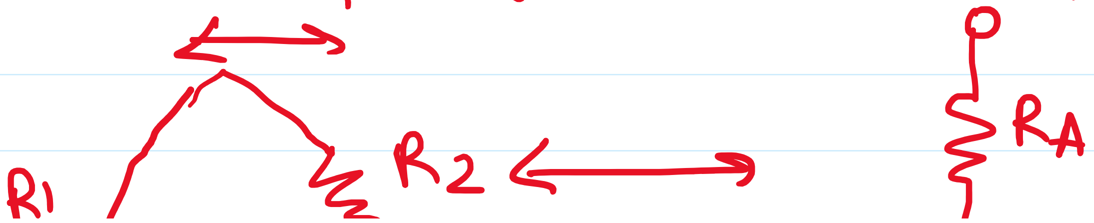
$$\frac{1}{R_T} = \frac{48}{14} + \frac{120}{22}$$

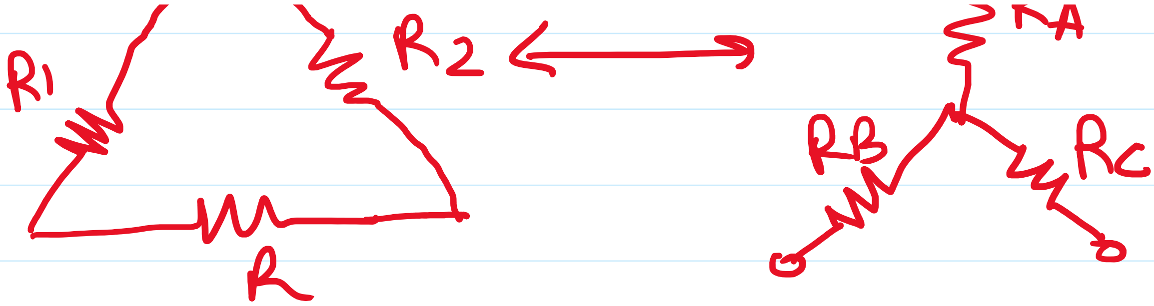
$$\frac{1}{R_T} =$$

$$R_{AB} = \underline{8 \| 6} \,\|\, \underline{12 \| 10}$$

$$R_{AB} = 2.09 = 2.1\ \Omega$$

Star to Delta tranformation




R1
R2
R
RA
RB
RC

# Star to delta conversion

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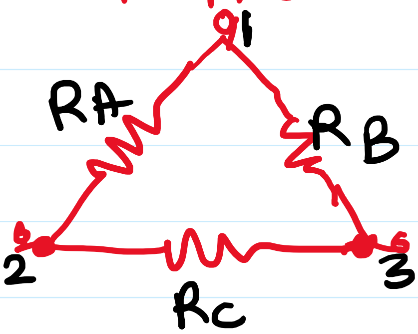
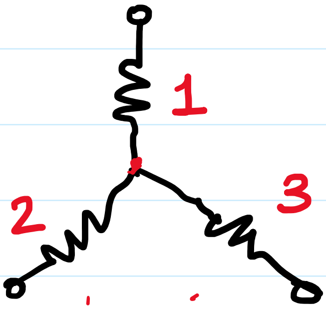
Delta



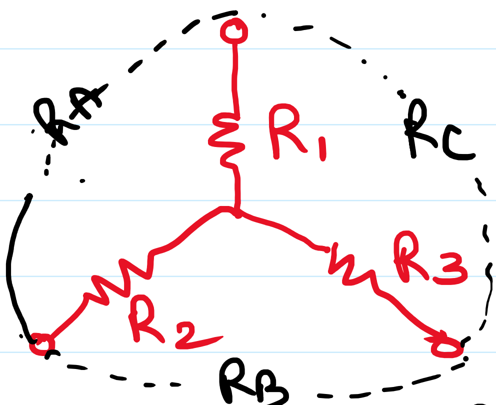

Star

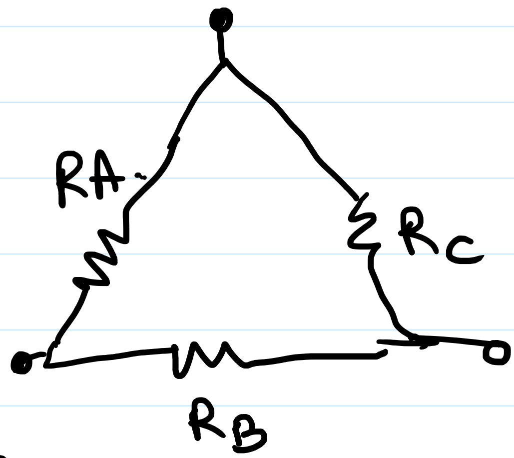



$$R_1 = \frac{R_A R_B}{R_A + R_B + R_C}$$

$$R_2 = \frac{R_A \cdot R_C}{R_A + R_B + R_C}$$

$$R_3 = \frac{R_B \cdot R_C}{R_A + R_B + R_C}$$




$$R_A = \frac{R_1 R_2 + R_2 R_3 + R_3 R_1}{R_3}$$

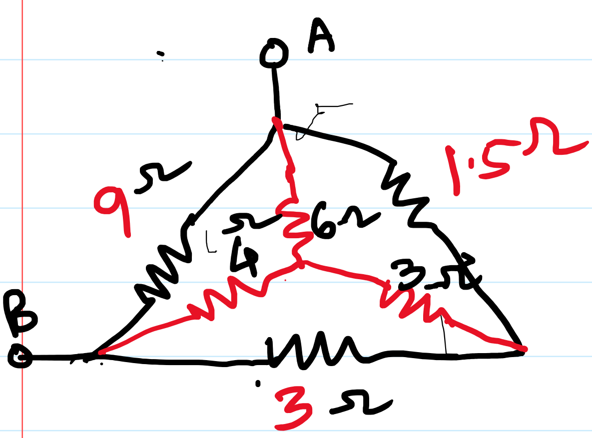
$$R_B = \frac{R_1 R_2 + R_2 R_3 + R_3 R_1}{R_1}$$

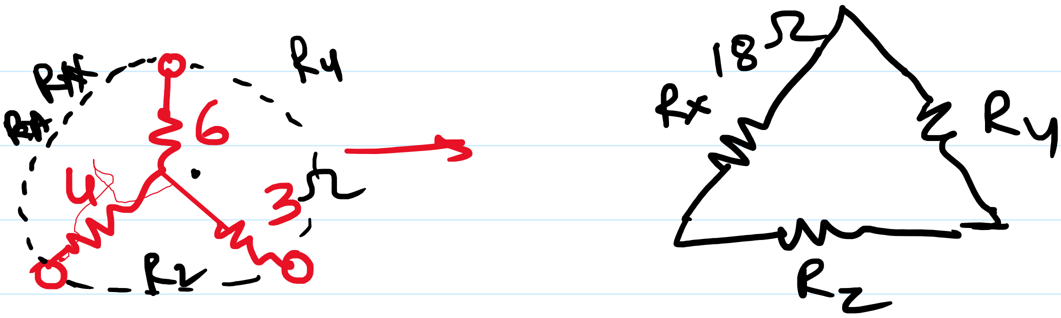
$$R_C = \frac{R_1 R_2 + R_2 R_3 + R_3 R_1}{R_2}$$

# Numerical 1 → find $R_{AB}$

find $R_{AB}$

Always solve inner ckt first

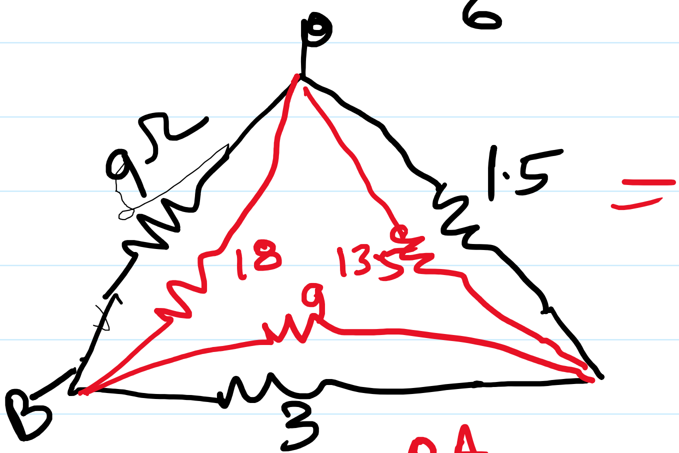



$$R_x = \frac{6\times4+6\times3+4\times3}{3} = \frac{24+18+12}{3}$$
$$= 18\ \Omega$$

$$R_y = \frac{54}{4} = 13.5\ \Omega$$

$$R_z = \frac{54}{6} = 9\ \Omega$$

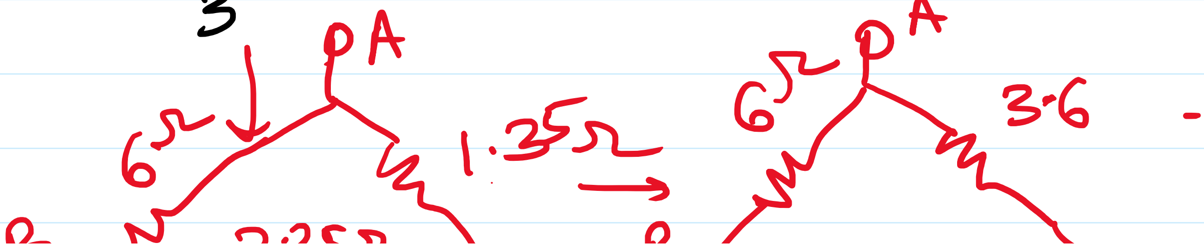


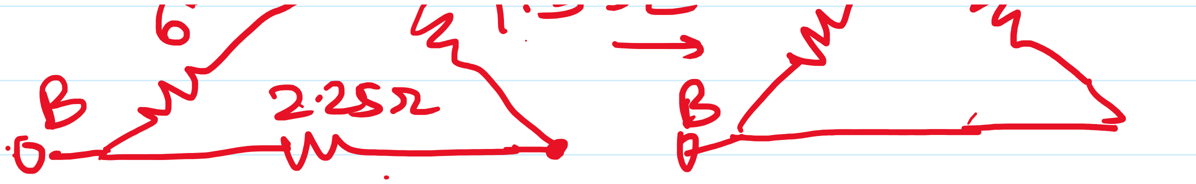

$=$

$9 \| 18 = 6\Omega$

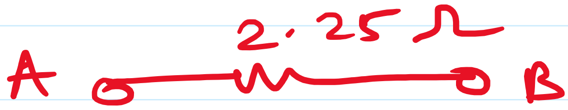
$13.5 \| 1.5 = 1.35\Omega$

$9 \| 3 = 2.25$

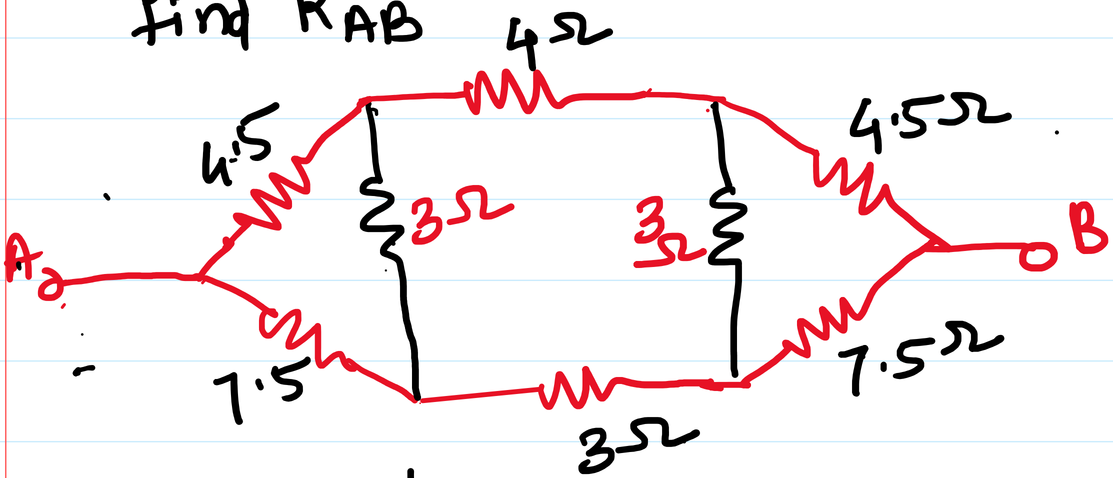


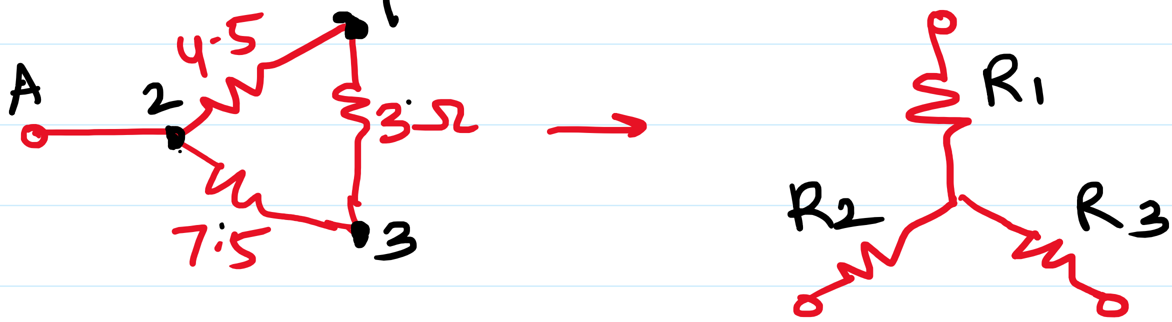



1·3 & 2·25 are in series



find $R_{AB}$

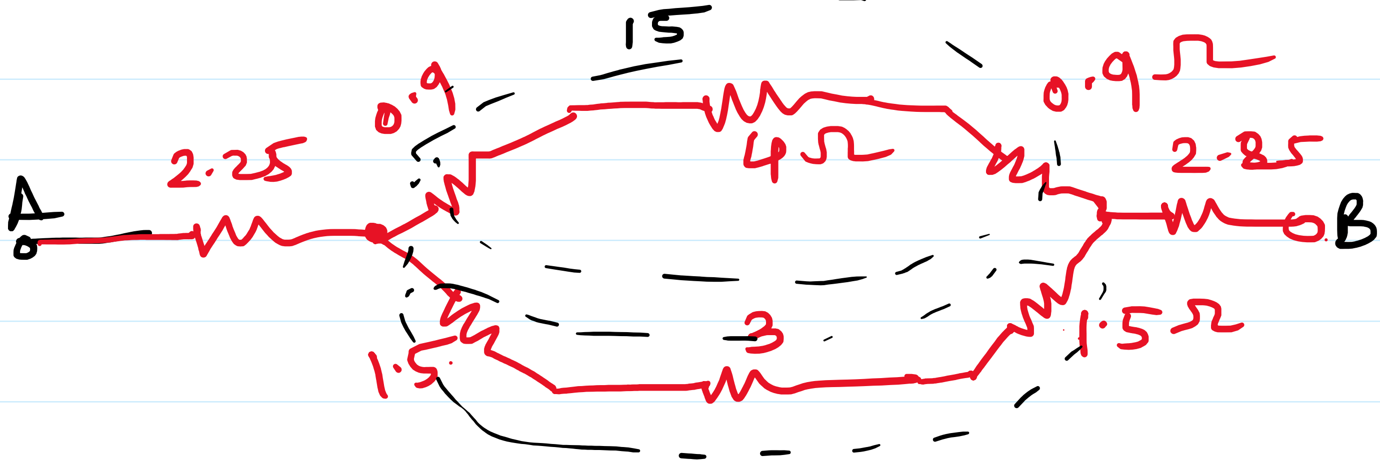


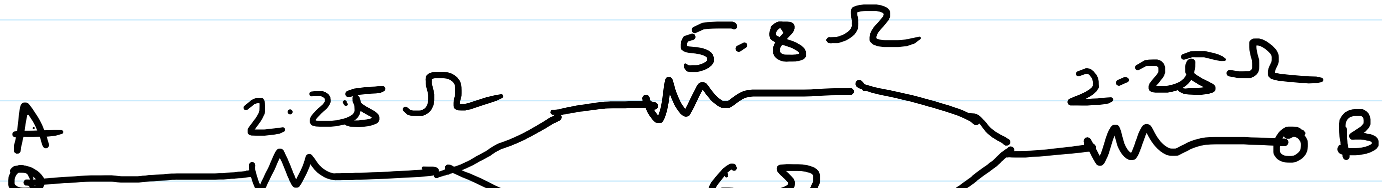



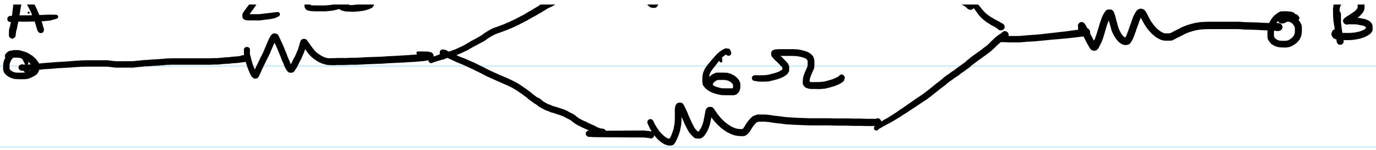

$$R_1 = \frac{4.5 \times 3}{4.5+7.5+3} = 0.9\,\Omega$$

$$R_2 = \frac{4.5 \times 7.5}{15} = 2.25\,\Omega$$

$$R_3 = \frac{7.5 \times 3}{15} = 1.5\,\Omega$$

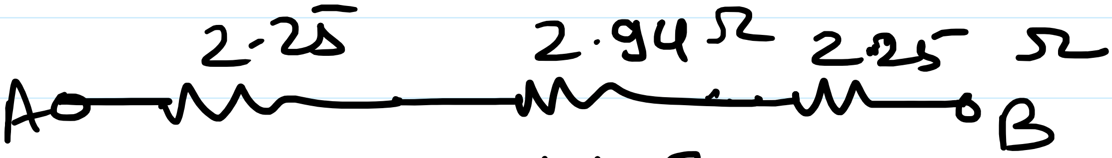


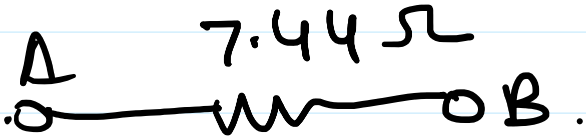





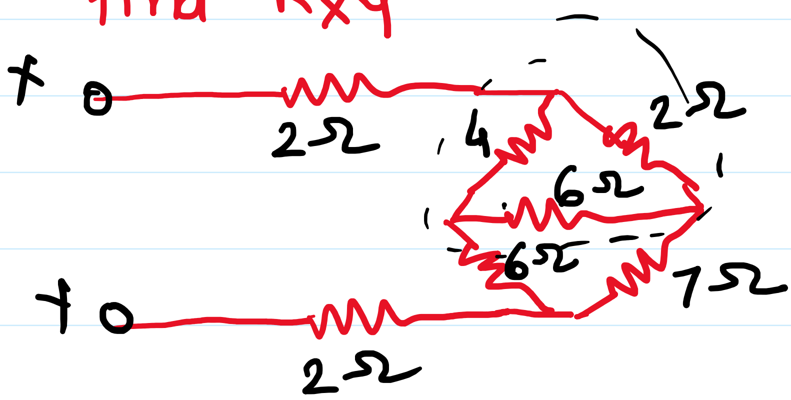

Now $5.8\,\Omega \parallel 6\,\Omega = \dfrac{5.8 \times 6}{5.8 + 6}$

$= 2.94\,\Omega$

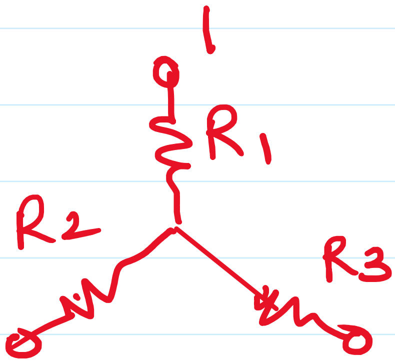


Find $R_{xy}$



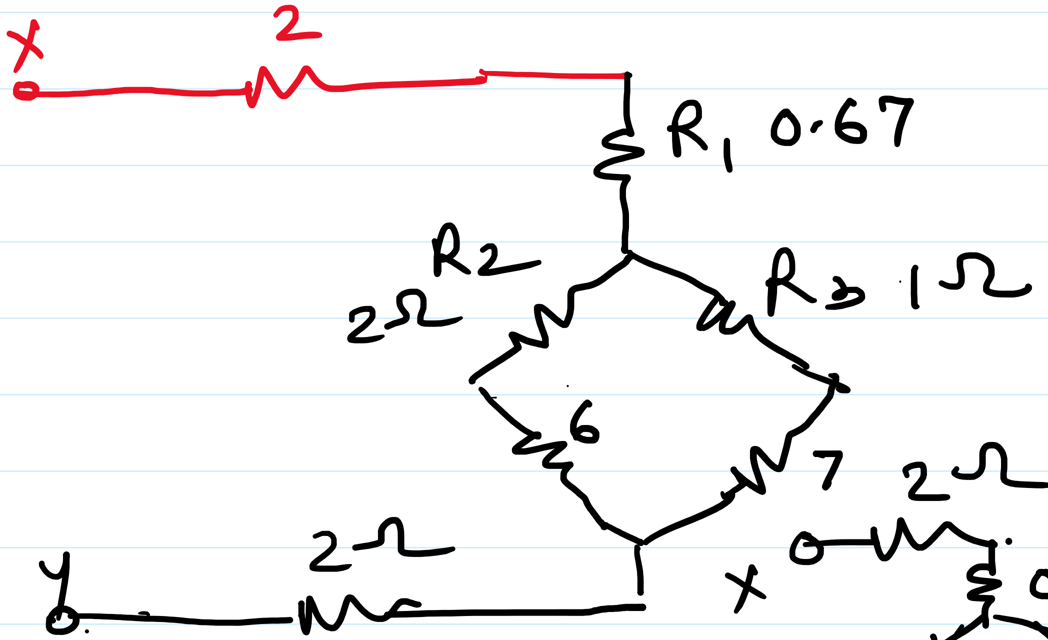


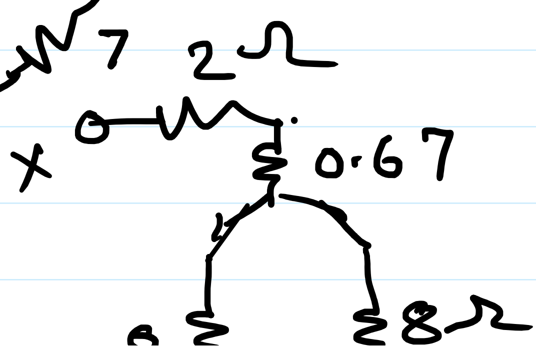


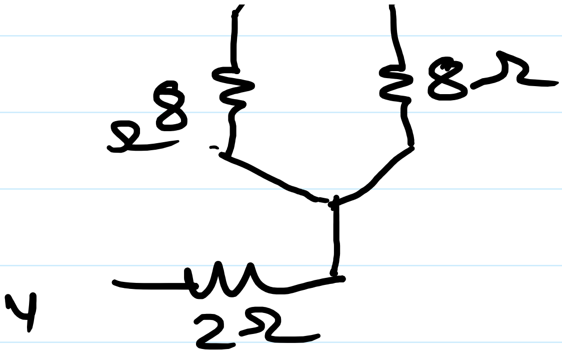

$$R_1 = \frac{4\times2}{6+4+2} = \frac{8}{12} = 0.67\,\Omega$$

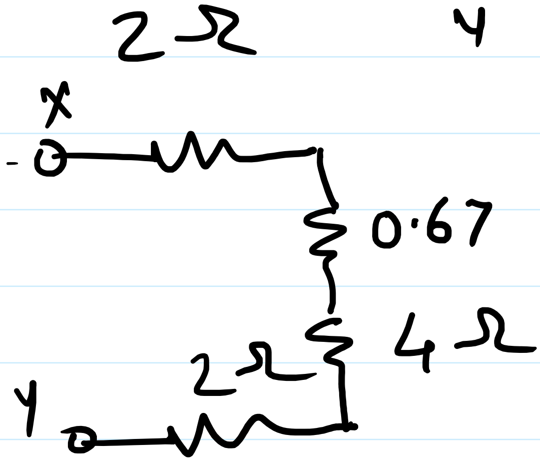
$$R_2 = \frac{6\times4}{12} = 2\,\Omega$$

$$R_3 = \frac{6\times2}{12} = 1\,\Omega$$





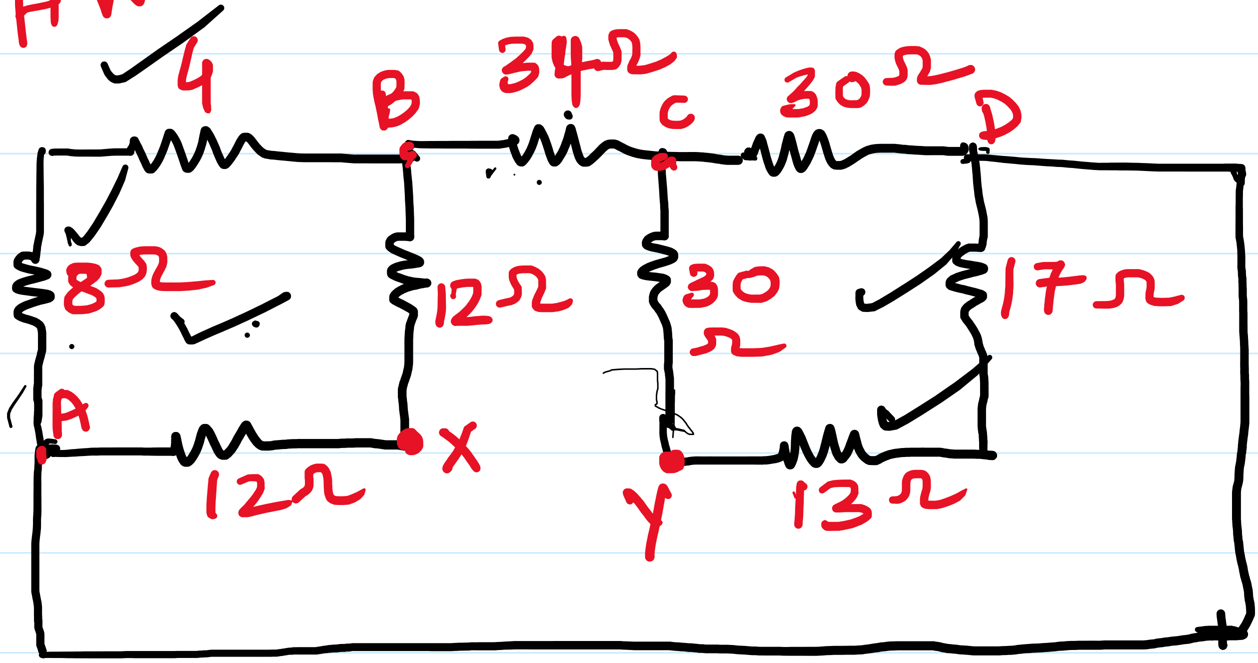

$\rightarrow R_{xy} = 8.67\Omega$

# Numerical 4 hw

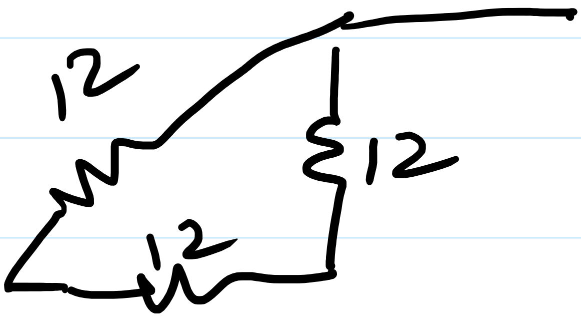
01 August 2024 11:27

find $R_{xy}$

H.W.




Ans →
$R_{xy} = 24.84\Omega$



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