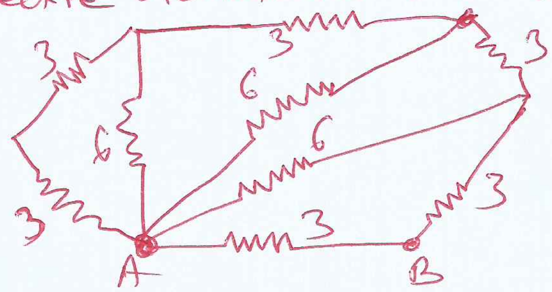
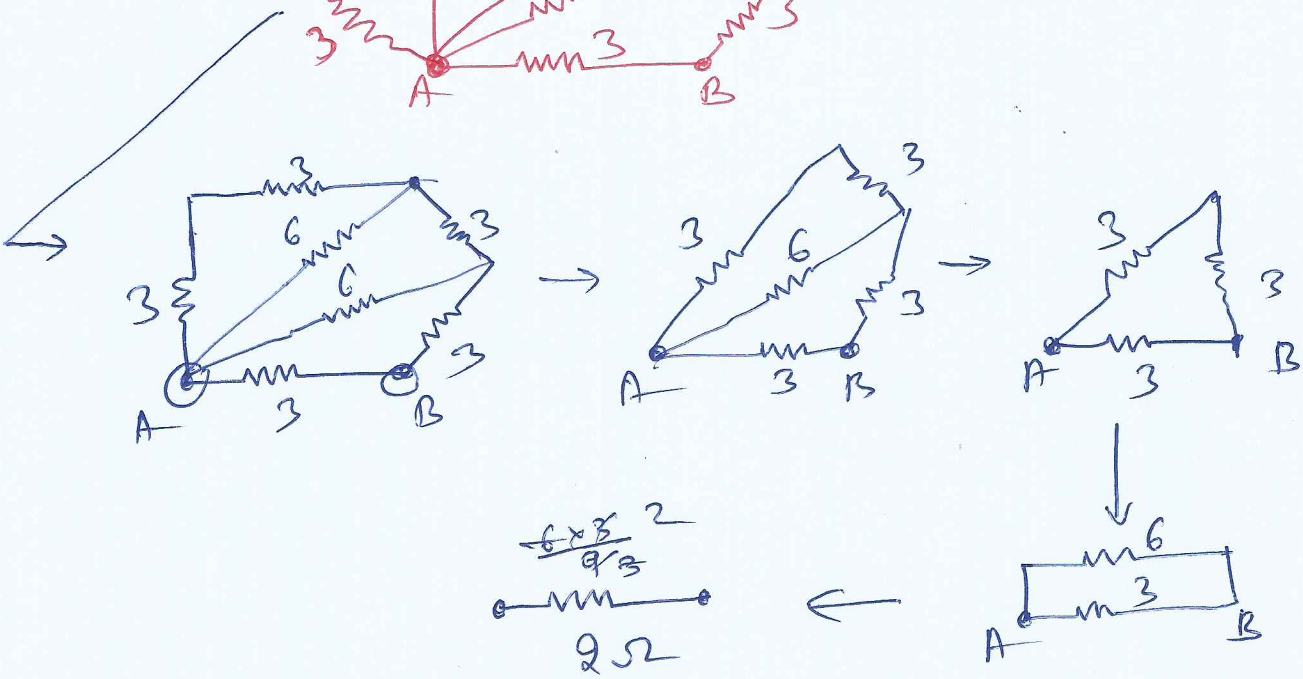
Q: An electric bulb is rated 220V and 100 W. When it is operated on 110 V, the power consumed will be ?

Ans — $P = VI$ since V becomes $V/2$ and since $I \propto V$, I becomes $I/2$

$$\therefore P = \frac{VI}{2\times 2} = \frac{100\,W}{4} = 25\,W$$

Q: Find the effective resistance betw. points A and B - - - -





$$\frac{6\times 3}{9} = 2$$

$2\,\Omega$

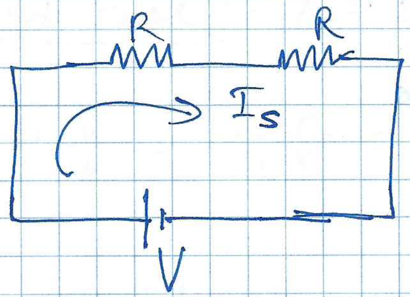
Datum .... 20..............

Onderwerp :

1) Two conducting wires of the same material and of equal lengths and equal diameters are first connected in series and then ~~in~~ parallel in a circuit across the same potential difference. The ratio of heat produced in series and parallel combinations would be — ?

Since ρ is same
l is same
A is same
$\therefore$ R is same for two conducting wires

(i)



$$I_S = \frac{V}{2R}$$

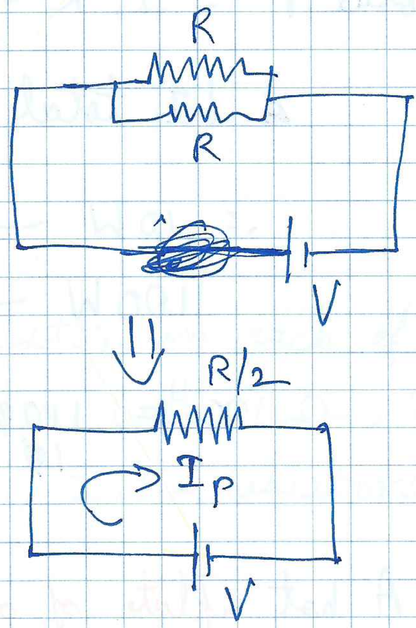
$$P_S = V I_S = V\frac{V}{2R} = \frac{V^2}{2R}$$

$$\therefore \frac{P_S}{P_P} = \frac{V^2/2R}{2V^2/R}$$

$$= \frac{\cancel{V^2}}{2\cancel{R}} \times \frac{\cancel{R}}{2\cancel{V^2}} = \frac{1}{4}$$

$$\boxed{P_S : P_P = 1 : 4}$$

(ii)



$$I_P = \frac{V}{R/2} = \frac{2V}{R}$$

$$P_P = V I_P$$

$$P_P = V \cdot \frac{2V}{R} = \frac{2V^2}{R}$$

Datum .... 20....

Onderwerp :

12) Several electric bulbs designed to be used on a 220 V electric supply line, are rated 10 W. How many lamps can be connected in $\parallel^{lel}$ with each other across the 2 wires of 220 V line if the max allowable current is 5 A

Sol:- $V = 220\,V$ $P = 10\,W$ each $I = 5\,A$

$$\text{Total } R = \frac{V}{I} = \frac{220}{5} = 44\,\Omega$$

$$\text{Total } P = I^2R = 5^2 \times 44 = 25 \times 44 = 1100\,W$$

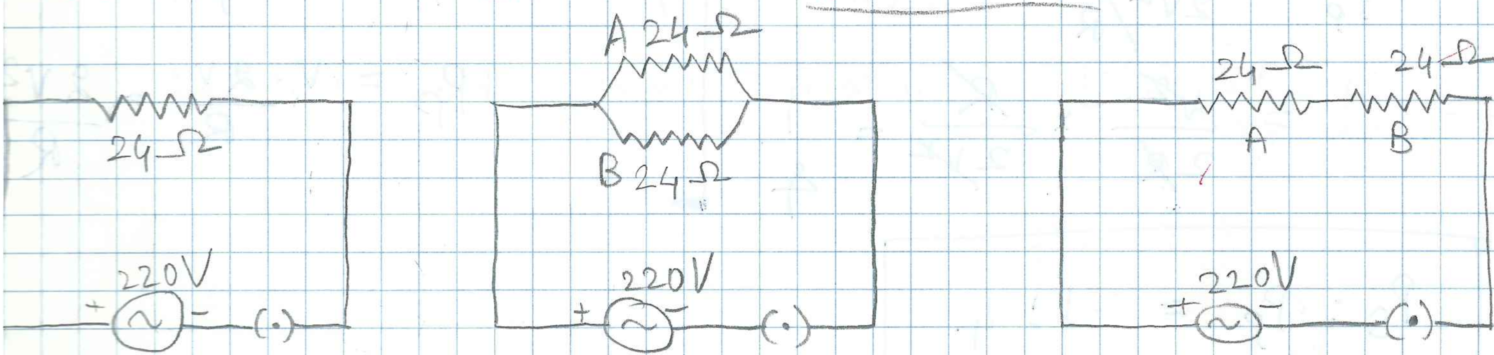
& Let total no of bulbs be x

$\therefore$ 10 W $\longrightarrow$ 1 bulb

1100 W $\longrightarrow$ x bulbs

$x = \frac{110\cancel{0}}{1\cancel{0}} = 110$ bulbs $\therefore$ total no of bulbs = 110

3) A hot plate of an electric oven connected to a 220 V line has 2 resistance coils A and B each of 24 Ω resistance which may be used separately in series or in parallel. What are the currents in the three cases.



first case second case third case

Datum .... 20.........

Onderwerp :

Sol:- <u>first case</u> :- $R = 24\,\Omega$ $V = 220\,V$

$$I = \frac{V}{R} = \frac{220}{24} = 9.16\,A$$

<u>Second case</u> :- $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{24} + \frac{1}{24} = \frac{\cancel{2}^{1}}{\cancel{24}_{12}}$

$$R_p = 12\,\Omega$$

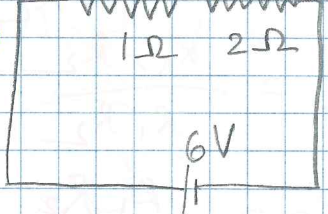
$$I = \frac{V}{R} = \frac{220}{12} = 18.3\,A$$

<u>Third case</u> :- $R = 24 + 24 = 48\,\Omega$

$$I = \frac{V}{R} = \frac{220}{48} = 4.58\,A$$

1) Compare the power used in the $2\,\Omega$ resistor in each of the foll circuits (i) a 6V battery in series with $1\,\Omega$, $2\,\Omega$ resistors (ii) 4V battery in //lel with $12\,\Omega$, $2\,\Omega$ resistors.

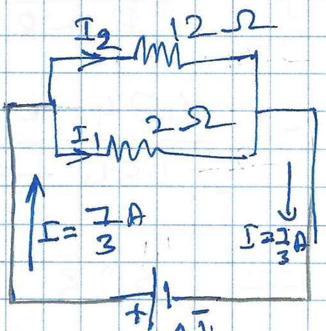
Sol: (i)



$V = 6V$ $R = 3\,\Omega$

$I = \frac{V}{R} = \frac{6}{3} = 2A$ $P_1 = I^2R = 2^2 \times 3 = 4 \times 3 = 12W$

(ii)



$V = 4V$. $\frac{1}{R_p} = \frac{1}{12} + \frac{1}{2} = \frac{1+6}{12} = \frac{7}{12}$ $R_p = \frac{12}{7}$

$I = \frac{V}{R} = 4 \div \frac{12}{7} = \cancel{4}^{1} \times \frac{7}{\cancel{12}_3} = \frac{7}{3}\,A$

~~$I_1 = 2\,\Omega$~~

Datum .... 20......

Onderwerp :

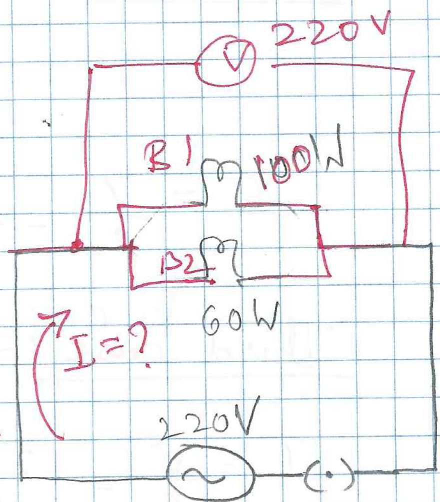
~~$P = I^2 R = 2^2 \times 2 = 8W$~~

$I_1 = \frac{V}{2\Omega} = \frac{4}{2} = 2A \qquad I_1 = 2A$

$P_2 = I^2 R = 2^2 \times 2 = 4 \times 2 = 8W$

$\therefore \boxed{P_1 = 12W \; ; \; P_2 = 8W}$

5)



Bulb 1 power $P_1 = 100W = \frac{V^2}{R_1}$

$\therefore R_1 = \frac{V^2}{P_1} = \frac{(220)^2}{100} = 484\Omega$

Bulb 2 power $P_2 = 60W = \frac{V^2}{R_2}$

$\therefore R_2 = \frac{V^2}{P_2} = \frac{(220)^2}{60} = 806.7\Omega$

$\therefore$ Resultant R (in parallel) $= \frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$

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

$\therefore R_p = \frac{R_1 R_2}{R_1 + R_2}$

$= \frac{484 \times 806.7}{484 + 806.7}$

$= 303\Omega.$

$\therefore I = \frac{V}{R_p} = \frac{220}{303} \times 1000$ mA

$= 726$ mA

$\boxed{I = 0.73A}$

$= 3.6 \times 10^6$ Watt second.
$= 3.6 \times 10^6$ Joule (J)

Datum .... 20 ....

Onderwerp : → Don't think about ~~1KPh~~ 1KWHr.

250×3600
$= 900 \times 10^3$ J
$= 9 \times 10^5$ J

(6) Which uses more energy a 250 W TV ~~set~~ set in 1 hr or a 1200 W toaster in 10 min? sus

Sol :- Energy used by TV set $=$ power x time ~~KWh~~ $= \cancel{\frac{2500 \times 3600}{1000}} = \cancel{900\,J}$

Energy used by toater $=$ ~~KWh~~ $= \cancel{\frac{1200 \times 600}{1000}} = \cancel{720\,J}$

1200×600
$= 72 \times 10^4$
$= 7.2 \times 10^5$ J

∴ More energy is ~~used~~ consumed by TV set.

7) An electric heater Greysor of resistance 8 Ω draws 15 A from the service mains ~~and serves~~ 2 hours. Calculate the rate at which heat is ~~development~~ developed in the heater.

Sol :- $R = 8\,\Omega$ $I = 15\,A$ $t = 2\,hrs$

Electric heater
8 Ω
15 A

~~Heat d~~ power $= I^2 R$
$= 225 \times 8$
$= 1800\,W$

$P = VI$
$= IR \cdot I$
$P = I^2 R$

Heat developed $=$ ~~1800~~ $p \times t$

$H = 1800 \times 2 \times 3600$

$H = 36 \times 36 \times 10^4$

$= 1296 \times 10^4$ Joule

$= 1.296 \times 10^7$ J

$H = I^2 R t$

Electricity : Questions & Answers

Datum 20

Onderwerp :

Q : What does an electric circuit mean ?

A : A continuous and closed path of an electric current is called an electric circuit.

Q : Define the unit of current ?

A : The unit of electric current is Ampere (in SI system). $I = Q/t$. One ampere is constituted (or resulted) by the flow of one coulomb of electric charge per second. $\Rightarrow 1A = \frac{1C}{1s}$

Q : Calculate the number of electrons constituting one coulomb of charge

A : 1 coulomb of electric charge contains 6×10^{18} electrons.

Q : Calculate the total charge in coulomb ? [not in book]

1 electron has negative charge $= 1.6 \times 10^{-19}$ coulomb

1 coulomb ~~contains~~ has $= 6 \times 10^{18}$ electrons.

$\therefore$ Total charge in ~~coulom~~ 1 coulomb $= 6 \times 10^{18} \times 1.6 \times 10^{-19}$

$= 6 \times 1.6 \times 10^{-1}$

$= 9.6 \times 10^{-1}$

$= 0.96$

≈ 1 coulomb.

(If you multiply these two, we will get 1 coulomb).

page 104 in this book

Q : Name a device that helps to maintain a potential difference across a conductor

A : cell or battery.

Q : What is meant by saying that the potential difference between two points is 1V

A : 1 Volt is the potential difference between two points in a current carrying conductor when 1 joule of work is done to move a charge of 1 coulomb from one point to the other.

$1 \text{ volt} = \frac{1 \text{ joule}}{1 \text{ coulomb}} \quad \therefore V = \frac{W}{Q}$

We know that $R = \rho \frac{l}{A}$ $\therefore \rho = R \frac{A}{l}$ ohm·m

~~Therefore~~ The ρ of constantan $= 49 \times 10^{-6}$ ohm·m means that if we take constantan wire of length = 1m and area of cross-section = $1 m^2$, its resistance will be equal to 49×10^{-6} ohms.

Q: How much energy is given to each coulomb of charge passing through a 6 V battery.

A: Formula is $\boxed{V = \frac{W}{Q}}$ $\therefore W = VQ$

$= 6 \times 1$

$= 6$ joules.

Q: On what factors does the resistance of a conductor depend?

A: The resistance of a conductor depends on

(i) its length (l)

(ii) its area of cross-section (A)

(iii) the nature of ~~its~~ its material (ρ) ($\rho \Rightarrow$ rho)

$\therefore \boxed{R = \rho \frac{l}{A}}$

Q: Will current flow more easily through a thick wire or a thin wire of the same material, when connected to the same source? Wh

A: The current flows more easily through a thick wire.

$R = \frac{\rho l}{A} \Longrightarrow$ since the resistance is inversely proportional to the cross-sectional area, the resistance is less in a thick wire, and ~~since~~ hence the current is more in a thick wire (according to ohms law $I = \frac{V}{R}$)

Q. Let the resistance of an electrical component remains constant while the potential difference across the two ends of the component decreases to half of its former value. What change will occur in the current through it?

A: Given R is constant

V becomes $\frac{V}{2}$

$I = ?$

According to ohm's law $V = IR$, since $I \propto V$, the current is also decreased by half.

Datum .... 20.....

Onderwerp :

(4) Q: Why are coils of electric toasters and electric irons made of an alloy rather than a pure metal?

Q: Alloys do not oxidise (burn) readily at high temperatures. For this reason, they are commonly used in electrical heating devices like electric iron, toasters etc..

Q: Given resistivity (ρ) of iron = $10 \times 10^{-8}\ \Omega m$ and
Mercury = $94 \times 10^{-8}\ \Omega m$
Copper = $1.62 \times 10^{-8}\ \Omega m$
Silver → $1.60 \times 10^{-8}\ \Omega m$
Aluminium → $2.63 \times 10^{-8}\ \Omega m$
Tungsten → $5.2 \times 10^{-8}\ \Omega m$

resistivity – more
manganese – $1.84 \times 10^{-6}\ \Omega m$
conductivity – less.

(a) Which among iron and manganese is a better conductor

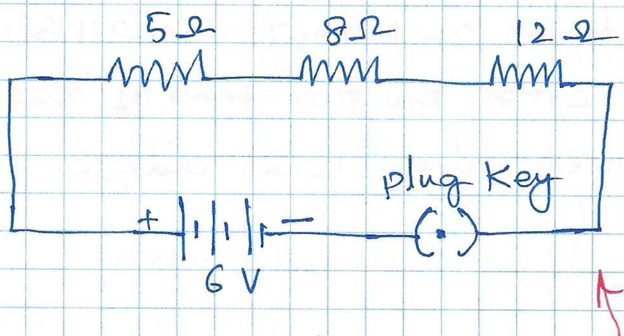
A → Iron (Since $R = \frac{\rho l}{A}$ and Conductivity = $\frac{1}{\rho}$)

(b) Which material is the best conductor

A → – Silver.

Q: Draw a schematic diagram of a circuit consisting of a battery of three cells of 2V each, a 5Ω resistor, an 8Ω resistor, and a 12Ω resistor, and a plug key, all connected in series)

A→)

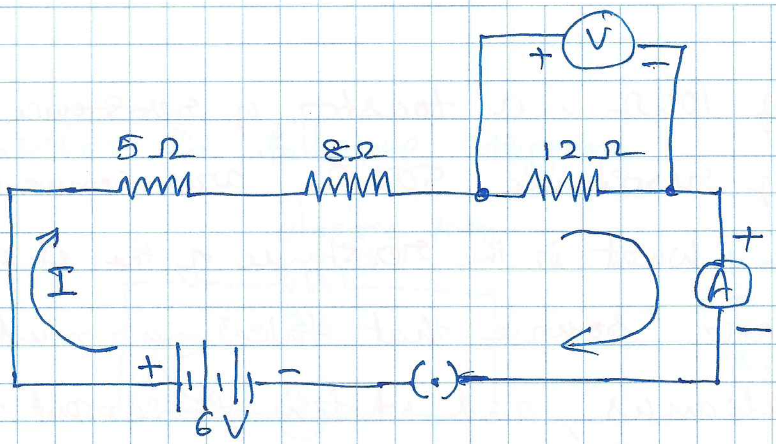


Q: Redraw the circuit in the above question, putting an ammeter to measure the current through the resistors and a voltmeter to measure the potential difference across the 12Ω resistor. What would be the readings in the

Datum .... 20..........

Onderwerp :

A →



∴ Total resistance R_T in the above series circuit

$$R_T = 5 + 8 + 12$$
$$= 25\ \Omega$$

$$\text{Current } I = \frac{V}{R_T} = \frac{6}{25}\ A$$

$$= \frac{6}{\cancel{25}} \times \cancel{1000}^{40}\ mA$$

$[1\,mA = 10^{-3}\,A$
$1\,\mu A = 10^{-6}\,A]$

$$= 240\ mA$$

$$\boxed{I = 0.24\ A} \longrightarrow (1)$$

Current through 12 Ω resistor = I = 0.24 A
(Since in series circuit, the current is constant throughout the electric circuit)

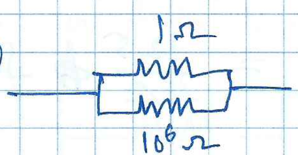
∴ potential difference across 12 Ω resistor $= V_{12\Omega} = I \times R$

$$= 0.24 \times 12$$
$$= 2.88\ V$$

∴ Ammeter reading = 0.24 A
Voltmeter reading = 2.88 V

Judge the equivalent resistance when the following are connected in parallel (a) 1 Ω and 10^6 Ω
(b) 1 Ω and 10^3 Ω and 10^6 Ω

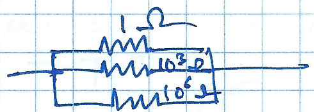
(a)



$$\frac{1}{R_T} = \frac{1}{1} + \frac{1}{10^6}$$
$$= 1 + 10^{-6}$$

$R_T =$

(b)



$$\frac{1}{R_T} = \frac{1}{1} + \frac{1}{10^3} + \frac{1}{10^6}$$
$$= 1 + 10^{-3} + 10^{-6}$$
$$R_T = \frac{1}{1 + 10^{-3} + 10^{-6}}$$

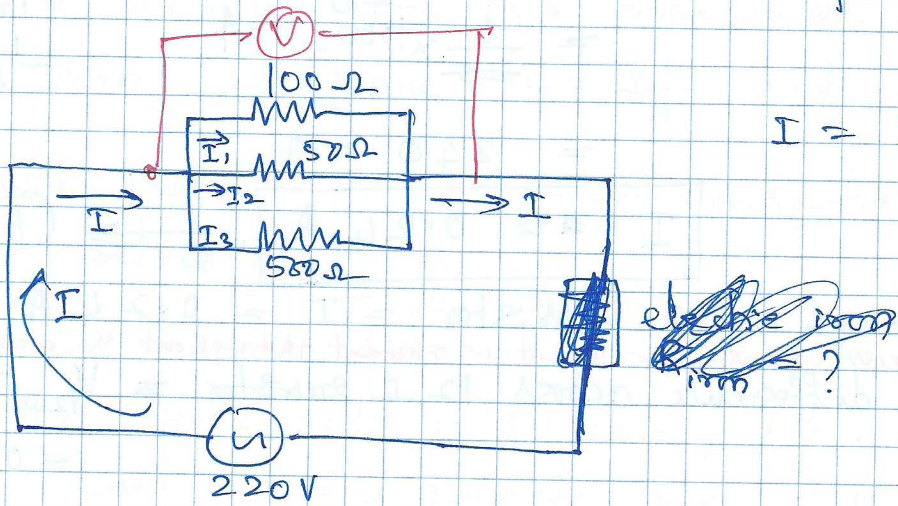
Datum 20

Onderwerp :

Q: An electric lamp of 100Ω, a toaster of resistance 50Ω and a water filter of resistance 500Ω are connected in parallel to a 220V source. What is the resistance of the electric iron connected to the same source that takes as much current as all three appliances, and what is the current through it

A: Given electric lamp = 100Ω
toaster = 50Ω
water filter = 500Ω
} Connected in parallel to a 220V source.

the total current from the above appliances should be flowing through the electric iron, so electric iron to be connected in series. ~~to~~ See the schematic diagram below.



$$I = I_1 + I_2 + I_3$$

~~Consider electric iron is~~ not connected ~~in the above diagram~~

Since voltage across three appliances = 220V

$I_1 = \frac{220}{100} = 2.2$

$I_2 = \frac{220}{50} = 4.4$

$I_3 = \frac{220}{500} = 0.4$

$\therefore I_1 + I_2 + I_3$

$2.2 + 4.4 + 0.4$

7A

OR

$\therefore$ Total Resistance $\frac{1}{R_T} = \frac{1}{100} + \frac{1}{50} + \frac{1}{500}$

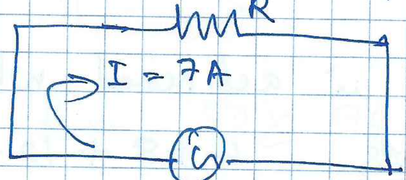
$= \frac{5 + 10 + 1}{500} = \frac{16}{500}$

$R_T = \frac{\cancel{500}\,125}{\cancel{16}\,4} = \frac{125}{4}\,\Omega$

$\therefore I = \frac{V}{R} = \frac{220}{125/4} = \frac{\cancel{220}\,44}{\cancel{125}\,25} \times 4 = \frac{176}{25}$

$I \approx 7A$

Now Consider the following diagram



$V = 220V$
$I = 7A$
$R_{iron} = ?$

$$R_{iron} = \frac{V}{I} = \frac{220}{7}$$

$= 31.4$

Ans: $\boxed{R_{iron} = 31.4\,\Omega.}$
$\boxed{I = 7A}$

Q: What are the advantages of connecting electrical device in parallel with the battery instead of connecting them in series ?

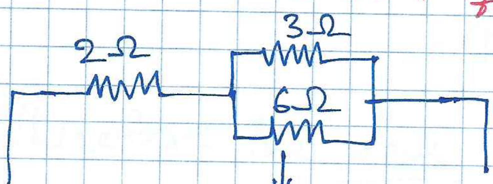
A → Advantages of Connecting electrical devices in parallel with the bat

(i) We Know that the current is constant throughout the circuit in series ~~circuit~~ circuit. But different electr devices require currents of widely different values to operate properly. So they need to be connected parallel.

(ii) Another major disadvantage of a series circuit is that when one ~~com~~ device fails, the circuit is broken and none of the other devices will work.

Q: How can 3 resistors of resistances 2Ω, 3Ω and 6Ω be connected to give a total resistance of (a) 4Ω (b) 1Ω

A → (a)

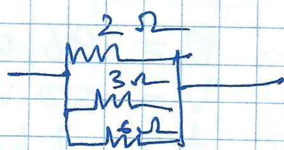


$$\frac{1}{R_T} = \frac{1}{3} + \frac{1}{6} = \frac{2+1}{6} = \frac{3}{6} = \frac{1}{2}$$

$R_T = 2$

$\therefore$ Total $R = 2 + 2 = 4\Omega$

(b)



$$\frac{1}{R_T} = \frac{1}{2} + \frac{1}{3} + \frac{1}{6} = \frac{3+2+}{6}$$

$= \frac{6}{6} = 1$

$\therefore R_T = 1\,\Omega$

The resistivity of heating element is higher than that of metal used in cord (wire) so the heating element offers higher resistance and hence gets heated more and glows while passing the current.

Datum .... 20.....

Onderwerp :

Q: What is (a) the highest, (b) the lowest resistance that can be secured by combinations of 4 ~~cells~~ coils of resistance 4 Ω, 8 Ω, 12 Ω, 24 Ω ?

→ (a) The highest resistance is achieved when the coils are connected in series $4 + 8 + 12 + 24 = 48\ \Omega$

(b) The lowest resistance is achieved when the coils are connected in parallel.

$$\frac{1}{R_T} = \frac{1}{4} + \frac{1}{8} + \frac{1}{12} + \frac{1}{24}$$

$$= \frac{6+3+2+1}{24} = \frac{12}{24} = \frac{1}{2}$$

$$\boxed{R_T = 2\ \Omega}$$

Q! Why does the cord of an electric heater not glow while the heating element does?

→ ~~Since the heating element is a good conductor of electricity, its temperature raises and glows. They are not ~~conne~~ ~~covered by~~ enclosed in an insulator since electric heater has to transfer heat to the surrounding material (water, cooking etc). Whereas the cord (wire) is thickly insulated for safety reasons and hence it does not glow.~~

Q! Compute the heat generated while transferring 96000 coulomb of charge in one hour through a potential difference of 50

→ Given $Q = 96{,}000$ Coulomb
$V = 50$ V
$t = 1$ hour $= 3600$ secs.
$H = ?$

PTO

Datum 20 96

Onderwerp :

Formula $P = VI$

$\boxed{H = VIt}$ we know that $I = \frac{Q}{t}$

$H = 50 \times \frac{80}{3} \times \cancel{3600}^{1200}$

$\cancel{H = VQ}$ $H = VQ$ $\cancel{Q = It}$ $I = \frac{\cancel{96{,}000}^{80}}{\cancel{3600}_{3}}$

$= 5 \times 8 \times 12 \times 10^4$

$H = 50 \times 96{,}000$

$I = \frac{80}{3}$

$= 40 \times 12 \times 10^4$

$= 4 \times 12 \times 10^5$

$= 480 \times 10^4$

$= 48 \times 10^5$

$= 4.8 \times 10^6$ j.

$H = 4.8 \times 10^6$ joules.

Q: An electric iron of resistance 20 Ω takes a current of 5A. Calculate the heat developed in 30 s.

A: → Given $R = 20\ \Omega$

$I = 5A$

$t = 30\ s$

$H = ?$

$H = VIt$ Since $(V = IR)$

$H = I^2Rt$

$= (5)^2 \times (20) \times (30)$

$= 25 \times 20 \times 30$

$= 25 \times 6 \times 10^2$

$= 150 \times 10^2 = 15 \times 10^3$ joules.

Q: What determines the rate at which energy is delivered by a current.

A: → we know that $\cancel{H = VIt}$ $\cancel{P = \frac{H}{t} = VI}$

Energy $H = VIt$

~~Power~~ $\cancel{P = VI}$

power $= \frac{H}{t} = VI$

Therefore the rate at which the energy is delivered by a current depends on the ~~voltage source V~~ power of the device.

Datum 20

Onderwerp :

Q: An electric motor takes 5 A from a 220 V line. Determine the power of the motor and the energy consumed in 2 h.

A →

$$P = VI = 220 \times 5 = 1100\,W$$

$$\boxed{P = 1.1\,KW.}$$

Energy consumed $H = VIt = Pt$

$$= 1100 \times 2 \times 3600$$

$$= 22 \times 36 \times 10^4$$

$$= 792 \times 10^4 \text{ joules.}$$

or

$$= 7.9 \times 10^6 \text{ joules.}$$

OR if we want to do it in KWhr

$H = VIt$ ($VI = 1.1\,KW$)

$= 1.1 \times 2$ ($t = 2\,hr$)

$$\boxed{H = 2.2\,KWh}$$

Verification.

$1\,KWh = 1000\,W \times 1$

$= 1000 \times 1 \times 60 \times 6$

$= 36 \times 10^5$

$= 3.6 \times 10^6$ joul

if $H = 2.2\,KWh$

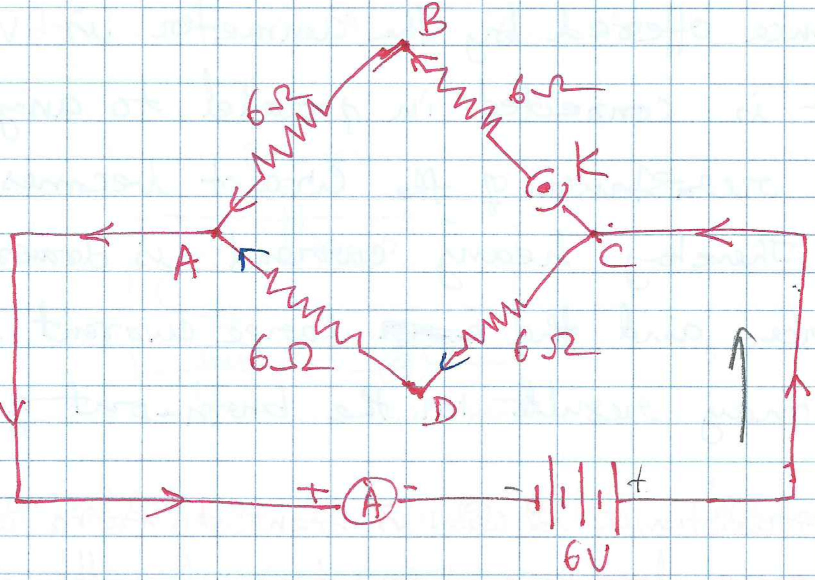
$= 2.2 \times 3.6 \times 10^6$

$= 7.9 \times 10^6$ jou

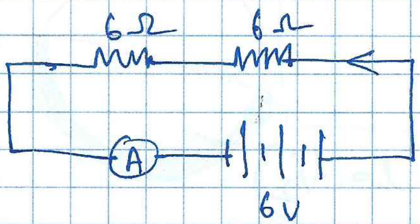
Datum .... 20 ....

Onderwerp :

S: Calculate the electric current in the given circuit when
(i) Key K is open (ii) Key K is closed.



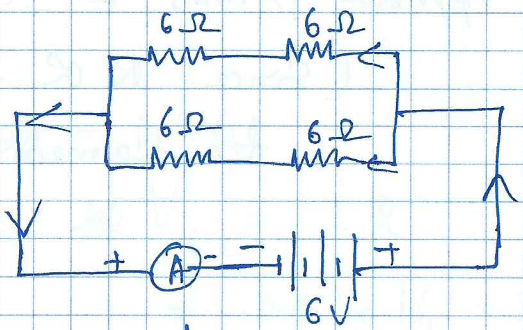
→ (i) Key (K) is open, circuit becomes



$$I = \frac{V}{R_T} = \frac{6V}{12\Omega} = 0.5A$$

$$\boxed{I = 0.5A}$$

(ii) Key (K) is closed, circuit becomes



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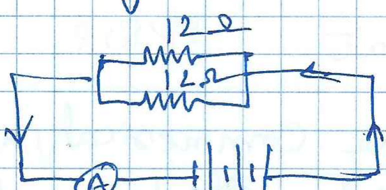
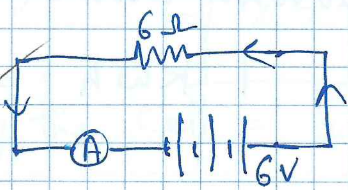




$$\frac{1}{R_T} = \frac{1}{12} + \frac{1}{12} = \frac{2}{12} = \frac{1}{6}$$

$$\underline{R_T = 6\Omega}$$

$$\therefore I = \frac{6V}{R_T} = \frac{6}{6} = 1A$$

$$\boxed{I = 1A}$$

Datum .... 20.......

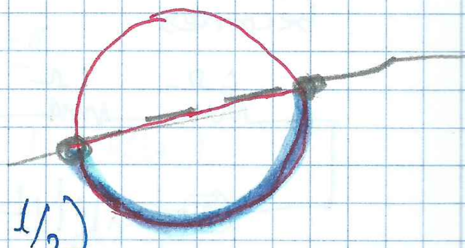
Onderwerp :

Q : Why is an ammeter likely to be burnt out if you connect it in parallel ?

A → The resistance offered by the ammeter is very small and if it is connected in parallel to any conductor, the overall resistance of the circuit becomes extremely small. Thereby heavy current is drawn from the voltage source and the large current through the ammeter may result in the burn-out of the ammeter.

Q : A wire of resistance 2 Ω is bent to form a circle. What is the resistance between two diametrically opposite points

A → Resistance between two diametrically opposite points = 1 Ω



(Since R ∝ length of wire

for diametrically opposite points $l = l/2$

$\therefore R = R/2$)

Q : What is the commercial unit of electrical energy ? Relate KWh and joule.

A → The commercial unit of electrical energy is Kilowatt hour (KWh), commonly known as 'unit'

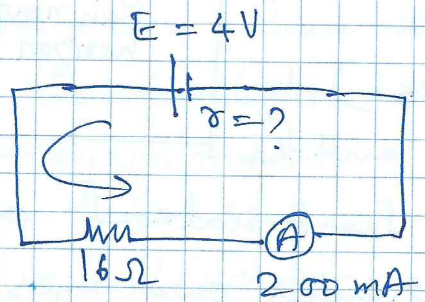
$1 \text{ KWh} = 1000 \text{ watts} \times 1 \text{ hr}$
$= 1000 \text{ watts} \times 60 \times 60 \text{ seconds}$
$= 36 \times 10^5$

$$\boxed{1 \text{ KWh} = 3.6 \times 10^6 \text{ Joule (J)}}$$

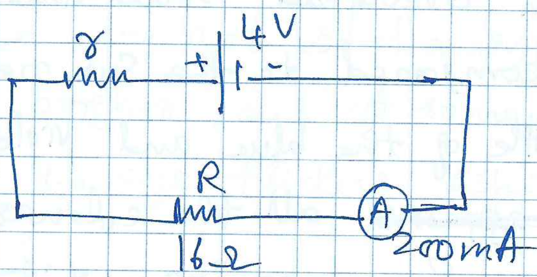
Datum .... 20........

Onderwerp :

Q: A cell has an emf of 4 V and is connected in series with a 16 Ω resistance coil. The current in the coil is found to be 200 mA. Calculate the internal resistance of the cell.



<u>Note</u> : A cell has an internal resistance, so the above circuit can be written as



$= 0.2\,A$

– Voltage across 16 Ω resistor $= V_{16\Omega} = IR$

$= 0.2 \times 16 = 3.2\,V$

– Voltage across r $= Ir = 0.2\,r$

$\therefore \quad 3.2\,V + 0.2\,r = 4\,V$

$0.2\,r = 0.8\,V \qquad \therefore \boxed{r = 4\,\Omega}$

$\therefore$ Internal resistance of the cell $= 4\,\Omega$.

Define the term 'resistivity' of a material

~~'Resistivity' of a material is the resistan~~

The 'resistivity' of a material is the resistance offered by the material of unit length and unit cross-sectional area.

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

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

Blank Sheet

02

DPS → III Weekly test.

Datum .... 20....

Onderwerp :

Calculate the cost of energy consumption in a household for the month of June given it uses (a) a geyser of 1.5 kW for 1.5 h daily (b) three fans 60 W each for 8 h daily? and Rate per unit is Rs 3.)

We know that Commercial unit of energy = 'unit' = 1 kWh

Month June has 30 days.

Energy consumption for the month June:

(a) Geyser → $1500\,W \times 1.5\,h \times 30$ days

$= 1500 \times 15 \times 3 = 22500 \times 3$

$= 67500$ Wh

(b) Fans → 3 fans × 60 W × 8 h × 30 days

$= 3 \times 60 \times 8 \times 30 = 180 \times 8 \times 30$

$= 1440 \times 30$

$= 43200$ Wh

Total (a) + (b) $= 67500 + 43200 = 110700$ Wh

$= 110.7$ kWh $= 110.7$ units

∴ 1 unit = Rs 3

110.7 units $= 110.7 \times 3 = 332.1$

$=$ Rs 332/—

An electric geyser has a power rating of 2 kW - 220 V. Calculate the minimum rating of the fuse wire (in whole numbers) for safe running of the geyser?

power $= P = VI$, $I = \frac{P}{V} = \frac{\cancel{2000}^{100}}{\cancel{220}_{11}} = \frac{100}{11} \simeq 10\,A$

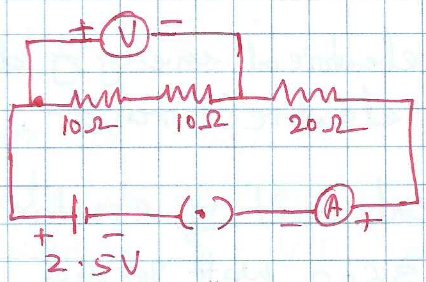
∴ the minimum rating of fuse wire = 10 A

Datum .... 20..............

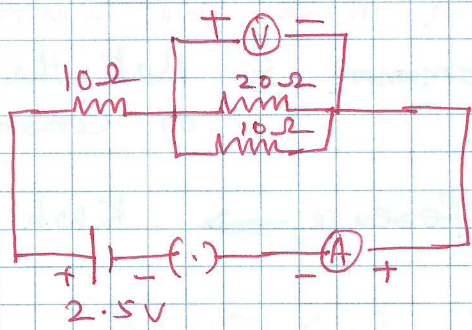
Onderwerp :

3) Study the three given circuits and and answer the question that follow :-

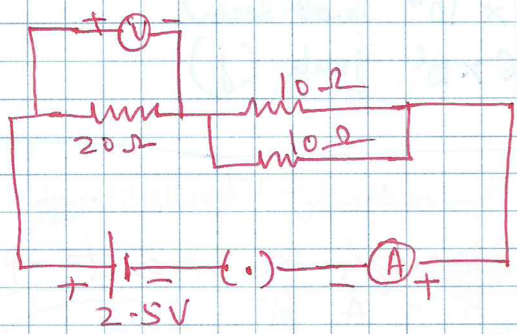
A



B



C



In which of these the voltmeter reads 2V ? justify ?

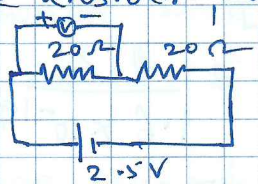
Answer : The answer is C, since in circuit C

$$I = \frac{2.5}{25} = \frac{1}{10} = 0.1\ A$$

Voltmeter Reading $= 20\ \Omega \times 0.1\ A = 2\ V$

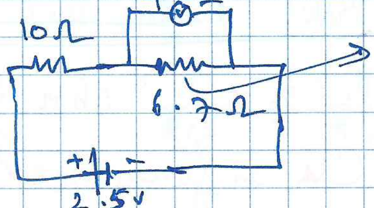
A B is not the answer, since Voltmeter reading $= 1.25\ V$, sin

A →



Since there are 2 equal resistances ~~potential~~ voltage is equally distributed across those resistors.

B →



$$\frac{1}{R_T} = \frac{1}{10} + \frac{1}{20} = \frac{1}{10}\left(1 + \frac{1}{2}\right) = \frac{3}{20}$$

$$\therefore R_T = \frac{20}{3} = 6.7$$

$\therefore V$ across $6.7\ \Omega < 1.25\ V$

$\therefore$ So B can not be the answer.

Datum .... 20...

Onderwerp :

④ State one difference between joule and KWh. What is common in these two units ?

Common → Both the units represent electrical energy dissipated or consumed in ~~an~~ an electric circuit.

Difference → KWh is the commercial unit of electric energy

$1\ KWh = 1000 \times 3600$ watt second

$= 3.6 \times 10^6$ watt second

$= 3.6 \times 10^6$ joule (j)

⑤ The charge of an electron is -1.6×10^{-19} Coulomb. How many electrons are transferred through a circuit per second if the current in the circuit is 0.2 A ?

Given charge of an electron ~~$= -1.6 \times 10^{-19}$ C~~ $= e = -1.6 \times 10^{-19}$ C

$I = 0.2$ A

$t = 1$ Se

$V = IR$

$Q = It$

$I = \frac{Q}{t}$

using $Q = It = 0.2 \times 1 = 0.2$ C

Using $\boxed{Q = Ne}$ where N is the number of electrons

$N = \frac{Q}{e} = \frac{0.2}{1.6 \times 10^{-19}} = \frac{2}{16} \times 10^{19} = \frac{10^{19}}{8}$

$N = \frac{100}{8} \times 10^{17} = 12.5 \times 10^{17}$ electrons.

⑥ The resistivity of copper is 1.62×10^{-8} ohm·m and that of an alloy is 49×10^{-6} ohm·m. Cu is considered a conductor whereas we have resistors made ~~of alloy~~ out of the later. Justify the underlined words.

→ Using $R = \rho \frac{l}{A}$, ρ_{cu} is 3000 times less than ρ_{alloy}, so R_{cu} is 3000 times less than R_{alloy} for the same 'l' and 'A'. Hence it is considered as a good conductor. Similarly, since ρ_{alloy} is 3000 times greater ~~than~~ than ρ_{cu}, ~~it~~ so R_{alloy} is 3000 times $> R_{cu}$. Therefore to realize practical resistors, we need less material for alloy compared to copper

From "~~Together with~~" book.

IMP

Datum .... 20.......

Onderwerp :

1) An electric bulb is rated 220 V and 100 W. When it is operated on 110 V, the power consumed will be

(a) 100 W (b) 75 W (c) 50 W (d) 25 W

⇒ Answer is (d)

Calculate the resistance of the bulb using $P = VI$ Since $I = \frac{V}{R}$

$$P = \frac{V^2}{R} \quad \therefore R = \frac{V^2}{P} = \frac{(220)^2}{100} = \frac{(22)^2 \times \cancel{10^2}}{\cancel{10^2}}$$

$$= (22)^2$$

∴ power consumed by the bulb when operated at 110 V

$$= \frac{V^2}{R} = \frac{\cancel{110}^{5} \times \cancel{110}^{5}}{\cancel{22} \times \cancel{22}} = \boxed{25\ W}$$

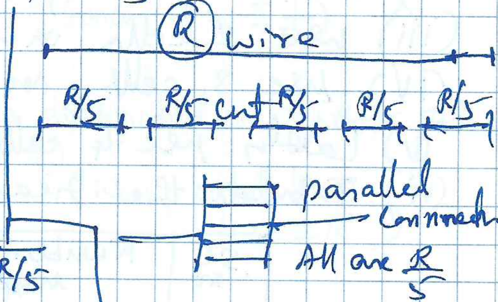
---

2) A piece of wire of resistance R is cut into five equal parts. These parts are then connected in parallel. If the equivalent resistance of this combination is R', then the ratio $\frac{R}{R'}$ is :

(a) $\frac{1}{25}$ (b) $1/5$ (c) 5 (d) 25

⇒ Answer → (d) When wire of resistance R is cut into 5 equal parts

∴ there will be 5 equal resistors of $\frac{R}{5}\ \Omega$ each.



When they are connected in parallel, the equivalent resistance = R'

$$\therefore \frac{1}{R'} = \frac{1}{R/5} + \frac{1}{R/5} + \frac{1}{R/5} + \frac{1}{R/5} + \frac{1}{R/5}$$

$$= \frac{5}{R/5} = \frac{25}{R}$$

$$\therefore \frac{1}{R'} = \frac{25}{R}$$

$$\boxed{\frac{R}{R'} = 25}$$

Datum .... 20....

Onderwerp :

(a) state Ohm's law
(b) Describe the activity with the help of a diagram to establish the relationship between current (I) flowing in a conductor and potential difference (V) maintained across its two ends.
(c) Draw the shape of the curve obtained when a graph is plotted between I and V.

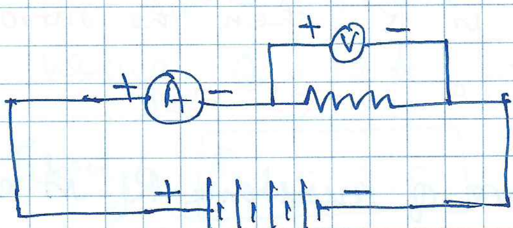
Ohm's law : The electrical current (I) flowing through a metallic wire is directly proportional to the potential difference (V) across its ends provided its temperature remains constant.

Mathematically : $V \propto I \Rightarrow V = IR$.

Aim : To establish the relationship between V across the resistor and the ~~current~~ current I passing through it.

Apparatus required : - Nichrome wire (length 0.5 m)
- Ammeter
- voltmeter
- Four cells of ~~each~~ 1.5 V each.

procedure :
(i) Setup the circuit as shown below



(ii) first use only 1 cell and note down ammeter and voltmeter readings
(iii) use 2 cells in series and note down the meter readings.
(iv) use 3 cells in series and note down the meter readings.
(v) Lastly use 4 cells in series and note down the meter readings.
(vi) Tabulate the readings as follows, calculate V/I

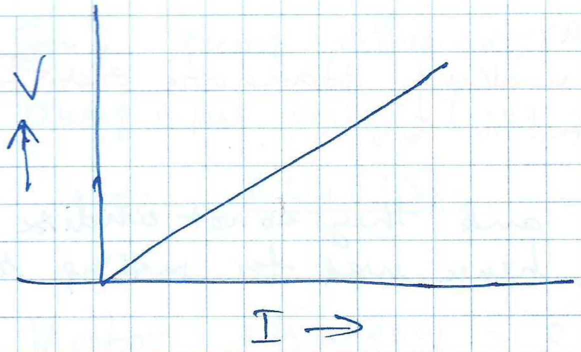
SL no	Number of cells used	Ammeter (I) reading (ampere)	voltmeter (V) reading (volts)	V/I
1	1			
2	2			
3	3			
4	4			

Observation : We will ~~observe~~ obtain approximately the same value for $\frac{V}{I}$

So $\frac{V}{I}$ graph is a straight line passing through the origin

Datum .... 20.....

Onderwerp :



From graph we observe that

$\frac{V}{I}$ = constant

$V = (\text{constant}) \times I$

or $V \propto I$ (proves ohm's law)

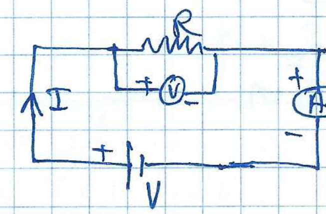
~~The~~ Conclusion :→ $V \propto I \Rightarrow V = IR$ where ~~R~~ the constant is called Resistance. If you change the wire, the graph will ~~be~~ be still a straight with a different slope (slope = resistance)

(a) State and prove the Joule's law of heating.
(b) Give the commercial unit of electrical energy and relate it to joule
(c) when four 40 W, 220 V bulbs are connected in series, find the current flowing in each. If one bulb fuses, what will be the current drawn from the source of 220 V?

According to Joule's law of heating, the heat H produced in a wire of resistance R while carrying a current I in time 't' is directly proportional to the square of current, resistance and time.

$$H = I^2Rt$$

Proof:—



The work done in moving the charge Q through a potential difference V is VQ

$W = VQ$ (Since $Q = It$)

$W = VIt$

This work done is dissipated in resistor as heat energy (H)

$H = VIt$ (using ohm's law $V = IR$)

$$\boxed{H = I^2Rt}$$

Commercial unit of electrical energy is KWh

1 KWh = 1000 W × 3600 sec

= 3.6×10^6 ~~joules~~ W-s

= 3.6×10^6 joules.

Resistance of 40 W bulb $= \frac{(220)^2}{40} = \frac{220 \times 220}{40} = 1210\ \Omega$ (using $P = VI = \frac{V^2}{R}$)

4 bulbs connected in series, so net R = 4 × 1210 = 4840 Ω

$\therefore I = \frac{220}{R} = \frac{220}{4840} = 0.045$ A

If one bulb fuses, since they are connected in series, circuit breaks, no current seen in the ammeter.

Q: Give reasons for the following
(i) Alloys are used in making standard resistances
(ii) Fuse wire is connected in series.

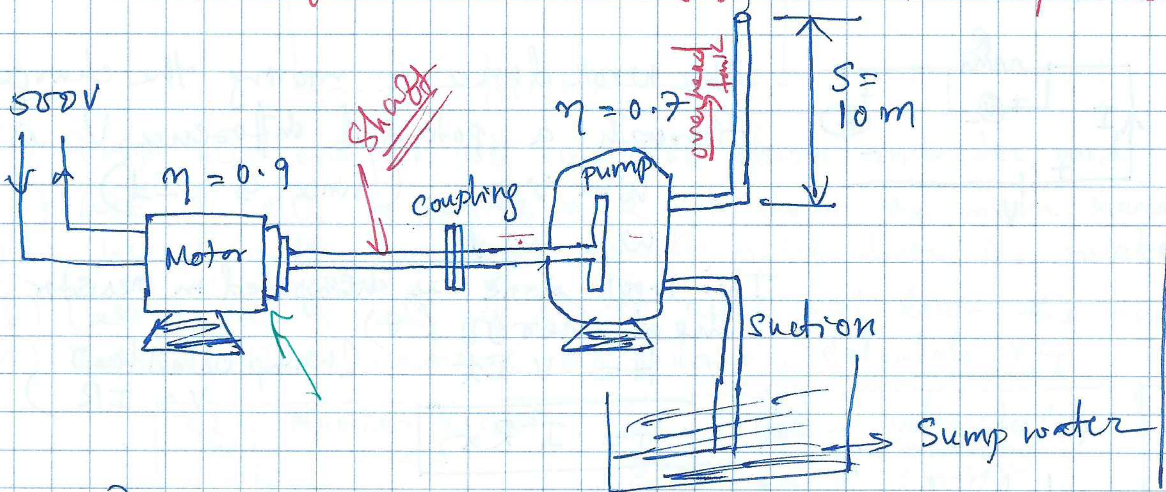
(i) Alloys have higher resistivity and they do not oxidise (burn) readily at high temperatures, hence used for making standard resistors.

(ii) Fuse wire is conneted in series because the fuse wire melts and breaks the circuit when unduly high current is passing through the circuit. When circuit breaks, the circuit and the electrical appliances are ~~protected~~ not damaged due to high current.

Q: An electrically driven pump lifts 15 ~~tonne~~ tonne of water in a minute to a height of 10 m. Assuming an efficiency of 70% for the pump and 90% for the motor, calculate

not for you

(i) motor output in kW
(ii) input current to the motor if supply voltage is 500 V
(iii) Find cost of running the pump for 3 hours daily for 30 days if price of electrical energy is 10 paise / kWh



~~P tonne~~
1 tonne = 1000 k
15 tonne = 15000 k

(Force)
Weight of water lifted (F) $= mg = 15,000 \times 9.8$ N
$= 147,150$ N

work done $= W = F \times S = 147,150 \times 10 = 1471500$ joule

Actual output Power required $= \frac{W}{time} = \frac{1471500}{60 \text{ Sec}} = 24,525$ J/s (W)
$= 24,525$ W

Datum .... 20......

Onderwerp :

(i) Since pump efficiency = 0.7

pump input power (or motor output power)

$$= \frac{24{,}525}{0.7} = 35{,}036\ W = 35.036\ KW$$

(ii) Motor efficiency = 0.9

$\therefore$ Motor input power $= \frac{35{,}036}{0.9} = 38{,}930\ W = 38.93\ K$

Current drawn by motor (using $p = VI$) $= I = \frac{P}{V} = \frac{38{,}930}{500}$

$= \underline{77.86\ A}$

(iii) Running time of pump = 3 hrs/day × 30 days

= 90 hr

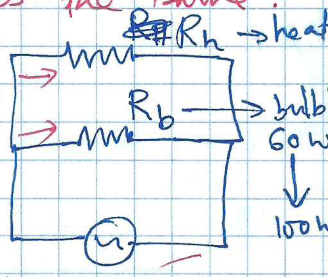
Energy consumed by the motor = 38.93 KW × 90 h

= 3503.7 KWh (units)

cost = 3503.7 × 0.1 → 10 paise = Rs 0.1

= Rs 350 paise 37

A heater joined in parallel with a 60 W bulb is connected to the mains. If the 60 W bulb is replaced by a 100 W bulb, will the rate of heat produced ~~by the heater~~ be more or less or remains the same. ???



Using $R = \frac{V^2}{P}$ $\left(P = VI = \frac{V^2}{R}\right)$

$R_b\ (100W) < R_b\ (60W)$

$\therefore (R_h \parallel R_{b(100)})$ decreases, ~~hence I increases~~ in the circuit ~~in the circuit~~

Using $H = I^2Rt = \frac{V^2}{R}t$

$$H = \frac{V^2}{R}t$$

Since R decreases (when 60 W → 100 W), H produced in the circuit increases.

it is true. ...produced ...the heater ...same when ...of 60 W is ...ced with bulb of 100 W

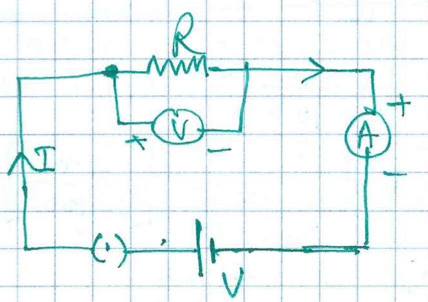
Datum .... 20.........

Onderwerp :

1) In a household electric circuit different appliances are connected in parallel to one another. Give two reasons.
The electric power consumed by a device may be calculated by using either of the two expressions $P = I^2 R$ or $P = V^2/R$. The first expression indicates that it is directly proportional to R, whereas the second expression indicates inverse proportionality.
How can the seemingly different dependence of P on R in these expressions be explained?
Two metallic wires A and B are connected in parallel. Wire A has length l and radius r, wire B has length 2l and radius 2r. Compute the ratio of the total resistance of parallel combination and the resistance of wire A and B

a) parallel connection is used in household appliances because
(i) Individual appliance can be operated at any time. Even if one appliance fails, the remaining appliances continue to work.
(ii) All appliances will get the same potential difference of 220 volts, needed for their operation. drop

b)



$P = I^2 R \longrightarrow ①$

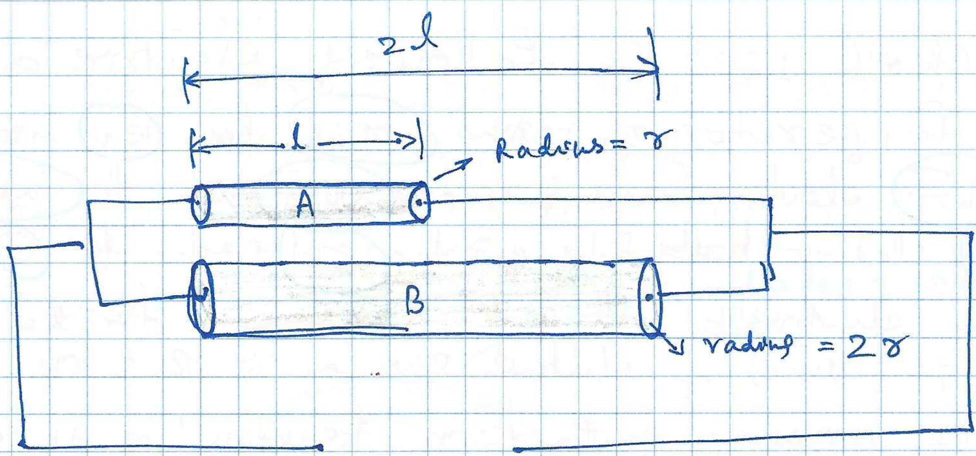
$P = \frac{V^2}{R} \longrightarrow ②$

In these two expressions, ~~say~~ R is constant.
But I and V are not independent parameters.
I and V ~~are dependent each~~ are related to each other. So these 2 expressions are not independent expressions, but ~~dependent~~ related expressions.
As we know that $V \propto I \Rightarrow V = IR$.
Substituting these, we see that both ① & ② are ~~equal~~ same.

Datum .... 20..............

Onderwerp :

(c)



Let Resistance of A = R1
and resistance of B = R2

Formula ~~R1~~

$R1 = \rho \frac{l1}{A_1}$, $R_2 = \rho \frac{l_2}{A_2}$ (ρ is same since same material is used)

Given $l_1 = l$, $l_2 = 2l$

$r_1 = r$, $r_2 = 2r$

$A_1 = \pi r^2$, $A_2 = \pi (2r)^2 = 4\pi r^2 = 4A_1$

$\boxed{R1 = \rho \frac{l}{A}} \rightarrow (1)$, $R2 = \rho \frac{2l}{4A} = \rho \frac{l}{2A}$

$\therefore \boxed{R_2 = \rho \frac{l}{2A}} \rightarrow (2)$

$R1 \parallel R_2 \rightarrow \frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{R_1 + R_2}{R1R_2}$

$R_T = \frac{R_1 R_2}{R_1 + R_2} = \frac{\rho \frac{l}{A} \cdot \rho \frac{l}{2A}}{\rho \frac{l}{A} + \rho \frac{l}{2A}} = \frac{\rho^{\cancel{2}} \frac{l^{\cancel{2}}}{2A^{\cancel{2}}}}{\cancel{\rho \frac{l}{A}} \left(\frac{3}{2}\right)} = \frac{\rho \frac{l}{A}}{3} = \frac{1}{3} \rho \frac{l}{A}$

$\therefore \boxed{R_T = \frac{1}{3} \rho \frac{l}{A}} \rightarrow (3)$

$\frac{(3)}{(1)} = \frac{R_T}{R_1} = \frac{\frac{1}{3} \cancel{\rho \frac{l}{A}}}{\cancel{\rho \frac{l}{A}}} = \frac{1}{3}$

$\therefore \boxed{\frac{R_T}{R_1} = \frac{1}{3}}$

Datum .... 20........

Onderwerp :

1) A household uses the following electric appliances:
(i) Refrigerator of rating 400W for ten hrs each day.
(ii) Two electric fans of rating 80 W each for twelve hrs each day
(iii) Six electric ~~bulbs~~ tubes of rating 18W each for 6 hrs each day
Calculate the electricity bill of the household for the month of June
if the cost per unit of electrical energy is Rs 3.00.
2) What is the meaning of the term 'frequency' of an alternating current? What is its value in India?
3) Why is an alternating current considered to be advantageous over direct current for long range transmission of electric energy?

1) We know that Commercial unit of energy = 'unit' = 1 kWh
Month June has 30 days.

Energy Consumption for the month June:

i) Refrigerator $\rightarrow$ $400 \times 10 \times 30$ = 120000 W = 120.0 kW
ii) Electric fans $\rightarrow$ $2 \times 80 \times 12 \times 30$ = 57,600 W = 57.6 kW
iii) electric tubes $\rightarrow$ $6 \times 18 \times 6 \times 30$ = 19,440 W = 19.44 kW

Total Consumption in June = 197.04 kW
$\simeq$ 197 units

1 unit = Rs 3.00
197 unit = 197×3 = Rs 591/—

Electricity Bill = Rs 591 = 00

2) In India, the armature of the AC Generator completes one full revolution in a time period $T = \cancel{\frac{1}{100}\text{ Seconds}}$. $\cancel{\frac{1}{100}\text{ Sec}}$ $\frac{1}{50}$ sec

$\therefore f = \frac{1}{T} = 50\text{ Hz} = 50$ cycles/sec

This means in one second, 50 sinewaves are generated.
The value of frequency in India = 50 Hz.

3) AC can be transmitted over long distances without much loss of energy as compared to DC. Therefore the cost of transmission is low.