شكراً لتحميلك هذا الملف من موقع المناهج الإماراتية

مراجعة شاملة نهاية الفصل

التواصل الاجتماعي بحسب الصف الثاني عشر المتقدم

روابط مواد الصف الثاني عشر المتقدم على تلغرام

التربية الاسلامية	اللغة العربية	اللغة الانجليزية	الرياضيات

المزيد من الملفات بحسب الصف الثاني عشر المتقدم والمادة فيزياء في الفصل الثاني

1	مراجعة شاملة نهاية الفصل
2	مراجعة نهائية قبل امتحان نهاية الفصل الثاني
3	مراجعة عامة وفق الهيكل الوزاري
4	الحل التفصيلي للمراجعة النهائية
5	أسئلة المراجعة النهائية اختيار من متعدد مع الحل

Wherever necessary, use the following formulas أينما لزم استخدم العلاقات التالية		
$J = \frac{i}{A}$	$i = \frac{dq}{dt}$	$i = \frac{dq}{dt} = -neu_d A$
$1\,S = \frac{1}{1\,\Omega}$	$\rho = \frac{E}{J}$	$\sigma = \frac{1}{\rho}$
$R = \rho \frac{L}{A}$	$V_{emf} = iR$	$V_{emf} = iR_1 + iR_2 = iR_{eq}$
$dU = i\,dt\,\Delta V$	$i = i_1 + i_2 = \frac{V_{emf}}{R_1} + \frac{V_{emf}}{R_2} = V_{emf}\left[\frac{1}{R_1} + \frac{1}{R_2}\right]$	$R = \frac{\Delta V}{i}$
$R = \frac{\Delta V}{i}$	$P = \frac{dU}{dt} = \frac{i\,dt\,\Delta V}{dt} = i\Delta V$	$E = \frac{\Delta V}{L}$
$dU = i\,dt\,\Delta V$	$\sum_{k=1}^{m} V_{emf,k} + \sum_{k=1}^{n} i_k R_k = 0$	$q(t) = q_{max}\left(1 - e^{-t/\tau}\right)$
$\sum_{k=1}^{n} i_k = 0$	$i = \frac{dq}{dt} = \left(\frac{V_{emf}}{R}\right)e^{-t/RC}$	$q(t) = q_{max}e^{-t/RC}$
$R_{eq} = \frac{R_1}{R_3} R_2$	$i(t) = \frac{dq}{dt} = -\left(\frac{q_{max}}{RC}\right)e^{-t/RC}$	$\vec{F}_B = q\vec{v} \times \vec{B}$
$r = \frac{mv}{\lvert q \rvert B}$	$\vec{F}_B = i\vec{L} \times \vec{B}$	$\tau = N\tau_1 = NIAB\sin\theta$
$d\vec{E} = \frac{1}{4\pi\varepsilon_0}\frac{dq}{r^3}\vec{r} = \frac{1}{4\pi\varepsilon_0}\frac{dq}{r^2}\hat{r}$	$d\vec{B} = \frac{\mu_0}{4\pi}\frac{id\vec{s} \times \vec{r}}{r^3} = \frac{\mu_0}{4\pi}\frac{id\vec{s} \times \hat{r}}{r^2}$	$\mu_0 = 4\pi \times 10^{-7}\ \frac{T\,m}{A}$
$k = 8.99 \times 10^9\ \frac{N\,m^2}{C^2}$	$q_e = -1.6 \times 10^{-19} C$ $q_P = +1.6 \times 10^{-19} C$	$m_e = 9.11 \times 10^{-31} kg$ $m_P = 1.67 \times 10^{-27} kg$

END OF TERM 2 REVISION
12 ADVANCE
PHYSICS
050 - 8210248
TEACHER: ALAA ALDEEN ALFAQEEH

(Part 1)

1- Show that by definition the electric current is related to net charge through the equation between current and charge related to time ..... Define electric current and specify its unit as the Ampere (1A=1C/s).

As mentioned in the textbook 117

بيّن أنه بالتعريف يرتبط التيار الكهربائي بالشحنة الصافية من خلال المعادلة بين التيار والشحنة المتعلقة بالوقت ... ...
حدد التيار الكهربائي وحدد وحدته على أنها الأمبير (1A = 1C / s)

The electric current, i, is the net charge passing a given point in a given time, divided by that time.

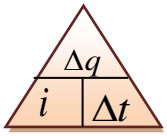
$$i = \frac{dq}{dt} \qquad q = \int i\,dt$$

The unit of current is C/s and is called Ampere(A).

The net amount of charge passing a given point in time t is the integral of the current with respect to time:

$$q = \int dq = \int_0^t i\,dt$$

$$i = \left|\frac{\Delta q}{\Delta t}\right|$$



Q1: How many electrons flow through a point in a wire in 3.00 s if there is a constant current of i = 4.00 A ?
a-7.5×10^{-19} electron b- 7.5×10^{19} electron c- 2.5×10^{19} electron d- 2.5×10^{-19} electron

Q2: The quantity of charge through a conductor is modeled as:
$Q = (4.00\ C\ s^{-4})\ t^4 - (1.00 Cs^{-1})\ t + (6.00\ mC)$. What is the current at time t = 3.00 s

a-231 A b- 431 A c- 623 A d- 765A

Q3 : A current flows in a conducting wire whose strength changes with time according to the equation [$I(t)= 3.0 + 2.0t^3$] , where the time is measured in seconds, and the current is measured in amperes. How much charge does this current pass in 2 s?

A)2C B)1 4.9C C) 14C D) 2.7C

Q4: The electric current is defined as:

A) The net charge passing the cross-sectional area of a conductor in a certain time interval.

B) The net charge passing the cross-sectional area of a conductor in a certain time interval times this time interval.

C) The net charge passing the cross-sectional area of a conductor in a certain time interval devided by this time interval.

D) The current density through the conductor devided by the time interval taken to pass.

Q5: The electric current can be calculated from the equation .....and its unit .....

$i = q\Delta t$, $C.s$ $i = \frac{q}{\Delta t}$, $\frac{s}{C}$ $i = \frac{\Delta t}{q}$, $\frac{s}{C}$ $i = \frac{q}{\Delta t}$, $\frac{C}{s}$

2- Define the current density J as the current per unit area flowing through a conductor.

يحدد كثافة التيار علي أنها التيار لكل وحدة مساحة تتدفق عبر الموصل As mentioned in the textbook (P :119)

The current per unit area flowing through the conductor. $\overrightarrow{(J)}$

$$i = \int \vec{J} \cdot d\vec{A}$$
$$J = \frac{i}{A}$$

Q6: An copper wire with a diameter of 1.02 mm, carries a constant current of 1.67 A. Find the current density.

$$J = \frac{i}{A} = \frac{1.67}{\pi(\frac{1.02 \times 10^{-3}}{2})^2} = 2.04 \times 10^6 \frac{A}{m^2}$$

Q7: The current density through a conductor is defined as:

A) The total current passing the cross-sectional area per unit time.

B) The cross-sectional area of a conductor times the current per unit cross- Sectional area.

C) The charge per unit area passing through a conductor`s cross- Sectional area.

D) The The current passing per unit perpendicular cross-Sectional area of a conductor.

Q8: The current density of a conductor is given by:

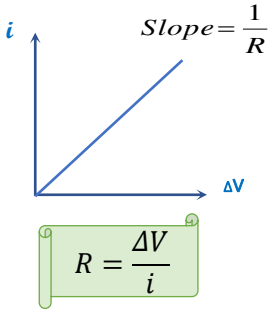
A) $J=\rho E$ B) $J=i/A$ C) $J=A/i$ D) $J=\rho L/A$

3- Recall and apply Ohm's Law (i=ΔV/R).

تذكر وتطبيق قانون أوم في حل المسائل

Ohm`s Law: The electric current flowing through a conductor is directly proportional to the potential difference across it."

$$\boldsymbol{i = \frac{\Delta V}{R}}$$



The resistance (R) : "The resistance is a material's opposition to the flow of electric current." "The resistance is the ratio of the potential difference across a resistor to the resulting current." measured in ohms Ω . (V/A)

Q9: Which of the following statements is true for the resistance of a copper wire at room temperature?

A) It increases as its length increases and its cross-sectional area decreases.
B) It increases with both its length and its cross-sectional area.
C) It increases as its cross-sectional area increases and its length decreases.
D) It increases by decreasing both its length and its cross-sectional area.

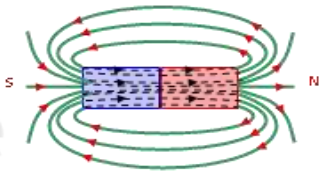
Q10: Calculate the effective resistance of a pocket calculator that has a 1.35-V battery and through which 0.200 mA flows.

a- 6750 Ω b- 2350 Ω c- 1245 Ω d- 1554Ω

4- **Recall that a magnetic field is represented using field lines**
.Identify the properties of a magnet (A magnet always has a north pole and a south pole - A single north or south pole cannot be isolated (they always come in pairs)
- Opposite magnetic poles attract and like poles repel
- Breaking a bar magnet in half results in two new magnets, each with a north and a south pole)
.- Recall that the SI unit of magnetic field strength is Tesla (T).

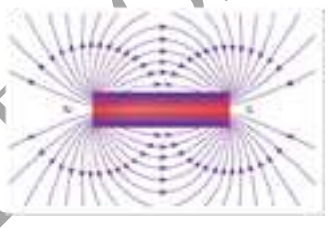
Magnetic field lines:

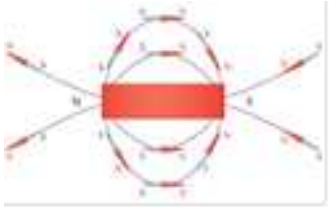
"Imaginary lines used to visualize the magnetic field and measure its intensity.



Magnetic fields around permanent magnets: $\vec{B}$

Magnetic field: (A quantitative vector in the region where the magnetic force of a magnet appears.)





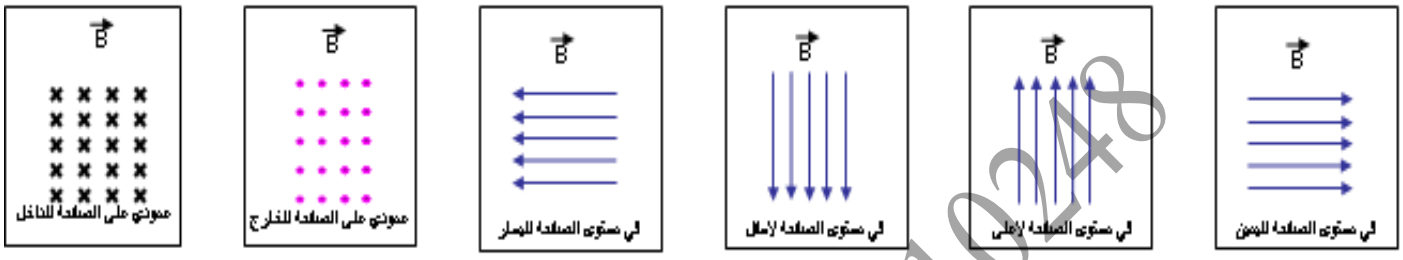
Magnetic field layout :

1. Using iron filings.

2. Using a small compass

Characteristics of magnetic field lines:

- Forms closed paths moving from the North Pole N to the South Pole S outside the magnet and then, continue inside the magnet from southern S to northern N.
- The direction of the field at a point tangential to the field line passing from that point.
- The field strength B at a point is proportional to the magnetic field lines density.
- Magnetic field lines do not cross each other.
- The uniform fields have straight, parallel, undirected, and equally spaced lines.



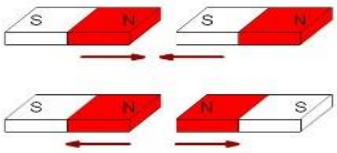
General characteristics of magnets :

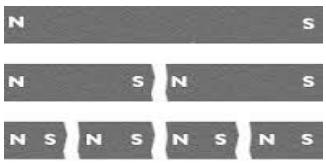
-If the magnet freely hanged in a horizontal plane, it rotates in North-South geographic direction.

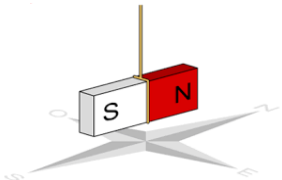
-Every magnets has two poles

1- North pole, the North seeking pole.
2- South pole, the south seeking pole.

- Like magnetic poles repel and opposite magnetic poles attract.
- If a magnet breaks into two or more parts, then each part becomes a new magnet with its own north and south pole.

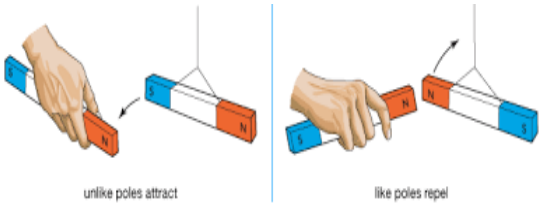






- The effect of magnet on other magnet :

1- If two like poles meet, they repel. 2- If two different poles meet, they attract.



Tesla T: (unit of the magnetic field) $$T = \frac{N.S}{c.m} = \frac{N}{A \cdot m} = \frac{kg}{c \cdot s}$$

"It is the uniform magnetic field in which, if a charge of 1 c moves at a speed of 1 m/s perpendicular to the magnetic field, it will be affected by a force of 1 N."

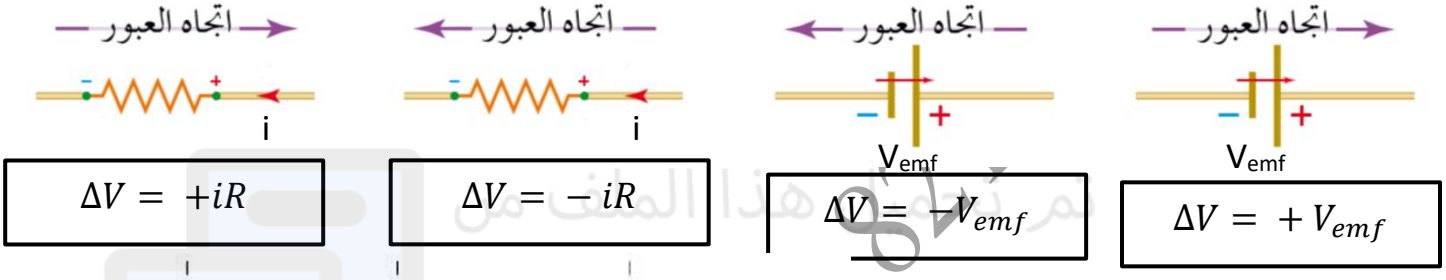
A smaller unit called Gauss “G” is used for the magnetic fields where: $1G = 10^{-4}$ T

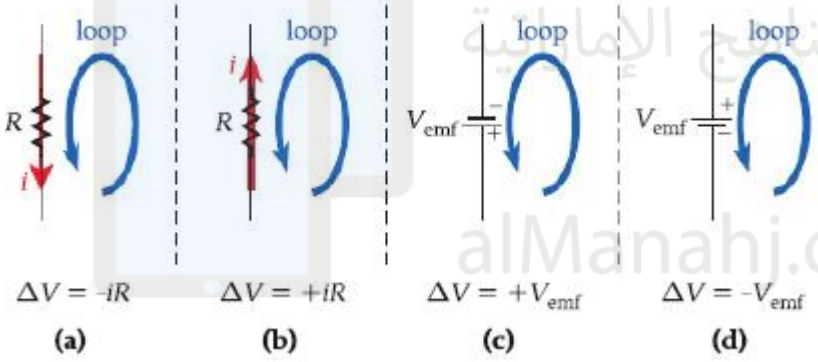
5- Explain the conventions used to determine the sign of potential differences around a single loop circuit containing several resistors and sources of emf given the assumed direction of current and the direction of analysis.Analyze single loop circuits containing two sources of emf and circuit elements.

اشرح الاصطلاحات المستخدمة لتحديد علامة الاختلافات المحتملة حول دائرة حلقة واحدة تحتوي على العديد من المقاومات ومصادر emfبالنظر إلى الاتجاه المفترض للتيار واتجاه التحليل.

تحليل الدوائر ذات الحلقة المفردة التي تحتوي على مصدرين لعناصر emfوالدوائر.

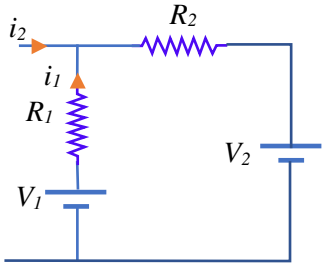
* If the direction of V_{emf} in the same direction chosen for the analysis, V_{emf} will be positive.
  If the direction of V_{emf} opposite to the direction chosen for the analysis ,V_{emf} will be negative.
* If the direction of "i " in the same direction chosen for the analysis, " R i " will be negative.
  If the direction of "i " opposite to the direction chosen for the analysis, " R i " will be positive.





Element	Direction of Analysis	Potential Change	
R	Same as current	$-iR$	(a)
R	Opposite to current	$+iR$	(b)
V_{emf}	Same as emf	$+V_{emf}$	(c)
V_{emf}	Opposite to emf	$-V_{emf}$	(d)

Q11: **In the loop shown:**

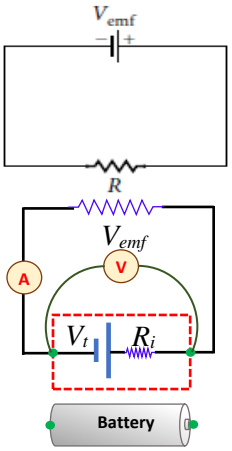


□ $\boldsymbol{V_1 - V_2 - i_1 R_1 - i_2 R_2 = 0}$
□ $\boldsymbol{V_1 - V_2 - i_1 R_1 + (i_1 + i_2)R_2 = 0}$
□ $\boldsymbol{V_1 + V_2 + i_1 R_1 - (i_1 + i_2)R_2 = 0}$
□ $\boldsymbol{V_1 - V_2 - i_1 R_1 - (i_1 + i_2)R_2 = 0}$

6- Define the electromotive force (emf) as the potential difference (voltage) supplied by a battery or a device (emf device). تعريف القوة الدافعة الكهربائية علي أنها فرق الجهد الذي emfتوفره البطارية أو جهاز

7- Identify that at least one component in a circuit must be a source of emf so that to drive current through the circuit حدد أن مكونًا واحدًا على الأقل في الدائرة يجب أن يكون مصدرًا لـ emfبحيث يقود التيار عبر الدائرة.

Electromotive Force and Ohm's law:



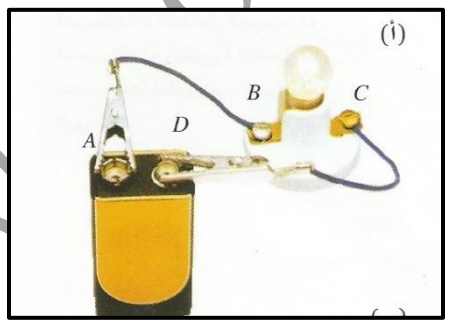
For a circuit like the one shown in Figure, the emf device provides the potential difference that creates the current flowing through the resistor. Therefore, in this case, Ohm's Law can be written in terms of the external emf as:

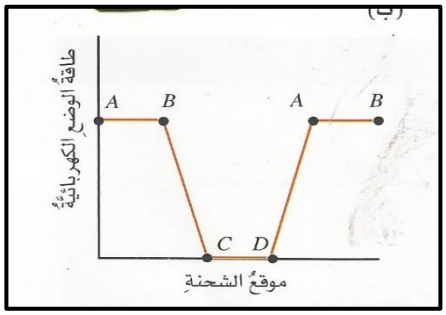
$$V_{emf} = i\,R$$

- ***Where V_{emf} is the external potential difference between the two terminals of the emf source when the current flows.**
- ***We will treat here resistors as ohmic devices; that is, devices that obey Ohm's Law.** $V_{emf} = i\,R$
- ***The change in potential is referred to as the potential drop across the resistor.**
- ***Sources of emf <u>add potential</u> difference to a circuit, and potential drops through resistors <u>reduce potential</u> in the circuit.**
- ***V_t is the potential difference between the two terminals of the emf source when the current is zero (Note: $V_t > V_{emf}$)**
- ***Ohm`s law for the simple circuit shown, where the battery has an internal** resistance R_i is: $V_t = i\,R_{eq} = i\,(R + R_i)$

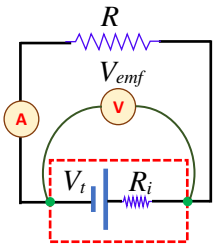
Note:
When the ammeter reads zero, the voltmeter reads the potential V_t . When the ammeter reads a non-zero current, the voltmeter reads the electromotive force V_{emf}.

Example : In the following figure, we notice that the charge leaves the battery at point A, and it carries a certain amount of electric potential energy. The charge loses this energy during its movement from B to C, and then gains this energy when it moves through the battery from D to A.





Q12: In the figure shown besides, if the voltmeter reads 13.5 V when the ammeter reads no current, and the same voltmeter reads 12.5 V when the ammeter reads 0.5 A.
Find the external resistance in the circuit and the internal resistance of the battery.



Solution:

$$R = \frac{V_{emf}}{i} \implies R = \frac{12.5}{0.5} = 25\ \Omega \qquad V_t = i(R + R_i) \implies R_i = \frac{13.5 - 12.5}{0.5} = 2\ \Omega$$

Q13: Which of the following has the same unit as the electromotive force (emf)?

a) current **b) electric potential** **c) electric field** **d) electric power**

Q14: A resistor with R = 10.0Ω is connected across a source of emf with potential difference V_{emf} = 1.50 V. What is the current flowing though the circuit?

a- 0.25A **b- 0.15A** **c- 1.5A** **d- 2.5A**

Part (2)

8- Define the mAh as a unit of charge where 1mAh=3.6 C.

Rechargeable batteries also display a rating in mAh (milliampere-hour), which provides information on the total charge the battery can deliver when fully charged. The mAh is another unit of charge:

1mAh =$(10^{-3}$ A)(3600 s)=3.6 As =3.6 C.

Q15: Suppose an AAA battery is able to supply 625 mAh before its potential drops below 1.5 V . How long will it be able to supply power to a 5-W bulb before the potential drops below 1.5 V.

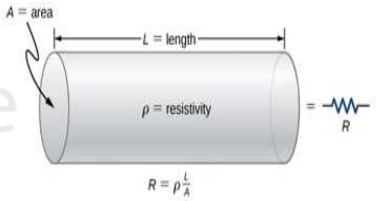
a-375 s **b- 675 s** **c- 1200 s** **d- 120 s**

9- Apply the equation (R=ρL/A) in solving problems to calculate an unknown quantity given the other quantities. طبّق المعادلة (R = ρL / A) في حل المسائل لحساب كمية غير معروفة تُعطى للكميات الأخرى.

The resistivity: ρ: A measure of how strongly a material opposes the flow of electric current." It equals the ratio of the applied electric field to the current density:

$$\rho = \frac{E}{J} = \frac{\Delta V/L}{i/A} = \frac{RA}{L}$$

$$R = \frac{\rho L}{A} \qquad \rho = \frac{RA}{L} \qquad \rho = \frac{E}{J}$$



(measured in Ωm)

The conductance: G: "The conductance is the reciprocal of the resistance."

$$G = \frac{1}{R} \Rightarrow G = \frac{i}{\Delta V}$$

(measured in Ω^{-1}) , (S) siemens , (A/V)

The conductivity σ : "The conductivity is the reciprocal of the resistivity."

$$\sigma = \frac{1}{\rho} \Rightarrow \sigma = \frac{L}{RA}$$

(measured in $\Omega^{-1}m^{-1}$)

Q16: **What is the resistance of the 80.0 m standard copper wire with section area A = $5.2612 \times 10^{-6} m2$**

$$\rho = 1.72 \times 10^{-8}\ \Omega m$$

a- 0.26Ω b- 0.62Ω c- 0.88Ω d- 0.77Ω

Q17: The diameter of copper wire is 8.252 mm. Find the resistance of a 1.00-km length of such wire used for power transmission.

$$\rho = 1.72 \times 10^{-8}\ \Omega m$$

a- 0.12Ω b- 0.22Ω c- 0.32Ω d- 0.52Ω

Q18: A voltage difference of (12.0 V) was applied between the two ends of a wire whose length is (1000 m) and its cross-sectional area is 4.5mm² , a current of (3.20×10−3 A) flow through it , find the resistivity of the wire.

a- 1.72×10-8 Ωm b- 1.68×10-5 Ωm c- 7.12×10-8 Ωm d- 6.18×10-8 Ωm

Q19: What is the resistance of a copper wire that has length L = 70.0 m and diameter d = 2.60 mm?
a) 0.119 b) 0.139 c) 0.163 d) 0.190 e) 0.22

Q20- What is the resistance of the 100.0-m standard copper wire has a diameter of 2.053 mm that is typically used in wiring household electrical outlets

a- 0.52Ω b- 0.11 Ω c-0.66 Ω d- 0.41 Ω

Q21: What is the resistance of a copper wire of length l = 10.9 m and diameter d = 1.3 mm? The resistivity of copper is 1.72×10^{-8} Ωm.

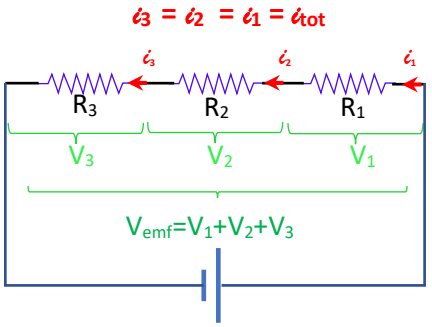
a- 0.141Ω b- 0.111 Ω c-0.661 Ω d- 0.411 Ω

10- Identify that same current flows through a set of resistors connected in series due to the fact that electric charge is conserved. Calculate the equivalent resistance for resistors connected in series as the sum of their individual resistances.

حدد أن نفس التيار يتدفق عبر مجموعة من المقاومات المتصلة في سلسلة بسبب حقيقة أن الشحنة الكهربائية محفوظة.
احسب المقاومة المكافئة للمقاومات المتصلة في سلسلة كمجموع مقاوماتها الفردية.

Resistors in Series:

- Connection as shown in figure.



-All resistors in series group have the same current;

$$i_1 = i_2 = i_3 = \cdots \ldots . = i_{tot}$$

-The electric potential of each resistor is directly proportional to its resistance; $\Delta V \ \alpha \ R$

-The total potential equals the sum of the individual potentials;

$$\Delta V_{tot(seriesgroup)} = \Delta V_1 + \Delta V_2 + \Delta V_3 + \cdots \ldots \ldots$$

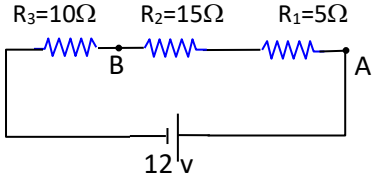
-The equivalent resistance equals the sum of the individual resistances;

$$R_{eq} = R_1 + R_2 + R_3 + \cdots \ldots$$

Q22: In the figure shown three resistors are connected to a potential difference 12 V.

1- What is the equivalent resistance of the three resistors?

2- Calculate the current for each resistor.



a- 50Ω , 0.2A b- 30Ω , 0.2A c- 30Ω , 0.4A d- 50Ω , 0.4A

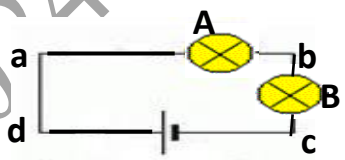
Q23: A learner connected two lamps A and B as in the figure with a battery, and noticed that the brightness of lamp A is greater than the brightness of lamp B. Answer the following

1 -What does the difference in brightness of the two lamps indicate. $R_A > R_B$

2 -If the learner connects point B to point A with a connecting wire without resistance, what will happen to the brightness of each of the two lamps?

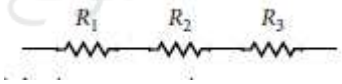
lamp A : turn off.

lamp B : the brightness increase.



Q24: Three identical resistors, R_1, R_2, and R_3, are wired together as shown in the figure. An electric current is flowing through the three resistors. The current through R_2

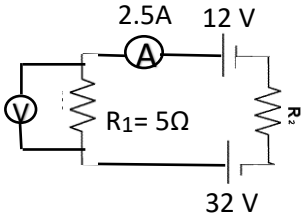
a) is the same as the current through R_1 and R_3.
b) is a third of the current through R_1 and R_3.
c) is twice the sum of the current through R_1 and R_3.
d) is three times the current through R_1 and R_3.
e) cannot be determined.



Q25: Which of the following is an incorrect statement?
a) The currents through electronic devices connected in series are equal.
b) The potential drops across electronic devices connected in parallel are equal.
c) More current flows across the smaller resistance when two resistors are in parallel connection.
d) More current flows across the smaller resistance when two resistors are in serial connection

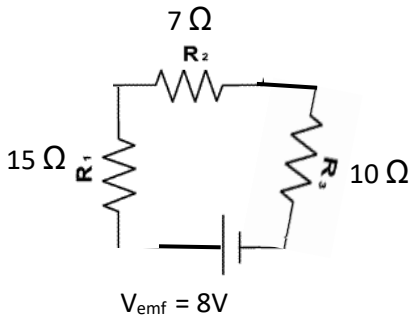
Q26: Depending to figure R_2 equal to :

a- 3Ω b- 5Ω c- 1Ω d- 2Ω

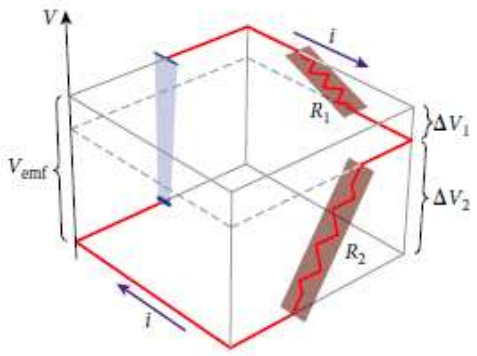


Q27: : Depending to figure V_3 equal to :

a-1.5V b- 2.5V c- 3.5V d- 4.5V



Q28: What are the relative values of the two resistances in Figure.



a) R1 < R2
b) R1 = R2
c) R1 > R2
d) Not enough information is given in the figure to compare the resistances.

Resistors in Parallel:

- Connection as shown in figure.

-All resistors in parallel group have the same electric potential (voltage);

$$V_1 = V_2 = V_3 = \ldots\ldots = V_{tot}$$

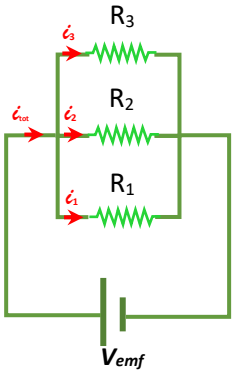
-The electric current in each resistor is inversely proportional to its resistance; $i \propto \frac{1}{R}$

-The total current equals the sum of the individual currents;

$$i_{tot(parallel\ group)} = i_1 + i_2 + i_3 + \ldots\ldots\ldots$$

-The reciprocal of the equivalent resistance equals the sum of reciprocals of the individual resistances;

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots$$



11- Show that the power delivered to an electric device is equal to the current passing through the device multiplied by the potential difference across its terminals (P=iΔV).Solve problems involving electric power.

القدرة الواصلة للجهاز الكهربائي تساوي حاصل ضرب التيار المار بالجهاز في فرق الجهد عبر أظهر أن أطرافه .

حل المسائل المتعلقة بالقدرة الكهربائية .

Energy and Power in electric Circuits:

A battery must do work to drive charges dq, from the negative terminal to the positive terminal (within the emf device) equal to the increase in electric potential energy of that charge, d*U*.

$$dU = dq\Delta V = idt\Delta V$$

Using the definition of power:

$$P = \frac{dU}{dt} = \frac{idt\Delta V}{dt} = i\Delta V$$ (The power is the rate of dissipated or produced energy)

$$P = i\Delta V = i^2R = \frac{\Delta V^2}{R}$$

This work is stored as electric potential energy:

P = U/ t . the unit of power is W (J/S)

Q29: A DC winch motor is rated at 20 A with a voltage of 115 V. What is the power consumed by the motor?

a-2300W b- 1300W c- 3300W d- 200W

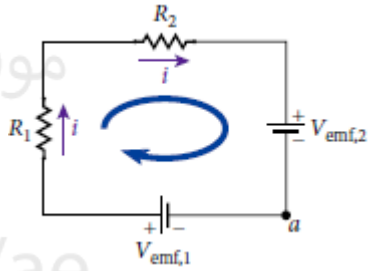
Q30: A flashlight has a light bulb filament resistance of 8 Ω and a battery voltage of 6 V. Calculate

The power that the lamp puts out when it is turned on . -1

a-4.5W b- 8W c- 1.5W d- 10W

12- Apply Kirchhoff's loop rule to single loop circuits. تطبيق قاعدة الحلقة لكيرشوف في دوائر الحلقة المفردة

A single-loop circuit containing two resistors and two sources of emf in series.



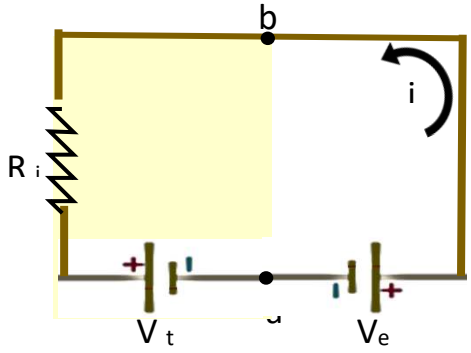
Q31: A 12.0V battery (Vt) with an internal resistance of R1 = 0.2Ω is charged with a battery charger (Ve) able of delivering a current of i = 6.0A, what is the minimum emf that the battery charger must provide in order to charge the battery ?

a- 3.22V

b- 13.2V

c-3.12V

d-2.13v

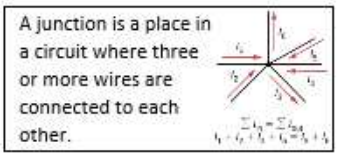


13- State Kirchhoff's junction rule: "The sum of the currents entering a junction must equal the sum of the currents leaving the junction" يذكر نص قانون كيرشوف الأول (الوصلة)

Kirchhoff`s Rules:

Multiloop circuits with emf devices and resistors that cannot be reduced to simple circuits containing parallel or series connections will be analyzed using Kirchhoff's Rules.

Kirchhoff's Junction Rule:

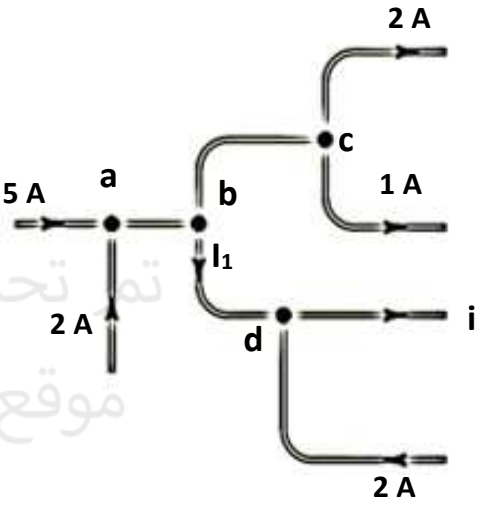


"The sum of the currents entering a junction must equal the sum of the currents leaving the junction."(Kirchoff's first rule is a form of the law of conservation of charge)

Q32:

The figure represents part of an electrical circuit.

. Using the data shown in the figure, calculate the electric current (i)



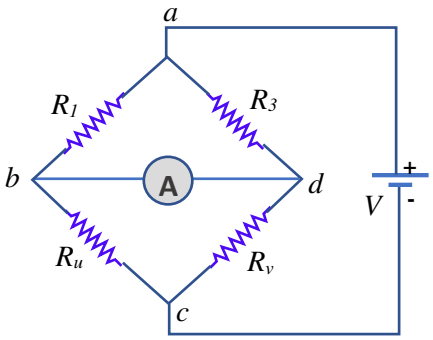
a-2 A b- 4 A c- 6 A d- 8 A

14- Solve problems on Wheatstone Bridge. يحل مسائل متعلقة بقنطرة ويتستون

The Wheatstone bridge:

The Wheatstone bridge is a particular circuit used to measure unknown resistances.

$$\frac{R_u}{R_v} = \frac{R_1}{R_3}$$



Note : When the current through the ammeter is zero , the equivalent resistance given by :

$$R_{eq} = \frac{(R_1 + R_u)(R_3 + R_v)}{R_1 + R_u + R_3 + R_v}$$

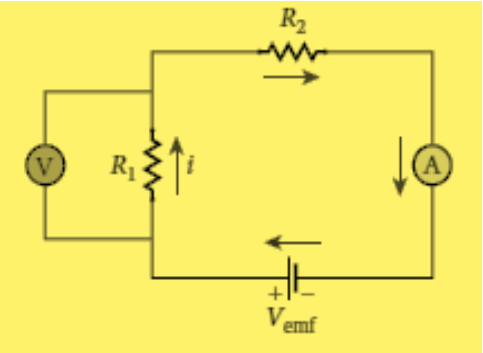
Q33:

In the circuit shown in the figure R_1= 24 Ω , R_3= 360 Ω ,
the ammeter reads zero when the variable resistance (R_v) is (60 Ω)
Calculate the value of the unknown resistor (R_u).

a- 4Ω b- 6Ω c- 2Ω d- 10Ω

15- Recall that an ammeter is a device used to measure current and voltmeter is a device used to measure potential difference

Ammeters and voltmeters:



The ammeter: " A device used to measure the electric current in a specific branch in a circuit."

- To measure the current, an ammeter must be wired in a circuit in series in the branch.

-The range of an ammeter can be extended adding a small resistance in parallel with its coil.

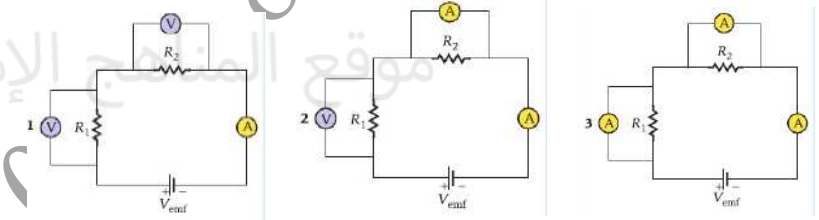
The voltmeter: " A device used to measure the potential difference between any two points in a circuit."

- To measure the potential difference between two points in a circuit, the voltmeter must be wired in parallel to these two points.

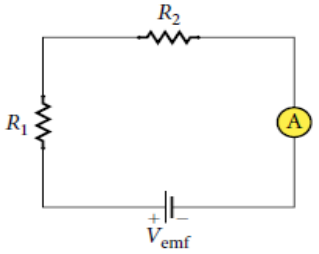
-The range of a voltmeter can be extended adding a large resistance in series with its coil.

Q34: Which of the circuits shown in the figure will not function properity ?

a-1 b- 2 c- 3 d- 2 and 3



Q35 : Two resistors, R1 = 3.00 and R2 = 5.00 , are connected in series with a battery with Vemf = 8.00 V and an ammeter with RA = 1.00 , as shown in the figure. What is the current measured by the ammeter



a-0.5A b- 0.88A c- 1.5A d- 1A

Extending the range of an ammeter:

Example:

An ammeter with a coil of resistance 2.5 Ω measures 400 mA current. What is the is the value of the resistance and how should it be connected with its coil to be able of measuring 20A current?

Solution:

The resistor should connected in parallel with the coil resistance.

$$V_{coil} = V_{parallel\ resistor}$$

$$i_{coil} \times R_{coil} = i_{parallel} \times R_{parallel}$$

$$400 \times 10^{-3} \times 2.5 = 20 \times R_{parallel}$$

$$R_{parallel} = 0.05\ \Omega$$

Extending the range of a voltmeter:

Example:

A voltmeter with a coil of resistance 800 Ω measures potential drop up to 15 V. What is the is the value of the resistance and how should it be connected with its coil to be able of measuring a maximum potential drop 240 V?

Solution:

The resistor should connected in series with the coil resistance.

$$i_{coil} = i_{series\ resistor}$$

$$\frac{V_{coil}}{R_{coil}} = \frac{V_{series\ resistor}}{R_{siries\ resistor}}$$

$$\frac{15}{800} = \frac{240-15}{R_{siries\ resistor}}$$

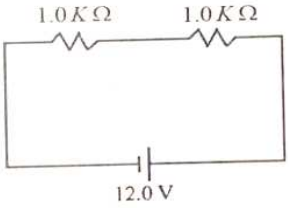
$$R_{series\ resistor} = 22667\ \Omega$$

Q36: A circuit consists of two identical resistance of 1KΩ in series with an ideal 12V battery . A student trying to measure the current through one of the resister , inadvertently connect the ammeter in parallel with that resister . How much current will flow through the ammeter , assuming that it has internal resistance of 1Ω?

a-0.081A **b- 0.012A** **c- 8.11A** **d- 1.02A**

R_{eq}= (1/1000+1/1)$^{-1}$ +1000 = 1001Ω

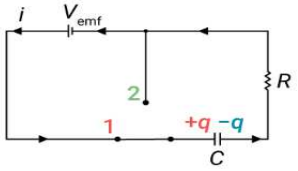
I= V_{emf}/R_{eq} = 12/1001 = 0.012A



16 Apply the relationship giving the charge as a function of time (and time constant) for a capacitor in a charging RC circuit q(t).

Charging a capacitor :

When the switch is connected to position 1, electric current **flows** from the positive terminal of the battery and the capacitor begins to charge.

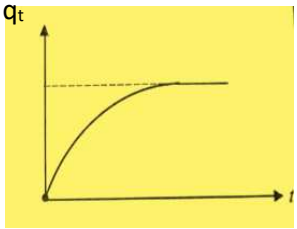


$$q_t = q_{max}\left(1 - e^{-t/\tau}\right)$$

At t= 0 ,q=0 and at t=∞ q=q_{max} = CV_{emf}

Time constant (τ): $\tau = RC$

CV_{emf} = q_{max}



Q37: Consider a circuit consisting of a 12.0-V battery, a 50.0Ω resistor, and a 100.0μF capacitor wired in series. The capacitor is initially completely discharged.

How long after the circuit is closed will it take to charge the capacitor to 90% of its maximum charge?

a- 0.0255 s b- 0.0115 s c- 0.0325 s d- 0.0911 s

$$q(t) = q_{\max}\left(1 - e^{-t/RC}\right), \qquad \left(1 - e^{-t/RC}\right) = \frac{q(t)}{q_{\max}} = 0.90$$

$$0.10 = e^{-t/RC}.$$

$$\ln 0.10 = -\frac{t}{RC},$$

$$t = -RC\ln 0.10 = -(50.0\ \Omega)(100\times10^{-6}\ \text{F})(-2.30) = 0.0115\ \text{s} = 11.5\ \text{ms}.$$

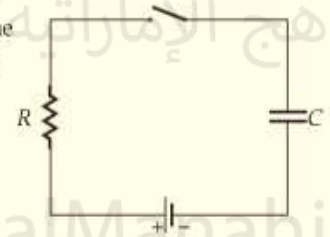
Q38: Which of the following will reduce the time constant in an RC circuit?
a) increasing the dielectric constant of the capacitor.
b) adding an additional 20 m of wire between the capacitor and the resistor.
c) increasing the voltage of the battery.
d) adding an additional resistor in parallel with the first resistor.

Q39: How long would it take, in multiples of the time constant, τ, for the capacitor in an RC circuit to be 98% charged?
a) 9 τ b) 0.9 τ c) 90 τ d) 4 τ

Q40:

6.11 An uncharged capacitor ($C = 14.9\ \mu\text{F}$), a resistor ($R = 24.3\ \text{k}\Omega$), and a battery ($V = 25.7$ V) are connected in series, as shown in the figure. What is the charge on the capacitor at $t = 0.3621$ s after the switch is closed?

a) 5.48×10^{-5} C
b) 7.94×10^{-5} C
c) 1.15×10^{-5} C
d) 1.66×10^{-4} C
e) 2.42×10^{-4} C



$$q_t = q_{max}\left(1 - e^{-t/\tau}\right)$$

$CV_{emf} = q_{max}$

Part (3)

17- Solve problems on multiloop circuits..Recall that an ammeter is a device used to measure current and voltmeter is a device used to measure potential difference.

Q41: In the circuit in the figure, there are three identical resistors (R= 4 Ω). The switch, S, is initially open. When the switch is closed, find the current flowing in R_1, R_2 .
V_{emf} = 12 V.

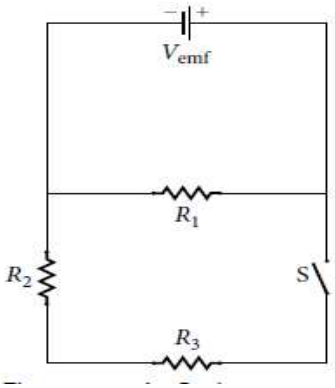
$$I_1 = \frac{V_{emf}}{R_1} = \frac{12}{4} = 3\ A.$$

$$R_{eq} = \left(\frac{4\times8}{4+8}\right) = 2.6\ \Omega.$$

$$I_{tot} = \frac{12}{2.6} = 4.5\ A.$$

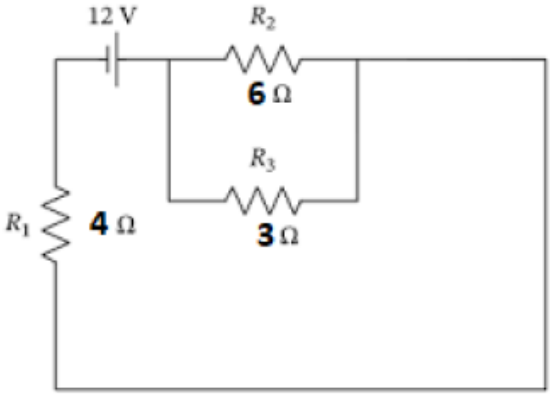
$$I_2 = I_3 = (4.5 - 3 = 1.5\ A).$$

Note: when switch closed, R_2, R_3 in parallel with R_1.



So R_1 has same voltage as when the switch was open. So same current flows through R_1.

Q42: According to the circuit bellow:



A- Find the potential difference across R_2.

$R_{eq} = \left(\frac{6 \times 3}{6+3}\right) + 4 = 6\ \Omega$

$I_{tot} = \frac{\Delta V}{R_{eq}} = \frac{12}{6} = 2\ A.$

$\Delta V_1 = I_{tot} \times R_1 = 2 \times 4 = 8\ V$

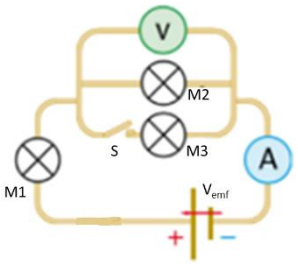
$\Delta V_2 = \Delta V_3 = 4\ V \quad [12 - 8 = 4\ V].$

B- Find the current in R_3.

$I_3 = \frac{\Delta V_3}{R_3} = \frac{4}{3} = 1.3\ A.$

Q43: Q42: Explain what happens to the reading of (A) and (V) and brightness

Of the bulbs (M1, M2, M3) after closing the switch s.



After closed the switch the R_{eq} will decrease and the total current increases. So the reading of Ammeter will increase. (So the brightness of bulb M_1 will increase.

bulb M_2: the current flow decrease So the brightness decrease. the reading of voltmeter will decrease. M_3 (brightness increase).

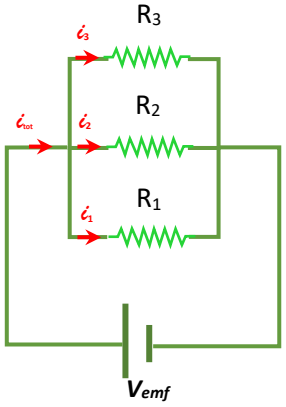
18- Calculate currents, voltages, and resistances for circuit arrangements containing resistors in series and in parallel.Calculate the equivalent resistance for resistors in parallel arrangements (1/Req=1/R1+1/R2+..).

Q44: Three resistors R1 = 1.00 Ω, R2 = 2.00 Ω, and R3 = 2.00 Ω, are connected in parallel. The parallel connection is attached to a 3.00 V voltage source.

(a) What is the equivalent resistance?

(b) Find the current supplied by the source to the parallel circuit.

(c) Calculate the currents in each resistor and show that these add together to equal the current output of the source.



Solution:

(a) $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R} + \frac{1}{R_3} \Rightarrow \frac{1}{R_{eq}} = \frac{1}{1} + \frac{1}{2} + \frac{1}{2} \Rightarrow R_{eq} = 0.5\ \Omega$

(b) $i_{tot} = \frac{V_{tot}}{R_{eq}} \Rightarrow i_{tot} = \frac{3}{0.5} \Rightarrow i_{tot} = 6\ A$

(c) $i_1 = \frac{V_1}{R_1} \Rightarrow i_1 = \frac{3}{1} \Rightarrow i_1 = 3\ A$

$i_2 = \frac{V_2}{R_2} \Rightarrow i_2 = \frac{3}{2} \Rightarrow i_1 = 1.5\ A$

$i_3 = \frac{V_3}{R_3} \Rightarrow i_3 = \frac{3}{2} \Rightarrow i_3 = 1.5\ A$

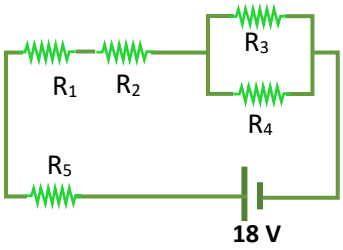
$i_1 + i_2 + i_3 = 3 + 1.5 + 1.5 = 6\ A = i_{tot}$

Note:

1- If one of the lamps burns out or is removed from its place, the brightness of the rest of the lamps will not be affected.

2- When adding a new lamp in parallel, the brightness of any lamp is not affected, and the value of the current passing through each lamp is not affected. However, the total current passing through the circuit increases because the equivalent resistance decreases.

Q45 : Five resistors R1 = 1.00 Ω, R2 = 2.00 Ω, R3 = 3.00 Ω, R4 = 6.00 Ω, and R5 = 4.00 Ω, are connected
as shown in figure. 18.00 V battery is attached to group.
(a) What is the equivalent resistance?
(b) Find the current supplied by the source to the circuit.
(c) Calculate the voltage drop across each resistor.



Solution:

(a) $R_{34} = (\frac{1}{R_3} + \frac{1}{R_4})^{-1} \Rightarrow R_{34} = \left(\frac{1}{3} + \frac{1}{6}\right)^{-1} \Rightarrow R_{34} = 2\ \Omega$

$R_{eq} = R_1 + R_2 + R_{34} + R_5 \Rightarrow R_{eq} = 1 + 2 + 2 + 4 \Rightarrow R_{34} = 9\ \Omega$

(b) $i_{tot} = \frac{V_{tot}}{R_{eq}} \Rightarrow i_{tot} = \frac{18}{9} \Rightarrow i_{tot} = 2\ A$

(c) $i_1 = i_2 = i_{34} = i_5 = i_{tot} = 2\ A$

$V_1 = i_1 R_1 \Rightarrow V_1 = 2 \times 1 = 2\ V$ $\quad V_2 = i_2 R_2 \Rightarrow V_2 = 2 \times 2 = 4\ V$

$V_3 = V_4 = V_{34} = i_{34} R_{34} \Rightarrow V_3 = V_4 = 2 \times 2 = 4\ V$ *and* $V_5 = i_5 R_5 \Rightarrow V_5 = 2 \times 4 = 8\ V$

19- Solve problems on multiloop circuits.

Apply Kirchhoff's loop rule to single loop circuits.

20- Express Kirchhoff's loop rule mathematically and apply in problem solving

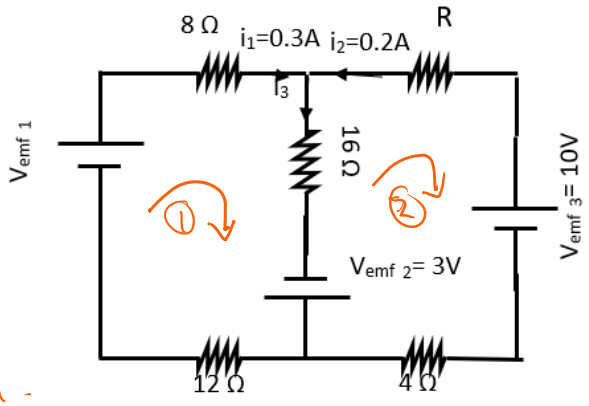
Solve problems on multiloop circuits.

Q46: Depending on the data in the circle shown in the figure, calculate

.a- The current passing through R= 16Ω .

.b- Electromotive force V_{emf1}.

c- The unknown resistance R.



(a) $I_{in} = I_{out}$

$I_3 = I_1 + I_2 \Rightarrow I_3 = 0.3 + 0.2 = 0.5\ A.$

(b) loop ①

$V_{emf,1} - (0.3 \times 8) - (0.5 \times 16) + 3 - (0.3 \times 12) = 0$

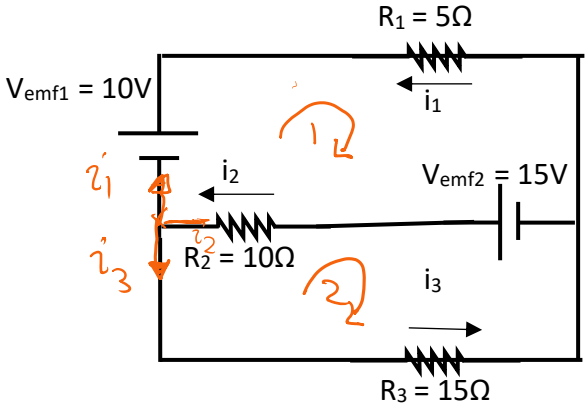
$V_{emf,1} = 11\ V$

(c) loop ②

$0.2R - 10 + (0.2 \times 4) - 3 + (0.5 \times 16) = 0$

$R = 21\ \Omega$

Q47: Depending on the data in the circuit shown in the figure, determine the magnitude of the currents i_1, i_2, and i_3 flowing through R_1, R_2, and R_3 respectively in the direction indicated in the .figure using Kirchhoff's current law and Kirchhoff's voltage law .



$i_1 + i_2 - i_3 = 0 \longrightarrow ①$

loop ①

$-10 + 5i_1 + 15 - 10i_2 = 0$

$5i_1 - 10i_2 = -5 \longrightarrow ②$

loop ②

$-15 + 15i_3 + 10i_2 = 0$

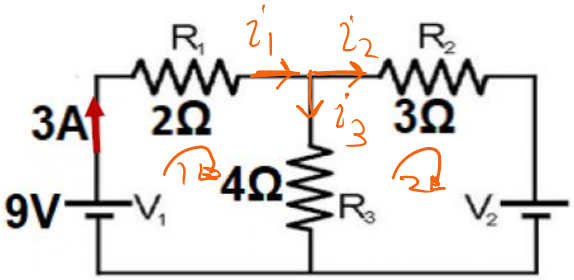
$10i_2 + 15i_3 = 15 \longrightarrow ③$

$i_1 = 0.09\ A$, $i_2 = 0.54\ A$, $i_3 = 0.63\ A.$

Q48: **In the figure bellow .**

- Find the currents in R_2 and R_3

- **potentials difference of the battery V_2.**



$3 - I_2 - I_3 = 0 \longrightarrow ①$

loop ①

$9 - 6 - 4\,i_3 = 0 \Rightarrow i_3 = 0.75\ A.$

$3 - I_2 - 0.75 = 0 \Rightarrow i_2 = 2.25\ A.$

loop ②

$-V_2 + (0.75 \times 4) + (2.25 \times 3) = 0$

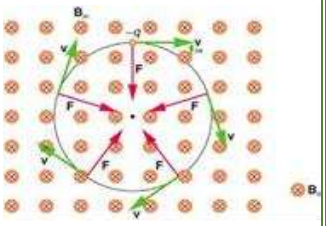
$V_2 = -3.75\ v$

*** Magnetic force on charged particle:**

If a charged particle moves in a direction that does not parallel the magnetic field, it is affected by a magnetic force

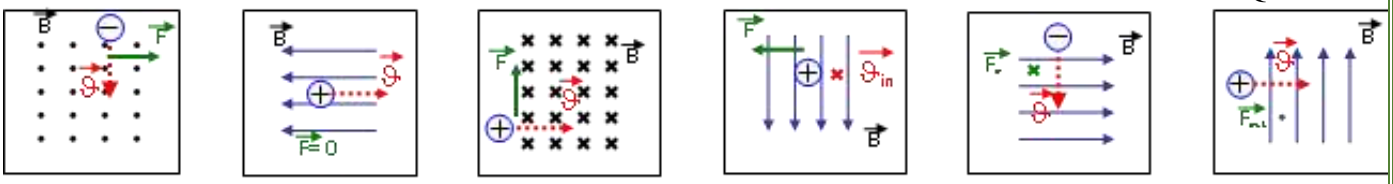
Given by: $\vec{F}_B = q\ \vec{v} \times \vec{B}$

where $(B_\perp = B\ Sin\theta)$ $F = q\ v\ B_\perp$ F= q v B Sinθ



*** Determining the direction of magnetic force on a charged particle:**

The first right-hand rule: "We put the fingers of the right hand; the thumb, the index, and the middle finger, perpendicular to each other, so that the thumb points in direction of the particle velocity and the index finger points in direction of the field, so the middle will be in the direction of the force if the charge is positive. (reverse direction if the charge is negative.)



- Radius of the circular path of a charged particle:

The magnetic force acts on the particle in a direction perpendicular to its velocity, always and continuously, which forces the particle to move in a circular path and the magnetic force is then the centripetal force:

$$F_c = F_B \quad \Rightarrow \quad \frac{mv^2}{r} = qv_\perp B \quad \Rightarrow \quad r = \frac{mv_\perp}{qB}$$

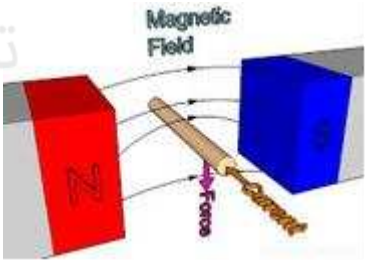
The radius can also be expressed in terms of the momentum of transverse motion of the particle: $P_t = mv_\perp$

$$r = \frac{P_t}{qB}$$

- **The magnetic force on a current carrying conductor:**

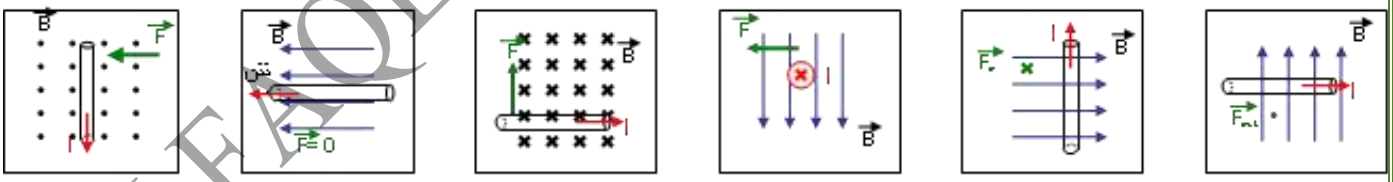
If a wire of length ℓ carrying current I is placed in a magnetic field B⊥ in a direction that are not parallel to the field It is affected by the magnetic force Fwire .Given by the equation:

$$\vec{F}_B = i\vec{L} \times \vec{B} \quad \Longrightarrow \quad F = B_\perp iL \quad or \quad F = BiL\,Sin\theta$$



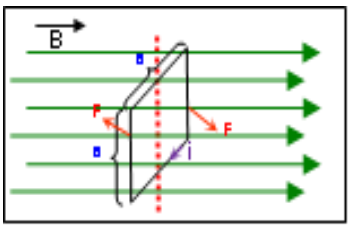
- Determine the direction of magnetic force on a current carrying conductor:

The first right-hand rule: " We put the fingers of the right hand; the thumb, the index, and the middle finger, perpendicular to each other, such that, the thumb points in direction of the conventional current and the index finger points in direction of the field, so the middle will be in the direction of the magnetic force on the wire.



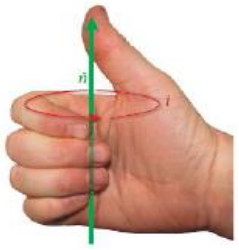
- **Torque on a current carring loop: $\vec{\tau}$**

When current carrying loop is placed in a magnetic field, its two sides are affected by two equal magnetic forces that are opposite in direction, these forces create a torque that tends to rotate the loop around its axis which is perpendicular to the field. The torque of magnetic force is given by the formula:



$$\vec{\tau} = NiA \times \vec{B} \quad \textbf{with magnitude equals} \quad \tau = NiA\ B\ Sin\theta$$

(θ is the angle between the unit vector n̂ that perpendicular to the plane of the coil and the magnetic field B .)



- **The second right-hand rule:** "If you curl the fingers of your right-hand in the direction of the conventional current in the loop, your thumb points in the direction of magnetic dipole moment vector $\vec{\mu}$ represented by the unit normal vector $\vec{n}$."
-

Extra Questions:

Q49: . A proton is accelerated from rest by a potential difference of 400. V. The proton enters a uniform magnetic field and follows a circular path of radius 20.0 cm. Determine the magnitude of the magnetic field.

$m_p = 1.67 \times 10^{-27}$ kg

$v = \sqrt{\frac{2q\Delta V}{m}} = \sqrt{\frac{2 \times 1.6 \times 10^{-19} \times 400}{1.67 \times 10^{-27}}} = 2.78 \times 10^5$ m/s.

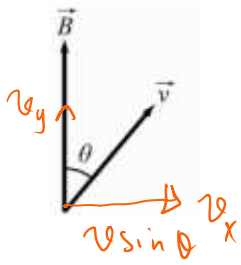
$r = \frac{mv}{qB} \Rightarrow B = \frac{mv}{qr} = \frac{1.67 \times 10^{-27} \times 2.78 \times 10^5}{1.6 \times 10^{-19} \times 0.2} = 0.014$ T.

Q50: An electron with a speed of 4.0×10^5 m/s enters a uniform magnetic field of magnitude 0.040 T at an angle of 35° to the magnetic field lines. The electron will follow a helical path.

a) Determine the radius of the helical path.

b) How far forward will the electron have moved after completing one circle?

(a) $r = \frac{m v_\perp}{|q| B} = \frac{9.11 \times 10^{-31} \times 4 \times 10^5 \sin 35}{1.6 \times 10^{-19} \times 0.04} = 3.26 \times 10^{-5}$ m.



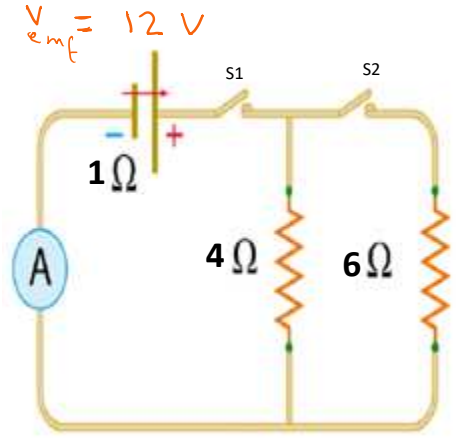
(b) $t = \frac{2\pi r}{v_\perp} = \frac{2\pi \times 3.26 \times 10^{-5}}{(4 \times 10^5 \sin 35)} = 8.76 \times 10^{-10}$ s.

$d = v_\parallel t = 4 \times 10^5 \cos 35 \times 8.76 \times 10^{-10} = 2.87 \times 10^{-4}$ m.

Q51: In the figure shown , Find the reading of the ammeter in the following cases :

A) When the switch s1 closed .

B) When the switch s1 and s2 closed .



(A) $I = \frac{V_{emf}}{R_{eq}} = \frac{12}{(4+1)} = 2.4\ A.$

(B) $R_{eq} = \left(\frac{4 \times 6}{4+6}\right) + 1 = 3.4\ \Omega.$

$I = \frac{12}{3.4} = 3.5\ A.$

Q52: The magnitude of the magnetic force on a particle with charge –2e moving with speed v = 1.0×10^5 m/s is 3.0×10^{-18} N. What is the magnitude of the magnetic field component perpendicular to the direction of motion of the particle?

$F_B = |q| v B \sin\theta \Rightarrow B = \frac{F_B}{2q_e v \sin 90} = \frac{3 \times 10^{-18}}{2 \times 1.6 \times 10^{-19} \times 1 \times 10^5}$

$B = 9.36 \times 10^{-5}\ T.$

Q53: The graph shows the charge versus time for an RC circuit. Using the graph shown: What is the charge on the capacitor after 2τ .

a- 0.18 mC b- 0.40 mC c- 1.00 mC d- 1.40 mC