ملزمة الوحدة الخامسة Resistance and Current التيار والمقاومة باللغة الانجليزية

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المزيد من مادة فيزياء:	ملفات ا كتب للمعلم ا كتب للطالب ا اختبارات الكترونية ا اختبارات ا حلول ا عروض بوربوينت ا أوراق عمل منهج انجليزي ا ملخصات وتقارير ا مذكرات وبنوك ا الامتحان النهائي ا للمدرس
	إعداد: يوسف ضهير

التواصل الاجتماعي بحسب الصف الثاني عشر المتقدم

صفحة المناهج الإماراتية على فيسبوك					
المواد على تلغرام	التربية الاسلامية	اللغة العربية	اللغة الانجليزية	الرياضيات	

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2	شرح وأوراق عمل الدرسين الأول والثاني من الوحدة الخامسة التيار والمقاومة منهج انسباير
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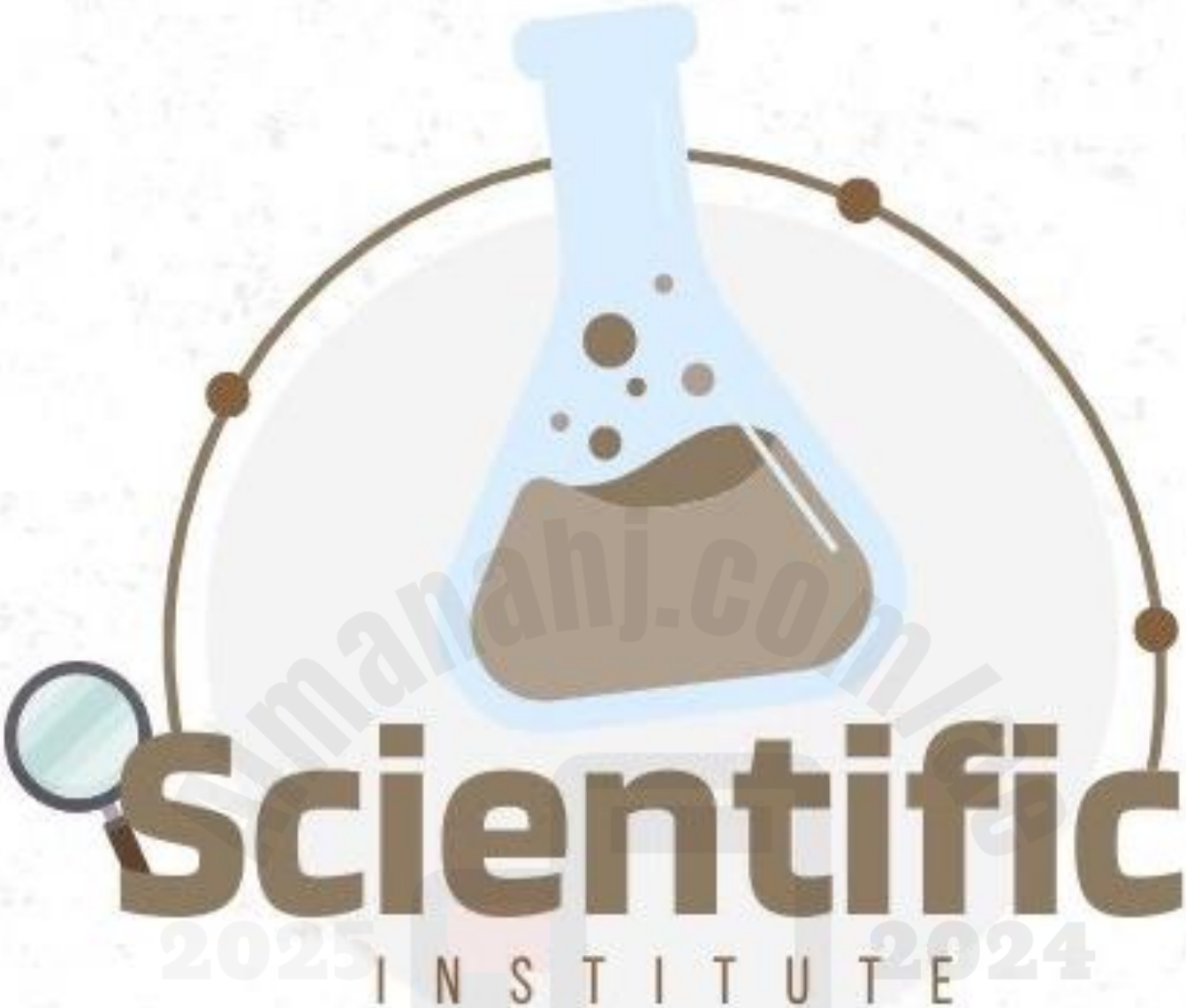
5	أسئلة اختبار الوحدة الخامسة التيار والمقاومة وفق منهج بريدج



physics

12ADV - 2025/2024

Unit (5) - Current and resistance

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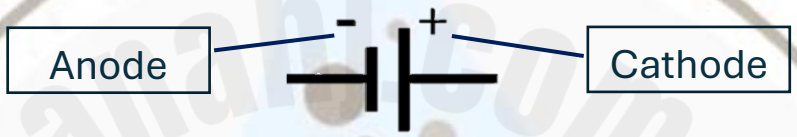
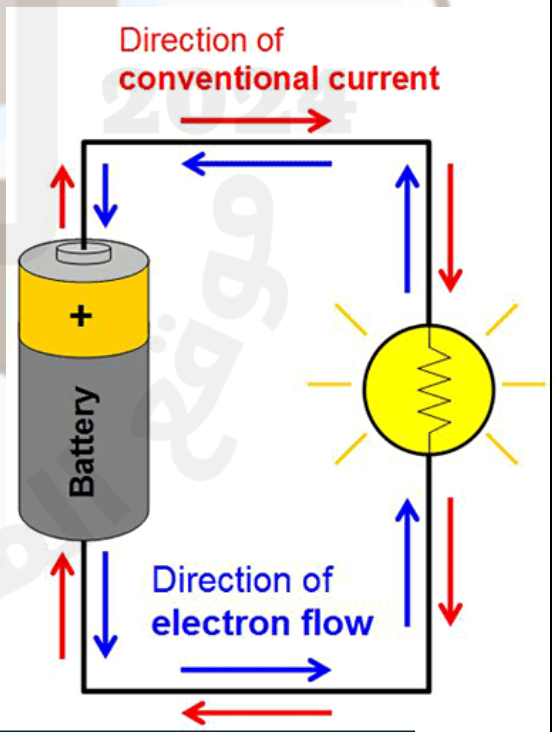
Battery

- A battery consists of a pair of electrodes with (usually opposite charges)
- the two poles must have a difference in electric potential V between them.
- The taller part of the battery is called the cathode, which has a positive charge and a higher electric potential.

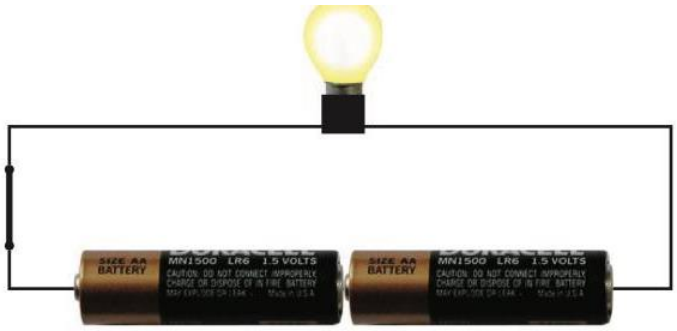


Electron moving direction

- **Inside the battery**: it gives electrons energy by moving them from high potential (cathode) to low potential (anode).
  #This process stores potential energy within the electrons.
- **Outside the battery:** the difference in electric potential V between the two poles causes electrons to move from the low-potential terminal (anode) to the high-potential terminal (cathode).



#As the electrons move between the battery poles, they gain energy that is delivered to the circuit components.



(e)

If two batteries are placed in the same orientation (series)

↓

the energy provided to the electrons will <u>increase</u>

↓

resulting in <u>more</u> energy being delivered to the circuit components

The wire carries electrons and is assumed to have zero resistance in this context, meaning <u>no</u> energy is lost as electrons pass through it.

Circuit components like lights, resistors, and others take energy from the electrons as they move through the circuit.

5.1

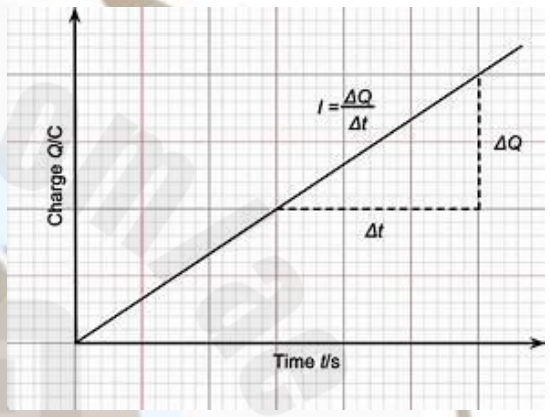
Lesson 1 – Electric Current

Electric current: is defined as the net charge passing through a point at a given time.

The **unit** of electric current is: (A) Ampere - equivalent to (C/s)

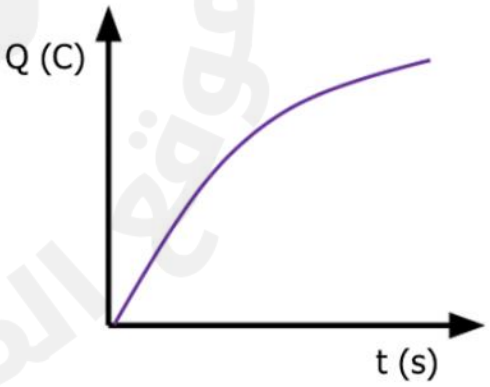
The formula for Electric current if the passing charge per second graph was linear **(straight line)** is:

$$q/t$$



If the charge passing through the wire is not constant (the graph is **not a straight line**) then the current is different each second and we need to use the differential form to find the current

$$dq/dt$$

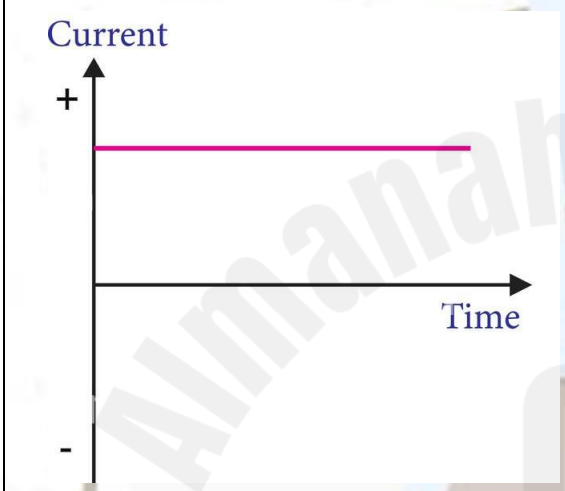
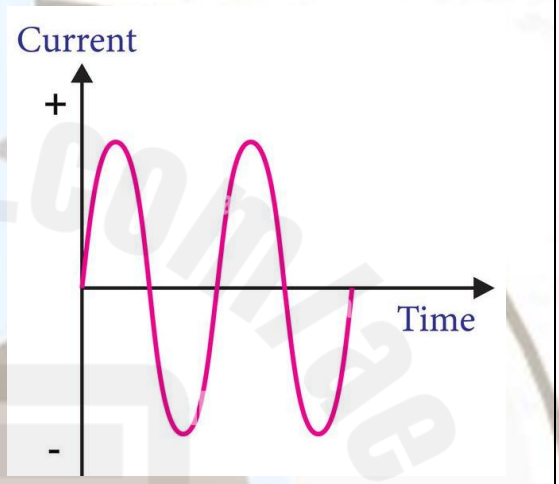


If we want to find the charge passing the wire through a time interval

for example, the charge passing the wire between t = 1s and t = 3s we need to use integration of I as a function of t

5.1

two types of current

Direct current	Alternating current
constant current that flows in only one direction	current that flows in two directions with no constant magnitude.
	

Important Notes

- Charge cannot be created or destroyed which means the charge (current) that gets into a conductor must leave with same magnitude.
- In metal conductor's electrons move consequently, but they move randomly in every direction, so there is no net charge moving.
- Charge could be measured by mAh which is equivalent to 3.6 C.

5.1

Direction of current

Is from high electric potential to low electric potential

in other words

The direction of the movement of the positive charge

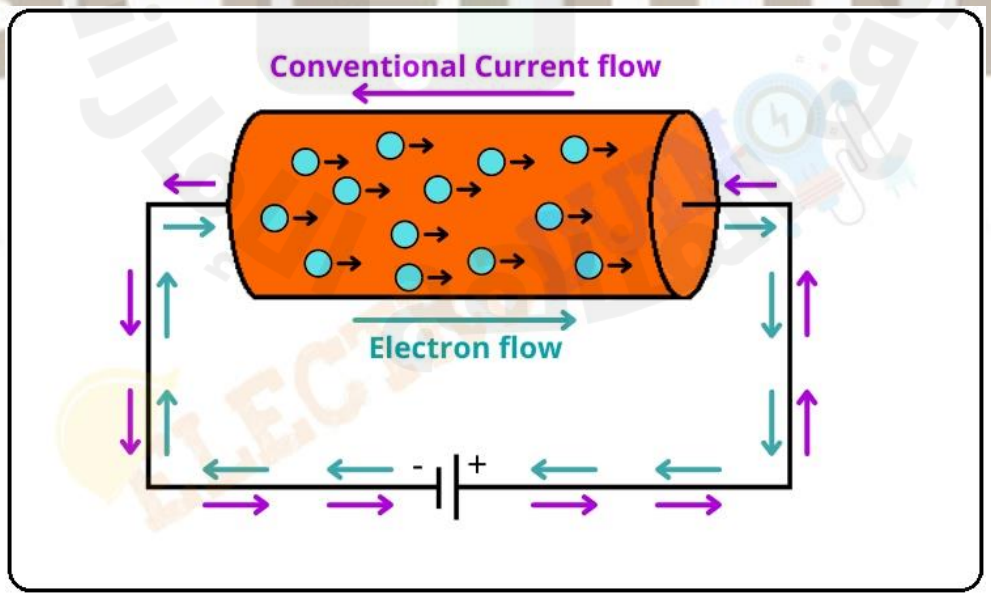
or

the direction of the electric field

this current is called convention current (positive current).

After this definition, scientist discovered that only electrons move in the circuit and they create the electric current, and electrons move oppositely to the conventional current.

However, they did not change the definition since would assume that positive charge is move since electrons are moving from one place to another and the part that loses electrons become positive.

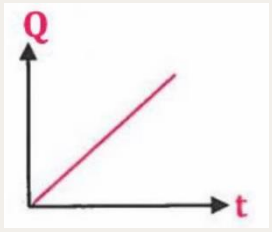


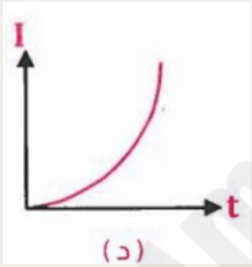
5.1

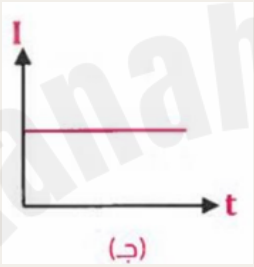
Questions

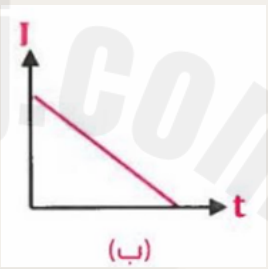
Easy

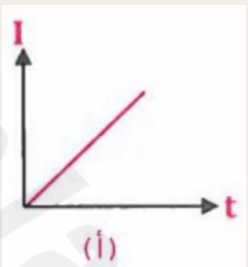
1) The graph shown represents the relationship between the amount of electric charge passing through a cross-section of a conductor and time. How can the relationship between the electric current in the conductor and time be represented graphically?











2) The total charge passing through a point over a time interval is given by the equation:

A) $q = \int_0^t 2idt^2$

B) $q = -\int_0^t idt$

c) $q = \int_0^t idt$

D) $q = \int_0^t 1/j\ dt$

3) If the relationship between charge and time is given as ($q = 5t^2 + 7t + 9$) in mA, what is the electric current (i) at time (t=2.5)?

A) 32 mA

B) 9.0 mA

c) 42 mA

D) 18 mA

5.1

4) A metallic wire carries an electric current that varies with time according to the equation $i = 6t^3 - 5t^2$, where i is measured in amperes. Determine the amount of electric charge passing through a cross-section of the wire during the time interval (t=0.5 s, t = 2.0 s)

A) 10.8 C B) 37.8 C

C) 45.3 C D) 1.5 C

Medium

5) If the electric current passing through the conductor is (2A) the amount of electric charge passing through a cross-section of the conductor in one minute is:

A) 120 C B) 60 C

C) 30 C D) 2 C

6) An electric current of 1.6A flows through a conductor. The number of electrons passing through a certain cross-section in 10s is ..... electrons.

A) $16x10^{17}$ B) 10^{17}

C) 10^{19} D) 10^{16}

7) In a hydrogen gas discharge tube, it is observed that 6×10^{18} electrons flow from left to right every second, while 4×10^{18} protons flow from right to left every second. Determine the electric current and its direction.

A) 1.6 A from left to right B) 1.6 A from right to left

C) 0.8 A from left to right D) 0.8 A from right to left

5.1

9) A nurse wants to administer 80 μg of dexamethasone to the heel of an injured soccer player. If she uses an iontophoresis device that applies a current of 0.14 mA, as shown in Figure 5.4, how long does the administration of the dose take? Assume that the instrument has an application rate of 650 μg/C and that the current flows at a constant rate.

10) A typical rechargeable AA battery is rated at 700 mAh. How long can this battery provides a current of 100 μA?

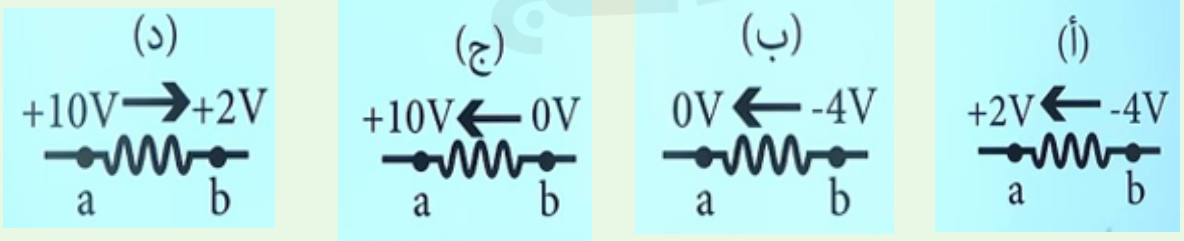
Hard

11) If i is current, t is time, E is electric field intensity, and x is distance, the ratio of $\int idt$ to $\int Edx$ may be expressed in

A) coulombs B) joules

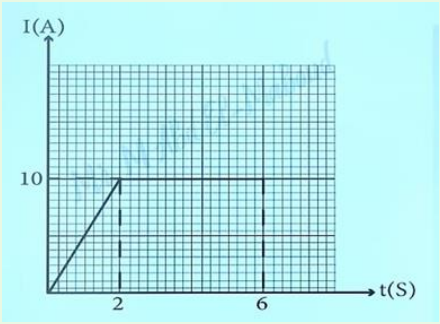
C) newtons D) farads E) henrys

12) In which of the following cases does the arrow correctly represent the direction of the electric current passing through the resistor between points a and b?



5.1

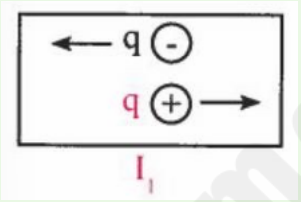
13) From the adjacent graph, determine the amount of charge passing through a cross-section of the conductor.

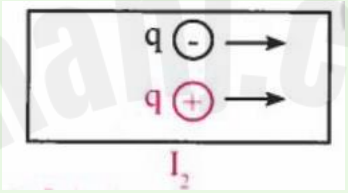


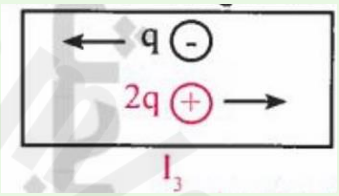
A) 10 C B) 50 C

C) 30 C D) 40 C

14) The charges shown in the figure moved in the same time interval, with the same speed, in the indicated conductors and directions. Determine the current resulting from their motion.



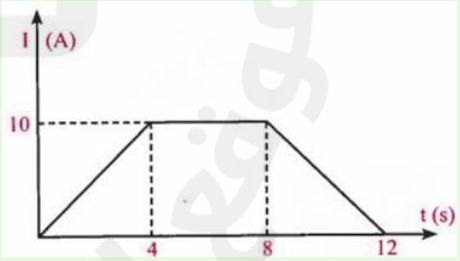




A) $I_3 > I_2 > I_1$ B) $I_3 > I_1 > I_2$

C) $I_1 = I_2 < I_3$ D) $I_1 = I_2 = I_3$

15) From the graph, determine the amount of electric charge passing through the conductor in 12 seconds.



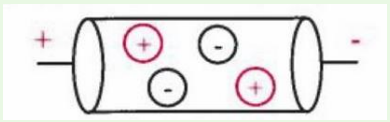
A) 120C B) 60 C

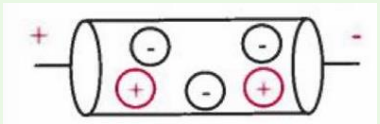
C) 80 C D) 0 C

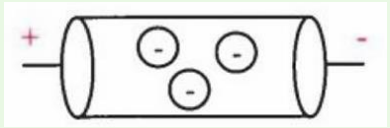
16) How many protons are in the beam traveling close to the speed of light in the Tevatron at Fermilab, which is carrying 11 mA of current around the 6.3 km circumference of the main Tevatron ring?

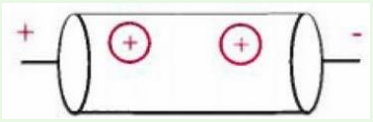
5.1

17) In the diagram, four conductors have equal amounts of electric charge. When a battery is connected to the ends of each conductor, determine which conductor will carry the highest current and which will carry the lowest current.

A) 

B) 

C) 

D) 

Very Hard

18) Assume that a beam of electrons flows at a constant rate in a straight line for one month (30 days), and the mass of the passing electrons is 0.1g . Determine the electric current.

A) 60 A

B) 6.78 A

C) 8.76 A

D) 6.2×10^{-4} A

5.2

Lesson 2 – Current Density

-Current density is a **vector** quantity

-Represents the current per unit area

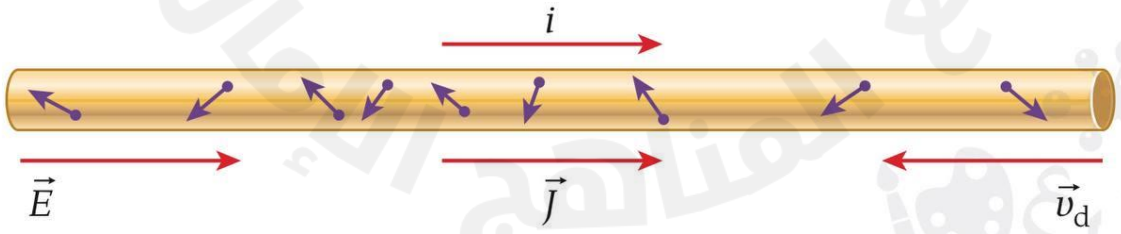
-The **unit** is: A/m^2

If we are speaking about constant current **(direct current)**, then the formula of current density J will be

$$J = i/A$$

If we are speaking about a normal wire, then the area of it will be (area of circle)

$$\pi r^2$$



5.2

Questions

Easy

19) What is the current density in an aluminium wire having a radius of 1.00 mm and carrying a current of 1.00 mA?

20) A current of 0.123 mA flows in a silver wire whose cross-sectional area is 0.923 mm^2. Find the current density in the wire assuming that the current is uniform.

Medium

21) Which of the following is not correct regarding electric current density (J) and electric current (i)?

A) The unit of current density is equal to amperes per meter

B) The unit of current density is equal to amperes per square meter

C) $j = i/A$

D) $i = \int j.dA$

5.2

22) An electric current of 2.5 A flows through a wire with a cross-sectional area A. If the wire is replaced by another wire with a radius three times that of the first wire, what will happen to the current density in the second wire?

A) It increases by a factor of 9 B) It increases by a factor of 3

C) It decreases by a factor of 1/3 D) It decreases by a factor of 1/9

23) Two conductors (a, b) have cross-sectional areas (A/2, A) respectively. If the same current passes through both wires, which of the following is correct regarding the current density in the two wires?

A) $J_a = 2J_b$ B) $J_b = 1/2J_a$

C) $J_a = 3J_b$ D) $J_a = 2J_b$

24) The electrons move through the wire as shown. If the direction of the electric field is from right to left, what is the direction of the current density J?

A) To the right B) Downward

C) To the left D) Upward

Hard

25) The number of charges flowing through a wire with a radius of (2.0 mm) each second is (4.5×10^{19}) charges. Calculate the current density J for the wire.

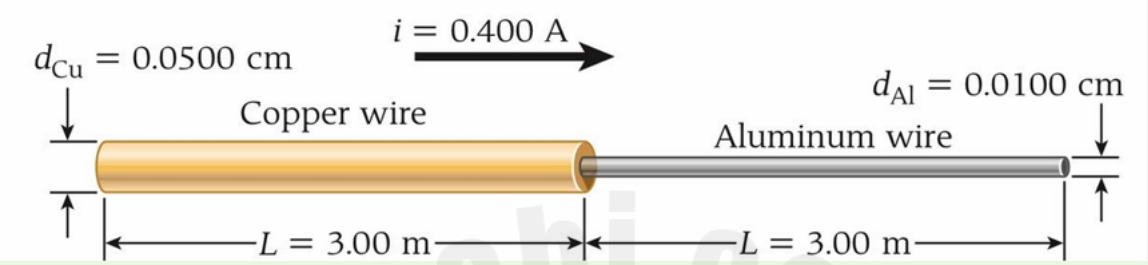
A) 3.3×10^5 A/ m^2 B) 5.7×10^5 A/ m^2

C) 8.8×10^5 A/ m^2 D) 7.5×10^5 A/ m^2

5.2

26) A copper wire has a diameter d_{cu} = 0.0500 cm, is 3.00 m long, and has a charge-carrier density of 8.50 x 10^{28} electrons/m^3. As shown in the figure, the copper wire is attached to an equal length of aluminium wire with a diameter d_{Al} = 0.0100 cm and a charge-carrier density of 6.02 x 10^{28} electrons/m^3. A current of 0.400 A flows through the copper wire.

What is the ratio of the current densities in the two wires, J_{Cu}/J_{al}



5.3

Lesson 3 – Resistivity and Resistance

To measure how much a material **allows or blocks** the movement of electrons, we use two different quantities:

Resistivity (ρ):

This measures how much the material resists the flow of electrons.

Its value **depends** on the type of material and the temperature.

The **unit** of resistivity: ohm-meter (Ω·m).

Conductivity (σ):

Conductivity is the reciprocal of resistivity; it measures how freely electrons can move through a material.

Like resistivity, it **depends** on the type of material and the temperature.

Its **unit** is : $ohm^{-1}{\cdot}meter^{-1}$ ($\Omega^{-1}{\cdot}m^{-1}$),

though this is often replaced by the **siemens** ($S{\cdot}m^{-1}$).

Resistance (R):

Resistance measures how much a material opposes the flow of electrons while relating the electric potential difference to current will be later explained in detail.

Its **unit** is: ohm (Ω).

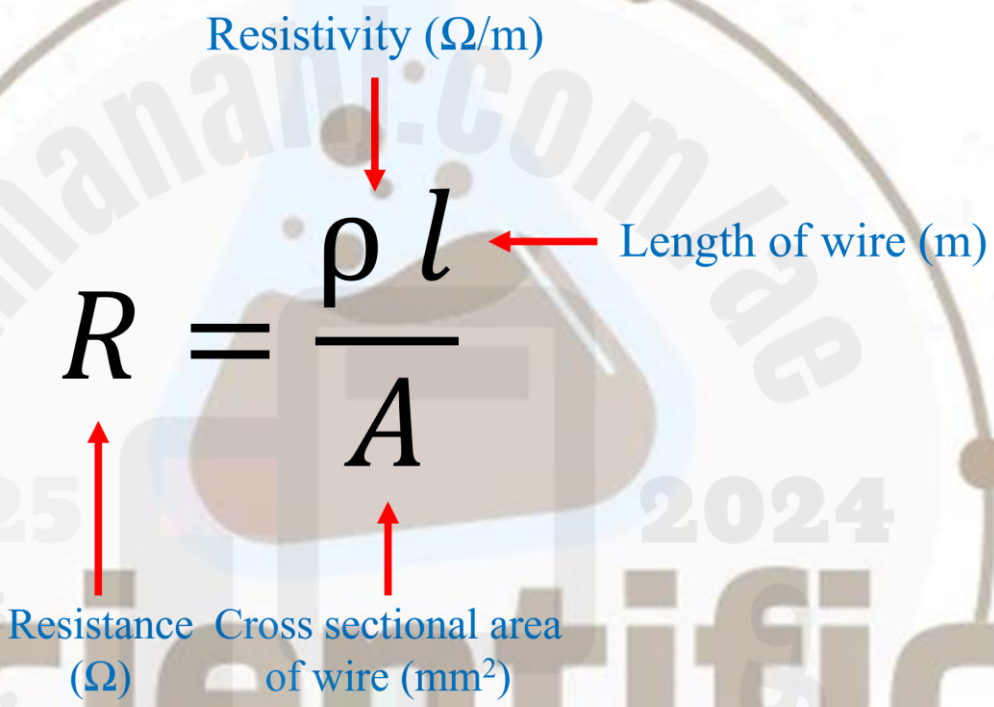
5.3

Conductance (G):

Conductance is the reciprocal of resistance. It measures how freely electrons can move through a material

Its **unit** is: siemens (S) or ohm^{-1} (Ω^{-1}).

Resistance formula:



Where the conductance G formula is the reciprocal of the resistance formula.

5.3

Formulas for solving questions

(regarding resistance)

Reshaping a conductor (such as pulling a wire):

The volume of the conductor is constant = Area × Length=

$$L_1 A_1 = L_2 A_2$$

$$\frac{L_1}{L_2} = \frac{A_2}{A_1} = \frac{r_2^2}{r_1^2}$$

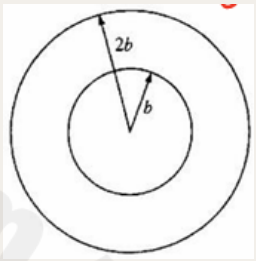
#Where the r radius determines the cross-sectional area of the wire.

5.3

Questions

Easy

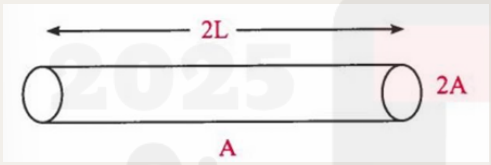
27) Two concentric circular loops of radii b and $2b$, made of the same type of wire, lie in the plane of the page, as shown above. The total resistance of the wire loop of radius b is R. What is the resistance of the wire loop of radius $2b$?

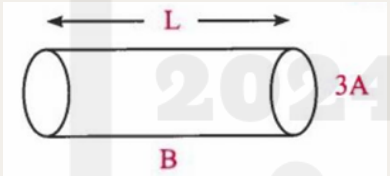


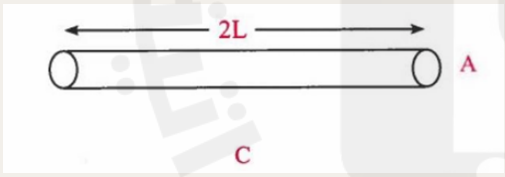
A) R/2 B) R

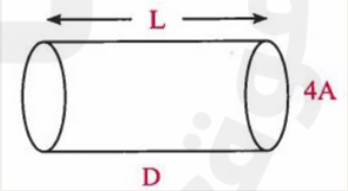
C) 2R D) 4R

28) Here are 4 conductors of uniform cross-section made of the same material but with different dimensions. The arrangement of these conductors in ascending order of their resistance, starting from the lowest to the highest, is: _____.







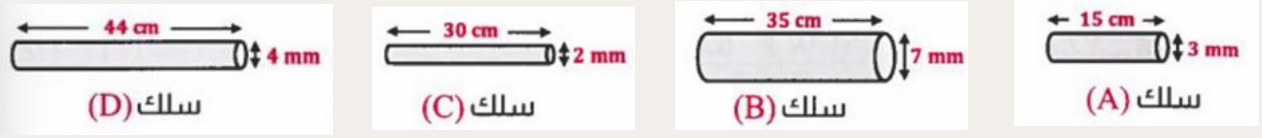


A) B → C → A → D B) D → A → C → B

C) C → A → B → D D) D → B → A → C

5.3

29) Four copper wires of different lengths and diameters:



The arrangement of the wires in terms of resistance is:

A) $R_A > R_C > R_B > R_D$

B) $R_C > R_D > R_A > R_B$

C) $R_D > R_B > R_C > R_A$

D) $R_B > R_D > R_A > R_C$

30) What is the resistance of the 100.0 m standard 12-gauge copper wire that is typically used in wiring household electrical outlets?

31) If the diameter of the wire in Example 5.2 is doubled, its resistance will:

A) increase by a factor of 4

B) increase by a factor of 2

C) stay the same

D) decrease by a factor of 2

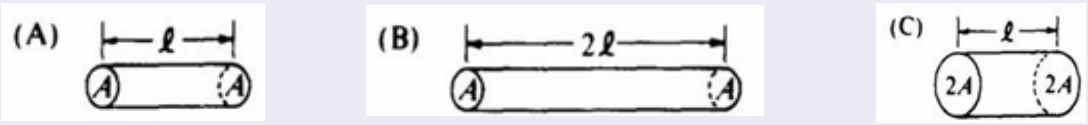
E) decrease by a factor of 4

32) What is the resistance of a copper wire of length l = 10.9 m and diameter d = 1.30 mm? The resistivity of copper is 1.72×10^{-8} Ω·m.

5.3

Medium

33) The five resistors shown below have the lengths and cross-sectional areas indicated and are made of material with the same resistivity. Which has the greatest resistance?



34) A wire of length L and radius r has a resistance R. What is the resistance of a second wire made from the same material that has a length L/2 and a radius r/2?

A) 4R B) 2R

C) R D) R/2

Hard

35) A wire made of a material with a resistance of 10 Ω is stretched to four times its original length. What is its new resistance?

A) 10 Ω B) 40 Ω

C) 80 Ω D) 160 Ω

36) Two copper wires: The first has a radius of r and an electrical conductivity coefficient of σ_1. The second has a diameter of 2r and an electrical conductivity coefficient of σ_2. At a constant temperature, which of the following relations is correct?

A) $\sigma_1 = 2\sigma_2$ B) $\sigma_1 = \sigma_2 / 4$

C) $\sigma_1 = 4\sigma_2$ D) $\sigma_1 = \sigma_2$

5.3

37) A wire with a resistance of R is stretched such that its length increases to three times its original length. What will its new resistance be?

A) 9R B) R/9

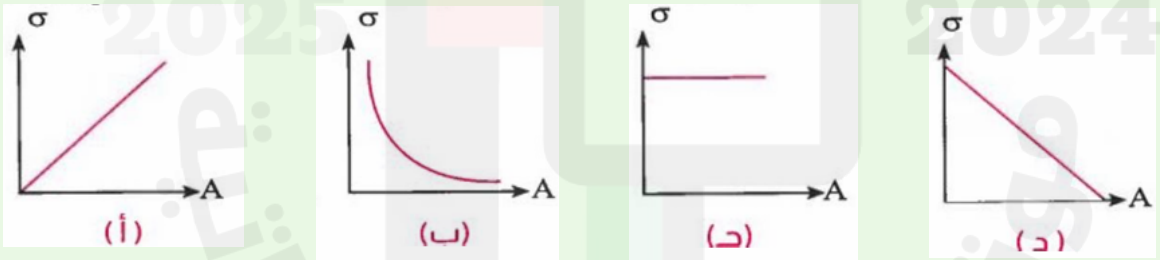
C) 3R D) R/3

38) Two wires made of the same material: If the diameter of the first wire is 3 times the diameter of the second wire, and the resistance of the second wire is 4 times the resistance of the first wire, then the length of the second wire is _____ times the length of the first wire.

A) 4/3 B) 4/9

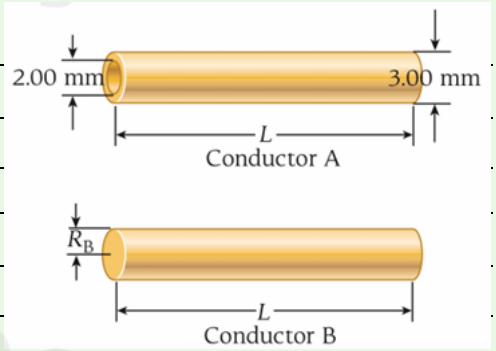
C) 72/2 D) 36/3

39) The correct graph between electrical conductivity and cross-sectional area is _____.



5.3

40) 5.33 Two conductors are made of the same material and have the same length L. Conductor A is a hollow tube with inside diameter 2.00 mm and outside diameter 3.00 mm; conductor B is a solid wire with radius RB. What value of RB is required for the two conductors to have the same resistance measured between their ends?



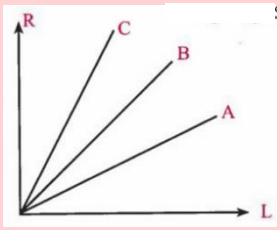
41) A rectangular wafer of pure silicon, with resistivity ρ = 2300 Ω·m, measures 2.00 cm by 3.00 cm by 0.0100 cm. Find the maximum resistance of this rectangular wafer between any two faces.

42) A copper wire that is 1.00 m long and has a radius of 0.500 mm is stretched to a length of 2.00 m. What is the fractional change in resistance, ΔR/R, as the wire is stretched? What is ΔR/R for a wire of the same initial dimensions made out of aluminium?

5.3

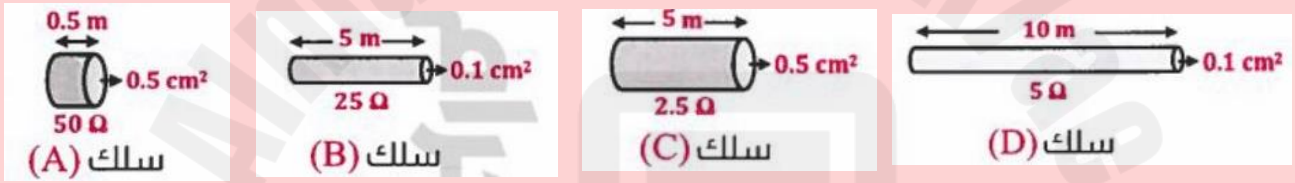
Very Hard

43) The diagram represents the relationship between the resistance R and the length of the wire L for three different materials (A, B, C) with equal cross-sectional areas. The arrangement of the electrical conductivity is:



A) $\sigma_C < \sigma_B < \sigma_A$ B) $\sigma_A < \sigma_B < \sigma_C$ C) $\sigma_B < \sigma_A < \sigma_C$

44) a)) Four wires made of different materials, with varying lengths, types, cross-sectional areas, and resistances are shown:



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b)) The arrangement of wires based on resistivity is:

A) $(pe)_A > (pe)_B > (pe)_C > (pe)_D$ B) $(pe)_D > (pe)_C > (pe)_B > (pe)_A$

C) $(pe)_B > (pe)_C > (pe)_D > (pe)_A$ D) $(pe)_A > (pe)_D > (pe)_C > (pe)_B$

---

c)) The arrangement of the wires based on electrical conductivity is:

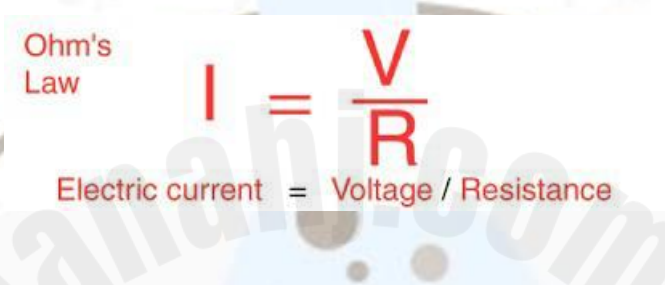
A) $\sigma_A > \sigma_C > \sigma_B > \sigma_D$ B) $\sigma_D > \sigma_C > \sigma_B > \sigma_A$

C) $\sigma_B > \sigma_C > \sigma_D > \sigma_A$ D) $\sigma_A > \sigma_D > \sigma_C > \sigma_B$

Lesson 4 – Electromotive Force and Ohm's Law

Ohms law

states that current is inversely proportional to the resistance and directly proportional to change in electric potential.



Important note :Electric potential difference and resistance are **independent** factors which affect the current.

If current in a circuit is increased that means either

the resistance is decreased by changing the resistor

or the change in electric potential is increased by changing the battery (emf source).

Electromotive force EMF

is basically the potential difference created by the emf source usually battery.

but it's said force since this change pushes the electrons and stores energy in them.

5.4

In simple circuit with an EMF source (battery) and a resistor

↓

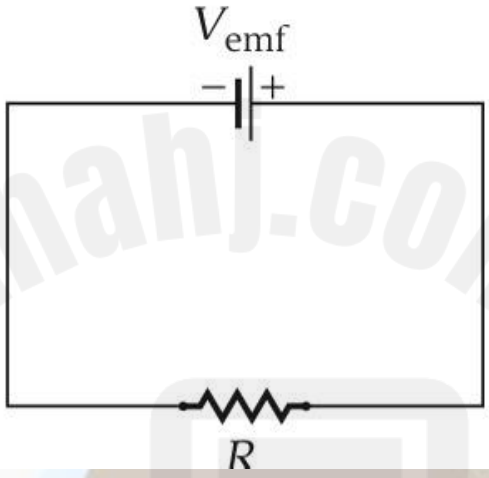
The battery increases the potential

↓

which is decreased in the resistor (potential drop)

↓

and the cycle continues.



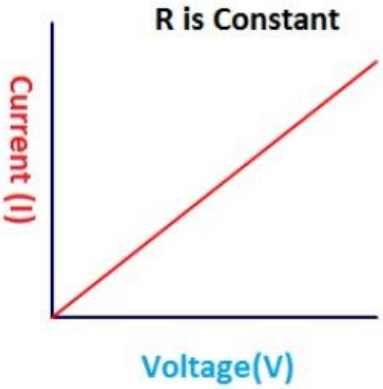
law of conservation of energy

The increase in electric potential must equal to the potential drop since the potential difference in any close path is always equal to 0.

Ohmic resistors

Are resistors that obey ohms law in which the graph of the electric current vs electric potential difference is straight line:

5.4

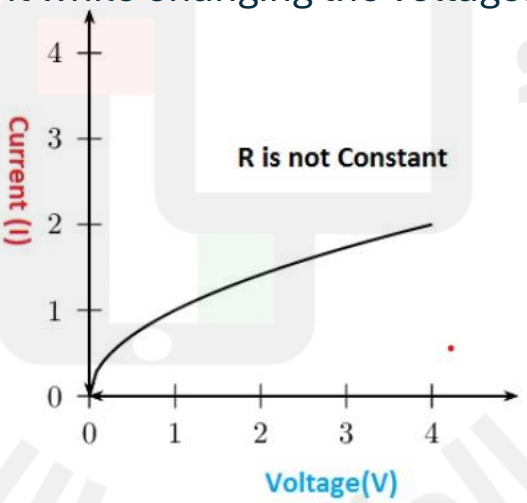


Note 1: electric potential difference is the independent factor that's why it is on the x-axis.

Note 2: The graph could have minor errors, however we estimate it is a straight line usually this is because the resistance of the wire and the temperature.

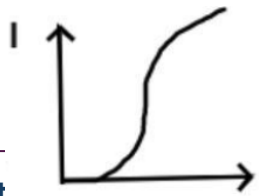
Non-Ohmic resistors

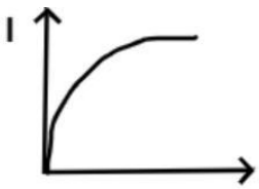
Resistors that don't follow ohms law in which resistance is changing with current while changing the voltage:



Non-Ohmic Devices Graph

Note: the graph could have any shape rather than a straight line.



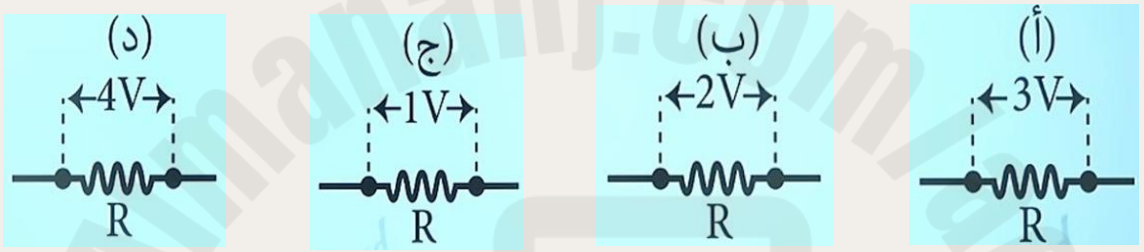


5.4

Questions

Easy

44) In which of the following cases is the current intensity through the resistance R the greatest?



45) One brand of 12.0 V automotive battery used to be advertised as providing "600 cold-cranking amps." Assuming that this is the current the battery supplies if its terminals are shorted, that is, connected to negligible resistance, determine the internal resistance of the battery. (IMPORTANT: Do not attempt such a connection as it could be lethal!)

5.4

Medium

46) A potential difference of 12.0 V is applied across a wire of cross-sectional area 4.50 mm^2 and length 1000 km. The current passing through the wire is 3.20×10^{-3} A.

What is the resistance of the wire?

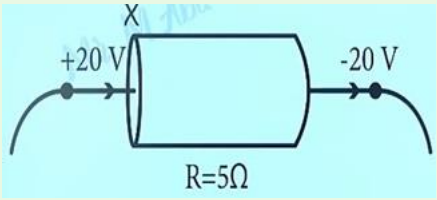
47) A copper wire has radius r = 0.0250 cm, is 3.00 m long, has resistivity $\rho = 1.72 \times 10^{-8}$ Ω·m, and carries a current of 0.400 A. The wire has a charge-carrier density of 8.50×10^{28} electrons/m^3.

a))What is the resistance of the wire?
b)) What is the electric potential difference, ΔV, across the wire?
c)) What is the electric field, E, in the wire?

5.4

Hard

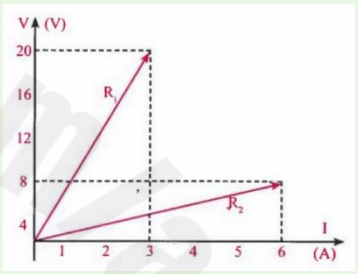
48) In the given diagram, the current intensity passing through cross-section X is _____.



A) 20 A B) 40 A

C) 8 A D) 200 A

48) In the diagram, the relationship between the voltage difference and the current intensity for two resistors, R1/R2, is _____.



A) 10/5 B) 1/5

C) 5 D) 2

49) A potential difference of 12 V is required to move 6.5×10^{18} electrons between the two ends of a conductor in two seconds. The resistance of the conductor is:

A) 23 Ω B) 121 Ω

C) 6 Ω D) 3.84 Ω

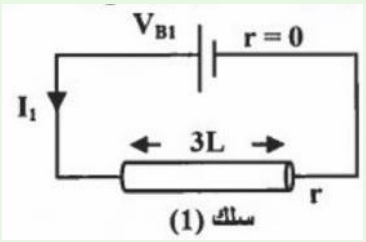
50) When the current I in a conductor of length L and cross-sectional area A is tripled by changing the battery used, the cross-sectional area of the conductor becomes:

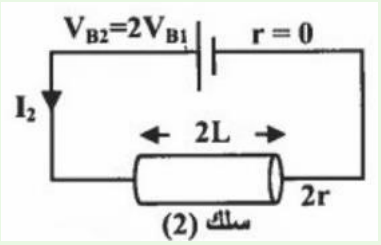
A) A B) 3 A

C) 1/3 A D) 6 A

5.4

51) Two wires made of the same material: The first wire has a length L and a radius r, while the second wire has a length 2L and a radius 2r. The ratio between I_1/I_2 is:





A) 12/1

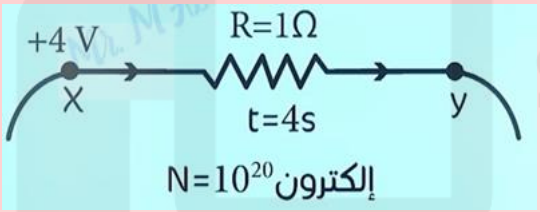
B) 1/12

C) 3/2

D) 1/6

Very Hard

52) In the given diagram, the value of the potential at point Y is _____.



A) 16 V

B) 4 V

C) 0 V

D) -4 V

5.5

Lesson 5 – Resistors in Series

Series circuits

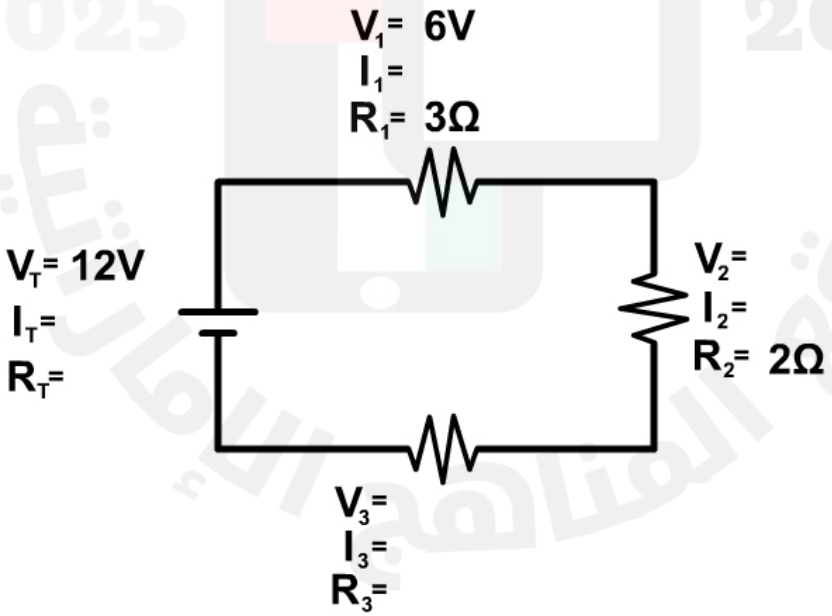
In series circuits the electric current across all devices are equal.

- The electric potential supplied by the battery is shared.

  (Usually unequally in which the largest resistance has the largest potential)

- The **sum of the voltage** across each device equals the voltage of the battery.

- The **total resistance** is the sum of all resistances, and it is always larger than any device resistor.



5.5

Ohm's Law	Series Rules
$V = IR$	$V_T = V_1 + V_2 + V_3 + \cdots$
$I = \frac{V}{R}$	$I_T = I_1 = I_2 = I_3 = \cdots$
$R = \frac{V}{I}$	$R_T = R_1 + R_2 + R_3 + \cdots$

Internal resistance

Sometimes the EMF source has its own resistance we consider the internal resistance as a resistor connected in series.

The V_{emf} is shared between the devices and the internal resistance, we could find it by finding total resistance adding the internal resistance.

$$V_{emf} = i\,(R_{eq} + R_i)$$

The delta V equals the potential difference supplied to the circuit's components.

Note: If one device is burned all devices stop working.

5.5

Questions

Easy

53) A light bulb is connected to a source of emf. There is a 6.20 V drop across the light bulb and a current of 4.10 A flowing through the light bulb.
a) What is the resistance of the light bulb?

54) Which of the following is an incorrect statement?

A) The currents through electronic devices connected in series are equal.

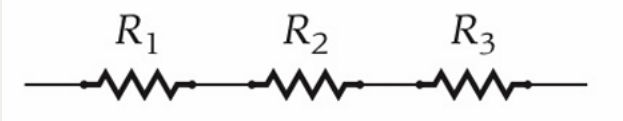
B) The potential drops across electronic devices connected in parallel are equal.

C) More current flows across the smaller resistance when two resistors are connected in parallel.

D) More current flows across the smaller resistance when two resistors are connected in series.

5.5

55) 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.

Medium

56) A resistor of unknown resistance and a 35.0-Ω resistor are connected across a 120. V emf device in such a way that an 11.0 A current flows. What is the value of the unknown resistance?

5.5

57) A battery has a potential difference of 14.50 V when it is not connected in a circuit. When a 17.91 Ω resistor is connected across the battery, the potential difference of the battery drops to 12.68 V. What is the internal resistance of the battery?

58) Consider a battery that has V_t = 12.0 V when it is not connected to a circuit. When a 10.0-Ω resistor is connected with the battery, the potential difference across the battery's terminals drops to 10.9 V. What is the internal resistance of the battery?

59) The emf of a battery is 12 volts. When the battery delivers a current of 0.5 ampere to a load, the potential difference between the terminals of the battery is 10 volts. The internal resistance of the battery is:

A) 1 Ω B) 2 Ω

C) 4 Ω D) 20 Ω E) 24 Ω

Hard

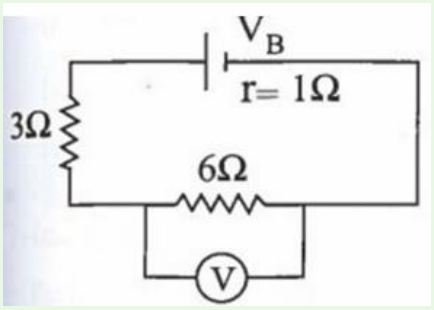
60) When a battery is connected to a 100. Ω resistor, the current is 4.00 A. When the same battery is connected to a 400. Ω resistor, the current is 1.01 A. Find the emf supplied by the battery and the internal resistance of the battery.

5.5

62) In the circuit shown, if the voltmeter reads 12 V, the emf of the battery V_B is:

A) 18 V B) 19 V

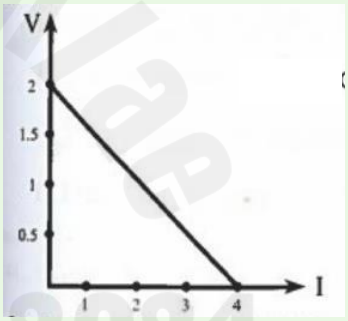
C) 20 V D) 21 V



63) The following diagram shows the relationship between the potential difference across the terminals of a battery and the current flowing through a closed circuit. The internal resistance of this column is:

A) 1.5 Ω B) 0.5 Ω

C) 2 Ω D) 4 Ω



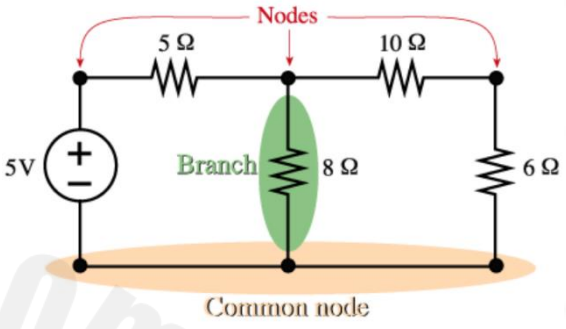
5.6

Lesson 6 – Resistors in Parallel

Parallel circuits

The current goes out of the battery and is distributed across the branches.

In parallel circuits a branch is a path between two points, each called **nodes**.



The **voltage** across each branch is equal,

but the **current** is different in which the lowest branch resistor has the largest resistance.

$$V_p = V_1 = V_2 = \dots V_x$$

The sum of the **currents** in each branch must equal the total current that goes from the battery.

$$I_p = I_1 + I_2 \dots I_x$$

The total **resistance** is calculated using the following formula:

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

To calculate the **total current**, we could use the total resistance and the potential difference supplied by the emf source.

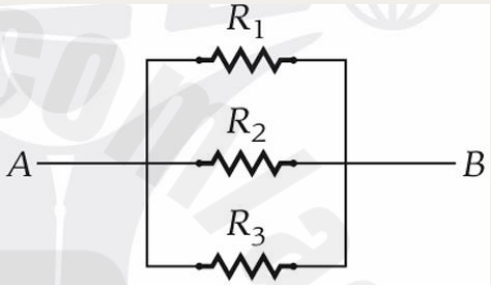
Note: If one branch is burned the other branches of parallel circuit will remain functioning

5.6

Questions

Easy

64) Three identical resistors, R_1, R_2, and R_3, are wired together as shown in the figure. An electric current is flowing from point A to point B. The current flowing 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.

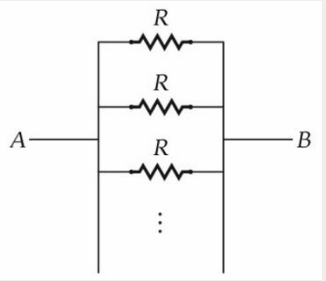
C) is twice the sum of the current through R_1 and R_3.

D) is three times the current through R_1 and R_3.

E) cannot be determined.

5.6

65) Three identical resistors, R_1, R_2, and R_3, are wired together as shown in the figure. An electric current is flowing from point A to point B. The current flowing through R_2:



A) increase B) stay the same

C) decrease D) change in an unpredictable manner

66) You make a parallel connection between two resistors, resistor A having a very large resistance and resistor B having a very small resistance. The equivalent resistance for this combination will be:

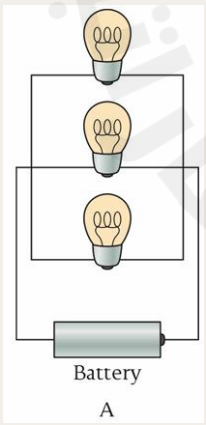
A) slightly greater than the resistance of resistor A

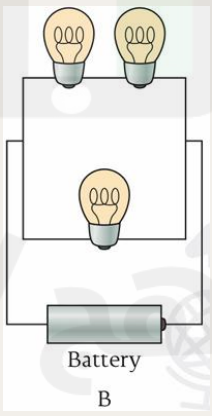
B) slightly less than the resistance of resistor A

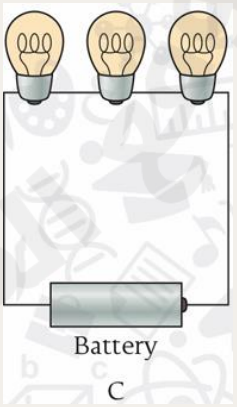
C) slightly greater than the resistance of resistor B

D) slightly less than the resistance of resistor B

67) Which of the arrangements of three identical light bulbs shown in the figure draws the most current from the battery?





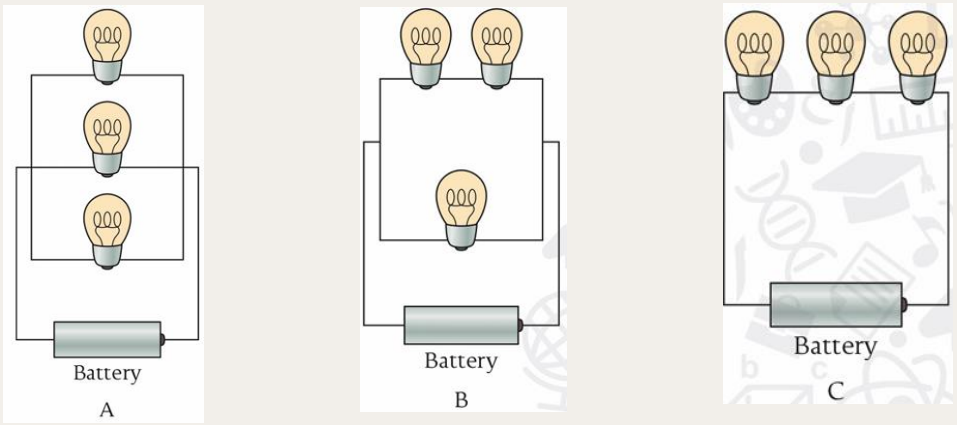


A) A B) B D) All three draw equal current

C) C E) A and C are tied for drawing the most current

5.6

68) Which of the arrangements of three identical light bulbs shown in the figure has the highest resistance?



A) A B) B D) All three draw equal current

C) C E) A and C are tied for having the highest resistance

69) Which of the following is an incorrect statement?

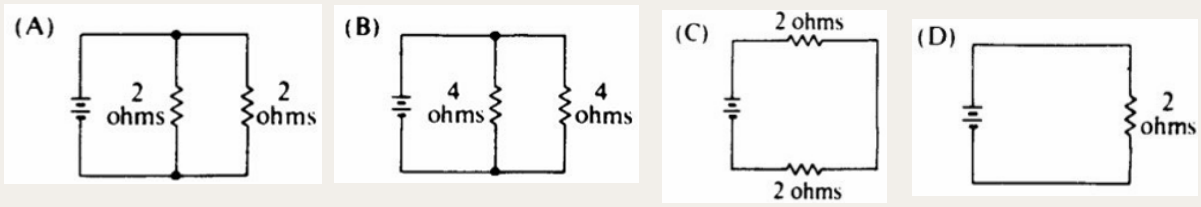
A) The currents through electronic devices connected in series are equal.

B) The potential drops across electronic devices connected in parallel are equal.

C) More current flows across the smaller resistance when two resistors are connected in parallel.

D) More current flows across the smaller resistance when two resistors are connected in series

5.6

70) 

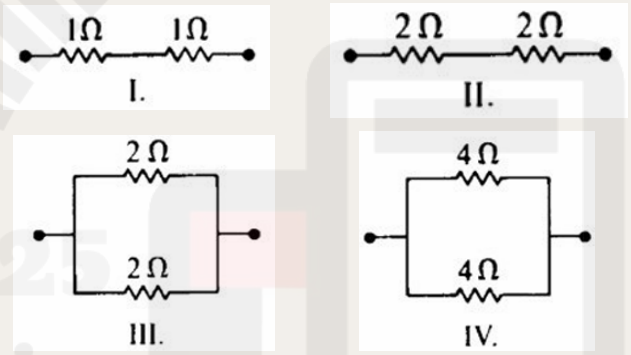
The batteries in each of the circuits shown above are identical and the wires have negligible resistance.

a)) In which circuit is the current furnished by the battery the greatest?

(A) (B) (C) (D) (E)

b)) In which circuit is the equivalent resistance connected to the battery the greatest?

(A) (B) (C) (D) (E)

71) 

Multiple Correct. Which arrangements of resistors shown above have the same resistance between the terminals? Select two answers.

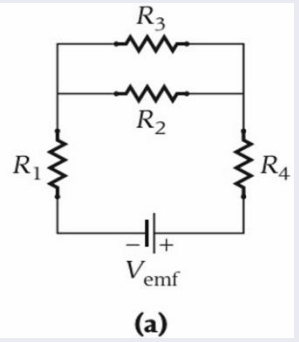
A) I B) II

C) III D) IV

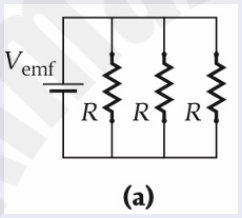
5.6

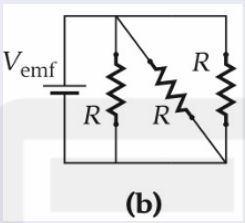
Medium

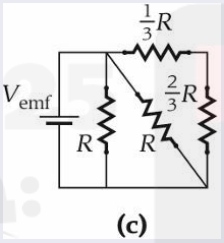
72) The circuit shown in Figure 5.20a has four resistors and a battery with V emf = 149 V. The values of the four resistors are R_1 = 17.0 Ω, R_2 = 51.0 Ω, R_3 = 114.0 Ω, and R_4 = 55.0 Ω. What is the magnitude of the potential drop across R_2?

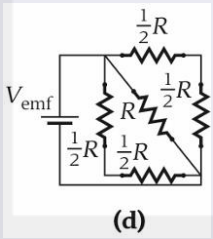


73) Which combination of resistors has the highest equivalent resistance?









A) combination (a)

B) combination (b)

C) combination (c)

D) combination (d)

E) The equivalent resistance is the same for all four.

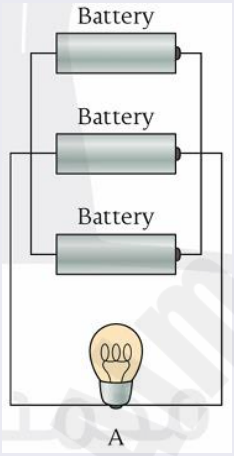
5.6

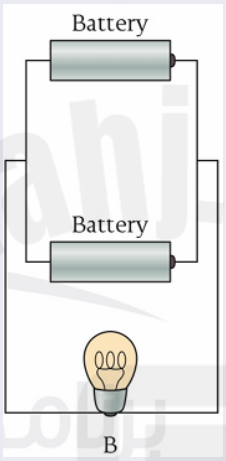
74) Identical batteries are connected in three different arrangements to the same light bulb as shown in the figure. Assume that the batteries have no internal resistance. In which arrangement will the light bulb shine the brightest?

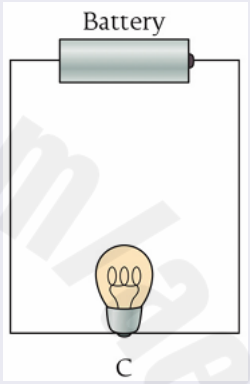
A) A B) B C) C

D) The bulb will have the same brightness in all three arrangements

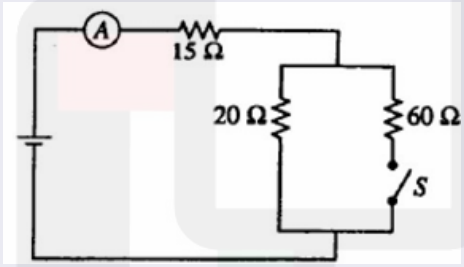
E) The bulb will not light in any of the arrangements







75)



When the switch S is open in the circuit shown above, the reading on the ammeter A is 2.0 A. When the switch is closed, the reading on the ammeter

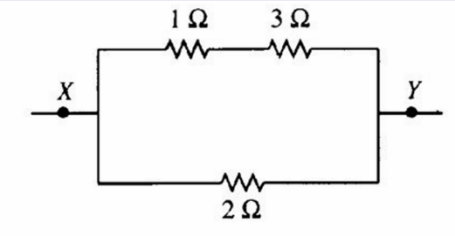
A) doubled B) increased slightly but not doubled

C) the same D) decreased slightly but not halved

E) halved

5.6

76)



The diagram above shows part of a closed electrical circuit. When there is a steady current in the circuit, the amount of charge passing a point per unit of time is:

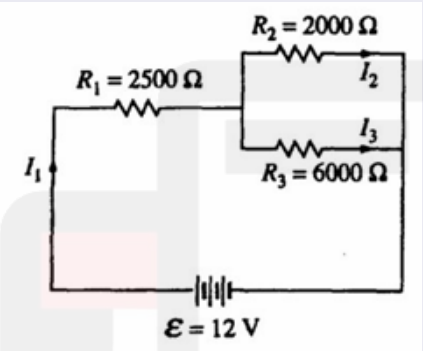
A) greater in the 1 Ω resistor than in the 3 Ω resistor

B) greater in the 1 Ω resistor than in the 2 Ω resistor

C) greater in the 2 Ω resistor than in the 3 Ω resistor

D) greater at point X than at point Y

77)



a))Which current is greater I_1 or I_2?

A) I_1 is greater, because it has more resistance

B) I_2 is greater, because it has less resistance

C) I_1 is greater, because of charge conservation

D) I_2 is greater, because of energy conservation

- -

b))What is the current I_1?

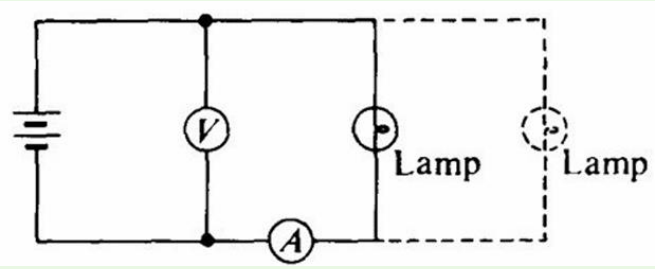
A) 1 mA B) 3 mA

C) 4 mA D) 12 mA

5.6

Hard

78) A lamp, a voltmeter V, an ammeter A, and a battery with zero internal resistance are connected as shown.



a)) How would the ammeter reading change when another lamp is connected in parallel with the first lamp as shown by the dashed lines?

A) increases, because the current through the ammeter splits to feed both branches

B) remains the same, because the ammeter measures the current provided by the battery

C) decreases, because the resistance of the circuit is increased

D) remains the same, because energy is conserved in the circuit

- - - - - - - - - - - - - - - - - -

b)) How would the voltmeter reading change when another lamp is connected in parallel with the first lamp as shown by the dashed lines?

A) decreases, because the current is split between the two branches

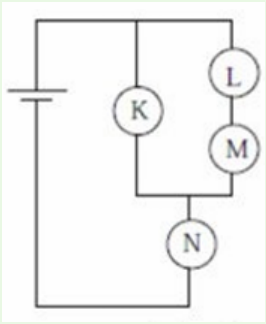
B) remains the same, because charge is conserved in the circuit

C) increases, because the resistance of the circuit is increased

D) remains the same, because energy is conserved in the circuit

5.6

79)



Four identical light bulbs K, L, M, and N are connected in the electrical circuit shown above

a)) Rank the current through the bulbs

A) K > L > M > N

B) L = M > K = N

C) L > M > K > N

D) N > K > L = M

- - - - - - - - - - - - - - - - - -

b)) Bulb K burns out. Which of the following statements is true

A) Only bulb N goes out

B) Bulb N becomes brighter

C) The brightness of bulb N remains the same

D) Bulb N becomes dimmer but does not go out

- - - - - - - - - - - - - - - - - -

c)) Bulb M burns out. Which of the following statements is true

A) Only bulb M goes out

B) Bulb N goes out but at least one other bulb remains lit

C) The brightness of bulb N remains the same

D) Bulb N becomes dimmer but does not go out

5.6

80) When two resistors, having resistance R_1 and R_2, are connected in parallel, the equivalent resistance of the combination is 5 Ω. Which of the following statements about the resistances is correct

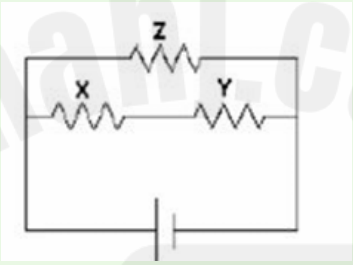
A) Both R_1 and R_2 are greater than 5 Ω

B) Both R_1 and R_2 are equal to 5 Ω

C) Both R_1 and R_2 are less than 5 Ω

D) The sum of R_1 and R_2 is 5 Ω

81)



Given the simple electrical circuit above, if the current in all three resistors is equal, which of the following statements must be true

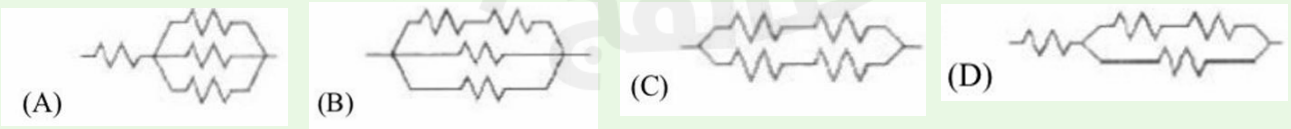
A) X, Y, and Z all have equal resistance

B) X and Y have equal resistance

C) X and Y added together have the same resistance as Z

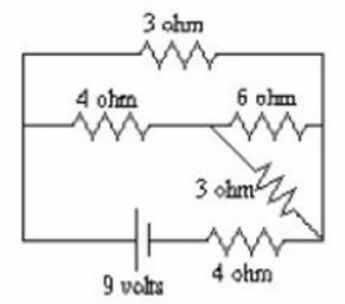
D) X and Y each have more resistance than Z

82) Given 4 identical resistors of resistance R, which of the following configurations would have an equivalent resistance of 4/3 R?



5.6

83)



What would be the total current being supplied by the battery in the circuit shown above

A) 3.0 amperes B) 2.0 amperes

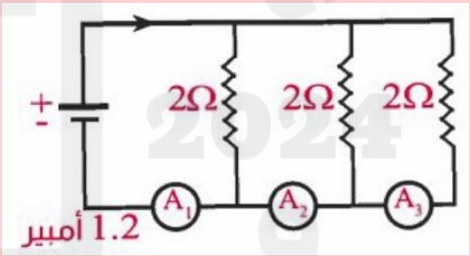
C) 1.5 amperes D) 1.0 amperes

Very Hard

84) In the electric circuit shown, if the reading of ammeter A_1 is 1.2 A, what is the reading of ammeter A_2 ?

A) 0.2 V B) 0.4 V

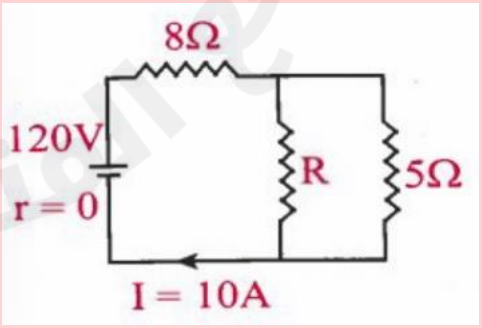
C) 0.6 V D) 0.8 V



85) In the circuit shown, the value of the resistance R is ?

A) 20 Ω B) 40 Ω

C) 60 Ω



5.7

Lesson 7 – Energy and Power in Electric Circuits

Work (Power)

We said that the battery (emf source) gives energy to the electrons, this given energy could be measured by the rate of work (power) that the battery does on electrons.

The same energy which was given to the electrons must be dissipated to the circuit components.

To measure the rate of work (power) we could use different formulas depending on what values we have:

$$P = IV$$

$$P = I^2V$$

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

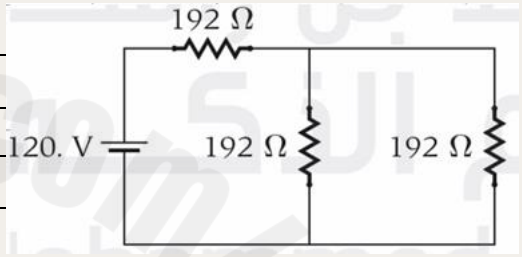
5.7

Questions

Easy

86) Three resistors are connected across a battery as shown in the figure

a) How much power is dissipated across the three resistors
b) Determine the potential drop



87) If the current through a resistor is increased by a factor of 2, how does this affect the power that is dissipated

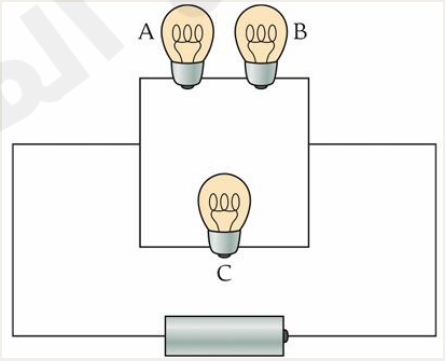
A) It decreases by a factor of 4

B) It increases by a factor of 2

C) It decreases by a factor of 8

D) It increases by a factor of 4

88) All three light bulbs in the circuit shown in the figure are identical. Which of the three shines the brightest



A) A B) B

C) C D) A and B

E) All three are equally bright

5.7

89) A wire of resistance R dissipates power P when a current I passes through it. The wire is replaced by another wire with resistance 3R. The power dissipated by the new wire when the same current passes through it is

A) P/9 B) P/3

C) P D) 3P E) 6P

90) If both the current and resistance in a circuit are doubled, the power dissipated will

A) Double B) Increase by 4 times

C) Increase by 8 times D) Decrease to 1/8

Medium

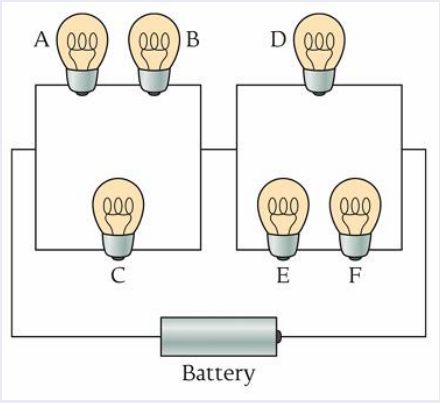
91) A hair dryer consumes 1600 W of power and operates at 110 V. (Assume that the current is DC. In fact, these are root-mean-square values of AC quantities, but the calculation is not affected)

a) Will the hair dryer trip a circuit breaker designed to interrupt the circuit if the current exceeds 15.0 A?

b) What is the resistance of the hair dryer when it is operating?

5.7

92) All of the six light bulbs in the circuit shown in the figure are identical. Which ordering correctly expresses the relative brightness of the bulbs? (Hint: The more current flowing through a light bulb, the brighter it is!)



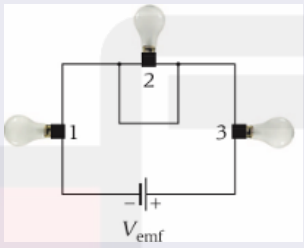
A) A = B > C = D > E = F

B) A = B = E = F > C = D

C) C = D > A = B = E = F

D) A = B = C = D = E = F

93) Three light bulbs are connected in series with a battery that delivers a constant potential difference, V_{emf}. When a wire is connected across light bulb 2 as shown in the figure, light bulbs 1 and 3



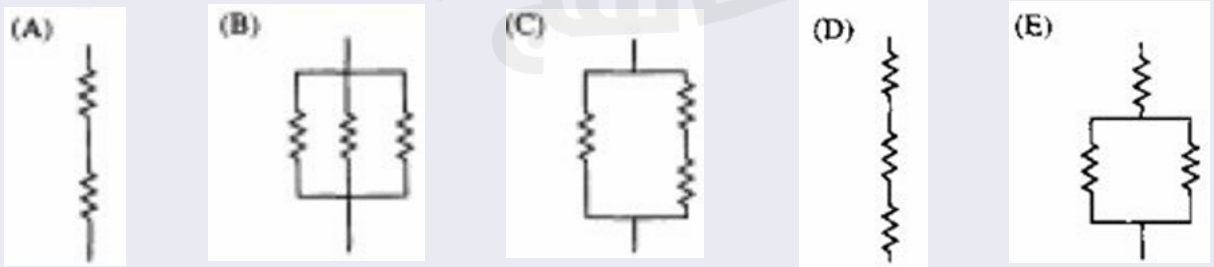
A) burn just as brightly as they did before the wire was connected.

B) burn more brightly than they did before the wire was connected.

C) burn less brightly than they did before the wire was connected.

D) go out.

94) Which of the following combinations of 4Ω resistors would dissipate 24 W when connected to a 12 Volt battery



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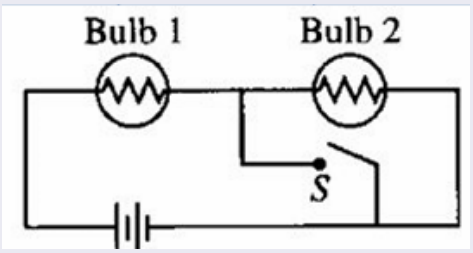
95)



The circuit in the figure above contains two identical lightbulbs in series with a battery. At first, both bulbs glow with equal brightness. When switch S is closed, which of the following occurs to the bulbs?

	Bulb 1	Bulb 2
A)	Goes out	Gets brighter
B)	Gets brighter	Goes out
C)	Gets brighter	Gets slightly dimmer
D)	Gets slightly dimmer	Gets brighter
E)	Nothing	Goes out

Hard

96) A voltage spike causes the line voltage in a home to jump rapidly from 110 V to 150 V. What is the percentage increase in the power output of a 100-W tungsten-filament incandescent light bulb during this spike, assuming that the bulb's resistance remains constant?

5.7

97) How much money will a homeowner owe an electric company if he turns on a 100.00 W incandescent light bulb and leaves it on for an entire year? (Assume that the cost of electricity is $0.12000/kWh and that the light bulb lasts that long.) The same amount of light can be provided by a 26.000 W compact fluorescent light bulb. What would it cost the homeowner to leave one of those on for a year?

98) Suppose an AAA battery is able to supply 625 mAh before its potential drops below 1.50 V. How long will it be able to supply power to a 5.00 W bulb before the potential drops below 1.50 V?

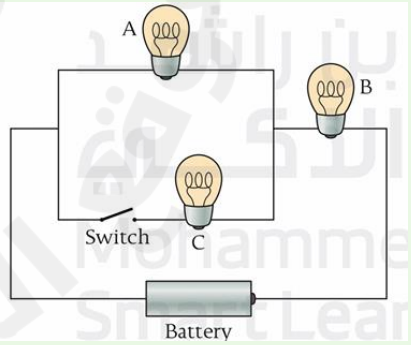
99) Three identical light bulbs are connected as shown in the figure. Initially, the switch is closed. When the switch is opened (as shown in the figure), bulb C goes off. What happens to bulbs A and B?

A) Bulb A gets brighter, and bulb B gets dimmer.

B) Both bulbs A and B get brighter.

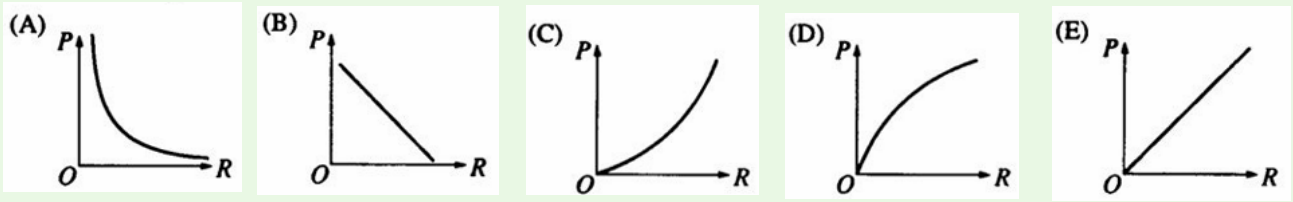
C) Both bulbs A and B get dimmer.

D) Bulb A gets dimmer, and bulb B gets brighter.

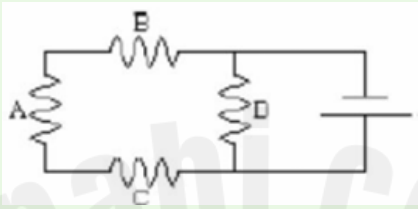


5.7

100) A variable resistor is connected across a constant voltage source. Which of the following graphs represents the power P dissipated by the resistor as a function of its resistance R?



101)

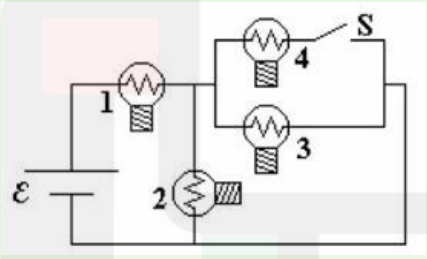


If all of the resistors in the above simple circuit have the same resistance, which would dissipate the greatest power?

A) resistor A B) resistor B

C) resistor C D) resistor D

102)



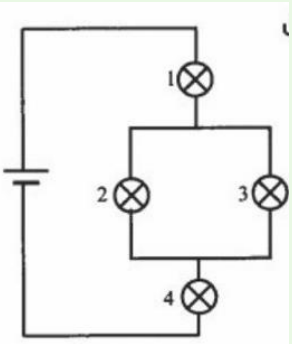
A circuit is connected as shown. All light bulbs are identical. When the switch in the circuit is closed, illuminating bulb #4, which other bulb(s) also become brighter?

A) Bulb #1 only B) Bulb #2 only

C) Bulbs #2 and #3 only D) Bulbs #1, #2, and #3

5.7

103) In the circuit shown, 4 identical light bulbs are connected to a battery. When bulb 3 is burned, the brightness of the remaining bulbs will be as follows:



A) Bulb 1: decreases, Bulb 2: increases, Bulb 4: increases

B) Bulb 1: decreases, Bulb 2: increases, Bulb 4: decreases

C) Bulb 1: increases, Bulb 2: decreases, Bulb 4: increases

D) Bulb 1: increases, Bulb 2: decreases, Bulb 4: decreases

Very Hard

104) Show that the power supplied to the circuit in the figure by the battery with internal resistance R_i is maximum when the resistance of the resistor in the circuit, R, is equal to R_i. Determine the power supplied to R.

"We hope this booklet has provided you with the understanding and support needed to excel in physics, and we wish you continued success and prosperity."