ELECTricity review

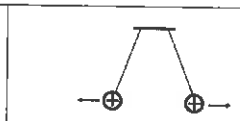
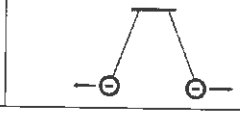
Electricity and Electromagnetism: Electrical Charge

I understand that two objects with similar electrical charges will repel each other and that two objects with opposite electrical charges will attract each other.

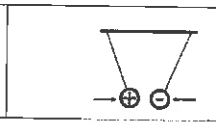
Explanation of Concept(s):

Brought close together, two electrically charged objects interact:

- when the charges are ***similar***, the objects ***repel*** each other

positive repels positive	
negative repels negative	

- when the charges are ***opposite***, the objects ***attract*** each other

positive and negative attract	

Questions

MULTIPLE CHOICE

1) The list below arranges different substances in increasing order of their tendency to acquire electrons. When two of these substances are rubbed together, the one situated lower on the list attracts electrons from the substance above and becomes negatively charged.

Table 1 ELECTROSTATIC SERIES CHART

acetate glass wool cat's fur, human hair calcium (Ca), magnesium (Mg), lead (Pb) silk aluminum (Al), zinc (Zn) cotton paraffin wax ebonite polyethylene (plastic) carbon (C), copper (Cu), nickel (Ni) rubber sulphur (S) platinum (Pt), gold (Au)	*[Weak hold on electrons]* *[Strong hold on electrons]*

In the laboratory, a student rubs a cotton cloth with each of the following substances: ebonite, plastic, acetate and glass. He then brings different samples together:

1) ebonite and plastic
2) plastic and acetate
3) acetate and glass
4) glass and ebonite

In which of the situations do the objects repel each other?

A) 1 and 2 B) 1 and 3 C) 2 and 4 D) 3 and 4

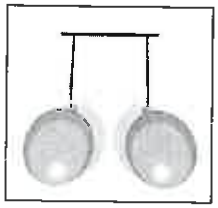
2) Five metallic spheres were electrically charged and then suspended as shown in the diagram below:

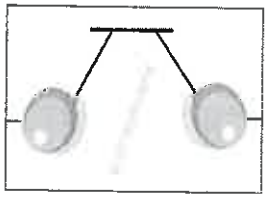
If sphere A lost electrons, which of the spheres were negatively charged?

A) B and C
B) C and D
C) D and E
D) B and E

CONSTRUCTED RESPONSE

3. A student rubbed two identical inflated balloons on a piece of fur and suspended them from a high stand. He then rubbed a plastic ruler with a piece of wool and placed it between the two suspended balloons. The balloons quickly went high in the air as shown in the diagrams below.





Knowing that the wool cloth transferred electrical charges to the ruler, determine the overall charge of the balloons, fur, ruler and wool cloth. Explain your answer.

Answer
1 – b
2 – d
3.

	Electrical Charge (positive/negative)	*Explanation*
balloons	*negative*	*The charges transferred from the wool to the balloons were electrons, because only electrons can move from one atom to another. The balloons acquired a surplus of electrons and became negatively charged.*
fur	*positive*	*By transferring electrons to the balloons, the fur acquired a deficit of electrons and became positively charged.*
ruler	*negative*	*Since the ruler repels the two balloons, it must be negatively charged. By rubbing the ruler with the wool cloth, the ruler acquired electrons.*
wool cloth	*positive*	*The wool cloth has transferred electrons to the ruler so it acquired a deficit of electrons and became positively charged.*

Electricity and Electromagnetism: Static Electricity

I understand and can describe static electricity as the transfer of electrons from one body to another.

Explanation of Concept(s):
An electrically neutral body contains the same amount of protons (*positive charges*) and electrons (*negative charges*). Protons are very tightly bound to the nucleus and cannot be easily removed. Some electrons however, are not so tightly bound and can be transferred from one body to another. These transfers usually occur when two bodies are rubbed against each other.

- *The atom that loses electrons becomes **positively charged**.*
- *The atom that gains electrons becomes **negatively charged**.*

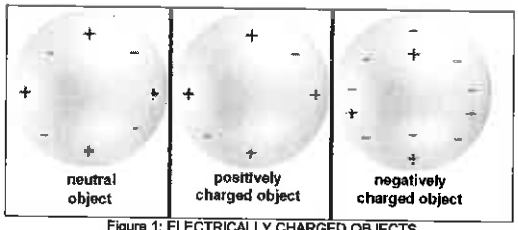


Figure 1: ELECTRICALLY CHARGED OBJECTS

Electrical charges can also be transferred from one body to another by direct contact.

Multiple choice Questions

1) Tom wants to prepare a surprise party for his baby sister. Amongst other things, he wants to decorate the walls of their house with multi-coloured balloons. Once the balloons are inflated, Tom rubs them on his hair for a few seconds and then sticks them to the wall. He knows that this is possible due to friction, as the balloons become electrically charged and are attracted to the wall.

Which of the following produced the static electricity?

F) The transfer of protons between the hair and the balloons.

G) The transfer of electrons between the hair and the balloons.

H) The transfer of electrons between the balloons and the wall.

I) The transfer of protons between the balloons and the wall.

2) **Among the statements below, find one that *is* ***TRUE*****.**

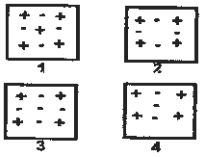
5) Positively charged objects have a deficit of protons.

6) Positively charged objects have surplus of electrons.

7) Negatively charged objects have a surplus of electrons.

8) Negatively charged objects have a surplus of protons.

3) The following diagram shows four different objects and their electrical charge. The positive sign *(+)* represents the charge of the protons and negative sign *(-)* represents the charge of the electrons.



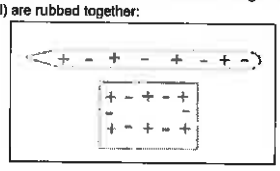
Which of these objects are positively charged?

A) 1 and 2 B) 2 and 3 C) 3 and 4 D) 1 and 4

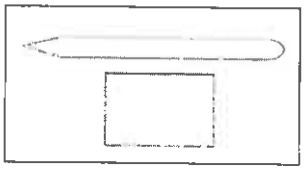
Constructed Response Question

4 Demonstrations using ebonite rods and wool cloth are very common in static electricity activities. After being rubbed with wool, an ebonite rod attracts small objects. Ebonite is known to hold its electrons very tightly when rubbed against other substances. Wool on the other hand, exerts very weak attraction on its electrons.

The diagram below shows the distribution of electrical charges before the two objects (ebonite rod and wool) are rubbed together:



A) Show the distribution of electrical charges in the two substances after the two objects are rubbed together *(use + and -)*. Explain your diagram.



Explanation:_____

_____

_____

_____

_____

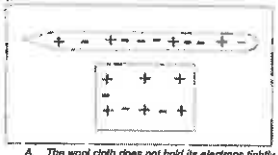
B) Explain why the ebonite rod attracts small objects after being rubbed with the wool cloth.

_____

_____

_____

Answers
Multiple choices
1. B; 2. C; 3.D;
Constructed response question MW F.1.b.i
4.



A. The wool cloth does not hold its electrons tightly, like the ebonite rod. By rubbing these substances together some electrons are transferred from the wool cloth to the ebonite rod. Before being rubbed, both objects contain equal numbers of positive and negative charges. After rubbing, the ebonite rod has a surplus of electrons whereas the wool cloth has a deficit of electrons.

NOTE: The number of negative charges that are added to the ebonite should equal the number negative charges that were removed from the wool cloth. The number of positive charges remains the same in both objects, because the positive charges cannot be transferred.

B. Since the ebonite has acquired a negative charge, when it is brought close to objects like small pieces of paper, Styrofoam etc, the positive charges in these objects will be attracted by the greater number of negative charges in the ebonite rod and will move towards it (get attracted to the ebonite rod).

Electricity and Electromagnetism: Ohm's Law

I understand and can explain the relationship between voltage, resistance and current intensity in an electrical circuit.

Explanation of Concept(s)

Ohm's law describes the relationship between several important physical quantities used in electricity.

The ***current intensity (I)*** represents the amount of charge that flows through a point of an electrical circuit in one second. *(Imagine the number of the cars (electrons) passing a point on a racetrack in one second.)*

The ***potential difference (V)*** is the amount of energy transferred by electrons between two points of an electrical circuit. *(Imagine the amount of push needed to get a car on a racetrack from point A to point B.)*

The ***resistance (R)*** of an element or a circuit is a property of materials. It represents the ability of a material to oppose (resist) the flow of electric charges. *(Imagine speed bumps slowing down the cars on a racetrack.)*

Ohm's Law states that:

"FOR A GIVEN RESISTANCE, THE POTENTIAL DIFFERENCE IN AN ELECTRICAL CIRCUIT IS DIRECTLY PROPORTIONAL TO THE CURRENT INTENSITY".

MULTIPLE CHOICE QUESTIONS

1) In an electrical circuit, the number of electrons crossing through the section of a wire in one second has doubled. The total resistance of the circuit stayed the same.

How did potential difference change?

A) The potential difference halved.

B) The potential difference doubled.

C) The potential difference quadrupled.

D) The potential difference stayed the same.

2) What will happen to the current intensity in an electrical circuit if, for a given resistance the potential difference was reduced by half?

A) It will double.

B) It will not be modified.

C) It will be reduced to half of the initial value.

D) None of the above.

CONSTRUCTED RESPONSE QUESTION

3) The resistance of a circuit is increased while the current intensity is maintained at the same value.

A) How will the voltage vary?

B) Explain why.

ANSWERS

1. *B*
2. *C*
3. *A) The voltage will increase.*
   B) The resistance of an electrical circuit represents the capacity of a material to oppose the flow of electrical charges. As the current intensity and voltage are directly proportional, if the current is maintained constant and the resistance is increased, more energy will be needed for the current to flow through the resistor, so the voltage will increase.

Electricity and Electromagnetism: Ohm's Law

I can use the equation (V = RI) to calculate voltage, resistance and current intensity in an electrical circuit (I can use Ohm's law in calculations)

Explanation of Concept(s)

The mathematical expression of Ohm's Law shows the direct proportionality between the potential difference and current intensity, for a given resistance:

V=R·I

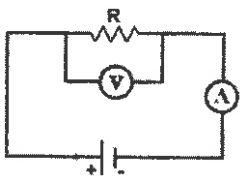
The above formula can be also written as: **R= V/I** and **I = V/R**

Where:

- V is the potential difference (voltage) expressed in volts (V)
- I is the current intensity (current) expressed in amperes (A)
- R is the resistance expressed in ohms (Ω)

Questions

In the circuit diagram below the voltmeter measures 12 V and the ammeter measures 0.6 A.



1. What is the resistance of element R?

A) 0.05 Ω B) 7.2 Ω C) 20 Ω D) 7.2 J

2. What is the potential difference of a current of 10 A flowing through a resistance of 25 Ω?

A) 250 Ω B)0.4 V C) 2.5 V D) 250 V

3. You have a large flashlight that requires a 1.5 V battery. **If the resistance of the light bulb is 3 Ω, what is the current flowing through the light bulb?**

A) 500 A B) 4.5 mA C) 2 A D) 4.5 A

CONSTRUCTED RESPONSE QUESTION

In the laboratory, a student was asked to measure different electricity parameters of an electrical circuit that needs 0.5 amps of current to function optimally. He has experimented with four different resistors and recorded the data in the table below.

Table 2 RESISTANCE AND POTENTIAL DIFFERENCE VALUES

Resistor	Resistance (Ω)	Potential difference (V)
1	60	12
2	24	12
3	48	12
4	36	12

Perform the necessary calculations to show which of the resistors should be used for the optimal functioning of the circuit.

ANSWERS

1 – C
2 – D
3 – B
4 – CONSTRUCTED RESPONSE QUESTION

Resistor 1:

$$I = \frac{V}{R} = \frac{12\ V}{60\ \Omega} = 0.2\ A$$

Resistor 2:

$$I = \frac{V}{R} = \frac{12\ V}{24\ \Omega} = 0.5\ A$$

Resistor 3:

$$I = \frac{V}{R} = \frac{12\ V}{48\ \Omega} = 0.25\ A$$

Resistor 4:

$$I = \frac{V}{R} = \frac{12\ V}{36\ \Omega} = 0.3\ A$$

Answer: The resistor that should be used is RESISTOR 2 because IT PROVIDES THE OPTIMAL AMOUNT OF CURRENT FOR THIS CIRCUIT

Electricity and Electromagnetism: Electrical Circuits

I understand and can describe the function of different components of an electrical circuit (e.g. the wires transmit electrons along the circuit; resistors transform electrical energy into another form of energy)

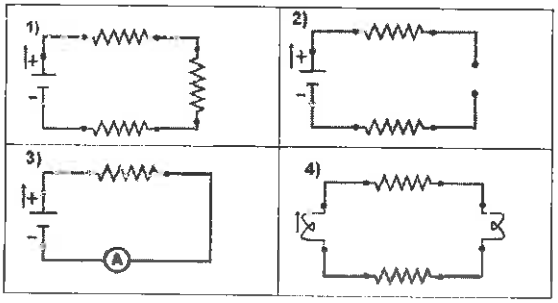
Explanation of Concept(s):
Electrical circuits transform electrical energy into other forms of usable energy (light, heat, sound, mechanical energy etc). The table below presents some components of electrical circuits and their specific role.

Table 3 BASIC ELECTRICAL CIRCUIT COMPONENTS AND THEIR FUNCTIONS

COMPONENT	ELECTRICAL FUNCTION	DESCRIPTION
power source, battery	power supply	creates a potential difference; transfers energy to electrons
wires	Conduction	connect the elements and the power supply; carry electrons from the source to the elements and back to the source
resistors(elements)	electrical resistance	limit the flow of electrons; transform electrical energy into other forms of energy (light, heat, sound etc)
switch	control	allows the current control by connecting or breaking the circuit; (when a switch is off, the electron flow is interrupted)
ammeter		measures the current flowing through a circuit (connected in series)
voltmeter		measures the potential difference (energy) that electrons have between two points of the circuit (connected in parallel)

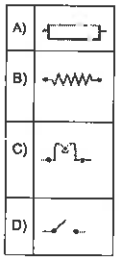
Multiple Choice Questions

1) In which of the following electrical circuits is the electron flow *NOT* possible?



A) 1 and 2 B) 1 and 3 C) 2 and 3 D) 2 and 4

2) Which of the components depicted by the symbols below is used to STOP the electron flow in an electrical circuit?



3) Which of the circuit components below is designed to hinder the flow of electrons through an electrical circuit?

A) a copper wire B) an alkaline battery C) a light bulb D) an electrical switch

Constructed Response Question
4) Draw arrows to match the components below with the right function they carry in electrical circuits:

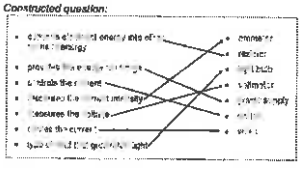
1. converts electrical energy into other forms of energy
2. provides the energy to the circuit
3. controls the current
4. measures the current intensity
5. measures the voltage
6. carries the current
7. component that generates light

a. ammeter
b. resistor
c. light bulb
d. voltmeter
e. power supply
f. switch
g. wires

Answers
Multiple choices:

1) D
2) D
3) C

Constructed question:



Electricity and Electromagnetism: Electrical Circuits

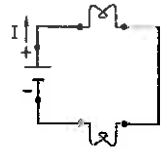
I would be able to identify the two main types of electrical circuits (series, parallel)

Explanation of Concept(s):

In an ***electrical circuit*** electrical charges flow continuously. In order for charges to flow, all parts of the circuit must be connected together.

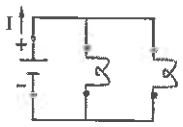
SERIES CIRCUITS
In a series circuit, elements are linked directly together (connected end to end). All charges follow the same pathway. If a part of the circuit is open or an element is defective, the current ceases to flow through the entire circuit.

Diagram 1: SERIES CIRCUIT



PARALLEL CIRCUITS
A parallel circuit branches out at least at one point (node). The charges follow different pathways. If a part of the circuit is open or an element is defective, the current continues to flow through the other branches.

Diagram 2: PARALLEL CIRCUIT

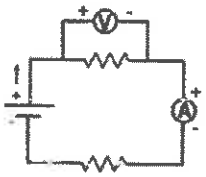


MEASURING INSTRUMENTS

- Ammeters are connected IN SERIES (the current passes through the ammeter).
- Voltmeters are connected IN PARALLEL (outside the element whose voltage is measured).

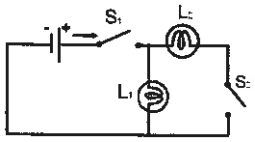
Example:

Diagram 3: MEASURING INSTRUMENTS



Questions

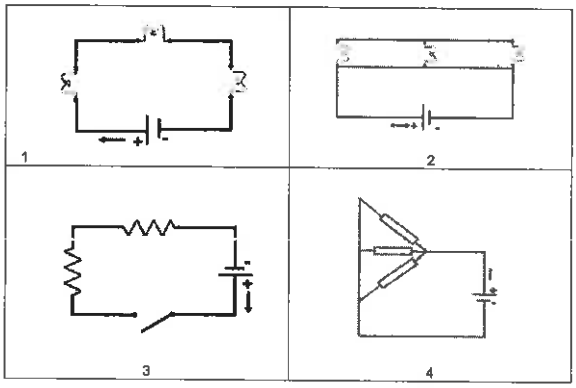
1) The diagram below shows a circuit made of two light bulbs, two switches and a power source.



Which of the following statements regarding this circuit is TRUE?

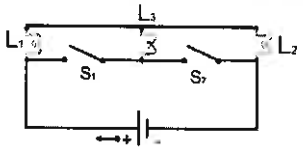
	S_1	S_2	L_1	L_2
A)	Opened	Closed	Off	On
B)	Closed	Opened	On	Off
C)	Opened	Closed	On	Off
D)	Closed	Opened	Off	On

2) Which of the circuits below are connected in parallel?



A) 1 and 4 B) 2 and 4 C) 1 and 3 D) 2 and 3

Constructed Response Question:
3) In the circuit below, if S_1 is open and S_2 is closed, which lightbulb(s) will light up?



ANSWERS
1- B
2- D
3 – All three light bulbs will light

Electricity and Electromagnetism: Electrical Circuits

I understand and can describe the differences between alternating and direct current

Explanation of Concept(s):
An ***electric current*** is an orderly flow of electrical charges. There are two types of electric current:
DIRECT CURRENT (DC) - electrons continuously move in the same direction (ex. the current produced by a battery).

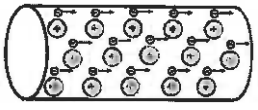


Figure 1 MOTION OF ELECTRONS IN DIRECT CURRENT

ALTERNATING CURRENT (AC) - electrons change direction many times every second (they flow back and forth); it is produced by power plants.

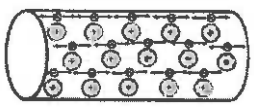


Figure 2 MOTION OF ELECTRONS IN ALTERNATING CURRENT

EXTRA INFORMATION
Power plants produce alternating current. This is more advantageous as during the electrical current distribution, less energy is lost. Since most electrical appliances and electronic devices function on direct current, they usually use a regulator that transforms alternating current into direct current.

Questions

Multiple Choice Questions

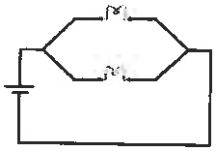
1) Which of the following statements describe an alternating current (AC)?

a) It is produced by a battery
b) Electrons change direction continuously.
c) The electrons and protons move in the opposite direction
d) Electrons move in the same direction.

Constructed Response Question:

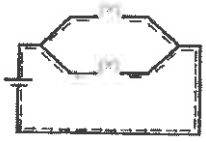
2) The following diagram consists of two light bulbs connected to a D-cell battery. The circuit uses direct current.

Use arrows to show electrons all along this



the motion of circuit.

ANSWERS
Multiple Choices
1) B
Constructed Response Question:



*** All arrows must point in the same direction (negative to positive or positive to negative)*

Electricity and Electromagnetism: Electrical Circuits

I understand and would be able to represent a simple electrical circuit using a diagram and appropriate symbols.

Explanation of Concept(s):

A simple electrical circuit contains at least the following components:
- a power source
- resistors (elements)
- wires

Most circuits also contain one or more switches. In electricity, circuits are represented by precise diagrams. Certain symbols are used to represent the elements of an electrical circuit:

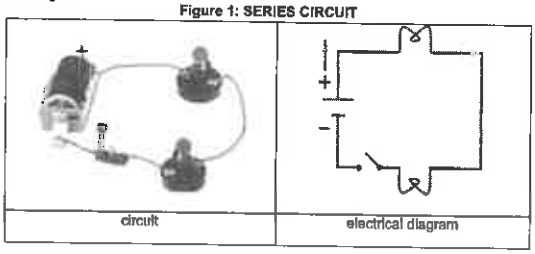
Table 1 ELECRICAL CIRCUIT SYMBOLS

wire	power supply	resistor	light bulb	switch	ammeter	voltmeter
					A	V

SERIES CIRCUIT

The figure below represents a series circuit consisting of a power supply (electrical battery) and two resistors (light bulbs) along with its representation using symbols, in an electrical diagram:

Figure 1: SERIES CIRCUIT

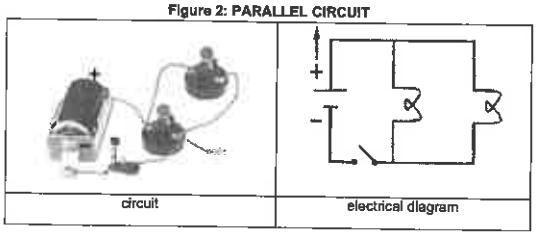


circuit	electrical diagram

PARALLEL CIRCUIT

The figure below represents a parallel circuit consisting of a power supply (electrical battery) and two resistors (light bulbs) along with its representation using symbols, in an electrical diagram:

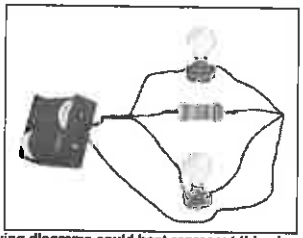
Figure 2: PARALLEL CIRCUIT



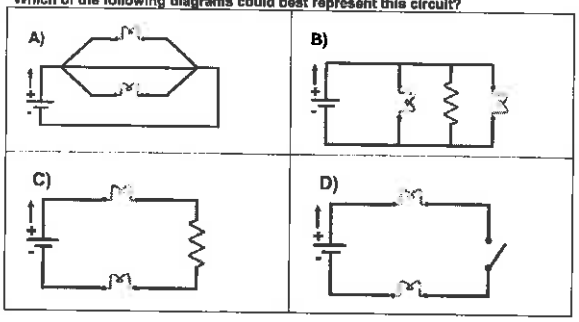
circuit	electrical diagram

Multiple Choice Questions

4) The figure below represents a simple electrical circuit containing a power source, two electrical bulbs and one resistor:

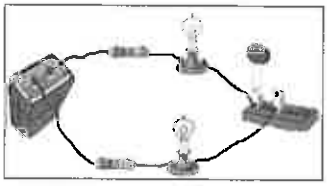


Which of the following diagrams could best represent this circuit?



Constructed Response Questions:

5) The electrical circuit below contains two resistors, two light bulbs, a power supply and a switch - all connected by copper wires as shown in the figure below.



Draw a diagram of this circuit using appropriate symbols used in electricity. Show the flow of charges on your diagram.

6) An electrical circuit is made of two resistors connected to a power supply, an ammeter and a voltmeter. In this circuit, all electrons follow the same pathway. The ammeter measures the current in both resistors whereas the voltmeter measures the potential difference of the first resistor only.

Draw the circuit diagram, indicating also the measuring instruments.

ANSWERS

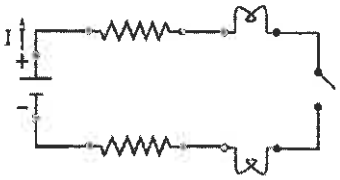
Multiple Choices

1) B

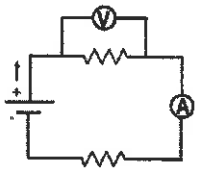
2) C

Constructed Response Questions:

3)



4)



FoL- Material World P.1 e.i

Electricity and Electromagnetism: Relationship between Power and Electrical Energy

I would be able to use the equation P= VI to calculate power, voltage and current intensity in an electrical circuit.

Explanation of Concept(s):

Electrical power is the amount of work an electrical device can perform in one second. The electrical power of a circuit is directly proportional to both voltage and current intensity and can be expressed in a formula as:

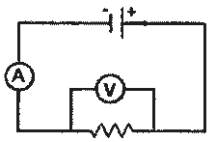
$$P = V I$$

Where:

- P is the electrical power expressed in watts (W)
- V is the voltage (potential difference) expressed in volts (V)
- I is the current intensity expressed in amperes (A)

Questions

1) A student was asked to assemble a simple electrical circuit made of a resistor and a battery and calculate its electrical power. Since he was asked to perform further calculations, he also connected a voltmeter and an ammeter to his circuit.
The diagram below represents the circuit that he assembled:



The current intensity in the circuit is 0.8 A and the voltage across the resistor is 20 V.
What is the electrical power of this circuit?

B) 0.04 W B) 16 kW C) 16 W D) 25 kW

2) What is the current drawn when a kettle with a power of 1.65 kW is connected to an 110V power supply?

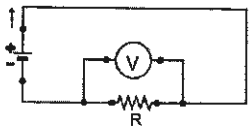
A) 0.015 A B) 1.5 A C) 15 A D) 66.7 A

3) What is the voltage required by an electric grill with a power of 2.2 kW and current 20 A?

A) 0.11 V B) 9.1 V C) 26.4 V D) 110 V

Constructed Response Questions:

4) In the electrical circuit represented below, the voltage is 100 V and resistor R has a value of 50 Ω.



Calculate the electrical power of resistor R. Show all your work.

ANSWERS
Multiple Choice
1) B
2) C
3) D
Constructed Response Question:
Example of an appropriate procedure:
1) Find current intensity:

$$I = \frac{V}{R} = \frac{100\ V}{50\ \Omega} = 2\ A$$

2) Find electrical power:

$$P = V \times I = 100\ V \times 2\ A = 200\ W$$

Answer: the electrical power of the resistor is 200 W

Electricity and Electromagnetism: Relationship between Power and Electrical Energy

I understand and would be able to explain, the relationship between the power of an electrical appliance, the electrical energy it consumes and the amount of time it is in operation.

Explanation of Concept(s):
The electrical energy consumed by an electrical appliance is directly proportional to the power of the appliance and the amount of time it is in operation. In other words, the more powerful an electrical appliance is, the more energy it consumes. The longer an appliance is in operation, the more energy it consumes.

Questions

1) Which of the following would reduce the cost of using an electrical appliance?

1. Increase the operation time.
2. Use an appliance with a lower power rating.
3. Use a cheap appliance.
4. Reduce the operation time.
5. Use an appliance with a higher power rating.

A) 1 and 3 B) 2 and 4 C) 3 and 5 D) 4 and 5

2. Lynn wants to buy a new hair dryer. The store sells two different models. The rating plates of the two appliances are shown below:

Model 1	Model 2
120 V 60 Hz 1200 W (1.2 kW)	120 V 60 Hz 1400 W (1.4 kW)

She usually dries her hair for about 15 minutes daily and she would like to use the least amount of energy possible.

Which of the two models should Lynn buy? Explain your answer

ANSWERS
Multiple Choice
1) B
Constructed Response Questions:
2)
Lynn should buy **Model 1.**

The power rating of Model 2 is lower. Since the amount of energy consumed by an appliance is directly proportional to its electrical power, for the same amount of operating time this model is going to use less energy.

Electricity and Electromagnetism: Relationship between Power and Electrical Energy

I would be able to use the equation $E = P\Delta t$ to calculate the electrical energy consumed, the power of an electrical appliance and the amount of time it is in operation

Explanation of Concepts

The electrical energy of an electrical circuit can be calculated using the formula:

$$E = P\,\Delta t$$

Where:
- **E** is the electrical energy expressed in joules (J) or kilowatt hour (kWh)
- **P** is the electrical power expressed in W (watt) or kilowatt (kW)
- Δt is the time interval expressed in seconds (s) or hours (h)

Questions

1) How much energy does an electric heater with a power of 200 W consume in 2 minutes?

A) 0.01 kJ B) 24 kJ C) 100 J D) 400 J

2) How much energy is consumed by an oven with an electrical power of 4 kW in use for 2.5 hours?

A) 0.9 kWh B) 10kWh C) 10 kJ D) 0.625 kJ

3) How long does it take for a kettle with a power of 2 kW to use 30 000 J of energy?

A) 15 s B) 15000 s C) 60 min D) 0.07 h

4) What is the power of an electric bulb that gives off 3600 J of energy in 10 minutes?

A) 6 kW B) 2.8 kW C) 6 W D) 360 W

Constructed response question:

5) A water heater has a resistor working with a potential difference of 230 V and a current of 50 A.

Calculate the energy consumed by this water heater in 30 minutes. Show all your work.

Answers
1) B
2) B
3) A
4) C
5) Example of an appropriate procedure:
1) Calculate the power of the resistor:

$$P = V \times I = 230V \times 50A = 11500\ W = 11.5\ kW$$

2) Express the time in hours:

$$t_h = 30 min \times \frac{1\ h}{60\ min} = 0.5\ h$$

3) Calculate the energy consumed by the resistor:

$$E = P \times \Delta t = 1.15kW \times 0.5\ h = 0.575\ kWh$$

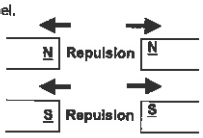
Answer: The resistor uses 0.575 kWh of energy in 30 minutes.
*** Please note the equivalent answer in Ws is 20 700 000 Ws ***

Electromagnetism: Forces of Attraction / Repulsion

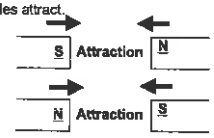
I understand that for magnets, different poles attract, while similar poles repel. I would be able to describe and interpret the magnetic field of a magnet and the behavior of a compass in the magnetic field of a magnet

Explanation of Concept(s):

1. Every magnet has two poles: North (N) and South [N]
2. Like poles repel.



3. Opposite poles attract.



4. All magnets have a magnetic field. A magnetic field is the space around a magnet where magnetic forces are felt (both attraction and repulsion).

5. Lines of Force show you the shape, direction, and strength of the magnetic field around a magnet.

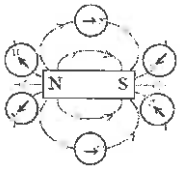
   SHAPE is shown by lines of force which can be straight, curved, circular, etc.

   DIRECTION is shown by arrowheads. The direction is always from North to South.

   STRENGTH is shown by how close the lines are to each other. The closer the lines of force are, the stronger the magnetic field.

6. A compass needle is a magnet. Therefore, the compass needle may change direction when it is placed in a magnetic field.

   The behavior of a compass in the magnetic field of a bar magnet is shown below.

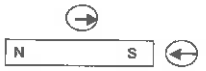


Questions:

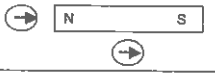
1. Which of the following correctly illustrates the behavior of a compass in the magnetic field of a bar magnet?

A)

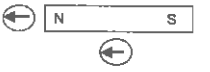
B)



C)



D)



2. Indicate which pole is the North pole of the magnet.

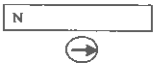
a)

b)

Answer:
1 B
2

a)

b)



Transformation of Energy: Law of Conservation of Energy

I understand and would be able to explain the law of conservation of energy.

Explanation of Concept(s):

The law of conservation of energy states that energy can neither be created nor destroyed, but it can be transferred or transformed from one form to another.

In an isolated system, the total amount of energy remains constant. More specifically, in a frictionless system, mechanical energy remains constant.

Multiple Choice Question

1. 30 joules of energy enter a light bulb. 20 joules of energy are transformed into light, how much energy is dissipated as heat?

   a) 10 joules
   b) 20 joules
   c) 30 joules
   d) 50 joules

Short Answer Question

2. Jim is excellent at bowling. He routinely gets several strikes during a typical game. Explain how a strike (i.e. when the bowling ball knocks down all of the bowling pins) illustrates the law of conservation of energy.

Answers

1. a
2. *The ball rolling down the alley has mechanical energy. The mechanical energy is transferred to the pins upon contact and it causes the displacement of the pins.*

Transformation of Energy: Law of Conservation of Energy

I would be able to apply the law of conservation of energy in different situations.

Explanation of Concept(s):

Examples of the Law of conservation of energy include:

The heating elements on a stove convert electrical energy into thermal energy. Hydraulic energy from a waterfall is transformed into mechanical energy to spin a turbine, which is further transformed into electrical energy by a generator.

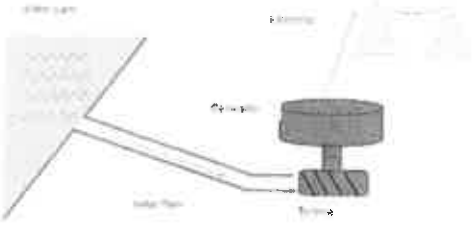
Multiple Choice

1. Consider a dishwasher. What energy path is taken for the dishes to be cleaned?

   a) electrical →mechanical →thermal (with some heat lost)
   b) electrical →mechanical →thermal
   c) mechanical →thermal→electrical
   d) mechanical →electrical →thermal

Constructed Response Question

2. Hydro Electric Energy



Describe why all the energy from the water flowing into the turbine is not transformed into electrical energy.

3. Self cleaning ovens have a special cycle (or mode) that will use extremely high temperatures to "cook-away" any residues or food deposits left within the oven walls. To protect the user from being exposed to extremely hot oven doors during this process, these ovens are typically over - insulated. How do you think this extra insulation affects the efficiency of the oven when used in normal "cooking-mode".

Answers

1. a
2. *The water travels along the following path:*
   It flows into the turbine which turns causing the generator to produce electricity which is then transferred along power lines. Due to this long process, not all the water's energy will be converted into electricity. Some will be lost in the process.
3. *Since these ovens are more insulated they will allow less heat to escape, as a result, more of the oven's heat will be used for cooking the food, and less will be lost to the oven's surroundings.*

Transformation of Energy: Energy Efficiency

*I understand and can use the definition of energy efficiency of a device or system as **'the proportion of energy consumed that is transformed into effective work'.***

I can determine the energy efficiency of a device by using the formula

$$\text{Energy Efficiency (\%)} = \frac{\text{Amount of useful energy (J)}}{\text{Amount of energy consumed (J)}} \times 100$$

Explanation of Concept(s):

Machines cannot convert all of the energy they use into a useful form. Some is changed into another form or released as heat in the environment.

Thus the energy efficiency of a machine is the percent of energy that is transformed for its original purpose.

$$\text{Energy Efficiency (\%)} = \frac{\text{Amount of useful energy (J)}}{\text{Amount of energy consumed (J)}} \times 100$$

Multiple Choice Questions

1. A kettle consumes 15 500 J of energy. It is 85 % efficient. How much energy was used by the kettle?

   a) 18 235 J
   b) 1 317 500 J
   c) 182 J
   d) 13 175 J

Constructed Response Question

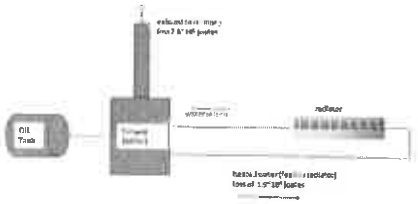
2. Some homes are still heated by hot water boiler furnaces which use domestic

heating oil as their source of combustion. The components of the system are an oil tank a furnace, water pipes and radiators.

The furnace burns the oil from the storage tank, the heat from the combustions is used to heat water which is then pumped to radiators throughout the house. These radiators are designed to dissipate the heat evenly within the room. A schematic of this is shown below.

If all the heat from the combustion was used to heat the water, the system would be 100% efficient, however some heat is lost in the furnace exhaust and some is lost from the pipes delivering the water to the radiators.

One litre of oil delivers 38 000 kJ of energy, assuming 7 600 kJ are lost to the exhaust, and 1 900 kJ are lost in transporting the hot water to the radiators; calculate the efficiency of this heating system.



Answers

1. *D*
   % Energy Efficiency = Amount of useful energy / Amount of energy consumed x 100

   85 / 100 = X / 15 500

   X = 13 175 J

2. *% Energy Efficiency = Amount of useful energy / Amount of energy consumed x 100*

   Amount of useful energy: this is the energy used to heat the hot water. This is the total energy minus any energy that is wasted

   38 000 – 7 600 – 1 900 kJ = 28 500 kJ
   % Energy Efficiency = 28 500 / 38 000 = 75%

Transformation of Energy: Energy Efficiency

I understand and would be able to explain how to improve the energy efficiency of an electrical appliance

Explanation of Concept(s):

Measures need to be taken to minimize the amount of energy lost in an electrical appliance.

Examples:

- Replacing an incandescent light bulbs with energy efficient light bulbs
- A cell phone's screen go to "sleep" when not in use

Multiple Choice Questions

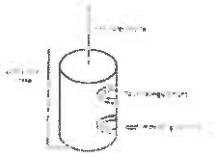
1. A carpenter is using a drill to make holes in a sheet of plywood, He is using an electric drill that is plugged into the wall. Which of the following are ways of increasing the efficiency of the drilling.

   1) Use a newer (sharper) drill bit.
   2) Use a shorter extension cord.
   3) Use a longer extension cord.

   A) 1 only
   B) 2 only
   C) 1 and 2
   D) 1 and 3

Constructed Response Question

2. The following is a schematic of an electric hot water heater that we find in most of our homes.



A cold water pipe intake fills the tank, the electrical elements heat the water which leaves the tank from the top pipe whenever we turn on a hot water faucet.
How can we prevent the heat loss from the hot water tank?

Answers

1. *C*
2. *Insulation can be placed around the tank to prevent heat leakage from the tank. The water intake pipe can be insulated. The hot water pipe leaving the tank can be insulated.*

Transformation of Energy: Distinction between Heat and Temperature

I understand and can describe heat as a form of energy.

Explanation *of Concept(s):*

The term heat is used to describe energy transfer from one body to another. The flow of heat is a transfer of energy that occurs due to a temperature difference. The unit for heat is the joule (J).

Multiple Choice Questions

1. A pot of water is put on the stove in order to make tea. The boiling water results from the kinetic energy of the excited water molecules. Which of the following statements are **false**:
   1) Heat is a measure of the energy of these water molecules.
   2) Temperature is a measure of the energy of these water molecules.
   3) The heat energy from the stove top burner is being transformed into energy in the water molecules.
   4) The temperature of the stove top burner is being transformed into energy in the water molecules

   a) 1 and 4
   b) 2 and 3
   c) 2
   d) 4

Constructed Response

2. A boy tightly clutches a snowball in his hands. Explain why the outer surface of the snowball begins to melt and why the boy's hand becomes cold.

Answers

1. *a*
2. *Heat is transferred from the warm body to the cold body until equilibrium is reached. The hand is cold due to loss of heat energy.*