SAMSUNG CHIP DESIGN FOR HIGH SCHOOL

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WEEK 2

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Assignment: Abrupt and Controlled Release of Potential Energy and Applications of Ohm's Law

Section 1: Abrupt and Controlled Release of Air Stored as Potential Energy

Scenario 1: Balloon Burst

When a balloon is inflated, the air inside is stored as potential energy due to compression. If the balloon is poked with a pin, the stored air escapes abruptly. This rapid release leads to the balloon bursting, demonstrating the uncontrolled release of potential energy. The energy is transformed into kinetic energy of air molecules, sound, and minor heat.

Scenario 2: Balloon Deflates Controlled

When the mouth of the balloon is opened, the air is released gradually. This controlled release of potential energy avoids the balloon bursting. The transformation of energy is slower, producing a controlled stream of air, which is safer and more predictable.

Section 2: Abrupt and Controlled Discharge of a Charged Battery

Scenario 1: Battery Connected to Itself

When a charged battery is directly connected to itself (short circuit), the stored potential energy (chemical energy) discharges rapidly. This abrupt discharge can generate excessive heat, leading to battery damage, leakage, or even explosion. The lack of resistance in the circuit causes uncontrolled energy flow.

Scenario 2: Battery Connected to a Load

When the battery is connected to a load (like a bulb or motor), the charges flow through the circuit in a controlled manner. The resistance provided by the load ensures that energy is released gradually, converting it into usable forms like light or motion without damaging the battery.

Section 3: Ohm's Law and Its Applications

Explanation of Ohm's Law

Ohm's Law states: Where:

- : Voltage (in volts)
- : Current (in amperes)
- : Resistance (in ohms)

From the formula, current is inversely proportional to resistance for a given voltage. This relationship allows us to predict the behavior of electrical circuits under varying conditions.

Numerical Examples Demonstrating Inverse Relationship of I and R:

1. A 12V battery connected to a 3Ω resistor produces a current of . Increasing the resistance to 6Ω reduces the current to .
2. A 9V battery powers a circuit with a 2Ω resistor. Current is . Doubling the resistance to 4Ω halves the current to .
3. For a 240V heater with 120Ω resistance, current is . Reducing resistance to 80Ω increases current to .
4. A lamp with a resistance of 15Ω connected to a 30V supply draws . Adding another 15Ω in series increases total resistance to 30Ω, reducing current to .
5. A car headlight with a 10Ω resistance and a 12V battery allows a current of . Adding 5Ω resistance reduces current to .
6. A 24V circuit with 8Ω resistance has . Increasing resistance to 12Ω drops the current to .
7. A loudspeaker with resistance 4Ω connected to a 20V source draws . Increasing resistance to 8Ω reduces current to .
8. A phone charger with 5Ω resistance operating at 10V delivers . Reducing resistance to 2.5Ω doubles current to .
9. An electric motor with 50Ω resistance connected to 100V allows . Increasing resistance to 100Ω reduces current to .
10. A flashlight with 2Ω resistance and a 6V battery has . Doubling resistance to 4Ω reduces current to .

Voltage as Floors in a Building

Voltage can be visualized as floors in a building:

1. Ground floor represents volts.
2. First floor is volt, second floor volts, and so on.
3. Basement floors are negative, with volt for the first basement, volts for the second, etc.
4. Examples include:
    - A fan operating on volts.
    - An LED circuit requiring volts.
    - A speaker functioning at volts to create specific sound effects.
    - A motor with a voltage difference from to volts for reversing polarity.
    - A solar cell generating volts in sunlight and volts in shade.

Section 4: Switch Scenarios and Examples

Understanding Switches

A switch controls the flow of current in a circuit by opening (off) or closing (on) the circuit. This mechanism is essential for managing energy usage and device operation.

Numerical Examples of Switch Scenarios

1. Switch On: A 60W bulb connected to a 120V source operates at .
2. Switch Off: When the switch is off, the circuit is open, and no current flows, resulting in .
3. Fan Control: A fan with a 100W motor and 220V supply has when the switch is on.
4. Water Pump: A 1kW pump connected to a 240V supply draws .
5. TV Operation: A 200W television on a 230V line consumes .
6. Refrigerator: A 150W refrigerator connected to a 220V line uses .
7. Car Lights: Headlights consuming 55W on a 12V system draw .

8. Doorbell: A 10W doorbell connected to a 24V supply operates with .
9. Laptop Charger: A 65W charger on a 19V system draws .
10. Microwave: A 1200W microwave connected to a 240V supply uses .

This document now includes detailed numerical examples to further clarify the concepts of Ohm's Law, energy release, and switch operation in practical scenarios.