S.4 HeLP RESOURCE SOLUTIONS

PHYSICS PAPER ONE

August 29, 2024

Item 1

Why the lady heard the sound of the guitar twice and determine the distance

Explanation of Hearing the Sound Twice: The lady heard the sound of the guitar twice because of an echo. An echo occurs when sound waves reflect off a surface (in this case, the shore) and travel back to the listener. The time it takes for the echo to return to the listener is the same as the time it takes for the sound to travel to the reflecting surface and back.

Calculating the Distance:

- **Speed of Sound in Air:** Given as $v_{\text{sound}} = 330$ m/s.
- **Time Interval for Echo:** The total time interval between hearing the original sound and the echo is 2 seconds. This time represents the time for the sound to travel to the shore and back.
- **Distance Calculation:**
  - The time to travel to the shore is $t/2$ where $t = 2$ s. So, time to travel one way (to the shore) is $2 \text{ s}/2 = 1$ s.
  - Using the formula Distance = Speed × Time:

$$\text{Distance} = v_{\text{sound}} \times \text{Time} = 330 \text{ m/s} \times 1 \text{ s} = 330 \text{ m}$$

Thus, the distance between the floating stage and the shore is 330 meters.

Why the color of the clothes of the audience kept on changing when colored lights flashed on them

Explanation: The color changes on the clothes occur due to the combination of colors reflected by the clothes and the flashing colors of the disco lights. Here's why:

- **Disco Lights:** The lights flash in different colors—red, blue, and green. Each color of light affects how the clothes look because of the way colored lights mix with the colors reflected by the clothes.

- **White Clothes with Yellow Spots:**
  - **White Clothes:** White clothes reflect all colors of light. When different colored lights flash on them, they reflect the light in the color of the flashing light.
  - **Yellow Spots:** Yellow spots reflect red and green light. The appearance of these spots changes based on which color of light is dominant:
    * **Red Light:** The white clothes will appear red, and the yellow spots will appear red.
    * **Blue Light:** The white clothes will appear blue, and the yellow spots will appear dark (since blue light is absorbed by yellow).
    * **Green Light:** The white clothes will appear green, and the yellow spots will appear green.

Because the lights are flashing in different colors, the appearance of the clothes changes dynamically with each color of the flashing light.

Why the laser source of light was preferred to provide laser light that enhanced visibility in the late hours of the night

Reasons for Using Laser Light:

- **High Intensity and Directionality:** Lasers emit light in a highly focused beam, making them much more intense and visible over long distances. This is crucial at night when visibility can be low.
- **Narrow Beam Spread:** Unlike conventional lights, lasers maintain a narrow beam, which reduces light scatter and ensures that the light remains concentrated and visible even from afar.
- **Clarity in Darkness:** Lasers provide a clear, distinct beam of light that stands out in the dark. This helps in marking or illuminating specific areas without being affected by ambient light conditions.
- **Visibility Enhancement:** Lasers are particularly effective for enhancing visibility in low-light conditions because their focused beam can penetrate through darkness better than broader light sources.

Comparing the wavelengths of the sound waves and laser light waves in air

Calculations:

- **Wavelength of Sound Waves:**
  - **Frequency of Sound:** $f_{\text{sound}} = 440$ Hz
  - **Speed of Sound in Air:** $v_{\text{sound}} = 330$ m/s

  - **Wavelength of Sound Waves:**

$$\lambda_{\text{sound}} = \frac{v_{\text{sound}}}{f_{\text{sound}}} = \frac{330 \text{ m/s}}{440 \text{ Hz}} \approx 0.75 \text{ m}$$

- **Wavelength of Laser Light:**
  - **Frequency of Laser Light:** $f_{\text{laser}} = 4.7 \times 10^8$ Hz
  - **Speed of Light in Air:** $v_{\text{light}} = 3.0 \times 10^8$ m/s
  - **Wavelength of Laser Light:**

$$\lambda_{\text{laser}} = \frac{v_{\text{light}}}{f_{\text{laser}}} = \frac{3.0 \times 10^8 \text{ m/s}}{4.7 \times 10^8 \text{ Hz}} \approx 0.64 \text{ m}$$

Comparison:

- **Wavelength of Sound Waves:** Approximately 0.75 m
- **Wavelength of Laser Light:** Approximately 0.64 m

The wavelength of sound waves in air is longer than that of laser light. Generally, electromagnetic waves (like light) have much shorter wavelengths than sound waves. This difference in wavelength is why light can be focused into a precise beam while sound spreads out more.

Item 2

a) Occurrence of Floods in One Area While Shining in Their School

The simultaneous occurrence of floods and sunshine in different locations can be explained by the following factors:

- **Tidal forces**: Tides bring about floods, known as tidal or coastal flooding, when exceptionally high tides, often called "king tides," coincide with high sea levels or storm surges. During these periods, the gravitational pull of the moon and the sun aligns, causing the ocean levels to rise more than usual. If these high tides occur simultaneously with strong onshore winds, heavy rainfall, or a storm surge, the water levels can exceed the normal high tide mark, leading to flooding in coastal areas. This type of flooding is typically temporary but can cause significant damage, especially in low-lying coastal regions.
- **Geographical Location**: Different locations on Earth can experience different weather conditions simultaneously due to their geographical positions. Weather patterns, including rain and floods, are influenced by local factors such as temperature, humidity, and atmospheric pressure.

- **Weather Systems**: Severe weather events like floods can occur in specific regions due to localized weather systems such as low-pressure areas, storms, or cyclones. These systems can cause heavy rainfall and flooding in one region while another region remains clear and sunny.

- **Distance and Climate Zones**: The world is divided into various climate zones, and different parts of the world can be experiencing different weather patterns at the same time. For example, while it might be sunny and warm in one location, another area could be experiencing heavy rain and floods due to its own climatic conditions.

b) Why It Was Night in the Outside Country While It Was Daytime in Their Area

The difference in day and night across different locations on Earth is due to:

- **Earth's Rotation**: The Earth rotates on its axis once approximately every 24 hours. This rotation causes different parts of the Earth to face towards or away from the Sun, resulting in day and night.

- **Time Zones**: The Earth is divided into different time zones based on its longitudinal position. As a result, while it might be daytime in one location, it could be nighttime in another. For instance, when it is noon in one part of the world, it could be midnight on the opposite side of the Earth.

- **Geographical Position**: The time of day varies according to the geographical location's longitude. This is why places in different longitudes experience day and night at different times.

c) How T.V Signals Broadcast from Where the Floods Were Happening Reached Them

Television signals are transmitted and received through several means: **Satellite Transmission**:

- Satellite communication works by transmitting signals between a ground station (on Earth) and a satellite in space. Here's how the process typically works:

- Uplink: A ground station sends a signal (data, voice, or video) to the satellite. This process is called "uplinking."

- Satellite Reception and Amplification: The satellite receives the uplink signal through its antenna. The signal is then amplified, processed, and often converted to a different frequency to avoid interference with the uplink frequency.

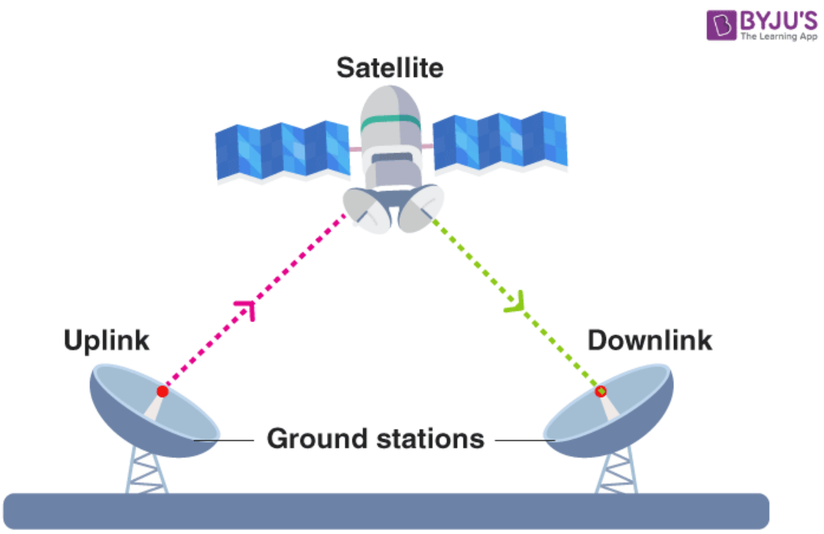

Figure 1: Communication satellite

- Downlink: The satellite then transmits the processed signal back to Earth, a process called "downlinking." This signal is sent to a different ground station or multiple stations.
- Reception and Distribution: The ground station receives the downlinked signal and processes it for distribution. This could involve broadcasting TV signals, providing internet connectivity, or relaying phone calls.

  By using satellites in geostationary orbits or other orbits, communication can be maintained over vast distances, including remote and isolated areas.

Other responses

- **Radio Waves**: Signals can also be transmitted via radio waves through antennas. These radio waves can travel long distances and can be received by TV receivers in different locations.
- **Fiber Optics and Cables**: TV signals can be sent through fiber optic cables or other communication infrastructure. These cables transmit data across great distances, including international boundaries.
- **Internet Streaming**: With modern technology, live broadcasts can be streamed over the internet. This allows viewers to watch live coverage from anywhere in the world via online platforms.

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Item 3

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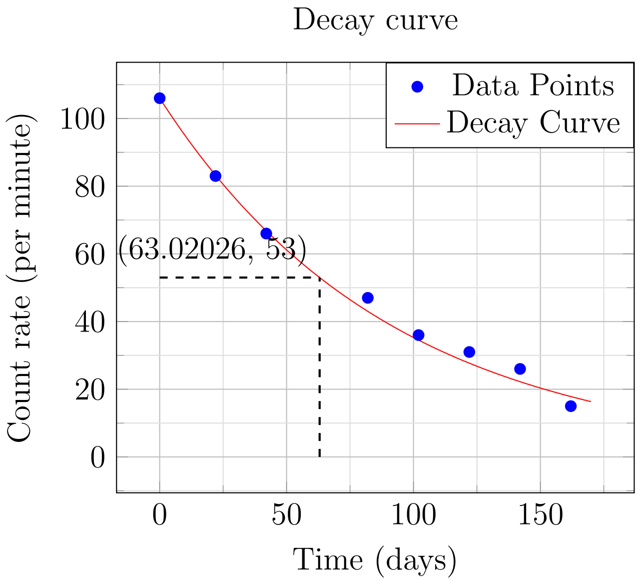


Figure 2: Decay Curve

The calculated half-life of the radioactive material from thegraph is 63.02-0 which is equal to 63.02 days.
Since the scientists recommended that the environment will be safe when the half-life value is less than 60 days, it appears the current radioactive material does not meet this safety criterion. Therefore, the residents should follow the advice to relocate for their safety.

Part (b): Sensitizing People About the Risks Associated with Radioactive Materials

Radiation Risks:

- **Health Hazards:**
  - Short-term Exposure: Acute radiation syndrome, which includes nausea, vomiting, diarrhea, and skin burns.
  - Long-term Exposure: Increased risk of cancer, genetic mutations, and cardiovascular diseases.
  - High-dose Exposure: Can be fatal.
- **Environmental Impact:**
  - Contamination of soil and water bodies.
  - Harm to flora and fauna, leading to ecological imbalance.
- **Handling Radioactive Materials:**
  - **Minimize Exposure:**
    - Limit the time spent near radioactive sources.
    - Maintain a safe distance from radiation sources.

    * Use shielding materials like lead or concrete to block radiation.

- **Personal Protective Equipment (PPE):**
    * Wear appropriate PPE such as gloves, masks, and protective suits when handling radioactive materials.
    * Use radiation detectors to monitor exposure levels.
- **Proper Disposal:**
    * Follow government regulations for the disposal of radioactive waste.
    * Use designated containers and storage facilities for radioactive materials.
- **Emergency Preparedness:**
    * Be aware of emergency procedures in case of a radiation leak.
    * Have an evacuation plan in place.

The nuclear equation for this process is:

$$^{208}_{104}\text{X} \longrightarrow {}^{196}_{102}\text{Y} + 3\,^{4}_{2}\text{He} + 4\,^{0}_{-1}\text{e} + \gamma$$

Explanation

- Alpha decay (α) reduces the mass number by 4 and the atomic number by 2 for each alpha particle emitted.
- Beta decay (β^-) increases the atomic number by 1 for each beta particle emitted, but does not change the mass number.
- Gamma rays (γ) are emitted but do not change the mass number or the atomic number.
- Therefore, for 3 alpha particles:

$$\Delta\text{Mass number} = 3 \times 4 = 12, \quad \Delta\text{Atomic number} = 3 \times 2 = 6$$

- For 4 beta particles:

$$\Delta\text{Atomic number} = 4$$

- The resulting nuclide Y will have:

$$\text{Mass number of Y} = 208 - 12 = 196$$

$$\text{Atomic number of Y} = 104 - 6 + 4 = 102$$

Thus, the balanced nuclear equation for the decay is:

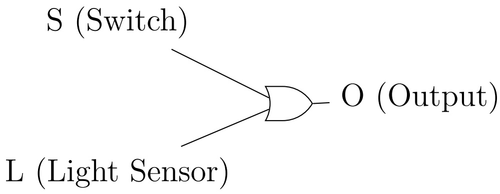
$$^{208}_{104}\text{X} \longrightarrow {}^{196}_{102}\text{Y} + 3\,^{4}_{2}\text{He} + 4\,^{0}_{-1}\text{e} + \gamma$$

ITEM 4: Home Security Light Control Circuit Design

Logic Circuit Diagram

The circuit can be designed using an OR gate where the output O depends on the states of a manual switch S and a light sensor L:

$$O = S + L$$



Truth Table

S	L	O
0	0	0
0	1	1
1	0	1
1	1	1

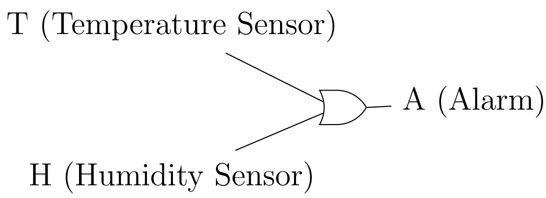
ITEM 5: Greenhouse Alarm System

Logic Circuit Design

To sound an alarm when the conditions are not suitable for good yields, we need to activate the alarm if either the temperature is above 35°C or the humidity is high.

The circuit can be designed using an OR gate where the alarm A is activated when either the temperature T is above 35°C or the humidity H is high:

$$A = T + H$$



Truth Table

T	H	A
0	0	0
0	1	1
1	0	1
1	1	1

1 ITEM 6

Solution

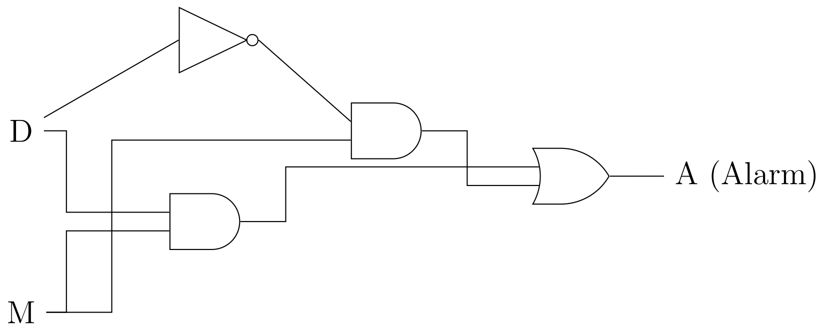
a) Logic Gate Configuration

To achieve the desired output for the burglar alarm system, we can use a combination of AND, OR, and NOT gates:

1. Use an **AND gate** to detect when both the door is opened (D = 1) and motion is detected (M = 1).

2. Use a **NOT gate** to invert the input of the door sensor (D), and then use another **AND gate** to detect when the door is closed (D = 0) and motion is detected (M = 1).

3. Finally, use an **OR gate** to combine the outputs of the two AND gates. The OR gate will output 1 (alarm activated) if either condition is met.



b) Truth Table

The truth table for the burglar alarm system is as follows:

D	M	NOT D (D')	D AND M	D' AND M	A (Alarm)
0	0	1	0	0	0
0	1	1	0	1	1
1	0	0	0	0	0
1	1	0	1	0	1

c) Explanation

The circuit is designed to activate the alarm light (A = 1) when either of the following conditions is met:

- The output of the first **AND gate** (D AND M) is 1 when both the door is open (D = 1) and there is motion detected (M = 1), fulfilling the first condition.
- The output of the **NOT gate** provides the inverse of D (D'). The second **AND gate** (D' AND M) outputs 1 when the door is closed (D = 0, hence D' = 1) and there is motion detected (M = 1), fulfilling the second condition.
- The final **OR gate** combines the outputs of the two AND gates, resulting in the alarm light being activated (A = 1) if either condition is met.

This logic gate configuration ensures the burglar alarm system works correctly according to the specified conditions.

ITEM 7

The Tank to Use for Storing the Required Amount of Water

First, we need to determine the capacity of each tank to see if they can hold 10,000 kg of water. The density of water is approximately 1 kg/L, so 10,000 kg of water is equivalent to 10,000 liters or 10,000,000 cm^3.

Capacity Calculation for Tank A:

- Cross-sectional area $A = 18380\,\text{cm}^2$

- Height $h = 550\,\text{cm}$ (since 5.5 m = 550 cm)

Volume of Tank A:

$$\text{Volume of Tank A} = A \times h = 18380\,\text{cm}^2 \times 550\,\text{cm} = 10,109,000\,\text{cm}^3$$

Capacity Calculation for Tank B:

- Cross-sectional area $A = 22200\,\text{cm}^2$
- Height $h = 450\,\text{cm}$ (since 4.5 m = 450 cm)

Volume of Tank B:

$$\text{Volume of Tank B} = A \times h = 22200\,\text{cm}^2 \times 450\,\text{cm} = 9,990,000\,\text{cm}^3$$

Since 10,000,000 cm^3 is needed, Tank A can accommodate this volume, but Tank B cannot.

The Type of Tank That Would Keep Water at the Required Temperature

Tank A is painted black, and Tank B is painted white. The color of the tank affects its ability to absorb and retain heat:

- Black surfaces absorb more heat and retain warmth better.
- White surfaces reflect more heat and are less effective at retaining warmth.

Therefore, Tank A (painted black) would be better at keeping the water warm for customers.

Position for the Tap on the Tank

To facilitate effective handwashing, the tap should be placed at the bottom of the tank to ensure easy access to water and complete drainage. Let's designate the position as K at the bottom of the tank.

Explanation:

- Position K: At the bottom of the tank, near the ground level. This placement allows gravity to assist in water flow, ensuring that all water can be used without any remaining in the tank, and making it easy for users to access the water without needing additional pressure mechanisms.

Advice on the Tank Stand

To ensure the tank stand can withstand the weight of the tank for a long time, the restaurant owner should consider the following measures:

- Material Strength: Use durable materials like reinforced plastic or metal stands that can support the weight of the tank and water (approximately 10,000 kg of water plus the tank weight).

- Stability and Balance: The stand should have a wide base to ensure stability and prevent tipping.
- Regular Maintenance: Inspect the stands regularly for any signs of wear and tear, corrosion, or weakening of joints and connections.
- Load Distribution: Ensure the load is evenly distributed to avoid any single point bearing too much weight, which could cause failure.
- Girders: Platics stands may also be replaced with iron or steel stands reinforced using girders.

Item 8

Saucepan

Material: Aluminum or Copper
Reason: Both aluminum and copper have high thermal conductivity, meaning they can quickly and evenly distribute heat. Aluminum is lighter and more cost-effective, while copper provides superior heat distribution.

Strainer

Material: Aluminum
Reason: Aluminum is lightweight, corrosion-resistant, and can be easily shaped into a strainer with small perforations.

Saucepan Covers (Lids)

Material: Aluminum
Reason: Aluminum is lightweight and easy to shape into a lid that fits snugly on a saucepan, helping retain heat and reduce cooking time.

Ladles

Material: Aluminum with a wooden handle
Reason: Aluminum is lightweight and durable, while a wooden handle would provide insulation to prevent burns when handling hot liquids.

Cups

Material: Melamine resin or Clay
Reason: Melamine resin is durable, lightweight, and resistant to breakage, making it ideal for school environments. Clay cups would be heavier and more fragile but could be considered for traditional aesthetics.

Plates

Material: Melamine resin or Clay
Reason: Melamine resin plates are durable and break-resistant, ideal for students. Clay plates can be considered for traditional uses but are more prone to breakage.

Determining Time to Heat Milk to 100°C

Given:

- Power of heater: $P = 4350\,\text{W}$
- Initial temperature of milk: $\theta_i = 25°\text{C}$
- Final temperature of milk: $\theta_f = 100°\text{C}$
- Mass of milk: $m_{\text{milk}} = 80\,\text{kg}$
- Specific heat capacity of milk: $c_{\text{milk}} = 3890\,\text{J}\,\text{kg}^{-1}\,\text{K}^{-1}$
- Initial temperature of copper cooking can: $\theta_i = 25°\text{C}$
- Final temperature of copper cooking can: $\theta_f = 100°\text{C}$
- Mass of copper cooking can: $m_{\text{milk}} = 5\,\text{kg}$
- Specific heat capacity of copper: $c_{\text{milk}} = 400\,\text{J}\,\text{kg}^{-1}\,\text{K}^{-1}$

Calculations

Heat Required for Milk

The temperature change $\Delta\theta$ is:

$$\Delta\theta = \theta_f - \theta_i = 100°\text{C} - 25°\text{C} = 75\text{ K}$$

The heat required to raise the temperature of the milk is:

$$Q_{\text{milk}} = m_m \times C_m \times \Delta\theta$$

$$Q_{\text{milk}} = 80\,\text{kg} \times 3890\,\text{J/kg·K} \times 75\,\text{K} = 23{,}412{,}000\,\text{J}$$

Heat Required for Copper

The heat required to raise the temperature of the copper is:

$$Q_{\text{copper}} = m_c \times C_c \times \Delta\theta$$

$$Q_{\text{copper}} = 5\,\text{kg} \times 400\,\text{J/kg·K} \times 75\,\text{K} = 150{,}000\,\text{J}$$

Total Heat Required

$$Q_{\text{total}} = Q_{\text{milk}} + Q_{\text{copper}}$$

$$Q_{\text{total}} = 23{,}340{,}000\,\text{J} + 150{,}000\,\text{J} = 23{,}490{,}000\,\text{J}$$

Time Required

$$t = \frac{Q_{\text{total}}}{P}$$

$$t = \frac{23{,}490{,}000\,\text{J}}{4350\,\text{W}} = 5{,}400\text{ s}$$

$$t = 5{,}400\text{ seconds} = 90\text{ minutes}$$

It will take approximately 89.29 minutes to heat the milk to 100°C.

Keeping Milk Hot in a Thermos Flask

A thermos flask is designed to minimize heat loss using the following principles:

Vacuum Insulation:

The thermos flask has a double-walled construction with a vacuum between the walls. The vacuum acts as an excellent insulator because it eliminates air, which significantly reduces heat transfer by conduction and convection.

Reflective Coating:

The inner surfaces of the walls are usually coated with a reflective material like aluminum, which reflects radiant heat back into the liquid, reducing heat loss by radiation.

Tight Seal:

The thermos flask has a tight-sealing lid to prevent heat loss through evaporation and to minimize air exchange, which could lead to heat loss by convection.

Item 9

Importance of the Fuse

Protection from Overcurrent:

The fuse is a safety device designed to protect the electrical circuit by melting and breaking the circuit when the current exceeds a certain level, preventing damage to appliances and reducing the risk of fire.

Protecting Appliances:

By interrupting excessive current, the fuse protects connected devices from damage due to overcurrent conditions, such as short circuits or electrical overloads.

Effectiveness of the Fuse

Rated Current:

The fuse in the extension is rated at 4A. This means it will blow if the current exceeds 4A, thereby cutting off the power supply.

Combined Current for TV and Flat Iron:

To check if the fuse will support both the TV and flat iron:

Power of TV: 75W
Power of Flat Iron: 600W
Voltage: 240V

$$I_{\text{TV}} = \frac{P_{\text{TV}}}{V} = \frac{75W}{240V} = 0.3125A$$

$$I_{\text{Flat Iron}} = \frac{P_{\text{Flat Iron}}}{V} = \frac{600W}{240V} = 2.5A$$

Total Current:

$$I_{\text{Total}} = I_{\text{TV}} + I_{\text{Flat Iron}} = 0.3125A + 2.5A = 2.8125A$$

The total current drawn by the TV and flat iron is 2.8125A, which is below the 4A rating of the fuse. Therefore, the fuse will not blow and will effectively support the TV and flat iron when plugged into the extension.

Connecting the Bulbs

Recommended Connection: Connect the bulbs in parallel.
Reason for Parallel Connection:

- **Constant Voltage:** In a parallel connection, each bulb receives the full mains voltage (240V), ensuring each bulb operates at its rated brightness.
- **Independence:** If one bulb fails, the others will continue to work, as each bulb operates independently.
- **Current Distribution:** In parallel, the total current is divided among the bulbs, preventing a single bulb from bearing the entire current load.

Current Through Parallel Bulbs
Given:

- Power of each bulb: 60W
- Voltage: 20V
- Number of bulbs: 4

Current through one bulb:

$$I_{\text{bulb}} = \frac{P_{\text{bulb}}}{V} = \frac{60W}{20V} = 3A$$

Total Current in Parallel:

$$I_{\text{total}} = I_{\text{bulb}} \times \text{Number of bulbs} = 3A \times 4 = 12A$$

The total current delivered through the parallel arrangement of the 4 bulbs is 12A.

Cost of Running Appliances for Two Days

Given:

- Cost per unit: UG Sh. 680
- Duration: 2 days

Power Consumption:

- TV: 75W for 5 hours per day
- Flat Iron: 600W for 2 hours per day
- 4 Bulbs: 4 × 60W for 12 hours per day

Daily Energy Consumption:

$$\text{Energy}_{\text{TV}} = 75W \times 5h = 375Wh = 0.375kWh$$

$$\text{Energy}_{\text{Flat Iron}} = 600W \times 2h = 1200Wh = 1.2kWh$$

$$\text{Energy}_{\text{Bulbs}} = 4 \times 60W \times 12h = 2880Wh = 2.88kWh$$

Total Daily Energy Consumption:

$$\text{Total Daily Energy} = 0.375kWh + 1.2kWh + 2.88kWh = 4.455kWh$$

Energy Consumption for 2 Days:

$$\text{Energy for 2 Days} = 4.455kWh \times 2 = 8.91kWh$$

Total Cost:

$$\text{Total Cost} = 8.91kWh \times \text{Cost per unit}$$

$$\text{Total Cost} = 8.91 \times 680\,\text{UG Sh}$$

$$\text{Total Cost} = 6058.8\,\text{UG Sh}$$

The amount of money required to keep all appliances running for two days is 6058.8 UG Sh.

Item 10

To make a simple cell using the given materials (Zinc and Copper electrodes, ammonium chloride jelly, and electrical conductor such as wire), follow these steps:

- Clean the Zinc and Copper electrodes to ensure they are free from any contaminants that could interfere with the cell's operation.
- Place the ammonium chloride jelly in a container. This will act as the electrolyte for the cell.

- Insert the Zinc electrode into one side of the container and the Copper electrode into the opposite side. Ensure the electrodes do not touch each other.
- Attach a wire to each electrode. Connect the free ends of the wires to a voltmenter to measure voltage.
- The free ends of the wire can as well be connected to the external circuit given in Figure a and Figure b

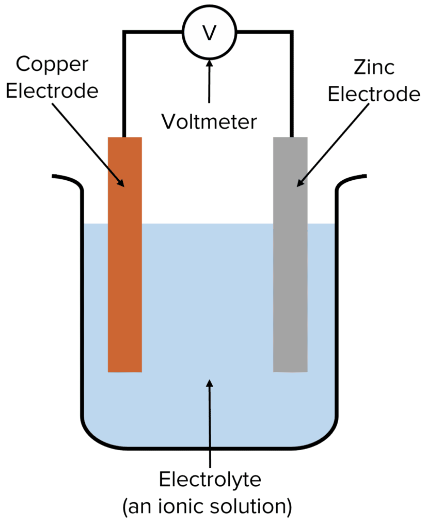


Figure 3: Simple cell

Finding the Ammeter Reading

Figure a: Parallel and Series Circuit

- Resistors in parallel:

$$R = \frac{2 \times 3}{2 + 3} = 1.2\Omega$$

- Resistors in series:

$$R_{\text{total, a}} = 1.2\Omega + 6\Omega = 7.2\Omega$$

Figure b: Series Circuit

- Resistors in Series:

$$R_{\text{total, b}} = 2\Omega + 3\Omega + 6\Omega = 11\Omega$$

Current Calculation

Assume the cell provides a voltage V.

- Current in Figure a:

$$I_a = \frac{V}{R_{\text{total, a}}} = \frac{6}{7.2\Omega} = 0.833A$$

- Current in Figure b:

$$I_b = \frac{V}{R_{\text{total, a}}} = \frac{6}{11\Omega} = 0.545A$$

Therefore, current I_a in Figure a is greater than the current I_b in Figure b.

Identical Bulbs and Circuit Continuity

Suppose all the resistors are replaced by identical bulbs, and only the bulb in place of the 3Ω resistor blows out:

- **Series Circuit (Figure b):** If one bulb blows out, the circuit is broken, and no current will flow through the circuit. Thus, the entire circuit will stop working.
- **Parallel Circuit (Figure a):** If one bulb blows out, the other bulbs will continue to work because they are connected in parallel. Each bulb has its own independent path to the voltage source.

Conclusion: The parallel circuit (Figure a) will continue working even if one bulb blows out.

Advantages of Parallel Connection

Advantages of Connecting Bulbs in Parallel:

- **Independent Operation:** Each bulb operates independently. If one bulb fails, the others will continue to function.
- **Consistent Voltage:** Each bulb receives the full voltage of the power source, ensuring consistent brightness.
- **Lower Equivalent Resistance:** The overall resistance of the circuit is lower in parallel, allowing for more current to flow and better performance.

Explanation: Parallel connections are more reliable because they ensure continuous operation of other components even if one fails, maintain consistent voltage across each component, and generally improve the efficiency of the circuit. [2]

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