APPENDICES
MAHATMA GANDHI UNIVERSITY

SCHOOL OF PEDAGOGICAL SCIENCES

QUESTIONNAIRE ON THE PRESENT STATUS OF TEACHING PHYSICS AT HIGHER SECONDARY LEVEL

Prepared by

MILIYA SUSAN JOSEPH

Guided by

Dr. P. J. JACOB

Sir/ Madam,

I am a Research Scholar in Education at School of Pedagogical Sciences, Mahatma Gandhi University. The following questionnaire is prepared to analyse the present status of teaching Physics in Higher Secondary Schools of Kerala. Please go through each question and mark your response by putting a tick mark (✓) and fill in the blanks at the required areas. I assure you that the confidentiality of your responses will be maintained and the data will be used for my research purpose only. Your co-operation and effort for this task is well appreciated.

Thanking You

Yours faithfully

Kottayam

Miliya Susan Joseph

Date

(Research Scholar)
Name of the Teacher: 

Name of the School: 

Teaching Experience: 

Type of the School:  Govt./ Govt. Vocational/ Govt. Aided

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Statements</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Do you find the time period to teach Physics in Higher Secondary is sufficient?</td>
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<tr>
<td>2</td>
<td>Do you utilize web resources to make the learning meaningful?</td>
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<td>3</td>
<td>Does your school provide facilities to use PowerPoint in Classrooms?</td>
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<td>4</td>
<td>Do you concentrate more on theories while teaching?</td>
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<td>5</td>
<td>Do your students try to memorize the concepts without understanding it?</td>
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<td>6</td>
<td>Do you get enough time to solve numerical problems in Classrooms?</td>
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<td>7</td>
<td>Do you give individual attention to students while solving Problems?</td>
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<td>8</td>
<td>Do you feel that majority of students are avoiding problems during exams?</td>
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<td>9</td>
<td>Do you feel that students can excel in Problem solving when they get individual help?</td>
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<td>10</td>
<td>Do you spend time to solve extra problems in class?</td>
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<td>11</td>
<td>Do you wait till all the students in the class to solve the given problem?</td>
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<tr>
<td>12</td>
<td>Do you feel the need of integrating technology for solving numerical problems in Physics?</td>
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<td>13</td>
<td>Do you spend time to solve application level questions in Physics while teaching?</td>
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<td>Question</td>
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<tr>
<td>14</td>
<td>Do you feel that application level questions are difficult for your students to answer?</td>
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<tr>
<td>15</td>
<td>Do you feel that Critical Thinking is necessary to apply the learned concepts in Physics to new situation?</td>
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<td>16</td>
<td>Do you prefer a strategy to enhance the critical Thinking of Students?</td>
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<td>17</td>
<td>Which method do you follow in teaching physics</td>
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<td></td>
<td>a) Activity Oriented Method</td>
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<td>b) Lecture method</td>
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<td>c) Lecture cum Demonstration</td>
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<td>d) Brainstorming</td>
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<td></td>
<td>e) Questioning</td>
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<td>18</td>
<td>In your opinion what may be the reason for poor performance in Physics?</td>
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<td>19</td>
<td>Give some suggestions to enhance the overall Achievement in Physics?</td>
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</table>
LESSON TRANSCRIPT ON STRATEGY BASED ON ANDES INTELLIGENT TUTORING SYSTEM – 1

I. General Information

| Name of the Teacher : Miliya Susan Joseph | Standard : XII |
| Name of the School : | Strength : |
| Subject : Physics | Duration : 60 min |
| Unit : Current Electricity | Date : |
| Topic : Emf and Internal Resistance of the Cell |

II. Curricular Objective of the Lesson

1. To make students understand the difference between Emf and Potential difference of a cell.
2. To make students understand the concept Internal Resistance of cells.
3. To help students to solve problems related to Emf and Internal resistance of Cells.

III. Instructional Objectives

- To enhance the understanding and application level of students regarding the Emf and Internal Resistance of the Cell.
- To enhance the analyzing, evaluating and creating abilities of students regarding the Emf and Internal Resistance of the Cell.
- To enhance the Critical Thinking of Students.
- To enhance the Problem solving Ability of Students.
IV. Concepts

1. The Potential difference across the cell when there is no current in the circuit (open circuit) is called the Emf of the Cell.
2. The Potential difference across the cell when current flows through the circuit (closed circuit) is called the voltage of the Cell.
3. The resistance offered to the current flow by the electrolyte of the cell is called Internal Resistance of the cell.

V. Technological Utilization

- **Materials**
  - Projector, Computers, CD Rom

- **Software Used**
  - **I- TIPS**: I – TIPS is an intelligent tutoring Integrated Problem Solving Software for solving numerical problems in Physics. It can be installed in the computer using the CD.

- **Images**
  - Image of a circuit.
  - Image to compare the open and closed circuit.
  - Image to derive the equation for internal resistance of the cell – Retrieved from http://www.qsstudy.com/physics/internal-resistance-cell

- **Videos**
  - Different videos are taken from the web to clarify the following concepts.
    - Direction and flow of Electric Current - https://www.youtube.com/watch?v=t6pqrkWSWL8
    - Emf and Internal Resistance of the cell – a) https://www.youtube.com/watch?v=h4gAl1iPKz5s
      b) https://www.youtube.com/watch?v=7WkIZx4LS3M.
VI. Previous knowledge

✓ Flow of electrons constitutes the Electric Current
✓ Conventionally, the direction of electric current is from positive to negative.

VII. Misconceptions

• Electric current flows from positive to negative.
• Open and Closed circuit does not make changes in the potential difference across the Cell.

VIII. Methods/ Activities Used

➢ Think-Pair- Share
➢ Group Discussion
➢ Questioning
➢ Verbal presentation
➢ Group Work
➢ One- Minute Paper
### IX. Lesson Transaction

<table>
<thead>
<tr>
<th>Instructional Phases</th>
<th>Instructional Activities</th>
<th>Students Response/Assessment</th>
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</thead>
<tbody>
<tr>
<td><strong>Phase I:</strong> Elicitation and Stimulation - Teacher checks the basic knowledge essential to learn the topic.</td>
<td>Students are directed to sit in Intelligent groups allotted for them. Teacher shows the image of an Electric circuit with the help of a projector and asked students to identify the components used in the electric Circuit. Teacher distributes the worksheet containing the following questions and ask them to find out the answer through Think – Pair – Share Strategy.</td>
<td>Students sit in their groups already allotted for them based on their previous Achievement scores. Students observed the image carefully and identify the components used in the circuit. Students initially identified the answers individually, then discussed with one of his/her</td>
</tr>
</tbody>
</table>
Worksheet – 1

a. Name the components used in the Electrical Circuit?

b. What is the direction of Electric Current?

c. What is the use of Ammeter?

d. How the ammeter is connected (series/parallel)?

e. What is the use of Voltmeter?

f. How the voltmeter is connected?

g. What is the use of Key in a circuit?

Consolidation

Cell, Ammeter, Voltmeter, Resistance and Key are the components of the Electric Circuit. The direction of flow of Electric Current is from positive to negative. Ammeter is used to measure the Electric Current and is connected in series with the circuit. Voltmeter is used to measure the potential difference and is connected in parallel to the circuit. Key is used to control the flow of Electric Current in a Circuit. When the key is closed, Electric current flows through the circuit. When the key is open, no current flows through the circuit.

The answers identified by the students are,


b. From positive to negative.

c. To measure Electric Current.

d. Series

e. To measure Potential difference.

f. Parallel.

g. To control the current flow.

group member and finally shared and discussed the answers in groups which revealed the basic understanding about the content.
### Phase II: Exploration and Extrapolation
Teacher through various tasks introduces the topic to be learned

<table>
<thead>
<tr>
<th>Task 1</th>
<th>Teacher shows a video of ‘how electric current flows in a circuit’ with the help of a projector and asks students to compare their knowledge with that obtained from the presentation through group discussion. (The snap shot of the video to be presented is given below).</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><a href="https://www.youtube.com/watch?v=t6pqrkWSWL8">https://www.youtube.com/watch?v=t6pqrkWSWL8</a></td>
</tr>
<tr>
<td>Consolidation</td>
<td>Electrons constitutes electric current in a circuit and the actual flow of Electric Current is from negative to positive.</td>
</tr>
<tr>
<td>Task 2</td>
<td>Teacher projects the following two figures on the screen with the help of a projector. Then the teacher ask students to compare the two figures and note down the points individually.</td>
</tr>
<tr>
<td></td>
<td>Students observed the video and identified the difference between conventional current flow and the actual flow of Electric Current in the Circuit. They also identified that the flow of electrons constitutes Electric Current</td>
</tr>
</tbody>
</table>
Students note down their observation.
Teacher then distribute a worksheet contain the following statements and ask them to identify those correct statements from the points.

**Worksheet – 2**

a. The value of the Emf of the cell and the voltmeter reading is different when the circuit is closed or open.
b. In an Open circuit the voltmeter shows the same reading as that of the Emf of the Cell.
c. The voltmeter shows different reading in the open circuit and closed circuit.
d. Whether open circuit or closed circuit makes no difference in the voltmeter reading.
e. The voltmeter reading of closed circuit is greater than that of open circuit.
f. The voltmeter reading of open circuit is greater than that of closed circuit.

Students observed the two figures and found out the similarities and differences in these two figures and note down their observations individually.

According to their individual observation
- Key is open in the first figure and key is closed in the second figure.
- The value of E and r is same in both the figures.
- The voltmeter reading is different in two figures.

Students went through the sentences in the worksheets and compared with the figure and found out the true sentences
### Task 3
Teacher asks the students to watch the following video retrieved from https://www.youtube.com/watch?v=h4gA1iPKz5s and ask to justify the true sentences given in the worksheet - 2. The snapshot of the video is given below.

![Circuit](image)

Students were allowed to discuss in groups using guided discovery method. Teacher helps the students through verbal clues while the video is playing.

### Task 4
Teacher projects the following figure on the screen with the help of a projector. Then the teacher asks students to derive an equation for the total resistance, Total current through the circuit and potential difference across each resistor in both cases. Teacher gives the clue to start the derivation from Ohm’s Law.

Students carefully watched the video presentation and with the help of verbal clues given by the teacher, the groups prepared clarification points for each sentences in the worksheet 2.

a, b, c and f were the true sentences identified by the students.
Students derive the equation for internal resistance of the cell in groups, with the help of teacher.

<table>
<thead>
<tr>
<th>Phase III : Explanation and Justification</th>
<th>Students derived the equation for internal resistance of the cell based on Ohm’s Law.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students justifies the findings of Phase II</td>
<td>Students in each group were directed to communicate the findings of the Phase II with proper justification.</td>
</tr>
<tr>
<td></td>
<td>Teacher through verbal presentation introduces the topics Emf, Voltage and Internal Resistance of the cell.</td>
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<tr>
<td></td>
<td>The teacher presents the topic with the help of a video retrieved from <a href="https://www.youtube.com/watch?v=7WkIZx4LS3M">https://www.youtube.com/watch?v=7WkIZx4LS3M</a>. The snapshot of the video presented is given below.</td>
</tr>
<tr>
<td></td>
<td>Students from each group present their justifications. Some of the justification presented is given below.</td>
</tr>
<tr>
<td></td>
<td>• Internal resistance of the cell is the reason behind the change in potential difference across the cell, when the key is closed.</td>
</tr>
<tr>
<td></td>
<td>• Internal resistance of the cell reduces the potential difference across it, when the key is closed.</td>
</tr>
</tbody>
</table>
• Students verify the expression for internal resistance derived in the Phsae II.
• Teacher clarifies all the doubts raised by the students.
• The Session will be consolidated by the teacher

**Consolidation**

- The Potential difference across the cell when there is no current in the circuit (open circuit) is called the Emf of the Cell.
- The Potential difference across the cell when current flows through the circuit (closed circuit) is called the voltage of the Cell.
- The resistance offered to the current flow by the electrodes and electrolyte of the cell is called Internal Resistance of the cell.
- It is denoted by r.
- Internal Resistance, \( r = \left( \frac{E}{V} - 1 \right) R \)
<table>
<thead>
<tr>
<th>Phase IV: Elaboration and Extension- This is the phase where students apply the learned concepts to new situations.</th>
</tr>
</thead>
<tbody>
<tr>
<td>In this phase students were asked to solve numerical problems using the software developed for the purpose. Teacher supervises students actions</td>
</tr>
<tr>
<td>Students solved the problems using I – TIPS software.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase V: Evaluation and Reflection- In this phase students evaluate their understanding individually and clarifies the doubts if any.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students were asked to prepare a one – minute paper that comprises three main ideas or points regarding the topic. Teacher ask three or four students to read the points. Students will be encouraged to share their ideas regarding the topic and class. The teacher clarifies the misconceptions if any.</td>
</tr>
<tr>
<td>Students prepared three main ideas or points regarding the topic in one minute. Shared their points before the class. Students also shared the strengths and weaknesses they experienced in the class.</td>
</tr>
</tbody>
</table>
X. Check – Out Activities


2. A battery of Emf 12 V and internal resistance 5 ohm is connected to a resistor. If the current through the circuit is 0.3 A, What is the resistance of the resistor?
LESSEE ON TRNSCRIPT ON STRATEGY BASED ON ANDES INTELLIGENT TUTORING SYSTEM-2

I. General Information

Name of the Teacher: Miliya Susan Joseph
Name of the School:
Subject: Physics
Unit: Current Electricity
Topic: Resistors in Series and Parallel
Standard: XII
Strength:
Duration: 45 min
Date:

II. Curricular Objective of the Lesson

1. To make students understand the concept of Resistors in Series.
2. To make students understand the concept of Resistors in Parallel.
3. To help the students to solve problems related to Resistors in series and parallel.
4. To help the students to solve problems related to combination of resistors.

III. Instructional Objectives

- To enhance the understanding level of students regarding the topic Resistors in Series and Parallel.
- To enable the students to apply the learned concepts to new and unfamiliar situation.
- To enhance the analyzing, evaluating and creating abilities of students.
- To enhance the Critical Thinking of Students.
- To enhance the Problem solving Ability of Students.

### IV. Concepts

<table>
<thead>
<tr>
<th>Resistors in Series</th>
<th>Resistors in Parallel</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Resistors are connected back to back.</td>
<td>a. Resistors are connected end to end.</td>
</tr>
<tr>
<td>b. Same Current passes through the circuit, I.</td>
<td>b. Different current passes through the circuit, I = I₁ + I₂ + I₃.</td>
</tr>
<tr>
<td>c. Potential difference across each resistor is different, V = V₁ + V₂ + V₃.</td>
<td>c. Potential difference across each resistor is the same, V.</td>
</tr>
<tr>
<td>d. Total Resistance is the sum of Individual Resistances, R = R₁ + R₂ + R₃</td>
<td>d. Reciprocal of total resistance is the sum of reciprocal of Individual Resistances. 1/R = 1/R₁ + 1/R₂ + 1/R₃</td>
</tr>
</tbody>
</table>
V. Technological Utilization

- **Materials**
  Projector, Computers, CD Rom

- **Software Used**
  I-TIPS: I-TIPS is an intelligent tutoring Integrated Problem Solving Software for solving numerical problems in Physics. It can be installed in the computer using the CD.

- **Images**
  - Image of a circuit – Ohm’s Law
  - Images of cells in series and parallel

- **Videos**
  Different videos are taken from the web to clarify the following concepts.
  - Resistors in Series - https://www.youtube.com/watch?v=u-7k8wpl_ZU
  - Resistors in Parallel - https://www.youtube.com/watch?v=MxH7hnuBfC4

VI. Previous Knowledge

Students knew that a potential difference is necessary for current to flow through a circuit. Also Resistors offers resistance to the flow of electric current in the circuit.

According to Ohm’s Law, \( V = R I \),

\[ I = \frac{V}{R} \]

Where \( V \) = Potential Difference between any two points.
I = Electric Current flowing through the circuit.

R = Resistance.

VII. Misconceptions

- The value of resistance (R) changes with the change in value of Potential Difference (V) and Electric Current (I).

VIII. Methods/ Activities Used

- Think-Pair-Share
- Group Discussion
- Questioning
- Verbal presentation
- Group Work
- One-Minute Paper
## IX. Lesson Transaction

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<tr>
<td>Phase I: Elicitation and Stimulation</td>
<td>Students are directed to sit in Intelligent groups allotted for them.</td>
<td>Students sit in their groups already allotted for them based on their previous achievement scores.</td>
</tr>
<tr>
<td>Teacher checks the basic knowledge</td>
<td>Teacher shows the image of an Electric circuit with the help of a projector and asked students to identify the components used in the electric Circuit.</td>
<td>Students observe the image carefully and identify the components used in the circuit.</td>
</tr>
<tr>
<td>essential to learn the topic.</td>
<td>Teacher distributes the worksheet containing the following questions and asks them to find out the answer through Think – Pair – Share Strategy.</td>
<td></td>
</tr>
</tbody>
</table>
**Worksheet – 1**

- Name the components used in the Electrical Circuit?
- What is the use of Ammeter?
- What is the use of Voltmeter?
- What is the relation connecting V, I and R based on Ohm’s Law?
- Whether the change in V and I affects the value of R?
- If you know the ammeter and voltmeter reading, how will you calculate the Resistance (R) of the circuit?
- If you know the value of Resistance (R) and voltmeter reading, how will you calculate the current (I) flowing through the circuit?
- If you know the value of Resistance (R) and Current (I) flowing through the circuit, what will be the reading in the voltmeter?

Students initially identified the answers individually, then discussed with one of his/her group member and finally shared and discussed the answers in groups which revealed the basic understanding about the content. The answers identified by the students were

- Cell, Voltmeter, Ammeter and Resistance
- Ammeter is used to measure the Electric Current.
- Voltmeter is used to
Different groups present the answers before the class. Teacher clarifies the misconceptions they have in their previous knowledge.

Consolidation

- Cell, Ammeter, Voltmeter and Resistance are the components of the Electric Circuit.
- Ammeter is used to measure the Electric Current.
- Voltmeter is used to measure the Potential Difference.
- According to Ohm’s Law, the ratio $V/I = R$, a constant.
- Since $R$ is a constant, the variation in $V$ and $I$ does not affect its value.
- The Resistance $R$ of the circuit can be calculated using the formulae, $R = V/I$.
- The Electric Current, $I$ of the circuit can be calculated using the formulae, $I = V/R$.
- The Potential Difference, $V$ of the circuit can be calculated using the formulae, $V = IR$.  

measure the Potential Difference.
- Resistance, $R = V/I$
- Electric Current, $I = V/R$
- Potential Difference, $V = IR$
Phase II: Exploration and Extrapolation - Teacher through various tasks introduces the topic to be learned

Task 1

Teacher projects the following figure on the screen with the help of a projector. Then the teacher asks students to compare the two figures and note down the points individually.

![Series Resistors](image1.png) ![Parallel Resistors](image2.png)

Students observed the two figures and noted their observations individually.

Students note down their observation.

Teacher then distribute a worksheet contain the following statements and ask them to categorize the statements into two as given in the worksheet.
Worksheet – 2

g. The potential difference across each resistors (R₁, R₂, R₃) is the same.

h. The resistors are connected back to back.

i. The current through each resistor is the same.

j. The potential difference across each resistors (R₁, R₂, R₃) is different.

k. The current through each resistor is different.

l. The resistors are connected end to end.

m. Total Resistance is the sum of Individual Resistances.

n. Reciprocal of total resistance is the sum of reciprocal of the individual resistances.

<table>
<thead>
<tr>
<th>Resistors in series</th>
<th>Resistors in Parallel</th>
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</table>

Students went through the sentences in the worksheets and categorize the sentences under Resistors in Series and Parallel. The answers identified by the students are

<table>
<thead>
<tr>
<th>Resistors in Series</th>
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</thead>
<tbody>
<tr>
<td>b</td>
<td>a</td>
</tr>
<tr>
<td>c</td>
<td>e</td>
</tr>
<tr>
<td>d</td>
<td>f</td>
</tr>
<tr>
<td>g</td>
<td>h</td>
</tr>
</tbody>
</table>
Task 2

Teacher asks the students to watch the following video retrieved from https://www.youtube.com/watch?v=u-7k8wpl_ZU and ask to justify the sentences categorized under Resistors in Series in the above worksheet 2. The snapshot of the video is given below.

Students were allowed to discuss in groups using guided discovery method. Teacher helps the students through verbal clues while the video is playing.

Task 3

Teacher asks the students to watch another video retrieved from https://www.youtube.com/watch?v=MxH7hnuBfC4 and ask to justify the sentences categorized under Resistors in Parallel in the above worksheet 2.

Students carefully watched the video presentations and with the help of verbal clues given by the teacher, the groups prepared clarification points for the sentences categorized under Resistors in Series in the worksheet 2.
The snapshots of the video are given below.

Students were allowed to discuss in groups using guided discovery method. Teacher helps the students through verbal clues while the video is playing.

**Task 4**
Teacher projects the following two figures on the screen with the help of a projector. Then the teacher asks students to derive an equation for the total resistance, Total current through the circuit and potential difference across each resistor in both cases. Teacher gives the clue to start the derivation from Ohm’s Law.

Students carefully watched the video presentations and with the help of verbal clues given by the teacher, the groups prepared clarification points for the sentences categorized under Resistors in parallel in the worksheet 2.
Students were allowed to discuss in groups using guided discovery method. Teacher helps the students through verbal clues.

**Phase III:**

**Explanation and Justification**

Students justify the findings of Phase II

- Students in each group were directed to communicate the findings of the Phase II with proper justification.
- Teacher through verbal presentation introduces the topics Resistors in Series and Parallel.
- Students check the equation derived in the previous session.
- Teacher clarifies all the doubts raised by the students.
- The Session will be consolidated by the teacher.

Students observed the two figures and derive the equations the total resistance, Total current through the circuit and potential difference across each resistor in series and parallel circuits.

**Students from each group present their findings. Some of the findings presented by the students are given below.**

- In series Circuit, there is only a single path for current to flow. That’s why a single current, I.
<table>
<thead>
<tr>
<th><strong>Consolidation</strong></th>
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<tr>
<td>d. Total Resistance is the sum of Individual Resistances, R = R₁ + R₂ + R₃</td>
<td>d. Reciprocal of total resistance is the sum of reciprocal of Individual Resistances. 1/R = 1/R₁ + 1/R₂ + 1/R₃</td>
<td></td>
</tr>
</tbody>
</table>

- In Parallel circuit, there are multiple paths, therefore multiple currents.
- All the resistors do not have direct connection with the cell in series circuit; therefore potential difference varies across each resistor.
- All the resistors have direct connection with the cell in Parallel circuit, Therefore potential difference across each resistor remains the same.

Students listened to the presentation and answered the questions asked by the teacher. Students clarified their doubts.
<table>
<thead>
<tr>
<th>Phase IV: Elaboration and Extension</th>
<th>In this phase students were asked to solve numerical problems using the software developed for the purpose. Teacher supervises students actions</th>
<th>Students solved the problems using I–TIPS software.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Phase V: Evaluation and Reflection</th>
<th>Students were asked to prepare a one-minute paper that comprises three main ideas or points regarding the topic. Teacher asks three or four students to read the points. Students will be encouraged to share their ideas regarding the topic and class. The teacher clarifies the misconceptions if any.</th>
<th>Students prepared three main ideas or points regarding the topic in one minute. Shared their points before the class. Students also shared the strengths and weaknesses they experienced in the class.</th>
</tr>
</thead>
</table>

This is the phase where students apply the learned concepts to new situations. Students solved the problems using I–TIPS software.
X. Check – Out Activities

1. The Potential Difference across each resistor in a parallel circuit is the same. Justify?

2. You have four 1 ohm resistors. How will you connect these resistors so that the total resistance is 2.5 ohm?
# LESSON TRANSCRIPT BASED ON PRESENT ACTIVITY ORIENTED METHOD - 1

<table>
<thead>
<tr>
<th>Name of the Teacher</th>
<th>Miliya Susan Joseph</th>
<th>Standard</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of the School</td>
<td></td>
<td>Strength</td>
<td></td>
</tr>
<tr>
<td>Subject</td>
<td>Physics</td>
<td>Duration</td>
<td>45 min</td>
</tr>
<tr>
<td>Unit</td>
<td>Current Electricity</td>
<td>Date</td>
<td></td>
</tr>
<tr>
<td>Topic</td>
<td>Emf and Internal Resistance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Curricular Statement

To understand the difference between Emf and Potential difference and to derive an expression for current and potential difference when the cells are connected in series and in parallel.

## Content Analysis

### Terms:

Cells, Emf, Internal Resistance, Potential Difference
**Facts:**

1. The potential difference across the cell is different when there is current and when there is no current flowing through the circuit.

2. Cells can be connected in series and parallel just like resistors.

**Concepts:**

- The potential difference across the cell when there is no current drawn from it is the Emf and the potential difference across the cell when there is current is called voltage.
- The resistance offered to the current flow by the electrodes and electrolyte of the cell is called Internal Resistance of the cell.

**Curricular Objectives**

1. The Pupil acquires knowledge about terms, facts and concepts.

2. Develops process skills such as observing, predicting, experimenting, communicating and inferring data.

3. Applies the above knowledge in relevant situations.

4. Develops components of creativity such as visualizing, combining objects and ideas in a new way.

5. Develop positive attitude towards Science.

**Entry Behaviour**

Students knew that a potential difference is necessary for current to flow through a circuit.
### Session 1: Sensitization
Teacher asks students to answer the following question.
- What all things are necessary for a bulb to glow?

#### Consolidation
Battery/Cell, wires, Bulbs, Switch etc
Teacher divides the whole class into 10 groups.

### Session 2: Presentation
Teacher asks the following questions to check their previous knowledge.
- What is Electric current?
- What is the direction of Electric Current?

#### Consolidation
- Electric Current is the rate of flow of electrons.
- The direction of flow of electric current is from positive to negative.

<table>
<thead>
<tr>
<th>Process/ Activity</th>
<th>Expected Response</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Session 1: Sensitization</strong></td>
<td>Students answered Batteries/Cells, bulb, switch electric wires etc</td>
</tr>
<tr>
<td>Teacher asks students to answer the following question.</td>
<td></td>
</tr>
<tr>
<td>• What all things are necessary for a bulb to glow?</td>
<td></td>
</tr>
<tr>
<td><strong>Consolidation</strong></td>
<td>Students answered the questions as, Electric current is the rate of flow of electrons. The direction of electric current is from positive to negative.</td>
</tr>
<tr>
<td>Battery/Cell, wires, Bulbs, Switch etc</td>
<td></td>
</tr>
<tr>
<td>Teacher divides the whole class into 10 groups.</td>
<td></td>
</tr>
</tbody>
</table>
Session 3

Activity I (Group Experiment)

Teacher distributes a cell with emf $E = 6\, \text{V}$, a bulb, voltmeter, ammeter, key and connecting wires to different groups. Students are directed to draw a circuit diagram that allows current flow through bulb.

Students are directed to make the connection as drawn by them and asks to note the potential difference across the cell when the key is closed and when the key is open.

Teacher then ask the following question.

- What is the value of potential difference across the cell when the key is closed and when the key is open?

Students observed that the voltmeter reading is 6 volt when the key is closed and less than 6 volt when the key is open.

Teacher then differentiates the concept emf (E) and Voltage (V).

Consolidation

The value of potential difference across the cell when the key is open is called Emf represented by the letter E.

The value of potential difference across the cell when the key is Closed is called Voltage represented by the letter V.
**Activity 2 (Group Experiment and Discussion)**

Teacher asked to measure the potential difference across the bulb when the key is closed?
Teacher distributes the worksheet containing the following questions and asks them to find out the answer after discussing in groups.

- Is there any relationship between potential difference across the cell and potential difference across the bulb when the key is closed.
- Why does the potential difference across the cell decrease whenever there is a current flow through the circuit?
- Derive an expression for the potential difference across the cell at the time of current flow using Ohm’s Law?

**Consolidation**

Potential difference across the cell and potential difference across the bulb is same when the key is closed. The decrease in potential difference is due to the presence of internal resistance and emf of the cell.

The potential difference across the cell at the time of Current flow, \( V = E - Ir \).
Session 4 (Problem solving)
Teacher directed to solve the following questions given in the worksheet. Teacher gives necessary help to students while solving the problem.

1. A battery of emf 10 volt and internal resistance $3\Omega$ is connected to a resistor. If the current in the circuit is 0.5 A. What is the resistance of the resistor?
2. The secondary cell after a long use has an emf 1.9 volt and an internal resistance $380\Omega$. What is the maximum current that can be drawn from the cell?

<table>
<thead>
<tr>
<th>Session 6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Application</strong></td>
</tr>
<tr>
<td>• Identify instances from daily life where you use cells and how they are connected in various equipments such as T.V Remote, Timepiece etc.</td>
</tr>
</tbody>
</table>

Students solved the problems given in the worksheet

Follow up activities

1. What can change the potential difference across a cell?
2. Write one difference between emf and voltage?
3. Write one difference between internal resistance and external resistance?
LESSON TRANSCRIPT BASED ON PRESENT ACTIVITY ORIENTED METHOD - 2

<table>
<thead>
<tr>
<th>Name of the Teacher</th>
<th>Miliya Susan Joseph</th>
<th>Standard : X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of the School</td>
<td></td>
<td>Strength :</td>
</tr>
<tr>
<td>Subject</td>
<td>Physics</td>
<td>Duration : 45</td>
</tr>
<tr>
<td>min</td>
<td></td>
<td>Date :</td>
</tr>
<tr>
<td>Unit</td>
<td>Current Electricity</td>
<td></td>
</tr>
<tr>
<td>Topic</td>
<td>Resistors in Series and Parallel</td>
<td></td>
</tr>
</tbody>
</table>

**Curricular Statement**

To understand the circuit connection of Resistors in Series and Parallel and to derive an expression for current, potential difference and equivalent resistance, when the cells are connected in series and in parallel.

**Content Analysis**

**Terms:**

Resistors in series and Resistors in parallel
Facts:

1. When two or more resistors are connected back to back, a single current passes through the circuit.

2. When two or more resistors are connected back to back, the potential difference across each resistor varies.

3. When two or more resistors are connected end to end, the value of current varies across each resistor.

4. When two or more resistors are connected end to end, the potential difference across each resistor will be the potential difference across the cell.

Concepts:

<table>
<thead>
<tr>
<th>Resistors in Series</th>
<th>Resistors in Parallel</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Resistors are connected back to back.</td>
<td>a. Resistors are connected end to end.</td>
</tr>
<tr>
<td>b. Same Current passes through the circuit, I.</td>
<td>b. Different current passes through the circuit, I= I₁ + I₂ + I₃.</td>
</tr>
<tr>
<td>c. Potential difference across each resistor is different, V = V₁ + V₂ + V₃.</td>
<td>c. Potential difference across each resistor is the same, V.</td>
</tr>
<tr>
<td>d. Total Resistance is the sum of Individual Resistances, R = R₁ + R₂ + R₃</td>
<td>d. Reciprocal of total resistance is the sum of reciprocal of Individual Resistances. 1/R = 1/R₁ + 1/R₂ + 1/R₃</td>
</tr>
</tbody>
</table>
Curricular Objectives

1. The Pupil acquires knowledge about terms, facts and concepts.

2. Develops process skills such as observing, predicting, experimenting, communicating and inferring data.

3. Applies the above knowledge in relevant situations.

4. Develops components of creativity such as visualizing, combining objects and ideas in a new way.

5. Develop positive attitude towards Science.

Entry Behaviour

Students knew that a potential difference is necessary for current to flow through a circuit. Also Resistors offers resistance to the flow of electric current in the circuit.

According to Ohm’s Law, Where $V =$ Potential Difference between any two points.

\[ I = \text{Electric Current flowing through the circuit.} \]
\[ R = \text{Resistance.} \]
Teaching – Learning Aids

Cell –6 volt, 2Ω resistor, 3Ω resistor, Electric wires, Ammeter, Voltmeter, Key, Worksheets

<table>
<thead>
<tr>
<th>Process/ Activity</th>
<th>Expected Response</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Session 1: Sensitization</strong></td>
<td>Students draw a rough figure.</td>
</tr>
<tr>
<td>Teacher asks students to draw a rough figure to indicate the arrangement of bulbs in a Christmas light. Students draw the figure and will summarize that bulbs are connected back to back. Teacher divides the whole class into 10 groups.</td>
<td><strong>Session 2: Presentation</strong></td>
</tr>
<tr>
<td>Teacher asks the following questions to check their previous knowledge. • What is the use of Resistors in a circuit? • What is the expression for Ohm’s Law?</td>
<td>Students answered that resistors offers resistance to the flow of electric current. According to Ohm’s Law, V=IR.</td>
</tr>
<tr>
<td><strong>Consolidation</strong></td>
<td></td>
</tr>
<tr>
<td>Resistors offer resistance to the flow of circuit. According to Ohm’s law, V=IR</td>
<td></td>
</tr>
</tbody>
</table>
### Session 3

**Activity I (Group Experiment)**

Teacher distributes a cell with emf $E = 6$ V, two resistors of $2\Omega$ and $3\Omega$, voltmeter, ammeter, key and connecting wires to different groups. Students are directed to draw a circuit diagram that allows current flow through bulb. Teacher instructs students to place the resistors back to back. Teacher also instructs students to connect the voltmeter across each resistor.

Students are directed to make the connection as drawn by them and asks to note the potential difference across each resistors when the key is closed.

Teacher then distributes the worksheet containing the following question.

<table>
<thead>
<tr>
<th>Worksheet- 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>- What is the value of potential difference across the $2\Omega$ and $3\Omega$ resistors each, when the key is closed?</td>
</tr>
<tr>
<td>- What is the value of Potential difference across both the resistors?</td>
</tr>
<tr>
<td>- Write a relation connecting the total potential difference and the potential difference across the individual resistors?</td>
</tr>
<tr>
<td>- What is the value of Ammeter reading?</td>
</tr>
</tbody>
</table>

Students draw the circuit diagram and made connections based on it.

Students observed the voltmeter reading across each resistor and across both the resistors. Students also observed the voltmeter reading.
Students observe the Potential difference across each resistor individually and in groups and finds that the total potential difference across both the resistors is the sum of potential difference across individual resistors. Also note down the ammeter reading and finds that a single current flows through the circuit.

**Consolidation**
The potential difference across $R_1 = V_1$
The potential difference across $R_2 = V_2$
The value of potential difference across both the resistors, $V = V_1 + V_2$
The value of Electric current across both the resistors, $I = I$

---

**Activity 2 (Group Work)**
Teacher asks to derive an expression for the equivalent resistance of the circuit using the relation, $V = V_1 + V_2$ and based on Ohm’s law.

Students derive the equations and will obtain, $R = R_1 + R_2$

**Consolidation**
In series circuit, equivalent resistance, $R_s = R_1 + R_2$ (Sum of individual resistors)

---

Students derived the equation to find out the total resistance in a series circuit using Ohm’s law.
**Activity 3 (Group Experiment)**
Teacher distributes a cell with emf $E = 6$ V, two resistors of $2\Omega$ and $3\Omega$, voltmeter, ammeter, key and connecting wires to different groups. Students are directed to draw a circuit diagram that allows current flow through bulb. Teacher instructs students to place the resistors back to backend to end. Teacher also instructs students to connect the voltmeter across each resistor. Students are directed to make the connection as drawn by them and asks to note the potential difference across each resistors when the key is closed . Teacher then distributes the worksheet containing the following question.

**Worksheet- 2**

- What is the value of potential difference across the $2\Omega$ and $3\Omega$ resistors each, when the key is closed?
- Write a relation connecting the total potential difference and the potential difference across the individual resistors?
- What is the value of Ammeter reading across each resistors?
- What will be the total current flowing through the circuit?

Students draw the circuit diagram and made connections based on it.

Students observed the voltmeter reading across each resistor and across both the resistors. Students also observed the voltmeter reading.
Students observe the Potential difference across each resistor individually and in groups and finds that the total potential difference across both the resistors is the same. Also note down the ammeter reading across each resistor and finds that a the value of current across each resistor varies.

**Consolidation**
The potential difference across R<sub>1</sub> = V
The potential difference across R<sub>2</sub> = V
The value of Electric Current across R<sub>1</sub> = I<sub>1</sub>
The value of Electric Current across R<sub>2</sub> = I<sub>2</sub>
The value of Electric current across both the resistors, I = I<sub>1</sub> + I<sub>2</sub>

**Activity 4 (Group Work)**
Teacher asks to derive an expression for the equivalent resistance of the circuit using the relation, I = I<sub>1</sub> + I<sub>2</sub> and based on Ohm’s law.
Students derive the equations and will obtain, 1/R = 1/R<sub>1</sub> + 1/R<sub>2</sub>

**Consolidation**
In series circuit, equivalent resistance, 1/R<sub>p</sub> = 1/R<sub>1</sub> + 1/R<sub>2</sub>

**Session 4 (Problem solving)**
Teacher directed to solve the following problems based on resistors in series and Parallel given in the worksheet. Teacher gives necessary help to students while solving the problem.
### Worksheet 3

1. Given three resistors, 6Ω, 2Ω and 4Ω. Find the total resistance of these three resistors a) when connected in series and b) when connected in parallel?
2. Two 3Ω resistors are connected in parallel. What will be the current across each resistor when connected to a battery of 3 volt?

### Session 6

**Application**

- Identify instances from daily life where you use resistors in series and parallel?

### Students solved the problems given in the worksheet

### Follow up activities

1. Prove that the total resistance in a series circuit is greater than the largest of individual resistors used?

2. Prove that the total resistance in a parallel circuit is smaller than the smallest of individual resistors used?
MAHATMA GANDHI UNIVERSITY
SCHOOL OF PEDAGOGICAL SCIENCES
PROBLEM SOLVING ABILITY TEST (DRAFT)

Standard XII Maximum Score : 60

General Instructions

➢ Answer all the questions.
➢ Read the instructions carefully before answering the questions.
➢ Write the answers in the answer sheets given separately.
➢ Write your name and roll number on the top right of the answer sheet.
➢ Start answering after getting instruction.
➢ Please return the answer sheets after the allotted time.

I. Answer the following questions (1 to 18) from the choices given under each question. Each question carries one mark.

1. 1kWh is equivalent to
   a) $10^2$ watt hour          b) $10^3$ watt hour
   c) $10^2$ watt               d) $10^3$ watt

2. The unit equivalent to volt ampere$^{-1}$?
   a) Coulomb                b) mho
   c) Ohm                     d) Siemen
3. Which formula will be used to calculate the number of electrons flowing through a conductor, provided the value of current (I), charge of electron (e) and the time(t) taken for the flow.

   a) \( n = \frac{I \times e}{t} \)  
   b) \( n = \frac{I \times t}{e} \)  
   c) \( n = I \times t \)  
   d) \( n = q \times e \)

4. Two physical quantities have the same unit volt. Identify the quantities?

   a) Potential Difference and Energy  
   b) Potential difference and Electric Field  
   c) Potential difference and Power  
   d) Potential Difference and EMF

5. 3M\( \Omega \) is equivalent to

   a) 3 \times 10^3 \( \Omega \)  
   b) 3 \times 10^9 \( \Omega \)  
   c) 3 \times 10^6 \( \Omega \)  
   d) 3 \times 10^{-6} \( \Omega \)

6. We have current density \( j = \frac{n e^2 \tau E}{m} \). The constants in the given formulae are

   a) n, e and m  
   b) e and m  
   c) n, e, \( \tau \) and m  
   d) n, e, E and m

7. Identify the mathematical expression for Kirchoff’s second law?

   a) \( \Sigma ir = 0 \)  
   b) \( \Sigma i = 0 \)  
   c) \( \Sigma ir = \Sigma E \)  
   d) \( \Sigma i = \Sigma E \)
8. Identify the relation between drift velocity and Electric Current
   a) $I \propto \frac{1}{v_d}$
   b) $I \propto v_d$
   c) $I \propto v_d^2$
   d) $I \propto \frac{1}{v_d^2}$

9. The unit equivalent to volt Ampere?
   a) Coulomb
   b) Joule
   c) Watt
   d) Siemen

10. 300mA is equivalent to
    a) $300 \times 10^{-3}$ A
    b) $300 \times 10^{-3}$ A
    c) $300 \times 10^2$ A
    d) $300 \times 10^{-2}$ A

11. Current density is defined as the ‘Electric Current flowing through unit area of cross – section’. Select the expression that resembles this statement.
    a) $J = I \times A$
    b) $J = A/I$
    c) $J = I/A$
    d) $J = 1/AI$

12. The charge of electron is
    a) $1.6 \times 10^{-9}$ C
    b) $1.6 \times 10^{-18}$ C
    c) $1.6 \times 10^{19}$ C
    d) $1.6 \times 10^{-19}$ C

13. The storage battery of a car has an emf of 12 volt. If the internal Resistance of the battery is 0.4 $\Omega$, Select the formula to calculate the current from the battery?
    a) $I = Er$
    b) $I = E/r$
    c) $I = r/E$
    d) None of the above
14. Identify the constants in the given formula, \( I = nAv_d\epsilon \)
   a) \( n \) and \( \epsilon \) only                  b) \( \epsilon \) only
   c) \( n, A \) and \( \epsilon \)                     d) None of the above

15. The S.I unit of electron mobility (\( \mu \)) is \( m^2 V^{-1} s^{-1} \) (metre \(^2\) Volt \(^{-1}\) second \(^{-1}\)).
   Select the equation corresponding to this unit?
   a) \( \mu = \frac{E}{v_d} \)                        b) \( \mu = \frac{v_d}{E} \)
   c) \( \mu = E v_d \)                               d) \( \mu = \frac{1}{E v_d} \)

16. Figure shows the current in a part of electrical circuit.

   ![Figure](image)

   Then current \( I \) is,
   a) 1.7A   b) 3.7 A   c) 1.3 A   d) 1A

17. A lamp of 100 W works at 220 volt. What is its resistance?
   a) 2.2 \( \Omega \)                                b) 0.455\( \Omega \)
   c) 484 \( \Omega \)                                d) 0.48 \( \Omega \)

18. 1mm\(^2\) is equivalent to
   a) \( 10^3 \) m\(^2\)                             b) \( 10^3 \) m\(^2\)
   c) \( 10^6 \) m\(^2\)                             d) \( 10^{-6} \) m\(^2\)
II. Read the following questions (19 – 22). Identify the mistakes if any and make necessary corrections. Each question carries 1 mark.

19. To solve a problem to find out the drift velocity of electrons through a conductor of length ‘L’, area ‘A’, number of electrons ‘n’ and carrying a current I, Ramu used the formulae \( V_d = \frac{nAe}{I} \). But unfortunately his answer is incorrect. Teacher asked Ramu to check whether he has written the formulae correctly. Analyze the formulae and make necessary corrections if any?

20. The balanced condition of Wheatstone’s bridge is given by \( \frac{P}{Q} = \frac{R}{S} \), where P, Q, R and S are four resistances in the four arms of Wheatstone’s Bridge. From the choices given below, identify the correct circuit which satisfies the above condition.

(a) ![Diagram](image1)

(b) ![Diagram](image2)

(c) ![Diagram](image3)

(d) ![Diagram](image4)
21. To find out the unknown resistance in the mete‌bridge, Ramu used the formulae, \( X = R \left( \frac{1000 - l}{l} \right) \). Identify the mistake if any and rewrite the equation.

22. Identify the mistake and rewrite the following formula to find out the temperature coefficient of resistance of the material.

\[
\alpha = \frac{R_2 - R_1}{R_2 (\theta_2 - \theta_1)}
\]

III. State the following sentences as True or False. Each question carries 1 mark

23. The SI unit of Electric Energy is watt hour.
24. The unit of conductivity is \( \Omega m \).
25. Conductance is usually denoted by the symbol G.
26. The equivalent resistance of a parallel combination of resistors is always greater than the largest resistance in the combination.
27. When a current flows out of a cell, the terminal potential difference is \( V = E - Ir \).
28. Temperature coefficient of resistance is denoted by the symbol r.
29. The unit of Potential Gradient is Volt.
30. mho and Siemen are two names of the unit of same physical quantity.
31. Analyze the following figure. Read the statements given below and identify the statement which is not True regarding the figure.
a. The resistance of the material is 0 at 0°C.

b. The material is a conductor.

IV. Answer the following questions in one or two steps. Each question carries 1 mark.

32. The V – I graph of a copper wire is shown below. Calculate its resistance?

33. Find the total resistance of the circuit shown below
34. V – I graph for a metallic wire at two temperatures $T_1$ and $T_2$ is shown in the figure below. Which of the two temperatures $T_1$ and $T_2$ is higher?

35. Find out the magnitude of resistance $X$ in the circuit shown below, when no current flows through the $5\Omega$ resistor?

36. Analyze the following figure and write a formulae to identify the resistance to be introduced in the resistance box ($R$), so that the balancing length will be ‘l’ cm.
37. Analyze the following figure and write an expression for the total current in the circuit?

![Circuit Diagram]

38. A current of 5 A flows through an electric press of resistance 11Ω. Calculate the energy consumed by the press in 1 minute?

39. Write down the relation between a Coulomb and an Ampere?

V. Answer the following questions with necessary steps. Each question carries 1½ marks.

40. A cell of emf 2 V and internal resistance 0.1 Ω is connected to a 3.9Ω external resistance. What will be the potential difference across the terminals of the cell?

41. A wire of resistance 5Ω is drawn out so that its length is increased to twice its original length. Calculate its new resistance?

42. A potentiometer wire of length 1m is connected to a driver cell of emf 3V as shown in the figure

![Potentiometer Diagram]
When a cell of 1.5 emf is used in the secondary circuit, the balance point is found to be at 60cm. On replacing the cell and using a cell of unknown emf, the balance point shifts to 80cm. Calculate the unknown emf of the cell?

43. In a meter bridge, the balance point is found to be at 39.5cm from the end A, when the resistor Y is of 12.5Ω. Determine the resistance of X?

44. Find out the resistivity of a conductor in which a current density $2.5 \times 10^6$ Am$^{-2}$ is found to exist, when an Electric Field of 15 V/m is applied on it?

45. When two resistances are in series, they have value 25 ohm and in parallel 4 ohm. Find each?

VI. Answer the following questions by using appropriate steps. Each question carries 2 marks.

46. Calculate the conductivity of the material of a wire of length 3m, area of cross section 0.2 m$^2$ and having a resistance of 2Ω?

47. Four resistances P= 5Ω, Q=6Ω R= 50Ω and X =60Ω are connected in the four arms of the Wheatstone’s bridge. If a cell of emf 1.5 V and negligible internal resistance is connected across the bridge, Calculate the current in the arms of the Wheatstone’s bridge ($I_1$ and $I_2$).
48. A potential difference of 10 volt is applied across a conductor of resistance 1KΩ. Find the number of free electrons through the conductor in 5 minutes?

49. How many electrons passes through a lamp in one minute, if the current is 0.3 A? Charge on electron = 1.6 x 10^{-19} C?

50. A potential difference of 6V is applied across a conductor of length 0.12 m. Calculate, the drift velocity of electrons, if the electron mobility is 5.6x10^{-6} m²V⁻¹s⁻¹?

51. Calculate the total Current flowing through the circuit?
### PROBLEM SOLVING ABILITY TEST (Draft)

#### Scoring Key and Marking Scheme

<table>
<thead>
<tr>
<th>Q.No</th>
<th>Answers</th>
<th>Marks Allotted</th>
<th>Total Marks</th>
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<td>I = $nAv_d , E$</td>
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<td><img src="image" alt="Diagram" /> a)</td>
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<td>$X = R\left(\frac{100 - l}{l}\right)$</td>
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\[ \alpha = \frac{R_2 - R_1}{R_1(\theta_2 - \theta_1)} \]

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<td>[ R = X \frac{l}{(100-l)} ]</td>
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<td>[ I = \frac{E_2-E_1}{R+r_1+r_2} ]</td>
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<td>[ H = F \times R \times t ]</td>
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<td></td>
<td>= 5 \times 5 \times 11 \times 5 \times 60 = 8.25 \times 10^4 J ]</td>
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<td>1 Ampere = ( \frac{1 \text{ Coulomb}}{1 \text{ Second}} )</td>
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<td>[ V = \frac{E}{R+r} \times R ]</td>
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<td>[ V = \frac{2}{3.9+0.1} \times 3.9 ]</td>
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<td>=1.95 V ]</td>
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<td>We have [ R = \rho \frac{l}{A} ]</td>
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<td></td>
<td>[ l = 2l; \text{ therefore, Area} = A/2 ]</td>
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<td>Resistance, [ R = \rho \frac{2l}{A/2} ]</td>
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<td>[ R = 4 \times \rho \frac{l}{A} ]</td>
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<td>[ R = 4 \times 5 = 20 ( \Omega ) ]</td>
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<td>42</td>
<td>$E_1 = 1.5 \text{ V}; l_1 = 60 \text{ cm}; l_2 = 80 \text{ cm}$</td>
<td>We have $\frac{E_1}{E_2} = \frac{l_1}{l_2}$</td>
<td>$E_2 = E_1 \frac{l_2}{l_1}$</td>
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<td>43</td>
<td>$Y = 12.5 \Omega; l = 39.5 \text{ cm}$</td>
<td>$X = Y \frac{l}{100 - l}$</td>
<td>$X = 12.5 \times \frac{39.5}{100 - 39.5}$</td>
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<tr>
<td>44</td>
<td>Given Current Density, $I/A = 2.5 \text{ Am}^{-2}$</td>
<td>Electric Field, $V/l = 15 \text{ V/m}$</td>
<td>Resistivity, $\rho = \frac{V}{I/A} = 15/2.5 \times 10^{-6}$</td>
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<tr>
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<tr>
<td>45</td>
<td>$R_s = 25 \text{ ohm}; R_p = 4 \text{ ohm}$</td>
<td>$R_1 + R_2 = 25 \text{ ohm}; \frac{R_1 R_2}{R_1 + R_2} = 4 \text{ ohm}$</td>
<td>Therefore $R_1 R_2 = 100$</td>
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<td>46</td>
<td>$l = 3 \text{ m}; A = 0.02 \text{ mm}^2 = 0.02 \times 10^{-6} \text{ m}^2; R = 2 \Omega$</td>
<td>$\rho = R \frac{A}{l}$</td>
<td>Conductivity, $\sigma = \frac{1}{\rho}$</td>
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</tbody>
</table>
| 47 | Applying Kirchoff's Second law to the closed part ABDA,  
   | $5I_1 - 50 I_2 = 0$  
   | $I_2 = \frac{I_1}{10}$  
   | Applying Kirchoff's second law to the closed part ABCLMA, $5I_1 + 6 I_1 = 1.5$  
   | $I_1 = 0.14 \text{ A}$  
   | Therefore $I_2 = \frac{0.14}{10} = 0.014 \text{ A}$ | 0.5 | 2 |
| 48 | $I = \frac{V}{R} = \frac{10}{10^3} = 10^{-2} \text{ A}$  
   | $I = \frac{n^*e}{t}$  
   | $n = \frac{I^*t}{e}$  
   | $= \frac{10^{-2} \times 5 \times 60}{1.6 \times 10^{-19}}$  
   | $= 1.875 \times 10^{19} \text{ electrons}$ | 0.5 | 2 |
| 49 | $I = 0.3 \text{ A}; t = 60 \text{ sec}; e = 1.6 \times 10^{19} \text{ C}$  
   | $I = \frac{n^*e}{t}$  
   | $n = \frac{I^*t}{e}$  
   | $= \frac{0.3 \times 60}{1.6 \times 10^{-19}}$  
   | $= 1.875 \times 10^{19} \text{ electrons}$ | 0.5 | 0.5+0.5 |
| 50 | Potential difference. $V = 6 \text{ volt}; l = 0.12 \text{ m};$  
   | Electron mobility, $\mu = 5.6 \times 10^{-6} \text{ m}^2 \text{ V}^{-1} \text{ s}^{-1}$  
   | Drift velocity, $V_d = \mu E$  
   | But $E = \frac{V}{l}$  
   | $= \frac{6}{0.12} = 50 \text{ Vm}^{-1}$  
   | Therefore $v_d = 5.6 \times 10^{-6} \times 50 = 2.8 \times 10^{-4} \text{ m/s}$ | 0.5 | 0.5 + 0.5 |
The resistances AB and BC are in series. Their effective resistance, \( R_1 = 30 + 30 = 60 \Omega \)

The \( R_1 \) and the resistance AC are in parallel. Their effective resistance, \( R = \frac{60 \times 30}{60 + 30} = 20 \Omega \)

Current through the circuit, \( I = \frac{E}{R} \)
\[ = \frac{2}{20} = 0.1 \text{ A} \]
### DIFFICULTY INDEX AND DISCRIMINATING POWER OF OBJECTIVE ITEMS OF PROBLEM SOLVING ABILITY TEST

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Appendix - IV B

MAHATMA GANDHI UNIVERSITY
SCHOOL OF PEDAGOGICAL SCIENCES
PROBLEM SOLVING ABILITY TEST (FINAL)

Standard XII                                                   Maximum Score : 30

Maximum Time : 30 mts

General Instructions

➢ Answer all the questions.

➢ Read the instructions carefully before answering the questions.

➢ Write the answers in the answer sheets given separately.

➢ Write your name and roll number on the top right of the answer sheet.

➢ Start answering after getting instruction.

➢ Please return the answer sheets after the allotted time.

I. Answer the following questions (1 to 10) from the choices given under each question. Each question carries one mark.

1. Which formula will be used to calculate the number of electrons flowing through a conductor, provided the value of current (I), charge of electron (e) and the time(t) taken for the flow.

   a) \( n = \frac{I \times e}{t} \)  
   b) \( n = \frac{I \times t}{e} \)

   c) \( n = I \times t \quad \)  d) \( n = q \times e \)
2. Identify the mathematical expression for Kirchoff’s second law?
   
   a) \( \Sigma ir = 0 \)          
   b) \( \Sigma i = 0 \)          
   c) \( \Sigma ir = \Sigma E \)    
   d) \( \Sigma i = \Sigma E \) 

3. Identify the relation between drift velocity and Electric Current
   
   a) \( I \propto 1/v_d \) 
   b) \( I \propto v_d \) 
   c) \( I \propto v_d^2 \) 
   d) \( I \propto 1/v_d^2 \) 

4. The unit equivalent to volt Ampere?
   
   a) Coulomb 
   b) Joule 
   c) Watt 
   d) Siemen 

5. Current density is defined as the ‘Electric Current flowing through unit area of cross – section’. Select the expression that resembles this statement.
   
   a) \( J = I*A \) 
   b) \( J = A/I \) 
   c) \( J = I/A \) 
   d) \( J = 1/AI \) 

6. The storage battery of a car has an emf of 12 volt. If the internal Resistance of the battery is 0.4 \( \Omega \), Select the formula to calculate the current from the battery?
   
   a) \( I = Er \) 
   b) \( I = E/r \) 
   c) \( I = r/E \) 
   d) None of the above 

7. Identify the constants in the given formula, \( I = nA\nu_d e \)
   
   a) \( n \) and \( e \) only 
   b) \( e \) only 
   c) \( n, A \) and \( e \) 
   d) None of the above
8. The S.I unit of electron mobility (µ) is \( m^2V^{-1}s^{-1} \) (metre \(^2\) Volt \(^{-1}\) second \(^{-1}\)). Select the equation corresponding to this unit?

\[
\begin{align*}
\text{a) } \mu &= \frac{E}{v_d} \\
\text{b) } \mu &= \frac{v_d}{E} \\
\text{c) } \mu &= E v_d \\
\text{d) } \mu &= \frac{1}{E v_d}
\end{align*}
\]

9. Figure shows the current in a part of electrical circuit.

Then current I is,

\[
\begin{align*}
\text{a) } 1.7A & \quad \text{b) } 3.7 A & \quad \text{c) } 1.3 A & \quad \text{d) } 1A
\end{align*}
\]

10. 1mm\(^2\) is equivalent to

\[
\begin{align*}
\text{a) } 10^{-3} \text{ m}^2 & \quad \text{b) } 10^3 \text{ m}^2 \\
\text{c) } 10^6 \text{ m}^2 & \quad \text{d) } 10^{-6} \text{ m}^2
\end{align*}
\]

II. Read the following questions (11 and 12). Identify the mistakes if any and make necessary corrections. Each question carry 1 mark.

11. The balanced condition of Wheatstone’s bridge is given by \( \frac{P}{Q} = \frac{R}{S} \), where P, Q, R and S are four resistances in the four arms of Wheatstone’s Bridge. From the choices given below, identify the correct circuit which satisfies the above condition.
12. To find out the unknown resistance in the metre bridge, Ramu used the formulae,
\[ X = R\left(\frac{1000 - I}{I}\right) \]. Identify the mistake if any and rewrite the equation.

III. State the following sentences as True or False. Each question carries 1 mark

13. The equivalent resistance of a parallel combination of resistors is always greater than the largest resistance in the combination.

14. When a current flows out of a cell, the terminal potential difference is \( V = E - Ir \).

15. mho and Siemen are two names of the unit of same physical quantity.

16. Analyze the following figure. Read the statements given below and identify the statement which is not True regarding the figure.
a. The resistance of the material is 0 at 0°C.

b. The material is a conductor.

IV. Answer the following questions in one or two steps. Each question carries 1 mark.

17. Find the total resistance of the circuit shown below

![Circuit Diagram]

18. V – I graph for a metallic wire at two temperatures T₁ and T₂ is shown in the figure below. Which of the two temperatures T₁ and T₂ is higher?

![V–I Graph]

Answer: T₂ is higher.
19. Find out the magnitude of resistance X in the circuit shown below, when no current flows through the 5Ω resistor?

![Circuit Diagram](image)

20. Analyze the following figure and write an expression for the total current in the circuit?

![Circuit Diagram](image)

21. A current of 5 A flows through an electric press of resistance 11Ω. Calculate the energy consumed by the press in 1 minute?

V. Answer the following questions with necessary steps. Each question carries 1½ marks.

22. A cell of emf 2 V and internal resistance 0.1 Ω is connected to a 3.9Ω external resistance. What will be the potential difference across the terminals of the cell?
23. In a meter bridge, the balance point is found to be at 39.5 cm from the end A, when the resistor Y is of 12.5 Ω. Determine the resistance of X?

VI. Answer the following questions by using appropriate steps. Each question carries 2 marks.

24. A potential difference of 10 volt is applied across a conductor of resistance 1 KΩ. Find the number of free electrons through the conductor in 5 minutes?

25. How many electrons passes through a lamp in one minute, if the current is 0.3 A?
Charge on electron = 1.6 x 10^{-19} C?

26. A potential difference of 6V is applied across a conductor of length 0.12 m. Calculate, the drift velocity of electrons, if the electron mobility is 5.6x10^{-6} m^2 V^{-1}s^{-1}?
### PROBLEM SOLVING ABILITY TEST (Final)

**Scoring Key and Marking Scheme**

<table>
<thead>
<tr>
<th>Q.No</th>
<th>Answers</th>
<th>Marks Allotted</th>
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<tbody>
<tr>
<td>1.</td>
<td>b) ( n = \frac{I \times t}{e} )</td>
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<tr>
<td>2.</td>
<td>c) ( \Sigma i_r = \Sigma E )</td>
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<td>3.</td>
<td>b) ( I \propto v_d )</td>
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<td>c) Watt</td>
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<td>5.</td>
<td>c) ( J = I/A )</td>
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<td>6.</td>
<td>b) ( I = E/r )</td>
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<td>7.</td>
<td>b) e only</td>
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<td>8.</td>
<td>b) ( \mu = \frac{v_d}{E} )</td>
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<td>9.</td>
<td>a) 1.7A</td>
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<td>d) ( 10^{-6} ) m²</td>
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<td>12.</td>
<td>( X = R\left(\frac{100-l}{l}\right) )</td>
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<td>16.</td>
<td>a. False</td>
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<td>17.</td>
<td>9Ω</td>
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<td>18.</td>
<td>T₂</td>
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<td>19.</td>
<td>6Ω</td>
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<td>20.</td>
<td>( I = \frac{E_2 - E_1}{R + r_1 + r_2} )</td>
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</tbody>
</table>
21. \[ H = I^2Rt \]
   \[ = 5 \times 5 \times 11 \times 5 \times 60 = 8.25 \times 10^4 J \]

22. \[ V = \frac{E}{R+r} \]
   \[ V = \frac{2}{3.9 + 0.1} \times 3.9 \]
   \[ = 1.95 \text{ V} \]

23. \[ Y = 12.5 \Omega; l = 39.5 \text{ cm} \]
   \[ X = Y \frac{l}{100-l} \]
   \[ X = 12.5 \times \frac{39.5}{100-39.5} \]
   \[ X = 8.16 \Omega \]

24. \[ I = \frac{V}{R} = \frac{10}{10^3} = 10^{-2} \text{ A} \]
   \[ I = \frac{q}{t} = \frac{n \times e}{t} \]
   \[ n = \frac{l \times t}{e} \]
   \[ = \frac{10^{-2} \times 5 \times 60}{1.6 \times 10^{-19}} \]
   \[ = 1.875 \times 10^{19} \text{ electrons} \]

25. \[ I = 0.3 \text{ A}; t = 60 \text{ sec}; e = 1.6 \times 10^{-19} \text{ C} \]
   \[ I = \frac{q}{t} = \frac{n \times e}{t} \]
   \[ n = \frac{l \times t}{e} \]
   \[ = \frac{0.3 \times 60}{1.6 \times 10^{-19}} \]
   \[ = 1.875 \times 10^{19} \text{ electrons} \]

26. Potential difference, \( V = 6 \text{ volt} \); Length \( l = 0.12 \text{ m} \); Electron mobility, \( \mu = 5.6 \times 10^{-6} \text{ m}^2 \text{V}^{-1} \text{s}^{-1} \)
   Drift velocity, \( V_d = \mu E \)
   But \( E = \frac{V}{l} \)
   \[ \frac{6}{0.12} = 50 \text{ Vm}^{-1} \]
   Therefore \( V_d = 5.6 \times 10^{-6} \times 50 = 2.8 \times 10^{-4} \text{ m/s} \)
### PROBLEM SOLVING ABILITY TEST (Final)

**Copy of the Response Sheet**

<table>
<thead>
<tr>
<th>Q. No</th>
<th>a</th>
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General Instructions:

This test is designed to analyze the critical thinking ability of students belonging to the age group 16 – 18. It consists of 4 parts.

   Part I : Inference
   Part II : Recognition of assumptions
   Part III: Interpretation
   Part IV: Evaluation of arguments.

Questions of each part are given separately under the respective headings and you have to follow the instructions given under each section before answering the question.

Part I – Inference

Directions: An Inference is a conclusion that a person can draw from certain observed and supposed facts. This inference may or may not be correct. In this part, each questions begins with a statement followed by two or three inferences. Here the subject is required to examine each inference thoroughly and select the correct inference/ inferences that is true with respect to each passage. Then choose the correct answer from the options given below and mark your answer in the space provided at the end of each question.
1. Studies have shown that 18.2% of H.S.S students of Kottayam district are above normal weight. It is found slightly higher among boys than in girls. Overweight is higher among students who are regular consumers of soft drinks and junk foods than among non consumers and is at a lower level among adolescents who participate in outdoor games than among the non participants. The problem of obesity is significantly higher among students whose fathers and mothers are fully employed, whereas it is lower among students whose mothers are part time or unemployed.

Proposed Inferences

I. Avoid soft drinks and junk foods is one of the way to reduce overweight.
II. Whether parents are employed or not makes no difference to the likelihood of their children developing obesity.
III. Students residing at hostels are at a relatively lower risk to be obese.

   a) Only I            b) Only II
   c) Only III          d) Both I and II

2. In 1841 Joule experimentally arrived at a mathematical relation now known after his name. He found that the amount of heat developed in a conductor depends on the quantity of current, resistance of conductor and also on the time for which current flows. He explained the heating effect on the basis of the law of conservation of energy.

Proposed Inferences

I. The intensity of electric current is a factor that determines the amount of heat developed in a conductor.
II. The above mentioned law is called Joule’s law of heating.
III. Heat developed in a conductor depends on the area of cross section of the conductor.
3. Studies have shown that the risk of crash related deaths are lowest when all occupants of a vehicle are restrained using seat belts.

Proposed Inferences

I. Passengers in both front seats and back seats are advised to wear seat belts for their safety.
II. All passengers are at the same risk to be injured in accidents.
III. The above statement is applicable only for the front seaters.

a) Only I 

b) Both I and II 

c) Only II 

d) Both II and III 

4. In Kerala the unhealthy dietary practices is responsible for 10 – 20 % of cancers. We had a predominantly plant based diet and with the advent of western life style we are moving towards a diet rich in animal proteins. This coupled with other habits like smoking and alcohol will lead to increase in the rate of cancer and other cardiovascular diseases. Prompt action has to be taken to spread the message of healthy life style and dietary practices.

Proposed Inferences

I. Plant based diet reduces the risk of cancer.
II. Whether Keralites are veg or non – veg makes no difference to the likelihood of developing cancer disease.
III. The easiest way to reduce the risk of cancer is to change the life style.

a) All the above 

b) Only I 

c) Both I and II 

d) Only III
5. During the last summer vacation, Tom and his family went to Goa for a trip. Their, they got an opportunity to ride in a hot air balloon.

When the school reopened, Tom shared his experience in the class. He said that, ‘The Hot air balloon consist of a bag containing air, a basket to carry passengers, and a burner. First we were asked to enter into the basket. A technician also entered with us and then he heated up the burner. Slowly, our balloon starts moving upward with us and after riding for 30 minutes he turned off the burner and slowly the balloon starts moving downwards and finally we reached the ground’.

Proposed Inferences

I. Newton’s Third Law is the principle behind this, i.e for every action there is an equal and opposite reaction.
II. When air gets heated up, it becomes more denser than cold air
III. When air gets heated up, it becomes less denser than cold air

a) Only I  b) Only III

6. Studies have shown that use of tobacco and exposure to second hand or environmental tobacco smoke is associated with increased risk of cancer and heart disease and adverse health effects. Thus Government of Kerala banned the manufacture, storage, sale and distribution of tobacco products on May, 2012. Government took necessary steps to convey the adverse effect of tobacco use through advertisements, posters, conducting campaigns, banning the sale of tobacco products near educational institutions, and regulation of health warning in tobacco products packs. But still people die from tobacco related illness

Proposed Inferences

I. There are people who are still unaware of the adverse effects of tobacco use.
II. The use of any products made up of tobacco is harmful to health.

III. Men use tobacco more than women
   a) Both I and II   b) Both II and III
   c) Only I         c) Only II

7. Studies showed that Stressful days usually lead us to have a worse mood and poorer mental health. But if we do small things for others we won’t feel as poorly on stressful days. If we engage in more social activities there was essentially no impact of stress on positive emotions or daily mental health. (The New Indian Express, 15 Dec 2015).

Proposed Inferences:

I. Whether we are engaging in less social activities or more social activities makes no difference on our Positive emotions.

II. Negative emotion is a symbol of less social.

III. Helping others reduces your stress.
   a) Only I    b) Only II
   c) Only III  d) All the above

8. Light consists of seven colours (VIBGYOR). Different colours have different wavelengths. When light falls on an object, it reflects the colour of that particular object and absorbs all others falling on it. For example, when it falls on an object say, a flower of colour red, it absorbs all the colours and reflect red colour. When it falls on a book of Blue colour, it absorbs all the colours and reflects the blue colour.

Proposed Inferences

I. When Light falls on an object, it either absorbs or reflects it.

II. Light is of single wavelength

III. The colour of an object we perceive depends on the wavelength of the light.
   a) Only I   b) Both I and II
   c) Both I and III  c) Only III
9. John started to spend 12 hours a day for Entrance test.

Proposed Inferences

I. John wish to achieve high in the entrance tests.

II. John is hard working.

III. John is highly determined

   a) None of the above  
   b) All the three
   c) Both I and II  
   c) Both I and III

10. Gestures are used for communication, but the same gestures may have different meanings in different cultures.

Proposed Inferences

I. No two cultures use the same gestures.

II. One gesture will never have the same meaning in two cultures.

III A person from one culture may misunderstand the gestures used by a person from another culture.

   a) Only I  
   b) Only II
   c) Only III  
   d) All the above

11. Blood cholesterol used to be thought of as a problem only for adults.

Proposed Inferences

I. Blood cholesterol affects adults only.

II. Blood cholesterol affects both adults and children.

III. Only children have a problem with blood cholesterol.

   a) Only I  
   b) Only II
   c) Both I and II  
   c) None of the above
12. Poor handwriting does not indicate the weak character of a person, as many eminent personalities were there with poor handwriting.

Proposed Inferences

I. Many Eminent Personalities had handwriting that was difficult to read.

II. A person’s handwriting reveals his character.

III. Whether handwriting good or bad never affects the character of a person.

   a) Only I           b) Only III
   c) Both I and III   c) All the above

13. As an architect, Alan preferred Roman style, to the English style preferred by Nathan.

Proposed Inferences

I. Nathan was an English architect.

II. Alan was a Roman architect.

III. Alan preferred to adopt the Roman style in his architecture.

   a) All the above     b) Only I
   c) Both I and II     d) Only III

14. The situation of this area is out of control. People are requested to be in their home only.

Proposed Inferences

I. Some serious incident was happening there.

II. The incident was a natural calamity.

III. Normalcy will be restored shortly.

   a) Only I           b) Both I and II
   c) Both I and III   d) All the above
15. Arun decided to reserve the rail tickets in October, for the journey he wants to make in December.

Proposed Inferences

I. There is more than one train to the same route.

II. There will be seats available in the desired class.

III. The railway issues tickets two months in advance.

   a) Both II and III       b) Only III
   c) Only II               d) All the above

16. A successful man has the ability to find out his strengths and weaknesses.

I. An unsuccessful man could not judge him accurately.

II. A successful man will never judge others.

III. Inability to judge others will make him unsuccessful

   a) All the three       b) None of the above
   c) Both I and III     d) Both II and III

17. The Owner of a company announced that, “We have to appoint more staff to satisfy the increasing demands”.

Proposed Inferences

I. The present staff is not competent.

II. The Company is flourishing.

III. The present staff is not enough to meet the demands.

   a) Both II and III       b) Only I
   c) Only II               d) Only III
18. Friendship is necessary for being happy.

Proposed Inferences

I. A person seems to be unhappy have no friends.

II. Happiness and friendships are relating factors

III. Only friends can make one happy.

a) All the three  
b) None of the above  
c) Only II  
d) Only III

19. Vitamin E tablets improve the circulation and this will inturn enhance your complexion.

I. Dull complexion is due to the absence of circulation.

II. Everyone should eat Vitamin E tablets.

III. Vitamin E tablets alone will improve the circulation.

a) Only I  
b) Only II  
c) Both I and III  
d) All the above

20. Neon light was a particular type of vapour lamp that uses the colourless inert gas neon. When an electric current is passed through a tube filled with neon at low pressure, it became luminous. The light so emitted is reddish-orange in colour. Today, the term “neon light” is given to those lamps of this type which may be filled with a variety of gases, depending on the colour that is desired. Eg: Blue light is produced by filling it with Argon. Colors can also be altered by changing the color of the glass tube. The tubes must be long to produce light efficiently. Therefore high voltages are required. Neon tube lamps are not be used for indoor illumination, but they have widespread use in outdoor especially for glowing, colourful advertising signs.

Proposed Inferences.

I. Modern neon lights are more efficient than those used in the past.

II. When electricity is applied, different gases produces different colours of light.
III. Colour of light depends on the colour of gas used.

    a) Only II                        b) Only III
    c) Both II and III                 d) All the above

**Part II : Recognition of Assumptions**

Directions : This part contains items which consist of one statement, followed by two assumptions. Here the subject is required to judge whether the series of given assumptions follow or not from the statement. Read the given statements and decide whether the assumptions given below follow or not from the statement at the top. Then mark your answer as a) Only I is implicit b) Only II is implicit c) Both I and II are implicit d) None is implicit.

1. **Statement**  The direction of flow of positive charges is taken as the direction of current.
   
   **Assumptions**
   I. Only positive charges constitute current.
   II. The direction of current is fixed.

2. **Statement**  Empty vessels makes the most noise
   
   **Assumptions**
   I. All vessels makes noise
   II. The vessels that make noise are always empty.

3. **Statement**  The Minister informed the public that there will be load shedding daily for one hour for the next two months.
   
   **Assumptions**
   I. The power production in the State is too low for some reasons
   II. We have to save power for the long use.

4. **Statement**  It is difficult to walk through a frictionless surface.
   
   **Assumptions**
   I. Walking through any surface depends on the friction of that surface.
   II. It is easy to walk through surfaces having friction.

5. **Statement**  In India the domestic power supply is 220V.
   
   **Assumptions**
   I. The value may be different for different countries.
   II. The value of power supply is fixed all over India.

6. **Statement**  A hungry man is an angry man.
Assumptions

I. All angry men are hungry.
II. Some angry men are hungry.

7. Statement The Government has decided to open a Medical college here.
Assumptions I. Many people in this area are suffering from illness.
II. More people will get the opportunity to study medicine

8. Statement The Midday Meal Scheme is a school meal programme of the government of India designed to improve the nutritional status of school-age children nationwide.
Assumptions I. The nutritional status of Indian school children is poor.
II. It helps to improve the enrolment of children.

9. Statement Traces of Ammonia have been found in Mar’s atmosphere. So there must be life on Mars.
Assumptions I. Ammonia is necessary for life to exist
II. Earth contains ammonia.

10. Statement Unemployment allowance should be given to all unemployed Indian youth above 18 years of age.
Assumptions I. There are unemployed youths in India who need monetary support
II. The government has sufficient funds to provide allowance to all unemployed youth.

11 Statement War begins in the minds of men, and it is in the minds of men that defence against war have to be built.
Assumptions I. Individuals are responsible for waging war
II. War arises because people do not believe in solving matters through peaceful talks.

12. Statement “If you want to study Physics, join institute Y”, A advice to B.
Assumptions I. Institute Y provides good education in Physics.
II. B listen to A advice.

13. Statement A warning in a train compartment – “To stop train, pull chain. Penalty for improper use is 500”.
Assumptions I. Some people misuse the alarm chain
II. On certain occasions, people may want to stop a running train.

14. Statement “The programme will start at 6 p.m but you can come there by 7 p.m or so and still there is no problem”.
Assumptions I. The programme will continue even after 7 p.m.
II. The programme may not start by that time.

15 Statement Raju was just elected as the president of the student senate. So he must be a senior.
Assumptions I. Only seniors can be the members of the student Senate.
II. Raju is a Senior.

16 Statement “Wanted a three bedroom flat in the court area for immediate possession”.- An advertisement.
Assumptions I. Flats are available in the court area.
II. Some people will respond to the advertisement.

17. Statement “As there is a great demand, every person seeking tickets of the programme will be given only four tickets”.
Assumptions I. No one is interested in getting more than four tickets.
II. The organizers are not keen on selling the tickets.

18 Statement It is desirable to put the child in school at the age of 5
Assumptions I. At this age, the child reaches the appropriate level of development
II. The Schools do not admit children after six years of age.

19 Statement “X – chocolate is an ideal gift for someone you love”.-An advertisement
Assumptions I. People generally give gifts to loved ones.
II. Chocolate can be considered as a gift item

20 Statement Why don’t you invite Johnny for the Birthday party?
Assumptions I. Unless invited Johnny will not attend the party.
II. Johnny is not from the same city.
Part III : Interpretation

Directions : In this part each question consists of several statements followed by two suggested conclusions supposed to be contained in the original statement. Here the subject is required to interpret the ideas contained in the statements.

Judge each conclusions independently and mark your answer as a) Only I follows  b) Only II follows  c) Both I and II follows d) Neither I nor II follows.

1  Statement  Seven days without exercise makes one weak
Interpretations  I. All healthy people do exercises daily.
II. Only exercise makes you healthy.
2  Statement  The Kerala government has decided to enforce a ban on vegetables and fruits with high levels of pesticide residue in them.
Interpretations  I. The government of Kerala seems to be conscious about the health of peoples.
II. Low levels of pesticide is allowed in fruits and vegetables
3  Statement  The purpose of life is to think what is true, to sense what is beautiful and to want what is good.
Interpretations  I. Truth, goodness and beauty makes the life purposeful
II. Thinking other than truth is worthless.
4  Statement  A person suffering from shortsightedness can see only near objects clearly and a person suffering from long sightedness can see only far objects clearly. The former can be corrected using concave lens and the latter using a convex lens.
Interpretations  I. A convex lens can be used to see near objects clearly.
II. Students having short sightedness should be seated in the front benches.
5  Statement  According to 2001 census the male literacy rate is 75.26% and female literacy rate is 53.67%. According to 2011 census,
female literacy rate is 65.46% where the male literacy rate is 82.14%.

Interpretations
I. Eventhough there is an improvement in the percentage of literacy, still female literacy lags behind male literacy.
II. By 2011 the female literacy rate becomes better than the male literacy rate in 2001.

6 Statement Navodhaya Vidyalayas were introduced as a result of the recommendation of NPE, 1986. They are fully residential and Coeducational schools for finding talented children from rural areas.

Interpretations
I. Only students from rural areas are admitted to these schools.
II. There were no such schools before 1986.

7 Statement The IT @ School Project, is an Information Technology project under the Department of General Education, Government of Kerala. Launched in 2001, the Project has remodelled conventional teaching methodologies in classrooms through the use of IT.

Interpretations
I. Conventional teaching methods gives less importance to Information Technology.
II. The conventional teaching methods were fully replaced by IT after 2001.

8 Statement A superconductor is a material that can conduct electricity or transport electrons from one atom to another with no resistance. This can be achieved only at very low temperatures.

Interpretations
I. All materials exhibit superconductivity at low temperatures.
II. Resistance is zero in superconductors.

9 Statement The Slogan of the Asian Games, Incheon 2014 was ‘Diversity Shines Here’. How will you Interpret this.

Interpretations
I. It represents and highlights the variety of Games to be conducted.
II. It represents Asia’s wonderful diversity in history, cultures, and religions.

10 Statement Students with high intellectual ability are required for the course. So they decided to conduct an objective type test for the entrance exam.

Interpretations I. Low intelligent students were not allowed to write the exam.
II. Objective type test items measures only the higher intellectual ability of students.

11 Statement A solar cell is an electronic device which directly converts sunlight into electricity. Light shining on the solar cell produces both a current and a voltage to generate electric power.

Interpretations I. Sunlight is essential for power generation in solar cell.
II. Solar cell can be used to satisfy the domestic needs.

12 Statement Resistance of metals increases with increase in temperature. Resistance of silicon increases by lowering the temperature.

Interpretations I. Silicon is not a metal.
II. There are substances whose resistances decreases with increase in temperature.

13 Statement Only those students who scored above 80% marks are admitted for the course. Asha scored 90%.

Interpretations I. Asha is admitted
II. Those who scored below 80% are not eligible.

14 Statement All metals obey Ohm’s law. Germanium does not obey Ohm’s law.

Interpretations I. Germanium is not a metal.
II. Some metals does not obey Ohm’s law.

15 Statement All students in my group are friendly. Rahul is not friendly.

Interpretations I. Rahul is not a member of my group.
II. Rahul must be social.

16 Statement All good athletes win. All good athletes eat well.
Interpretations  
I. All those who eat well are good athletes  
II. All those who win eat well.

Statement  
Pollution is a slow poison, and therefore social scientists and the media must work together to create sensitivity among people.

Interpretations  
I. Media is aware about the effects of pollution.  
II. People are not aware about the harmful effect of Pollution.

Statement  
Ozone depletion and Global Warming are the two environmental problems caused by the release of some pollutants into the atmosphere

Interpretations  
I. Control of pollutants can reduce Global warming and Ozone depletion.  
II. Human activities are the reason behind all environmental problems

Statement  
Cactus Plant has thick leaves and it requires less water

Interpretations  
I. Plants with thick leaves requires little water.  
II. Cactus can be grown in places where water is not in abundance

Statement  
Students studying in the school ‘Y’ are highly disciplined.
Arun is studying in school ‘Y’

Interpretations  
I. Arun is highly disciplined.  
II. All disciplined students are studying in school ‘Y’.

Part IV : Evaluation of Arguments.

Directions : Read the statements given below. Each statement is followed by two arguments either positive or negative. Consider each argument as true and decide which argument strongly supports the statement or not and mark your answer in the space provided as  
a) Only argument I is strong  
b) Only argument II is strong  
c) Both I and II are strong  
d) Neither I nor II is strong
1 Statement Should vegetables be washed before cutting.
Arguments I. No it would remove the nutrients.
II. Yes it would reduces the level of pesticides that may be present in it.

2 Statement Should alcohol be banned?
Arguments I. Yes, it spoils not only the individual but also his entire family.
II. No, it is used for entertainment and relaxing purpose.

3 Statement It is recommended to sit inside a closed car, When there is thunder and lightning on a rainy day.
Arguments I. Yes, it will protect us from lightning.
II. Yes, it will protect us from rain.

4 Statement Should organic farming in schools be encouraged?
Arguments I. Yes, it will contribute the economic development of the state
II. Yes, it will be helpful for satisfying the domestic need.

5 Statement Should government provide free education up to secondary level
Arguments I. Yes, it will be helpful for students from low income families.
II. No, it will be a burden for the government.

6 Statement Should students be encouraged to take part in extra curricular activities.
Arguments I. Yes, it would enhance the teamwork and self esteem of students.
II. It will make him socially responsible

7 Statement Should women education in ICT be encouraged?
Arguments I. Yes, it will help in women’s empowerment
II. Yes, it will enhance the economic development of our country.

8 Statement Should the use of social medias be reduced?
Arguments I. Yes, it will reduce social crimes.
II. No, it is an easy and inexpensive way to share information with a large group at the same time.

9 Statement Should there be students union in college/university?
Arguments I. No. This will create a political atmosphere in the campus.
II. Yes, it is very necessary. Students are future political leaders.

10 Statement Should cottage industries be encouraged in rural areas?
Arguments I. Yes. Rural people are creative.
II. Yes. This would help to solve the problem of unemployment to some extent.

11 Statement Should all the annual examinations up to Std. V be abolished?
Arguments I. Yes. The young students should not be burdened with such examinations which hampers their natural growth
II. No. The students will not study seriously as they will get automatic promotion to the next class and this will affect them in future

12 Statement Should high chimneys be installed in industries?
Arguments I. Yes. It reduces pollution at ground level.
II. No. It increases pollution in upper atmosphere

13 Statement Should internal assessment in colleges be abolished?
Arguments I. Yes. This will help in reducing the possibility of favouritism
II. No. Teaching faculty will lose control over students.

14 Statement Should 'computer knowledge' be made a compulsory subject for all the students at secondary school level?
Arguments I. No, our need is 'bread' for everyone, we cannot follow western models.
II. Yes. We cannot compete in the international market without equipping our children with computers.

15 Statement Should the vehicles older than 10 years be rejected in metros in India?
Arguments I. Yes. This is a significant step to lower down the pollution level in metros.
II. No. It will be very difficult for vehicle owners

16 Statement Should the rule of wearing helmet for both driver and pillion rider while driving a motor bike be enforced strictly?
Arguments I. Yes. It is a rule and rules should be followed strictly by all.
II. No. It does not ensure safety as only the head is protected and rest of the body is not.

17 Statement Should admission to all professional courses be made on the basis of past academic performance rather than through entrance tests?
Arguments

I. Yes. Many deserving candidates securing high marks in their qualifying academic examinations do not perform well on such entrance tests.

II. No. The standard of examinations and assessment conducted by different Boards and universities are not comparable and hence there is a need to conduct entrance tests to calibrate them on a common yardstick.

18 Statement Should we switch to a green fuel (fuel extracted from food grains)?

Arguments

I. Yes, it does not pollute the environment.

II. No, it will increase the prices of food products.

19 Statement Should women be given equal opportunity in the matter of employment in every field?

Arguments

I. Yes. They are equally capable.

II. No. They have to shoulder household responsibilities.

20 Statement Should Open book system of examination be encouraged?

Arguments

I. Yes, it will be helpful for the deeper understanding of the subject.

II. No, this is not a true test.
## CRITICAL THINKING TEST (Draft)

### Scoring Key

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* Items selected for the Final Form.
MAHATMA GANDHI UNIVERSITY

SCHOOL OF PEDAGOGICAL SCIENCES

CRITICAL THINKING TEST (Final)

Standard XII                                Maximum Score : 40

Maximum Time : 40 mts

General Instructions:

This test is designed to analyze the critical thinking ability of students belonging to the age group 16 – 18. It consists of 4 parts.

Part I : Inference
Part II : Recognition of assumptions
Part III: Interpretation
Part IV: Evaluation of arguments.

Questions of each part are given separately under the respective headings and you have to follow the instructions given under each section before answering the question.

Part I – Inference

Directions : An Inference is a conclusion that a person can draw from certain observed and supposed facts. This inference may or may not be correct. In this part, each questions begins with a statement followed by two or three inferences. Here the subject is required to examine each inference thoroughly and select the correct inference/ inferences that is true with respect to each passage. Then choose the correct answer from the options given below and mark your answer in the space provided at the end of each question.
1. Studies have shown that 18.2% of H.S.S students of Kottayam district are above normal weight. It is found slightly higher among boys than in girls. Overweight is higher among students who are regular consumers of soft drinks and junk foods than among non consumers and is at a lower level among adolescents who participate in outdoor games than among the non participants. The problem of obesity is significantly higher among students whose fathers and mothers are fully employed, whereas it is lower among students whose mothers are part time or unemployed.

Proposed Inferences

I. Avoid soft drinks and junk foods is one of the way to reduce overweight.

II. Whether parents are employed or not makes no difference to the likelihood of their children developing obesity.

III. Students residing at hostels are at a relatively lower risk to be obese.

b) Only I                               b) Only II

c) Only III                              d) Both I and II

2. Studies have shown that the risk of crash related deaths are lowest when all occupants of a vehicle are restrained using seat belts.

Proposed Inferences

IV. Passengers in both front seats and back seats are advised to wear seat belts for their safety.

V. All passengers are at the same risk to be injured in accidents.

VI. The above statement is applicable only for the front seaters.

a) Only I                               b) Both I and II

c) Only II                               c) Both II and III
3. In Kerala the unhealthy dietary practices is responsible for 10 – 20 % of cancers. We had a predominantly plant based diet and with the advent of western life style we are moving towards a diet rich in animal proteins. This coupled with other habits like smoking and alcohol will lead to increase in the rate of cancer and other cardiovascular diseases. Prompt action has to be taken to spread the message of healthy life style and dietary practices.

Proposed Inferences

I. Plant based diet reduces the risk of cancer.
II. Whether Keralites are veg or non – veg makes no difference to the likelihood of developing cancer disease.
III. The easiest way to reduce the risk of cancer is to change the life style.

a) All the above                       b) Only I
   c) Both I and II                    d) Only III

4 . Studies have shown that use of tobacco and exposure to second hand or environmental tobacco smoke is associated with increased risk of cancer and heart disease and adverse health effects. Thus Government of Kerala banned the manufacture, storage, sale and distribution of tobacco products on May, 2012. Government took necessary steps to convey the adverse effect of tobacco use through advertisements, posters, conducting campaigns, banning the sale of tobacco products near educational institutions, and regulation of health warning in tobacco products packs. But still people die from tobacco related illness

Proposed Inferences

I. There are people who are still unaware of the adverse effects of tobacco use.
II. The use of any products made up of tobacco is harmful to health.
III. Men use tobacco more than women

a) Both I and II                       b) Both II and III
   c) Only I                          c) Only II
5. Light consists of seven colours (VIBGYOR). Different colours have different wavelengths. When light falls on an object, it reflects the colour of that particular object and absorbs all others falling on it. For example, when it falls on an object say, a flower of colour red, it absorbs all the colours and reflect red colour. When it falls on a book of Blue colour, it absorbs all the colours and reflects the blue colour.

Proposed Inferences

I. When Light falls on an object, it either absorbs or reflects it.

II. Light is of single wavelength

III. The colour of an object we perceive depends on the wavelength of the light.

b) Only I  b) Both I and II

c) Both I and III c) Only III

6. John started to spend 12 hours a day for Entrance test.

Proposed Inferences

I. John wishes to achieve high in the entrance tests.

II. John is hard working.

III. John is highly determined

b) None of the above b) All the three

c) Both I and II c) Both I and III

7. Poor handwriting does not indicate the weak character of a person, as many eminent personalities were there with poor handwriting.

Proposed Inferences

I. Many Eminent Personalities had handwriting that was difficult to read.

II. A person’s handwriting reveals his character.

III. Whether handwriting good or bad never affects the character of a person.
8. Friendship is necessary for being happy.

Proposed Inferences

I. A person seems to be unhappy have no friends.

II. Happiness and friendships are relating factors

III. Only friends can make one happy.

a) All the three  b) None of the above

c) Only II  d) Only III

9. Neon light was a particular type of vapour lamp that uses the colourless inert gas neon. When an electric current is passed through a tube filled with neon at low pressure, it became luminous. The light so emitted is reddish-orange in colour. Today, the term “neon light” is given to those lamps of this type which may be filled with a variety of gases, depending on the colour that is desired. Eg: Blue light is produced by filling it with Argon. Colors can also be altered by changing the color of the glass tube. The tubes must be long to produce light efficiently. Therefore high voltages are required. Neon tube lamps are not be used for indoor illumination, but they have widespread use in outdoor especially for glowing, colourful advertising signs.

Proposed Inferences.

I. Modern neon lights are more efficient than those used in the past.

II. When electricity is applied, different gases produces different colours of light.

III. Colour of light depends on the colour of gas used.

a) Only II  b) Only III

c) Both II and III  d) All the above
Part II : Recognition of Assumptions

Directions : This part contains items which consist of one statement, followed by two assumptions. Here the subject is required to judge whether the series of given assumptions follow or not from the statement. Read the given statements and decide whether the assumptions given below follow or not from the statement at the top. Then mark your answer as a) Only I is implicit b) Only II is implicit c) Both I and II are implicit d) None is implicit.

1. Statement The direction of flow of positive charges is taken as the direction of current.
   Assumptions I. Only positive charges constitute current.
   II. The direction of current is fixed.
2. Statement Empty vessels makes the most noise
   Assumptions I. All vessels makes noise
   II. The vessels that make noise are always empty.
3. Statement In India the domestic power supply is 220V.
   Assumptions I. The value may be different for different countries.
   II. The value of power supply is fixed all over India.
4. Statement A hungry man is an angry man.
   Assumptions I. All angry men are hungry.
   II. Some angry men are hungry.
5. Statement Traces of Ammonia have been found in Mar’s atmosphere. So there must be life on Mars.
   Assumptions I. Ammonia is necessary for life to exist
   II. Earth contains ammonia.
6. Statement Unemployment allowance should be given to all unemployed Indian youth above 18 years of age.
   Assumptions I. There are unemployed youths in India who needs monetary support
   II. The government has sufficient funds to provide allowance to all unemployed youth.
7. **Statement**  
“If you want to study Physics, join institute Y”, A advice to B.  
**Assumptions**  
I. Institute Y provides good education in Physics.  
II. B listen to A advice.

8. **Statement**  
“The programme will start at 6 p.m but you can come there by 7 p.m or so and still there is no problem”.  
**Assumptions**  
I. The programme will continue even after 7 p.m.  
II. The programme may not start by that time.

9. **Statement**  
Raju was just elected as the president of the student senate. So he must be a senior.  
**Assumptions**  
I. Only seniors can be the members of the student Senate.  
II. Raju is a Senior.

10. **Statement**  
“As there is a great demand, every person seeking tickets of the programme will be given only four tickets”.  
**Assumptions**  
I. No one is interested in getting more than four tickets.  
II. The organizers are not keen on selling the tickets.

11. **Statement**  
Why don’t you invite Johnny for the Birthday party?  
**Assumptions**  
I. Unless invited Johnny will not attend the party.  
II. Johnny is not from the same city.

**Part III : Interpretation**

Directions: In this part each question consists of several statements followed by two suggested conclusions supposed to be contained in the original statement. Here the subject is required to interpret the ideas contained in the statements.

Judge each conclusions independently and mark your answer as a) Only I follows  b) Only II follows  c) Both I and II follows d) Neither I nor II follows.

1. **Statement**  
Seven days without exercise makes one weak  
**Interpretations**  
I. All healthy people do exercise daily.  
II. Only exercise makes you healthy.

2. **Statement**  
A person suffering from shortsightedness can see only near objects clearly and a person suffering from long sightedness
can see only far objects clearly. The former can be corrected using concave lens and the latter using a convex lens.

Interpretations
I. A convex lens can be used to see near objects clearly.
II. Students having short sightedness should be seated in the front benches.

3 Statement
According to 2001 census the male literacy rate is 75.26% and female literacy rate is 53.67%. According to 2011 census, female literacy rate is 65.46% where the male literacy rate is 82.14%.

Interpretations
I. Even though there is an improvement in the percentage of literacy, still female literacy lags behind male literacy.
II. By 2011 the female literacy rate becomes better than the male literacy rate in 2001.

4 Statement
Navodhaya Vidyalayas were introduced as a result of the recommendation of NPE, 1986. They are fully residential and Coeducational schools for finding talented children from rural areas.

Interpretations
I. Only students from rural areas are admitted to these schools.
III. There were no such schools before 1986.

5 Statement
The IT @ School Project, is an Information Technology project under the Department of General Education, Government of Kerala. Launched in 2001, the Project has remodelled conventional teaching methodologies in classrooms through the use of IT.

Interpretations
I. Conventional teaching methods gives less importance to Information Technology.
II. The conventional teaching methods were fully replaced by IT after 2001.

6 Statement
A superconductor is a material that can conduct electricity or transport electrons from one atom to another with no resistance. This can be achieved only at very low temperatures.
Interpretations

I. All materials exhibit superconductivity at low temperatures.
II. Resistance is zero in superconductors

7 Statement
A solar cell is an electronic device which directly converts sunlight into electricity. Light shining on the solar cell produces both a current and a voltage to generate electric power.

Interpretations
I. Sunlight is essential for power generation in solar cell.
II. Solar cell can be used to satisfy the domestic needs.

8 Statement
Resistance of metals increases with increase in temperature.
Resistance of silicon increases by lowering the temperature.

Interpretations
I. Silicon is not a metal.
II. There are substances whose resistances decreases with increase in temperature.

9 Statement
Only those students who scored above 80% marks are admitted for the course. Asha scored 90%.

Interpretations
I. Asha is admitted
II. Those who scored below 80% are not eligible.

10 Statement
Pollution is a slow poison, and therefore social scientists and the media must work together to create sensitivity among people.

Interpretations
I. Media is aware about the effects of pollution.
II. People are not aware about the harmful effect of Pollution.

11 Statement
Ozone depletion and Global Warming are the two environmental problems caused by the release of some pollutants into the atmosphere.

Interpretations
I. Control of pollutants can reduce Global warming and Ozone depletion.
II. Human activities are the reason behind all environmental problems.
12. Statement: Cactus Plant has thick leaves and it requires less water

Interpretations:
I. Plants with thick leaves requires little water.
II. Cactus can be grown in places where water is not in abundance

Part IV: Evaluation of Arguments.

Directions: Read the statements given below. Each statement is followed by two arguments either positive or negative. Consider each argument as true and decide which argument strongly supports the statement or not and mark your answer in the space provided as

a) Only argument I is strong  
b) Only argument II is strong  
c) Both I and II are strong  
d) Neither I nor II is strong

1. Statement: Should vegetables be washed before cutting.
   Arguments:
   I. No it would remove the nutrients.
   II. Yes it would reduce the level of pesticides that may be present in it.

2. Statement: Should government provide free education up to secondary level
   Arguments:
   I. Yes, it will be helpful for students from low income families.
   II. No, it will be a burden for the government.

3. Statement: Should students be encouraged to take part in extra curricular activities.
   Arguments:
   I. Yes, it would enhance the teamwork and self esteem of students.
   II. It will make him socially responsible

4. Statement: Should the use of social medias be reduced?
   Arguments:
   I. Yes, it will reduce social crimes.
   II. No, it is an easy and inexpensive way to share information with a large group at the same time.

5. Statement: Should the vehicles older than 10 years be rejected in metros in India?
   Arguments:
   I. Yes. This is a significant step to lower down the pollution level in metros.
   II. No. It will be very difficult for vehicle owners
6 Statement Should the rule of wearing helmet for both driver and pillion rider while driving a motor bike be enforced strictly?
Arguments I. Yes. It is a rule and rules should be followed strictly by all.
II. No. It does not ensure safety as only the head is protected and rest of the body is not.

7 Statement Should women be given equal opportunity in the matter of employment in every field?
Arguments I. Yes. They are equally capable.
II. No. They have to shoulder household responsibilities.

8 Statement Should Open book system of examination be encouraged?
Arguments I. Yes, it will be helpful for the deeper understanding of the subject.
II. No, this is not a true test.
## CRITICAL THINKING TEST (Final)

### Scoring Key

**Part – I: Inference**

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**Part II – Recognition of Assumptions**

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**Part III: Interpretation**

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**Part IV – Evaluation of Arguments**

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## CRITICAL THINKING TEST (Final)

### Copy of the Response Sheet

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#### Part III: Interpretation

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#### Part IV – Evaluation of Arguments

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General Instructions

- Answer all the questions.
- Each question carries 1 mark.
- Read the instructions carefully before answering the questions.
- Write the answers in the Response sheet given separately.
- Start answering after getting instruction.
- Please return the Response sheets after the allotted time.

I. Answer the following questions (1 to 26) from the choices given under each question.

1. Kirchhoff’s first and second laws of electrical circuits are the consequences of
   a) Conservation of energy and electric charge respectively
   b) Conservation of energy only
   c) Conservation of electric charge only
   d) Conservation of electric charge and energy respectively.
Potential difference between terminals when K (key) is open is called?

a) Emf  

b) lost voltage  

c) terminal voltage  

d) induced voltage

2. A steady current flows in a metallic conductor of non-uniform cross section. 
Which of these is constant along the conductor.

a) Current  

b) Current density  

c) Electric field  

d) drift speed

3. Identify the correct statement from those given below.

i. The product of volt and coulomb is joule.

ii. The product of volt and ampere is joule per second.

iii. The product of volt and watt is horse power.

iv. kilowatt hour is also known as Board of Trade Unit (B.O.T)

a) All the four are correct 

b) i and iii are correct 

c) iii and iv are correct 

d) i, ii and iv are correct

5  The SI unit of electric current is Ampere. The unit equivalent to Ampere is

a. Cs  

b. Cs⁻¹  

c. Cs⁻²  

d. Cs²

6  The internal resistance of a cell is the resistance of

a. material used in the cell  

c. electrodes of the cell

b. electrolyte used in the cell  

d. All the above

7. Si & Cu are cooled from 300 k to a temperature of 60 k. Then resistivity

a. for Si increases and for Cu decreases

b. for Cu increases and for Si decreases
c. decreases for both Si & Cu
d. increases for both Si & Cu.

8. Resistance : length
   a) current : time                          b) conductance : Resistance
   c) Current : Potential difference        d) Current : Resistance

9.

![Image of a circuit diagram]

Six equal resistances are connected between points P, Q and R as shown in the figure. The net resistances will be maximum in between
a) P & Q  b) P & R  c) Q & R  d) QR & PR

10. Three cells of 1.5V each is connected in parallel as shown in the figure below. What happens to the total emf of the combination if one cell is removed from the circuit?

![Image of a circuit diagram]

a. Increases    b. decreases    c. remains constant    d. reduces to half

11. The SI unit of conductance is Siemen. The unit equivalent to Siemen is
   a. Ω m            b. Ω⁻¹ m⁻¹   c. Ω⁻¹          d. Ω m⁻¹
12. When a wire of uniform cross-section ‘a’, length ‘l’ and resistance R is bent into a complete circle, resistance between any two of the diametrically opposite points will be

   a) \(\frac{R}{8}\)  b) \(\frac{R}{4}\)  c) \(\frac{4}{R}\)  d) \(\frac{R}{2}\)

13. A long resistance wire is stretched between two iron nails. A battery of 2V is applied across the wire. One end of a torch bulb is connected to a nail and other end is made in contact as shown in the figure.

If this wire is slid over the resistance wire from nail 1 to nail 2, what happens to the brightness of the bulb.

   a) Increases  b) decreases  c) remains constant  d) first increases then decreases

14. In a Wheatstone’s bridge, all the four arms have equal resistance R. If the resistance of the galvanometer arm is also R, the equivalent resistance across the battery will be

   a) R  c) \(\frac{R}{2}\)
   b) 2R  d) \(\frac{R}{4}\)

15. Ohm’s law is not obeyed by

   a) electrolytes  c) vacuum tubes
   b) discharge tube  d) all of these

16. With a certain cell, the balance point is obtained at 65cm from the end of a potentiometer wire. With another cell, the balance point is obtained at 60cm. Find the ratio of the em.f’s of the two cells
17. Forty electric bulbs are connected in series across a 220 V supply. After one bulb get fused, the remaining 39 bulbs are again connected in series across the same supply. The illumination will be

a. equal in both the cases
b. more with 40 bulbs than with 39
c. more with 39 bulbs than with 40
d. in the ratio $40^2 : 39^2$

18. Three copper wire of length ‘l’ and cross sectional area ‘A’ are (l, A); (2l, A/2) and (l/2, 2A). Resistance is minimum in

a. wire of cross – sectional area A/2
b. wire of cross – sectional area A
c. Wire of cross- sectional area 2A
d. all the above

19. Pick the odd one out from the following


20. A cell of emf $\mathbf{E}$ having negligible internal resistances is connected to three resistances $R_1$, $R_2$ and $R_3$ as shown in figure.

If $R_1 > R_2 > R_3$ then

a) $I_1 > I_2 > I_3$  b) $I_1 = I_2$  c) $I_1 < I_3$  d) $I = I_1 + I_2 + I_3$

21. Pick the odd one out from the following

a) Ohm’s law  b) Lenz’s law  c) Coulomb’s law  d) Gauss’s law
e) Law of conservation of energy

22. A fuse wire is a wire of

a) low resistivity and low melting point
b) high resistivity and low melting point
c) low resistivity and high melting point
d) high resistivity and high melting point

23. Which of the following is the correct expression according to the figure

a) \[ I_1 - I_2 - I_3 + I_4 - I_5 = 0 \]
b) \[ I_2 + I_3 + I_5 + I_1 + I_4 = 0 \]
c) \[ +I_1 - I_2 - I_3 - I_4 - I_5 = 0 \]
d) None of the above

24. The following question consists of two statements, each printed as assertion and reason. While answering these questions you should choose any one of the following responses.

Assertion: In a simple battery circuit, the point at the lowest potential is the positive terminal of the battery.

Reason: The electrons flows from higher potential to lower potential.

a) Both assertion and reason are true and reason is the correct explanation of assertion.
b) Both assertion and reason are true and reason is not the correct explanation of assertion.
c) Assertion is true but reason is false
d) Both assertion and reason are false
25. The following question consists of two statements, each printed as assertion and reason. While answering these questions you should choose any one of the following responses.

**Assertion:** Manganin or constantan is used for making standard resistors.

**Reason:** Their resistivity is high, while temperature coefficient is low.

a) Both assertion and reason are true and reason is the correct explanation of assertion.

b) Both assertion and reason are true and reason is not the correct explanation of assertion.

c) Assertion is true but reason is false

d) Both assertion and reason are false

26. A technician has only two resistors. By using them singly in series or in parallel, he is able to obtain the resistances of values 3, 4, 12 and 16Ω. What are the resistances of the two resistors?

a. 6 and 10Ω  
b. 4 and 12Ω  

c. 7 and 9Ω  
d. 5 and 12Ω

II. **Answer the following questions in a word or a sentence.**

27. The relation between voltage V and current I through the conductor given by Ohm’s law is $V \alpha I$. Give another relation for Ohm’s law in terms of current density (j) and electric field (E)?

28. A wire of resistivity $\rho$ is stretched to double its length. What will be its new resistivity?

29. State the following sentence as true or false?

   “The value of resistance of a conductor depends upon the potential difference applied across it or the current passed through it.”

30. Why is a slide wire bridge also called as a meter bridge?
31. Give the mathematical expression of the principle of potentiometer?

32. Analyze the following figure and give an equation for the current passing through the circuit?

![Circuit Diagram](image)

33. Anita studied in her physics class that, a carbon resistor has usually four bands of different colours. But when she bought a resistor from the shop it has only three bands and the fourth band is absent. Initially she gets confused but then she got the reason. What you may think be the answer to her doubt?

34. Electric current has both magnitude and direction, but it is not a vector quantity. Why?

35. The following circuit is a standard circuit in the modified form. Identify the circuit?

![Circuit Diagram](image)

36. A circuit diagram is given below. Analyze the figure and answer the question given below.

![Circuit Diagram](image)
If 1.5 cell is replaced by a 3V cell what will be the balancing length?

37. A rectangular conductor of length ‘l’ and area of cross section ‘A’ and electron density ‘n’ is shown below.

When the face Y is given positive potential and X negative potential, what will happen to the electrons inside the block?

38. In the potentiometer circuit shown, the balance point is at X.

State with reason, where the balance point will be shifted, when resistance R is increased, keeping all parameters unchanged.

39. What happens if the galvanometer and cells are interchanged at the balancing point of the given metre bridge?

40. Analyze the following figure and find the current passing through the resistor R₃?
41. Predict the relative brightness of the three identical bulbs shown in the figure when ‘S’ is closed?

42. Calculate the combined resistance of the following two resistors?

43. In a meter bridge, the balance point is found to be at 45 cm from the end A, when the resistor Y is of 15 \( \Omega \). Determine the resistance of X?

44. Under an external electric field electrons drift slowly inside the conductor. When the temperature increases what happens to the drift velocity?

45. The voltage – current variation of two metallic wires ‘X’ and ‘Y’ at constant temperature are as shown in figure. Assuming that the wires have the same length and the same diameter, explain which of the wires will have larger resistivity.
46. Give any one difference between emf and potential difference?

47. Remya makes the following circuit to measure the emf of a cell.

![Circuit Diagram]

She says that the voltmeter reading will give the emf of the cell. But the physics teacher says that the emf measured in this way is not accurate. Justify the statement?

48. Give any one difference between internal resistance and external resistance?

49. From the following figure which one corresponds to a typical semiconductor?

50. Temperature coefficient of resistance of silicon and carbon are negative. What does it mean. Justify?

51. Is the internal resistance of the cell not a constant. Justify?

52. Suggest any one possible solution to avoid electrical shock while ironing?
53. You are provided with three resistors $2\Omega$, $4\Omega$ and $6\Omega$. How will you connect these three resistances so that the effective resistance would be $3\Omega$?

54. You have three identical cells having small internal resistances. How will you connect the three cells (in series / parallel) so that the internal resistance is minimum?

III. **Draw circuit diagrams for the questions given below.**

55. To construct an electronic circuit, you want to select a $470\, K\Omega$ resistor with 5% tolerance. Draw a schematic diagram indicating the colour combinations that you will select?

56. You are provided with three identical electrical bulbs A, B and C and a cell of 250 V. Draw a circuit diagram in such a way that Brightness of A = Brightness of B > Brightness of C.

57. When an animal touches an electric fence the animal gets a shock by completing an electrical circuit. Draw an equivalent circuit using symbols, which shows the completed electrical circuit. (Assume that the animal has a resistance.)

58. Figure below shows a search light consisting of a resistor (the filament of the light bulb) connected to a 3V battery. Draw the equivalent circuit diagram using symbols of resistors and cells.

59. The effective resistance between the points A and B is $16\Omega$. Make necessary changes in the diagram so that the effective resistance becomes $4\Omega$.
60. If you make connections as shown in the following figure, the bulb will not glow. Make necessary changes in the figure so that the bulb will glow?
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<td>Emf is the potential difference between the terminals of battery in an open circuit and potential difference is the difference in potential between any two points in a closed circuit.</td>
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<td>Since the voltmeter draws current the emf measured is not accurate</td>
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<td><strong>48</strong></td>
<td>Internal resistance is the resistance offered by the cell and external resistance is the resistance offered by the resistor or device connected externally with the cell</td>
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<td>b) For semiconductor resistivity decreases with increase in temperature.</td>
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## ACHIEVEMENT TEST IN PHYSICS

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MAHATMA GANDHI UNIVERSITY  
SCHOOL OF PEDAGOGICAL SCIENCES  
ACHIEVEMENT TEST IN PHYSICS (FINAL)

Standard XII                                                                                     Maximum Score : 40

Maximum Time: 40 mts

General Instructions

➢ Answer all the questions.
➢ Each question carries 1 mark.
➢ Read the instructions carefully before answering the questions.
➢ Write the answers in the Response sheet given separately.
➢ Start answering after getting instruction.
➢ Please return the Response sheets after the allotted time.

I. Answer the following questions (1 to 26) from the choices given under each question.

1. Kirchoff’s first and second laws of electrical circuits are the consequences of

   f) Conservation of energy and electric charge respectively
   g) Conservation of energy only
   h) Conservation of electric charge only
i) Conservation of electric charge and energy respectively.

2. Potential difference between terminals when K (key) is open is called?
   b) Emf  b) lost voltage  c) terminal voltage  d) induced voltage

3. The internal resistance of a cell is the resistance of
   a material used in the cell  c electrodes of the cell
   b electrolyte used in the cell  d All the above

4. Si & Cu are cooled from 300 k to a temperature of 60k. Then resistivity
   e. for Si increases and for Cu decreases
   f. for Cu increases and for Si decreases
   g. decreases for both Si & Cu
   h. increases for both Si & Cu.

5. Resistance : length
   a) current : time  b) conductance : Resistance
   c) Current : Potential difference  d) Current : Resistance

6. Six equal resistances are connected between points P, Q and R as shown in figure. The net resistances will be maximum in between
   a) P & Q  b) P & R  c) Q & R  d) QR & PR

7. Three cells of 1.5V each is connected in parallel as shown in the figure
9. A long resistance wire is stretched between two iron nails. A battery of 2V is applied across the wire. One end of a torch bulb is connected to a nail and other end is made in contact as shown in the figure.

If this wire is slid over the resistance wire from nail 1 to nail 2, what happens to the brightness of the bulb.

b) Increases  b) decreases  c) remains constant  d) first increases then decreases

10. In a wheatstone’s bridge, all the four arms have equal resistance R. If the resistance of the galvanometer arm is also R, the equivalent resistance across the battery will be

a) R  c) R/2
b) 2R  d) R/4
11. Ohm’s law is not obeyed by
   a) electrolytes  c) vacuum tubes
   b) discharge tube  d) all of these

12. Forty electric bulbs are connected in series across a 220 V supply. After one bulb gets fused, the remaining 39 bulbs are again connected in series across the same supply. The illumination will be
   a) equal in both the cases
   b) more with 40 bulbs than with 39
   c) more with 39 bulbs than with 40
   d) in the ratio $40^2 : 39^2$

13. Three copper wire of length ‘l’ and cross sectional area ‘A’ are (l, A); (2l, A/2) and (l/2, 2A). Resistance is minimum in
   a) wire of cross – sectional area A/2
   b) wire of cross – sectional area A
   c) Wire of cross- sectional area 2A
   d) all the above

14. A cell of emf $\mathcal{E}$ having negligible internal resistances is connected to three resistances $R_1$, $R_2$ and $R_3$ as shown in figure.

   ![Diagram](image)

   If $R_1 > R_2 > R_3$ then
   b) $I_1 > I_2 > I_3$  b) $I_1 = I_2$  c) $I_1 < I_3$  d) $I = I_1 + I_2 + I_3$

15. Pick the odd one out from the following
   b) Ohm’s law  b) Lenz’s law  c) Coulomb’s law  d) Gauss’s law
   j) Law of conservation of energy
16. A fuse wire is a wire of

a) low resistivity and low melting point  
b) high resistivity and low melting point 
c) low resistivity and high melting point  
d) high resistivity and high melting point

17. Which of the following is the correct expression according to the figure

a) \[ I_1 - I_2 - I_3 + I_4 - I_5 = 0 \]  
b) \[ I_2 + I_3 + I_5 + I_1 + I_4 = 0 \]  
c) \[ +I_1 - I_2 - I_3 - I_4 - I_5 = 0 \]  
d) None of the above

18. The following question consists of two statements, each printed as assertion and reason. While answering these questions you should choose any one of the following responses.

Assertion: In a simple battery circuit, the point at the lowest potential is the positive terminal of the battery.

Reason: The electrons flows from higher potential to lower potential.

e) Both assertion and reason are true and reason is the correct explanation of assertion.

f) Both assertion and reason are true and reason is not the correct explanation of assertion.

g) Assertion is true but reason is false

h) Both assertion and reason are false
19. A technician has only two resistors. By using them singly in series or in parallel, he is able to obtain the resistances of values 3, 4, 12 and 16Ω. What are the resistances of the two resistors?
   a. 6 and 10Ω  b. 4 and 12Ω  
c. 7 and 9Ω  d. 5 and 12Ω

II. Answer the following questions in a word or a sentence.

20. The relation between voltage V and current I through the conductor given by Ohm’s law is VαI. Give another relation for Ohm’s law in terms of current density (j) and electric field (E)?

21. State the following sentence as true or false?

   “The value of resistance of a conductor depends upon the potential difference applied across it or the current passed through it.”

22. Analyze the following figure and give an equation for the current passing through the circuit?

![Figure](image)

23. Anita studied in her physics class that, a carbon resistor has usually four bands of different colours. But when she bought a resistor from the shop it has only three bands and the fourth band is absent. Initially she gets confused but then she got the reason. What you may think be the answer to her doubt?
24. The following circuit is a standard circuit in the modified form. Identify the circuit?

![Circuit Diagram]

25. A circuit diagram is given below. Analyze the figure and answer the question given below.

![Circuit Diagram 2]

If 1.5 cell is replaced by a 3V cell what will be the balancing length?

26. A rectangular conductor of length ‘l’ and area of cross section ‘A’ and electron density ‘n’ is shown below.

![Conductor Diagram]

When the face Y is given positive potential and X negative potential, what will happen to the electrons inside the block?
27. What happens if the galvanometer and cells are interchanged at the balancing point of the given metre bridge?

28. Analyze the following figure and find the current passing through the resistor R₃?

29. Predict the relative brightness of the three identical bulbs shown in the figure when ‘S’ is closed?

30. Calculate the combined resistance of the following two resistors?
31. In a meter bridge, the balance point is found to be at 45 cm from the end A, when the resistor Y is of 15 Ω. Determine the resistance of X?

32. The voltage – current variation of two metallic wires ‘X’ and ‘Y’ at constant temperature are as shown in figure. Assuming that the wires have the same length and the same diameter, explain which of the wires will have larger resistivity.

33. Give any one difference between internal resistance and external resistance?

34. From the following figure which one corresponds to a typical semiconductor?

35. You are provided with three resistors 2Ω, 4Ω and 6Ω. How will you connect these three resistances so that the effective resistance would be 3Ω?
III. Draw circuit diagrams for the questions given below.

36. You are provided with three identical electrical bulbs A, B and C and a cell of 250 V. Draw a circuit diagram in such a way that Brightness of A = Brightness of B > Brightness of C.

37. When an animal touches an electric fence the animal gets a shock by completing an electrical circuit. Draw an equivalent circuit using symbols, which shows the completed electrical circuit. (Assume that the animal has a resistance.)

38. Figure below shows a search light consisting of a resistor (the filament of the light bulb) connected to a 3V battery. Draw the equivalent circuit diagram using symbols of resistors and cells.

39. The effective resistance between the points A and B is 16Ω. Make necessary changes in the diagram so that the effective resistance becomes 4Ω.

40. If you make connections as shown in the following figure, the bulb will not glow. Make necessary changes in the figure so that the bulb will glow?
### ACHIEVEMENT TEST (Final)

**Scoring Key**

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22 \[ I = \frac{E}{R+r} \]

23 It has 20% tolerance

24 Wheatstone’s Bridge

25 Remains the same

26 Electron will accelerate towards Y

27 The galvanometer shows no deflection

28 \[ I_3 = I_1 + I_2 \]

29 A>B>C

30 165\(\Omega\)

31 12.2\(\Omega\)

32 Y

33 Internal resistance is the resistance offered by the cell and external resistance is the resistance offered by the resistor or device connected externally with the cell

34 b) For semiconductor resistivity decreases with increase in temperature.

35 Connect 2\(\Omega\) and 4\(\Omega\) in series and 6\(\Omega\) in parallel to them.
### ACHIEVEMENT TEST IN PHYSICS (Final)

Copy of the Response Sheet

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RAVEN’S STANDARD PROGRESSIVE –MATRICES
Response Sheet

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Published by MANASAYAN, New Delhi by special arrangements with the original publisher H. K. LEWIS & CO. LTD., LONDON.

(a) J.C. Raven

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Time | Total | Grade

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WEB RESOURCES USED FOR VARIOUS TOPICS IN LESSON TRANSACTION

1. Electric Current and Flow of Electric Charges in a Conductor
   a) https://www.youtube.com/watch?v=5laTkjINHrg
   b) https://www.youtube.com/watch?v=HXOok3mfMLM
   c) https://www.youtube.com/watch?v=hAhQtG5_SBk

2. Drift Velocity
   a) https://www.youtube.com/watch?v=qgOJY4GNK0w
   b) https://www.youtube.com/watch?v=PbpQT_TCu0k

3. Electron Mobility and Current Density
   a) https://photon.libretexts.org › The Science of Solar › Solar Basics
   b) https://www.youtube.com/watch?v=PbpQT_TCu0k

4. Ohm’s Law, Resistance and Conductance.
   a) https://www.youtube.com/watch?v=6T-4Xi92QfE
   b) https://www.youtube.com/watch?v=y6xkMl5QZHE
   c) https://www.youtube.com/watch?v=nWAP3NebCFk

5. Resistors in Series and Parallel.
   ➢ Resistors in Series - https://www.youtube.com/watch?v=u-7k8wpl_ZU
   ➢ Resistors in Parallel - https://www.youtube.com/watch?v=MxH7hnuBfC4

   a) https://www.youtube.com/watch?v=ITAcZP2oyvc
   b) https://www.youtube.com/watch?v=G-dLS9tO1Gg
   c) https://www.youtube.com/watch?v=PIJTu8z0-_U

7. Colour Code of resistors
   a) https://www.youtube.com/watch?v=G1mZutobxD

8. Electric Energy
   a) https://www.youtube.com/watch?v=7EZLSEyYe74
   b) https://www.youtube.com/watch?v=U18MAOkGutQ
9. Electric Power
   a) https://www.youtube.com/watch?v=BGhyIFUjRfc

10. Internal Resistance and EMF of the Cell
    a) https://www.youtube.com/watch?v=h4gA1iPKz5s
    b) https://www.youtube.com/watch?v=7WkIzx4LS3M

11. Cells in Series and Parallel
    a) https://www.youtube.com/watch?v=5lBDdcF6eAk
    b) https://www.youtube.com/watch?v=OH2ZHt8N_U4

12. Kirchoff’s Laws
    a) https://www.youtube.com/watch?v=OYerdzZPSI0
    b) https://www.youtube.com/watch?v=ZDoyIghi44
    c) https://www.youtube.com/watch?v=paDs-HnmkIo
    d) https://www.khanacademy.org/.../kirchhoffs.../ee-kirchhoffs-current

13. Wheatstone’s Bridge
    a) https://www.youtube.com/watch?v=3rOvQ3qFZp
    b) https://www.youtube.com/watch?v=_kJURIUPIlw

14. Metre Bridge
    a) https://www.youtube.com/watch?v=5Rk2klHiPBc
    b) https://www.youtube.com/watch?v=UMIuUDIiDpQ

15. Potentiometer
    a) https://www.youtube.com/watch?v=nE_JOalao7M
    b) https://www.youtube.com/watch?v=B-mU-oSz1qw