To determine the specific resistance of a wire by using Meter Bridge

Q1. Define specific resistance (resistivity) of a wire. Write the formula for determining the specific resistance of a wire and its SI unit.

Ans. Specific resistance or resistivity is the resistance of a conductor having unit length

and unit cross-sectional area. The formula for determining the specific resistance of a wire, ρ = (R × A) / L

where ρ = specific resistance, R = resistance, A = area of cross-section, L = length of the

wire. Its SI unit is ohm-metre (Ωm).

Q2. What is the principle of a meter bridge?

Ans. A meter bridge works on the principle of the Wheatstone Bridge.

In a balanced Wheatstone bridge, the ratio of two known resistances equals the ratio of two unknown resistances.
In a meter bridge, the resistance of the wire is proportional to its length because the wire is uniform.

At balance condition: $\frac{R}{S} = \frac{l}{100-l}$

Here:

R= unknown resistance

S= known resistance

l= balancing length

So, instead of directly measuring resistance, we compare lengths.

Q3. Why is no current flowing through the galvanometer at balance point?

Ans. At the balance point, the electric potential at both ends of the galvanometer becomes equal.

Current flows only when there is potential difference. $I \propto V$
Since Potential difference = 0. Therefore, current = 0

That is why galvanometer shows null deflection.

This condition gives high accuracy because no current is drawn from the bridge branch.

Q4. Why should the bridge wire be uniform?

Ans. Uniform means: same material everywhere and same thickness everywhere

If the wire is not uniform: equal lengths will not have equal resistance and resistance will not vary linearly with length

Then the formula: $R \propto L$, will fail, causing wrong results.

Gentle touch ensures temporary contact only.

Q5. Why is diameter measurement very important?

Ans. Area depends on square of radius: $A = \pi r^2$
So, a tiny error in radius creates a large error in area.

Example:

- 2% error in radius
- gives about 4% error in area

Since resistivity calculation uses area, the final answer becomes inaccurate.

Q6. What does the null point represent in this experiment?

Ans. It represents the point where the galvanometer shows zero deflection, indicating that the bridge is balanced.

Q7. Why does temperature affect resistance?

Ans. In metals higher temperature causes atoms to vibrate more and electrons collide more frequently. Therefore, electron flow becomes difficult. Hence resistance increases.

Q8. Why are repeated readings taken?

Ans. Every measurement contains random errors. Taking multiple readings reduces accidental mistakes, improves reliability and gives better average value. Scientific experiments always prefer averaged observations.

Q9. Why is the bridge wire usually 1 meter long?

Ans. The bridge wire usually 1 meter long because calculations become simple, scale directly gives length in cm and sufficient accuracy is obtained

The formula uses: $100 - l$
which becomes convenient with 1-meter wire.

Q10. Why is it important to interchange the known and unknown resistances during the experiment? Why is the null point kept near the middle of the bridge wire?

Ans. Interchanging them helps to eliminate errors such as contact resistance and thermoelectric effects. The null point is kept near the middle (between 30 cm and 70 cm) to obtain maximum accuracy and minimize experimental error in the readings.

Q11. Why is a galvanometer used in the meter bridge experiment?

Ans. A galvanometer is used to detect the balance (null) point — the position on the wire at which no current flows through the galvanometer, indicating that the bridge is balanced.

Q12. Differentiate between resistance and specific resistance.

Ans. Resistance depends on the dimensions (length and area) as well as the material of the conductor, whereas specific resistance depends only on the material of the conductor and is independent of its dimensions. The unit of resistance is ohm (Ω), while the unit of specific resistance is ohm-meter (Ωm).

Q13. Why is the diameter of the wire measured at several different places? Why is a screw gauge used to measure the diameter of the wire?

Ans. The wire may not be perfectly uniform throughout its length. Measuring the

diameter at several places and taking the mean value gives a more accurate and reliable value of the area of cross-section.

A screw gauge has a least count of 0.01 mm, which makes it suitable for measuring very small diameters accurately. Using a less precise instrument would introduce significant errors in the calculated area of cross-section.

Q14. What is the relation between the resistance of a wire and its length, area of cross-section?

Ans. Resistance is directly proportional to the length of the wire ($R \propto L$). This means that if the length of a wire is doubled (keeping the material and cross-section constant), its resistance also doubles. Resistance is inversely proportional to the area of cross-section of the wire ($R \propto 1/A$). This means that a thicker wire (larger area) offers less resistance to the flow of current.

Q15. What is a rheostat and its function?

Ans: A rheostat is a variable resistor used to control current in the circuit. It protects the wire and instruments from excessive current.

Q16. On what factors does resistance depend?

Ans: Resistance depends on the length, area of cross-section, material, and temperature of the conductor.

Q17. Why should the key be opened after taking readings?

Ans: The key should be opened to prevent heating of the wire. Heating changes resistance and affects accuracy.

Q18. What precautions should be taken in meter bridge experiment?

Ans: Connections should be tight and the bridge wire should be clean. The jockey should be pressed gently and the balance point should be near the center.

Q19. Why is Wheatstone bridge method accurate?

Ans: The Wheatstone bridge uses the null deflection method, which minimizes

measurement errors and gives accurate results.

Q20. What is a shunt? How does connecting a shunt affect the galvanometer circuit? Why is a shunt used with the galvanometer during the experiment?

Ans: A shunt is a very low-resistance wire connected in parallel with a sensitive device (like a galvanometer) to bypass the major portion of the current. Since a very low resistance is connected in parallel, the effective combined resistance of the galvanometer and shunt becomes extremely low. A low-resistance shunt is used initially to protect the galvanometer from large currents and it is removed when approaching the null point for accuracy.

Q21. What is the value of the current through the galvanometer at the balance point? What does it mean if the galvanometer deflects in only one direction when touching both ends of the wire?

Ans: The current flowing through the galvanometer is exactly zero ($I_g = 0$). It means there is either a wrong connection in the circuit or the selected known resistor (R) is too high or too low.

Q22. How do we find the value of x? What are possible sources of error?

Ans: By using the formula, $x = (R * l) / (100 - l)$. We plug in the value of the known

resistance R and the balancing length l measured from the left end. Possible errors are i) non-uniform cross-section of wire. ii) end resistances at the binding screws. iii) heating of wire due to current. iv) parallax error in reading balance point.