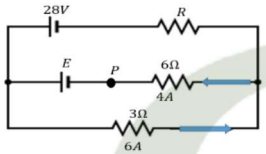
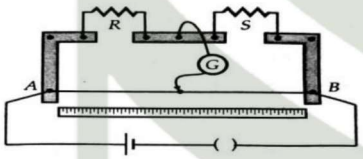
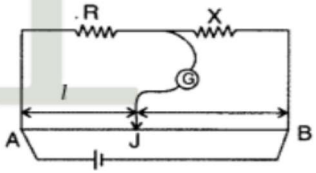
1. Kirchhoff's law in electricity is very useful in solving the complicated circuit connections,



   a) What are the two basic Kirchhoff's laws?
   b) Using Kirchhoff's law in electrical circuits, find,
      i. The current in resistor R
      ii. The unknown emf E
      iii. The resistance R
      iv. If the circuit is broken at P, what is the current in resistor R.
2. Wheatstone bridge is a good engineering of circuit designing. It has several uses and sometimes it shows problems in measuring resistance.
   a) Write the balance condition Wheatstone bridge along with circuit diagram.
   b) Can we measure the internal resistance of a car battery with help of Wheatstone bridge?
   c) Under what condition, Wheatstone bridge work perfectly.
3. Meter Bridge is usually used to determine the resistance of a wire segment and the comparison of two resistors.
   a) On what principle does it work?
   b) In Meter Bridge shown below, the null point is found at a distance of 60.0 cm from A. If now a resistance of 5Ω is connected in series with S, the null point occurs at 50 cm. Determine the values of R and S

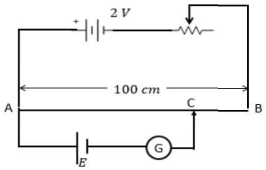


   c) In a meter bridge when the resistance in the left gap is 3Ω and an unknown resistance in the right gap, the balance point is obtained at 40 cm from the zero end. Find the value of unknown resistance. On shunting the unknown resistance with 2Ω, find the shift of the balance point on the bridge wire.
   d) In the meter bridge experiment, the balance point was observed at J with l=20cm.
      i) The values of R and X were doubled and then interchanged. What would be the new position of balance point?

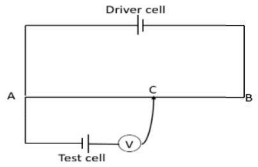


   e) What happens if the meter bridge wire is made with copper wire?
4. Potentiometer is an ideal voltmeter that measures the emf of the cell very accurately,
   a) How is it superior to the voltmeter in the accurate measurement of emf?
   b) What is the working principle of potentiometer?
   c) How can we increase sensitivity of potentiometer?
   d) The driver cell of a potentiometer has an emf of 2 V and negligible internal resistance. The potentiometer wire has a resistance of 3 Ω. Calculate the resistance needed in series with the wire if a p.d. 5 mV is required across the whole wire. The wire is 100 cm long and a balanced length of 60 cm is obtained for a thermocouple of emf E. Find the value of E?
5. a) b) The variation of potential difference V with length L in case of two potentiometers X and Y is as shown in diagram. Which one of these two will you prefer for comparing the emf of two cell? Justify your logic.

   b) If the length of the wire be doubled, what will be the effect on the position of zero deflection in a potentiometer?
   c) The potentiometer wire has resistance of 10Ω. If the resistance R is maintained to be 40Ω, the source of unknown resistance E is balanced by 40 cm length of the potentiometer wire. What is the value of E?



6. A student sets up a circuit as shown in figure below to measure the emf of a test cell. [NEB 2079 (Model)]
   a. Explain why he is unable to find a balance point and state the change he must make in order to achieve the balance.
   b. He obtained the balance point for a distance of 37.5 cm using a standard cell of emf 1.50 V. And for the test cell, the balance distance AB was 25 cm. Calculate the emf of the test cell.
   c. He could have used an ordinary voltmeter to measure the emf of the test cell directly. The student however, argues that the above instrument is more precise than an ordinary voltmeter. Justify his logic.



7. A shunt is used to convert a galvanometer of resistance G into an ammeter.
   a) A shunt must have very low resistance. Why?
   b) A galvanometer of resistance 5 Ω can bear a maximum current of 25 mA. Find the suitable resistance to convert it into,
      i. An ammeter of range (0-10A)
      ii. Voltmeter of range (0-2V)
   c) The resistance of a galvanometer coil is 9.36 ohm, and the current required for full-scale deflection is 0.0224A. We want to convert this galvanometer to an ammeter reading 20 A full scale. The only shunt available has a resistance of 0.025 ohm. What resistance must be connected in series with the coil?
8. a) What difference are there between super conductor and conductor? Discuss with necessary plots.
   c) What is joules law of heating?

Thermoelectric effect

What is thermoelectric effect (Seebeck effect)*: The phenomenon of production of electricity by keeping junctions (contact points) of two different metals at different temperatures is known as Seebeck Effect or thermoelectric effect.*

On what factor does production of thermo-emf depends*: Nature of metals used as pair in thermocouple and Temperature difference of two junctions of the thermocouple*

Cause of Seebeck effect*: Diffusion of electron from one metal to another.*

Note:

- ***Sb-Bi thermocouple is more preferred as compared to other thermocouples****, Because Sb-Bi thermocouple produces maximum thermo-emf for a given difference in temperature of the two junctions.*
- ***The thermoelectric effect obeys the law of conservation of energy****, In Seebeck Effect, Heat energy absorbed by the hot junction is converted into electric energy.*
- *Neutral Temperature: The temperature of hot junction at which the Thermo-Emf becomes maximum is known as Neutral Temperature (θn). Its value depends on: Nature of metal used in thermocouple but does not depend on the temperature of cold junction.*