PHYSICS WORKSHEET

CLASS : XII

Chapter 2

Topic**: Electrostatic potential and Capacitance**

LEVEL 1

1. Define electric potential.
   Derive the expression for the electric potential at any point due to a point charge.
2. Plot a graph comparing the variation of potential V and electric field E due to point charge Q as a function of distance R from the point charge.
3. Deduce an expression for the electric potential due to an electric dipole at any point on its axis. Mention one contrasting feature of electric potential of a dipole at a point as compared to that due to a single charge.
4. Deduce an expression for the electric potential due to an electric dipole at an equatorial plane?
5. Write properties of equipotential surface.
   Can two equipotential surfaces intersect? Give reasons.
6. Draw equipotential surfaces
   (i) Due to a point charge Q>0
   (ii) For uniform field
   (iii) For dipole
   (iv) For two equal charges
7. Why is there no work done in moving a charge from one point another on an equipotential surface?

8. Deduce the expression for the potential energy of a system of two point charges q_1 and q_2 brought from infinity to the points $\mathbf{r_1}$ and $\mathbf{r_2}$ respectively in the presence of external electric field **E**.

9. An electric dipole of dipole moment **p** is held in a uniform electric field**E.**
   (i) Prove that no translatory force acts on the dipole.
   (ii) Hence prove that the torque acting on the dipole is given by pEsinΘ.
   (iii) How much work is required in turning the electric dipole, from the position of most stable equilibrium to the position of most unstable equilibrium.

OR

Derive an expression for the potential energy of an electric dipole.

10. In which orientation, a dipole placed in a uniform electric field is in (i) stable, (ii) unstable equibilirium?
11. In a particular situation, an electric dipole has its dipole moment aligned with the electric field. Is the equilibrium stable or unstable?
12. Explain the underlying principle of working of a parallel plate capacitor.
    If two similar plates, each of area A having surface charge densities +σ and – σ are separated by a distance d in air, write expressions for
    (i) The electric field between the plates.
    (ii) The potential difference between the plates
    (iii) The capacitance of the capacitor so formed?
13. (i) What is dielectric?
    (ii)Why does the capacitance of a parallel plate capacitor increase on introduction of a dielectric in between its two plates?
    (iii)Derive an expression for the capacitance of such a capacitor having two identical plates each of area A and separated by distance x . The space between the plates has a medium of dielectric constant k.

14.(i) Derive an expression for the energy stored in a parallel plate capacitor.

(ii) Show that this energy can be expressed in terms of electric field as ½ $\varepsilon_o E^2 Ad$, where A is area of each plate and d is the separation between the plates.

(iv) Hence derive the expression for energy density.

LEVEL 2

15.Air between parallel plates of capacitor is replaced by a dielectric medium of dielectric constant k. How does it change the total energy of the capacitor if

(i) The capacitor remains connected to the same battery?

(ii) The capacitor is disconnected from the battery?

16.How will the (i) energy stored and (ii) the electric field inside the capacitor be affected when it is completely filled with a dielectric material of dielectric constant 'K'?

17.A capacitor of capacitance C is charged fully by connecting it to a battery. If separation between the plates is doubled, what happen to:

(a) Charge stored by capacitor?

(b) Potential difference?

(c) Field strength between the plates?

(d) Energy stored by capacitor?

18.Show that area under Q-V graph gives energy stored by a capacitor.

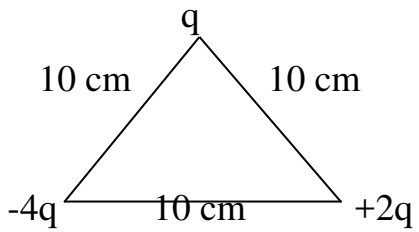
19.Can electric potential at a point be zero, while the electric field is not zero?

20.Two protons are brought nearer. What will be the effect on potential energy of system?

21.How does the energy stored in a capacitor change if after disconnecting the battery, the plates of a charged capacitor is moved farther?

LEVEL 3

22. An electric dipole of length 10 cm having charges 6x 10^{-3}Cm, placed at 30 ^{o} with respect to a uniform electric field, experience a torque of magnitude $6(3)^{1/2}$ Nm. Calculate (i) magnitude of electric field and (ii) potential energy of electric diploe.
23. A small sphere of radius r_1 and charge q_1 is enclosed by a spherical shell of radius r_2 and charge q_2. Show that if q_1 is positive, charge will necessarily flow from the sphere to shell, no matter, what the charge q_2 on the shell is.
24. A cube of side b has a charge q at each of its vertices. Determine the potential and electric field due to this charge- array at the centre of the cube.
25. Calculate the work done to dissociate the system of three charges placed on the vertices of a triangle as shown. Q= 1.6 x 10^{-10} C.



26. A parallel plate capacitor with air between the plates has a capacitance of 8 pF. The separation between the plates is now reduced by half and the space between them is filled with a medium of dielectric constant 5. Calculate the value of capacitance of the capacitor in the second case.
27. Three capacitors each of capacitance 9 pF are connected in series:
    (a) What is the total capacitance of the combination?
    (b) What is the potential difference across each capacitor if combination is connected to 120 V supply?

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PHYSICS WORKSHEET

CLASS : XII

Chapter 10

Topic: Wave Optics 2-Numericals

LEVEL 1

1. Which of the following waves can be polarized (i) Heat waves (ii) Sound waves (iii) radio waves(iv) cathode rays(v)X-rays? Give reason .
2. At what angle of incidence should a light beam strike a glass slab of refractive index $\sqrt{3}$, such that the reflected and refracted rays are perpendicular to each other?
3. If a light beam shows no intensity variation when transmitted through a polaroid which is being rotated; does it mean that the light is unpolarised ? Explain briefly.

LEVEL 2

4. In a single –slit diffraction experiment, the width of the slit is made double the original width. How does this affect the size and intensity of the central diffraction band ?
5. If the angle between the pass axes of a polarizer and analyser is 45^{o} , Write the ratio of the intensities of original light and the transmitted light after passing through the analyser?
6. The refractive index of a material is $\sqrt{3}$. What is the angle of refraction if the unpolarised light is incident on it at the polarizing angle of the medium?

7. Why is the interference pattern not detected, when two coherent sources are far apart?
8. Why is the interference pattern not detected, when two coherent sources are infinitely close to each other?
9. The intensity at the central maxima (O) in a Young's double slit experiment is I_0. If the distance OP equals one-third of the fringe width of the pattern, show that the intensity at point P would be $I_o/4$.

LEVEL 3

10. (i) Light passes through two polaroids P_1 and P_2 with axis of P_2 making an angle θ with the pass axis of P_1. For what value of θ is the intensity of emergent light zero?

    (ii) A third polaroid is placed between P_1 and P_2 with its pass axis making an angle β with the pass axis of P_1 . Find a value of β for which the intensity of light emerging from P_2 is $I_0/8$, where I_0 is the intensity of light on the polaroid P_1.
11. Two polaroids P_1 and P_2 are placed with their pass axes perpendicular to each other. Unpolarised light of intensity I_o is incident on P_1 . A third polaroid P_3 is kept in between P_1 and P_2 such that its pass axis makes an angle of 30^o with that of P_1. Determine the intensity of light transmitted through P_1 ,P_2 and P_3.
12. Find the ratio of intensities at two points on a screen in Young's double slit experiment when waves from the two slits have a path difference of (i) 0 and (ii) $\lambda/4$.
13. Two polaroids are set in crossed positions. A third polaroid is placed between the two making an angle θ with the pass axis of the first polaroid. Write the expression of the intensity of light transmitted from the second

polaroid. In what orientations will the transmitted intensity be (i) minimum (ii) maximum?

14. Two coherent waves of equal amplitude produce interference pattern in Young's double slit experiment. What is the ratio of intensity at a point where phase difference is $\pi/2$ to intensity at center?

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PHYSICS WORKSHEET

CLASS:XII

Chapter 3: Current Electricity

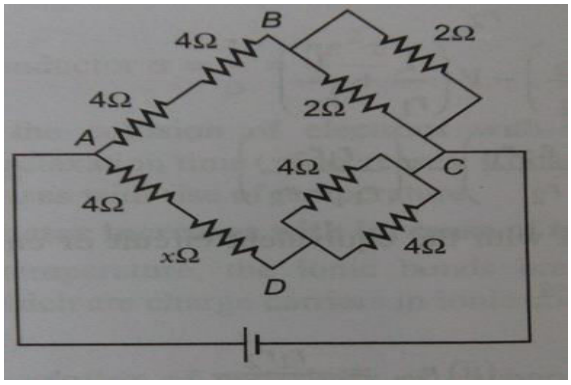
LEVEL 1

1. State ,with help of circuit diagram, the working principle of a meter bridge. Obtain the expression used for determining the unknown resistance.
2. What happens if the galvanometer and cell are interchanged at the balance point of the bridge?
3. Why is it considered important to obtain the balance point near the mid-point of the wire in case of meter bridge?
4. State the working principle of a potentiometer. Draw a circuit diagram to compare emf of two primary cells. Derive the formula used.
5. Which material is used for potentiometer wire and why?
   Ans. Alloys like nichrome or manganin.These alloys have high resistivity and low temperature coefficient of resistance.ie,its resistance does not change due to heating.
6. How can the sensitivity of a potentiometer be increased?
   Ans. Sensitivity can be increased by reducing potential gradient. Two ways: (i) By increasing length of potentiometer wire. (ii) By reducing the current in the circuit.
7. Describe briefly, with circuit diagram, how a potentiometer is used to measure the internal resistance of a given cell.
8. Define relaxation time. How is it related to the drift velocity of free electrons. Use this relation to deduce the expression for the electrical resistivity of the material.
9. Define the terms (i) drift velocity (ii) relaxation time.
10. Prove that the current density of a metallic conductor is directly proportional to the drift speed of electrons.
11. Prove that current density is directly proportional to the relaxation time.
12. State Kirchhoff's rules.
13. Define electrical resistivity of a material. Write its S.I unit.

14. Derive an expression for resistivity of a metal in terms of number density and mass of free electrons present in it.
15. Draw a graph showing the variation of resistivity with temperature for (i) semiconductor- Si,Ge (ii) Metals-copper, aluminium etc (iii) alloys-nichrome, manganin
16. Draw V-I graph for Ohmic and non-Ohmic materials. Give one example for each.
17. Define potential gradient and write its SI unit.
18. Under what condition is the error in determining the unknown resistance minimized in meter bridge?
19. State and explain the principle of Wheat stones principle. Deduce it using Kirchhoff's laws.

LEVEL 2

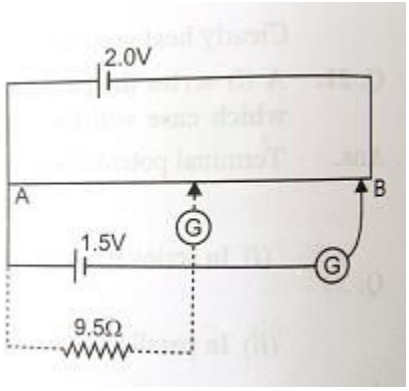
20. A uniform wire of resistance 50Ω is cut into 5 equal parts. These parts are now connected in parallel. What is the value of equivalent resistance of the combination?
21. The metallic conductor is at temperature T_1. The temperature of metallic conductor is increased to T_2. How will the product of its resistivity and conductivity change?
22. The given circuit represents a balanced Wheatstone's bridge. Calculate the value of resistance x.



LEVEL 3

23. Two conducting wires X and Y of same diameter but different materials are joined in series across a battery. If the number density of electrons in X is twice that in Y, find the ratio of drift velocity of electrons in the two wires.
24. Given fig. shows a 2V potentiometer used for the determination of internal resistance of a 1.5 V cell. The balance point of the cell in open

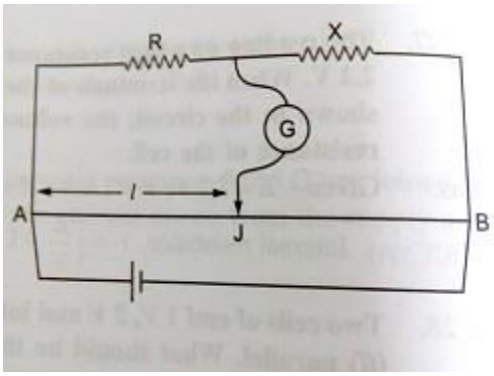
circuit is 76.3 cm. When a resistor of 9.5 Ω is used in external circuit of the cell, the balance point shifts to 64.8 cm. Determine the internal resistance of the cell.



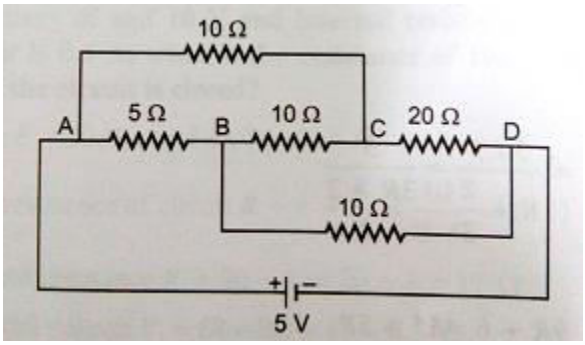
25. In the meter bridge experiment, balance point was observed at J with AJ = l

(i) The value of R and X were doubled and then interchanged. What would be the new position of balance point?

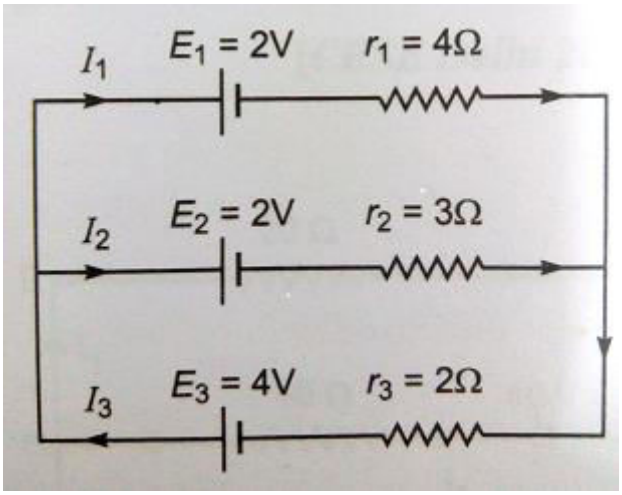
(ii) If the galvanometer and battery are interchanged at the balance position, how will the balance point get affected?



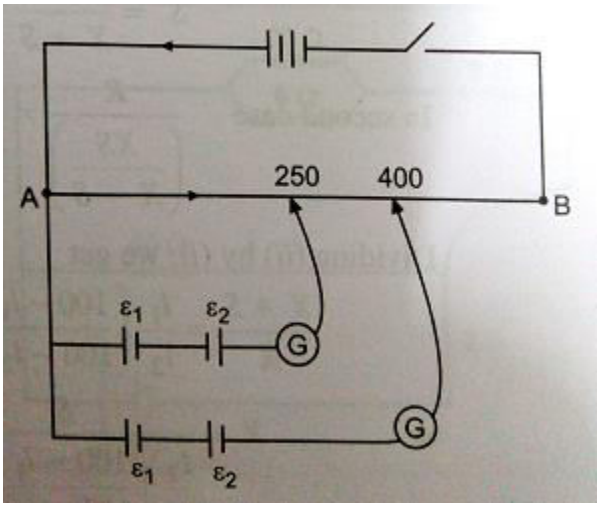
26. Calculate the value of the current drawn from a 5 V battery in the circuit as shown.



27. Use Kirchhoff's rules to write the expressions for the currents I_1, I_2 and I_3 in the circuit diagram shown.



28. Two primary cells of emfs wire ε_1 and ε_2 ($\varepsilon_1 > \varepsilon_2$) are connected to a potentiometer wire AB as shown in fig. If the balancing lengths for the two combinations of the cells are 250 cm and 400 cm, find the ratio of ε_1 and ε_2.



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