



Class  
**12**  
CBSE

**Chapterwise**  
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**PHYSICS**

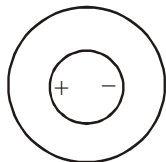


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**Q.1** Derive an expression for electric field intensity at any point on equatorial line of dipole. [CBSE 1999, 2013]



**Q.2** Give the SI unit of electric moment of a dipole.

[CBSE 1999, 2006]

**Q.3** Is electric field intensity a vector or a scalar quantity?

[CBSE 2000(C)]

**Q.4** Using Gauss's theorem derive an expression for electric field intensity at a point due to an infinite plane sheet of charge. How is the field directed if (i) the sheet is positively charged (ii) negatively charged.

[CBSE 2002, 2004, 2007, 2012]

**Q.5** Does a dipole experience a force when placed in the non-uniform electric field?

[CBSE 2002]

**Q.6** What is the direction of electric dipole moment?

[CBSE 2002]

**Q.7** Given two point charges  $q_1$  and  $q_2$  such that  $q_1 q_2 < 0$ . What is the nature of the force between them?

[CBSE 2003]

**Q.8** Name the dielectric whose molecules have

i) non-zero and

ii) Zero dipole moment.

[CBSE(AI) 2004C]

**Q.9** The distance of the field point on the axis of a small dipole is double. By what factor will the electric field, due to the dipole change.

[CBSE 2004C]

**Q.10** What is electric flux? Write its SI unit. Using Gauss theorem deduce an expression for field due to charged infinite sheet.

[CBSE 2006]

**Q.11** What is meant by electric flux?

[CBSE 2008]

**Q.12** What is S.I. unit of electric flux?

[CBSE 2008]

**Q.13** Draw an equipotential surface for a uniform electric field.

[CBSE 2008]

**Q.14** Force between two point electric charges kept at a distance  $d$  apart in air is  $F$ . If these charges are kept at the same distance in water; how does the force between them change?

[CBSE 2008]

**Q.15** Draw the electric field lines due to a uniformly charged thin spherical shell when charge on the shell is

(i) positive and (ii) negative. [CBSE Delhi 2008]

**Q.16** Find expressions for the force and torque on an electric dipole kept in a uniform electric field. [CBSE 2008]

**Q.17** A uniform electric field  $\vec{E} = E_x \hat{i}$  N/C for  $x > 0$  and

$\vec{E} = -E_x \hat{i}$  N/C for  $x < 0$  are given. A right circular cylinder of length  $l$  cm and radius  $r$  cm has its centre at the origin and its axis along the X-axis. Find out the net outward flux. Using Gauss's law, write the expression for the net charge within the cylinder.

[CBSE Delhi 2008 (C)]

**Q.18** A uniform electric field  $\vec{E} = E\pi \hat{i}$  N/C for  $x > 0$  are given.

A right circular cylinder of length  $l$  cm. and radius  $l$  cm has its centre at the origin and its axis along x-axis. Find out the net outward flux. Using Gauss's law, write the expression for net charge within the cylinder.

[CBSE 2008]

**Q.19** A spherical rubber balloon carries a charge that is uniformly distributed over its surface. As the balloon is blown up and increases in size, how does the total electric flux coming out of the surface change? Give reason.

[CBSE 2008C]

**Q.20** A uniformly charged conducting sphere of diameter 2.5m has a surface charge density  $100 \mu\text{C}/\text{m}^2$ . Calculate

i) charge on the sphere and

ii) total electric flux passing through the sphere.

[CBSE Delhi 2008]

**Q.21 a)** Find an expression for electric field intensity at a point due to long straight uniformly charged wire.

**b)** Draw a graph to show that the variation of  $E$  with perpendicular distance  $r$  from the line of charge.

**c)** Find the work done in bringing a charge  $q$  from  $\perp r$  distance  $r_1$  to  $r_2$  ( $r_2 > r_1$ ) [CBSE 2008, 2009, 2018]

**Q.22** State Gauss's theorem in electrostatics. How will you prove it for spherically symmetric surface?

[CBSE 2008, 2009, 2015]

**Q.23** Derive an expression for field intensity at any point on axial line of dipole.

[CBSE 2009, 2013]

**Q.24** Use Gauss's law to derive the expression for the electric field between two uniformly charged large parallel sheets with surface charge densities  $\sigma$  and  $-\sigma$  respectively.

[CBSE 2009]

**Q.25** What orientation of an electric dipole in a uniform electric field corresponding to its

[CBSE 2010]

i) stable and

ii) unstable equilibrium.

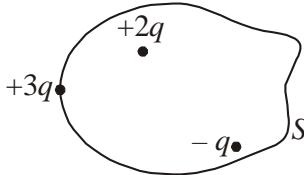
**Q.26** A metallic spherical shell has an inner radius  $R_1$  and outer radius  $R_2$ . A charge  $Q$  is placed at the centre of

the spherical cavity. What will be surface charge density on *i*) the inner surface and *ii*) the outer surface?

[CBSE 2010]

- Q.27** Figure shows three point charge  $+2q$ ,  $-q$  and  $+3q$ . The charges  $+2q$  and  $-q$  are enclosed within a surface 'S'. What is the electric flux due to this configuration through the surface 'S'?

[CBSE Delhi 2010]



- Q.28** A charge  $Q \mu\text{C}$  is placed at the centre of a cube. What would be the flux through one face?

[CBSE (F) 2010, (AI) 2012]

- Q.29** Two small identical electrical dipoles  $AB$  and  $CD$ , each of dipole moment ' $p$ ' are kept at an angle of  $120^\circ$ . What is the resultant dipole moment of this combination?

If this system is subjected to electric field ( $\vec{E}$ ) directed along  $+X$  direction, what will be the magnitude and direction of the torque acting on this?

[CBSE Delhi 2011]

- Q.30** Plot a graph showing the variation of Coulomb's force

( $F$ ) versus  $\left(\frac{1}{r^2}\right)$ , where  $r$  is the distance between the two charges:  $(1\mu\text{C}, 2\mu\text{C})$  and  $(2\mu\text{C}, -3\mu\text{C})$ . Interpret the graphs obtained.

[CBSE 2011]

- Q.31** Two insulated charged copper spheres  $A$  and  $B$  of identical size have charges  $q_A$  and  $-3q_A$  respectively. When they are brought in contact with each other and then separated, what are the new charges on them?

[CBSE 2011]

- Q.32** Two insulated charged copper spheres  $A$  and  $B$  of identical size have charges  $q_A$  and  $q_B$  respectively. A

third sphere  $C$  of the same size but uncharged is brought in contact with the first and then contact with the second and finally removed from both. What are the new charges on  $A$  and  $B$ .

[CBSE (F) 2011]

- Q.33** Force of attraction between two point charges placed at a distance  $d$  is  $F$ . What distance apart should they be kept in the same medium so that the force between them is  $F/3$ ?

[CBSE 2011]

- Q.34** Define the term electric dipole moment.

[CBSE 2011, 2012, 2013]

- Q.35** A charge  $q$  is placed at the centre of a cube of side  $l$ . What is the electric flux passing through two opposite faces of the cube?

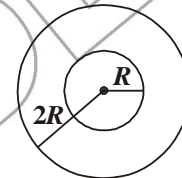
[CBSE 2012]

- Q.36** Is dipole moment a vector or a scalar quantity?

[CBSE 2013]

- Q.37** Two concentric metallic spherical shells of radii  $R$  and  $2R$  are given charges  $Q_1$  and  $Q_2$  respectively. The surface charge densities on the outer surfaces of the shells are equal. Determine the ratio  $Q_1 : Q_2$ .

[CBSE (F) 2013]



- Q.38** Two charges of magnitudes  $-2Q$  and  $+Q$  are located at points  $(a, 0)$  and  $(4a, 0)$  respectively. What is the electric flux due to these charges through a sphere of radius  $3a$  with its centre at the origin?

[CBSE 2013]

- Q.39** A hollow cylindrical box of length  $1 \text{ m}$  and area of cross-section  $25 \text{ cm}^2$  is placed in a three dimensional coordinate system as shown in the figure. The electric field in the region is given by  $\vec{E} = 50x\hat{i}$ , where  $E$  is in  $\text{NC}^{-1}$  and  $x$  is in metres.

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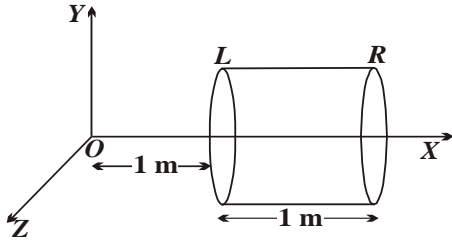
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Find

- i) net flux through the cylinder.
- ii) charge enclosed by the cylinder.

[CBSE Delhi 2013]

**Q.40** Write an expression for electric field intensity at a point due to uniformly charged spherical shell, when the point lies outside the shell. [CBSE 2013]

**Q.41 a)** An infinitely long positively charged straight wire has a linear charge density  $\lambda \text{ cm}^{-1}$ . An electron is revolving around the wire as its centre with a constant velocity in a circular plane perpendicular to the wire. Deduce the expression for its kinetic energy. [CBSE (F) 2013]

**b)** Plot a graph of the kinetic energy as a function of charge density  $\lambda$ . [CBSE (F) 2013]

**Q.42** Using Gauss's theorem derive an expression for electric field intensity at a point due to uniformly charged spherical shell. [CBSE 2013]

**Or**

Use Gauss's Law to derive the expression for the electric field due to a uniformly charged thin spherical shell of radius  $R$  at a point  $r$  :

- i) inside the shell and
- ii) outside the shell.

**Or**

According to Gauss's Law, "electric flux due to a charge enclosed by a closed surface is independent of the shape or size of the surface (enclosing the charge)". Justify this statement by giving suitable examples.

[CBSE 2016]

**Q.43** A positive point charge ( $+q$ ) is kept in the vicinity of an uncharged conducting plate. Sketch electric field lines originating from the point on to the surface of the plate. [CBSE 2014]

**Q.44** Why don't the electrostatic field lines form closed loops? [CBSE (AI) 2014, Allahabad]

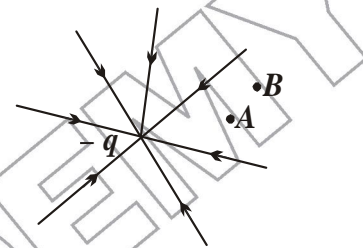
**Q.45** Given a uniform electric field  $\vec{E} = 5 \times 10^3 \hat{i} \text{ N/C}$ , find the flux of this field through area of  $10 \text{ cm}$  on a side

whose plane is parallel to the  $Y-Z$  plane. What would be the flux through the same square if the plane makes a  $30^\circ$  angle with the  $X$ -axis? [CBSE Delhi 2014]

**Q.46** Two infinitely large plane thin parallel sheets having surface charge densities  $\sigma_1$  and  $\sigma_2$  ( $\sigma_1 > \sigma_2$ ) are shown in the figure. Write the magnitudes and directions of the net fields in the regions marked  $II$  and  $III$ . [CBSE (F) 2014]

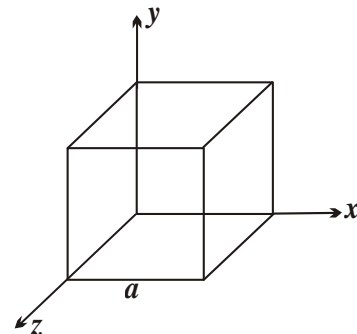
**Q.47** Sketch the electric field lines for two point charges  $q_1$  and  $q_2$  for  $q_1 = q_2$  and  $q_1 > q_2$  separated by a distance  $d$ . [CBSE Chennai 2015]

**Q.48** The field lines of a negative point charge are as shown in the figure. Does the kinetic energy of a small negative charge increase or decrease in going from  $B$  to  $A$ ?



[CBSE Panta 2015]

**Q.49** Given the electric field in the region  $\vec{E} = 2x\hat{i}$ , find the net electric flux through cube and the charge enclosed by it [CBSE Delhi 2015]

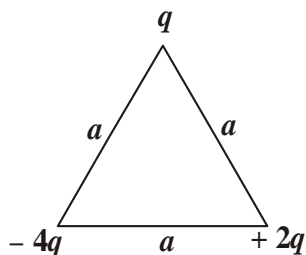


**Q.50** What is the electric flux through a cube of side  $1 \text{ cm}$  which encloses an electric dipole? [CBSE Delhi 2015]

**Q.51** What is the amount of work done in moving a point charge  $Q$  around a circular arc of radius ' $r$ ' at the centre of which another point charge ' $q$ ' is located? [CBSE 2016]

**Q.52** Two metallic spheres of radii  $R$  and  $2R$  are charged so that both of these have same surface charge density  $\sigma$ . Find the ratio  $Q_1 : Q_2$ . [CBSE 2016]

**Q.53** Obtain an expression for the work done to dissociate the system of three charges placed at the vertices of an equilateral triangle of side ' $a$ ' as shown below. [CBSE 2016]



**Q.54** What is the amount of work done in moving a point charge  $Q$  around a circular arc of radius ' $r$ ' at the centre of which another point charge ' $q$ ' is located ?

[CBSE 2016]

**Q.55** A charge is distributed uniformly over a ring of radius ' $a$ '. Obtain an expression for the electric field intensity  $E$  at a point on the axis of the ring. Hence show that for points at large distances from the ring, it behaves like a point charge.

[CBSE 2016]

**Q.56** How does the electric flux due to a point charge enclosed by a spherical Gaussian surface get affected when its radius is increased?

[CBSE 2016]

**Q.57** Define electric flux. Write its SI unit.

[CBSE 2016]

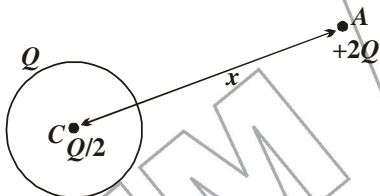
**Q.58** A thin metallic spherical shell of radius  $R$  carries a charge  $Q$  on its surface. A point charge  $Q/2$  is placed at the centre  $C$  and another charge  $+2Q$  is placed outside the shell at  $A$  at a distance  $x$  from the centre as shown in the figure.

*i)* Find the electric flux through the shell.

*ii)* State the law used.

*iii)* Find the force on the charges at the centre  $C$  of the shell and at the point  $A$ .

[CBSE 2016]



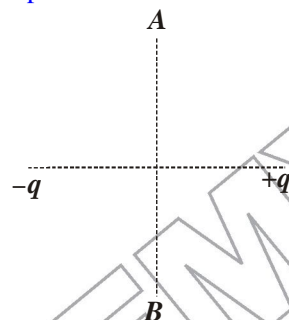
**Q.59** Derive an expression for the electric field intensity at a point on the equatorial line of an electric dipole of dipole moment  $\vec{p}$  and length  $2a$ . What is the direction of this field ?

[CBSE 2016]

**Q.60** Derive an expression for the work done in rotating a dipole from the angle  $\theta_0$  to  $\theta_1$  in a uniform electric field  $E$ .

[CBSE 2016]

**Q.61** A charge ' $q$ ' is moved from a point  $A$  above a dipole of dipole moment ' $p$ ' to a point  $B$  below the dipole in equatorial plane without acceleration. Find the work done in the process.



[CBSE 2016]

**Q.62** Define torque acting on a dipole of dipole moment  $\vec{p}$  placed in a uniform electric field  $\vec{E}$ . Express it in the vector form and point out the direction along which it acts.

*a)* What happens if the field is non-uniform?

*b)* What would happen if the external field  $\vec{E}$  is increasing

*(i)* parallel to  $\vec{p}$  and

*(ii)* anti-parallel to  $\vec{p}$  ?

[CBSE 2016]

**Q.63** Derive an expression for the work done in rotating a dipole from the angle  $\theta_0$  to  $\theta_1$  in a uniform electric field  $E$ .

[CBSE 2016]

**Q.64** Plot the graph of electric field with distance from the centre of the uniformly charged spherical shell at a point *(i)* outside the shell and *(ii)* inside the shell.

[CBSE 2016]

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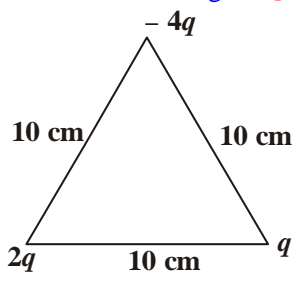


- Q.65** Four point charges  $Q, q, Q$  and  $q$  are placed at the corners of a square of side ' $a$ ' as shown. Find the  
 a) resultant electric force on charge  $Q$ .  
 b) potential energy of the system. [CBSE 2018]
- Q.66** Three point charges  $q, -4q$  and  $2q$  are placed at the vertices of an equilateral triangle  $ABC$  of side ' $l$ ' as shown. (a) obtain the expression for the magnitude of resultant electric force acting on charge ' $q$ ' (b) Find out the amount of work done to separate the charges at infinite distance. [CBSE 2018]
- Q.67** a) Define electric flux. Is it a scalar or a vector quantity. A point charge  $q$  is at a distance  $d/2$  directly above the centre of a square of side ' $d$ ' use Gauss' law to obtain the expression for electric flux through the square.

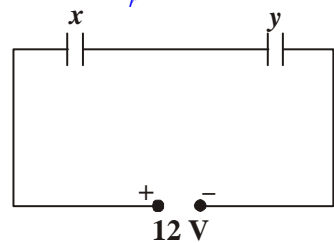
- b) If the point charge is now moved to a distance ' $d$ ' from the centre of the square and the side of the square is doubled, explain how the electric flux will be affected? [CBSE 2018]
- Q.68** Find expressions for the force and torque on an electric dipole kept in a uniform electric field. [CBSE 2019, 2020]
- Or  
 An electric dipole is held in a uniform electric field.  
 i) Using suitable diagram show that it does not undergo any translatory motion, and  
 ii) derive an expression for torque acting on it and specify its direction.

<b>2</b>	<b>Electrostatic Potential and Capacitance</b>
<b>CHAPTER</b>	

- Q.1** Electric field is not zero at a point. Can electric potential be zero at this point? [CBSE 2003]
- Q.2** What is an equipotential surface? [CBSE (Foreign) 2008]
- Q.3** Derive an expression for electric potential at a point due to electric dipole. Also find its value on (i) axial line (ii) equatorial line.  
 Or  
 Derive the expression for the electric potential at a point due to an electric dipole. Mention the contrasting features of electric potential of a dipole at a point as compared to that due to a single charge. [CBSE 2007, 2008]
- Q.4** Draw an equipotential surface for a system consisting of two charges  $Q, -Q$  separated by a distance  $r$  in air. Locate the points where the potential due to the dipole is zero. [CBSE 2008, (AI) 2013]
- Q.5** i) Two point charges  $4Q$  and  $Q$  are separated by a distance  $1$  m in air. At what point on the line joining the charges is the electric field intensity zero?  
 ii) Also calculate the electrostatic potential energy of the charge if  $Q = 2 \times 10^{-7} \text{C}$ . [CBSE (AI) 2008C]
- Q.6** Calculate the work done to dissociate the system of three charges placed on the vertices of a triangle as shown  $q = 1.6 \times 10^{-10} \text{C}$  in diagram: [CBSE Delhi 2008]



- Q.7** Two charges  $5 \text{ nC}$  and  $-2 \text{ nC}$  placed at points  $(5 \text{ cm}, 0, 0)$  and  $(23 \text{ cm}, 0, 0)$  in a region of space where there is no other external field. Calculate the electrostatic potential energy of this charge system. [CBSE Delhi 2008C]
- Q.8** The two plates of a parallel plate capacitor are  $4 \text{ mm}$  apart. A slab of dielectric constant  $3$  and thickness  $3 \text{ mm}$  is introduced between the plates with its faces parallel to them. The distance between the plates is so adjusted that the capacitance of the capacitor becomes  $\frac{2}{3}$ rd of its original value. What is the new distance between the plates? [CBSE (AI) 2008]
- Q.9** What is the work done in moving a test charge  $q$  through a distance of  $1 \text{ cm}$  along the equatorial axis of an electric dipole? [CBSE 2009]
- Q.10**  $X$  and  $Y$  are two parallel plate capacitors having the same areas of plates and same separation between the plates.  $X$  has air between the plates and  $Y$  contains a dielectric medium  $\epsilon_r = 4$ .



- i) Calculate the potential difference between the plates of  $X$  and  $Y$ .  
 ii) What is the ratio of electrostatic energy stored in  $X$  and  $Y$ ? [CBSE Delhi 2009]

**Q.11** Depict the equipotential surface for a system of two identical positive point charges placed at distance 'd' apart. [CBSE 2010,2013]

**Q.12** Find an expression for the capacitance of a parallel plate capacitor when a dielectric slab of dielectric constant  $K$  and thickness  $t = d/2$  but of same area as the plates is inserted between the capacitor plate. [CBSE 2010,2013]

**Q.13** A parallel plate is charged by a battery. When the battery remains connected, a dielectric slab is inserted in the space between the plates. Explain what changes if any, occur in the values of

- i) potential difference between the plates
- ii) electric field strength between the plates
- iii) capacitance
- iv) charge on the plates
- v) energy stored in the capacitor? [CBSE Delhi 2010]

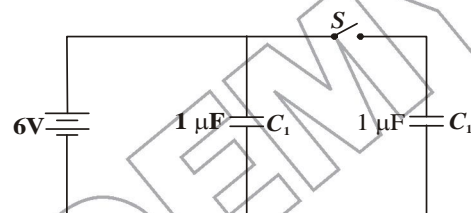
**Q.14** A hollow metal sphere of radius 10 cm is charged such that the potential on its surface is 5 V. What is the potential at the centre of the sphere? [CBSE 2011]

**Q.15** A point charge  $Q$  is placed at point  $O$  as shown in the figure. Is the potential difference  $V_A - V_B$  positive, negative, or zero, if  $Q$  is (i) positive (ii) negative? [CBSE Delhi 2011]



**Q.16** Two uniformly large parallel thin plates having charge densities  $+\sigma$  and  $-\sigma$  are kept in the  $X-Z$  plane at a distance 'd' apart. Sketch an equipotential surface due to electric field between the plates. If a particle of mass  $m$  and charge  $-q$  remains stationary between the plates, what is the magnitude and direction of this field? [CBSE Delhi 2011]

**Q.17** Figure shows two identical capacitors,  $C_1$  and  $C_2$  each  $1 \mu\text{F}$  capacitance connected to a battery of 6 V. Initially switch 'S' is closed. After sometimes 'S' is left open and dielectric slabs of dielectric constant  $K = 3$  are inserted to fill completely the space between the plates of the two capacitors. How will the (i) charge and (ii) potential difference between the plates of the capacitors be affected after the slabs are inserted? [CBSE Delhi 2011]



**Q.18** You are given an air filled parallel plate capacitor  $C_1$ . The space between its plates is now filled with slabs of dielectric constants  $K_1$  and  $K_2$  as shown in  $C_2$ . Find the capacitances of the capacitor  $C_2$  if area of the plates is  $A$  distance between the plates is  $d$ . [CBSE (F) 2011]

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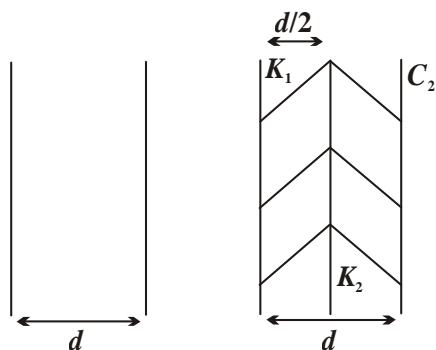
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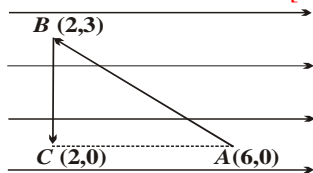
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**Q.19** Net capacitance of three identical capacitors in series is  $3 \mu\text{F}$ . What will be their net capacitance if connected in parallel? Find the ratio of energy stored in the two configurations if both are connected to the same source. [CBSE 2011]

**Q.20** A test charge ' $q$ ' is moved without acceleration from  $A$  to  $C$  along the path from  $A$  to  $B$  and then from  $B$  to  $C$  in electric field  $E$  as shown in figure (i) calculate the potential difference between  $A$  and  $C$ . ii) At which point (of the two) is the electric potential is more and why? [CBSE 2012]



**Q.21** Why is electrostatic potential constant throughout the volume of conductor and has the same value (as inside) on its surface? [CBSE 2012]

**Q.22** How much work is done in moving a  $500 \mu\text{C}$  charge between two point on equipotential surface? [CBSE 2012]

**Q.23** A  $4 \mu\text{F}$  capacitor is charged by a  $200 \text{ V}$  supply. It is then disconnected from the supply and is connected to another unchanged  $2 \mu\text{F}$  capacitor. How much electrostatic energy of the first capacitor is lost in the form of heat and electromagnetic radiation? [CBSE (F) 2012]

**Q.24** A capacitor of  $150 \text{ pF}$  is charged by a  $220 \text{ V}$  battery. The battery is then disconnected and the charged capacitor is connected to another uncharged capacitor of  $50 \text{ pF}$ . Calculate the difference between the final energy stored in the combined system and the initial energy stored in the single capacitor. [CBSE (F) 2012]

**Q.25** Plot a graph comparing the variation of potential ' $V$ ' and electric field ' $E$ ' due to a point charge ' $Q$ ' as a function of distance ' $R$ ' from the point charge. [CBSE Delhi 2012]

**Q.26** Calculate the amount of work done in rotating a dipole, of dipole moment  $3 \times 10^{-8} \text{ Cm}$ , from position of stable equilibrium to the position of unstable equilibrium, in a uniform electric field of intensity  $10^4 \text{ N/C}$ . [CBSE (F)2012]

**Q.27** What is a parallel plate capacitor? Derive an expression for the capacitance of a parallel plate capacitor. [CBSE 2012, 2013]

**Q.28** Electric field is always normal to the equipotential surface. Explain why? [CBSE 2012, 2014]

**Q.29** What is the nature of equipotential surfaces around a point charge? [CBSE 2013]

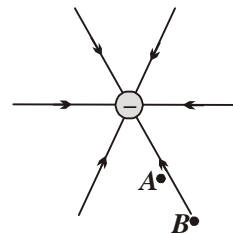
**Q.30** While travelling back to his residence in the car, Dr. Pathak was caught up in a thunderstorm. He stopped driving the car and waited for thunderstorm to stop. Suddenly noticed a child walking alone on the road. He asked the boy to come inside the car till the thunderstorm stopped. Dr. Pathak dropped the boy at his residence. The boy insisted that Pathak should meet his parents. The parents expressed their gratitude to Dr. Pathak for his concern for safety of the child.

- Why is it safer to sit inside a car during a thunderstorm?
- Which two values are displayed by Dr. Pathak in his actions?
- Which values are reflected in parents' response to Dr. Pathak?
- Give an example of a similar action on your part in the past from everyday life. [CBSE Delhi 2013]

**Q.31** A capacitor of unknown capacitance is connected across a battery of  $V$  volts. The charge stored in it is  $360 \mu\text{C}$ . When potential across the capacitor is reduced by  $120 \text{ V}$ , the charge stored in it becomes  $120 \mu\text{C}$ . Calculate:  
 i) The potential  $V$  and the unknown capacitance  $C$ .  
 ii) What will be the charge stored in the capacitor, if the voltage applied has increased by  $120 \text{ V}$ ? [CBSE Delhi 2013]

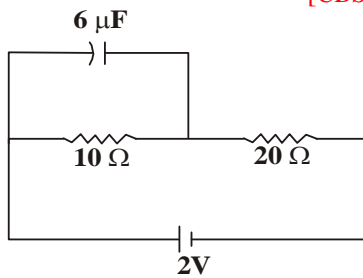
**Q.32** A slab of material of dielectric constant  $K$  has the same area as that of the plates of a parallel plate capacitor but has the thickness  $d/3$ , where  $d$  is the separation between the plates. Find out the expression for its capacitance when the slab is inserted between the plates of the capacitor. [CBSE (A) 2013]

**Q.33** Figure shows the field lines due to a negative point charge. Give the sign of the potential energy difference of a small negative charge between the points  $A$  and  $B$ . [CBSE (F) 2014]



**Q.34** A parallel plate capacitor of capacitance  $C$  is charged to a potential  $V$ . It is then connected to another uncharged capacitor having the same capacitance. Find out the ratio of the energy stored in the combined system to that stored initially in the single capacitor. [CBSE (AI) 2014]

- Q.35** Find the charge on the capacitor as shown in the circuit. [CBSE (F) 2014]



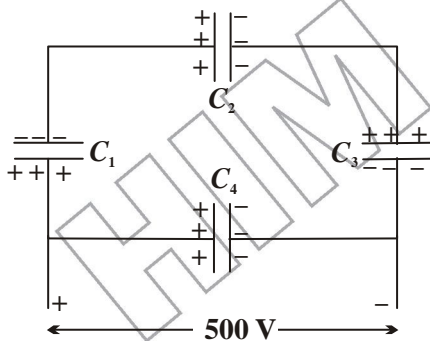
- Q.36** In a parallel plate capacitor with air between the plates, each plate has an area of  $6 \times 10^{-3} \text{ m}^2$  and the separation between the plates is 3 mm.

- Calculate the capacitance of the capacitor.
- If this capacitor is connected to 100 V supply, what would be the charge on each plate?
- How would charge on the plates be affected, if a 3 mm thick mica sheet of  $K = 6$  is introduced between the plates while the voltage supply remains connected? [CBSE (F) 2014]

- Q.37** Four charges  $+q, +q, -q$  and  $-q$  are to be arranged respectively at the four corners of a square  $ABCD$  of side 'a'.

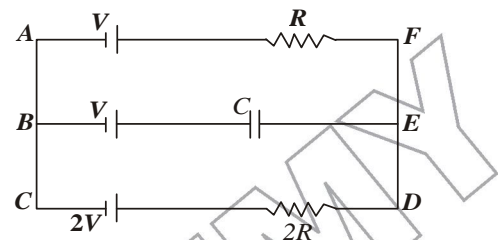
- Find the work required to put together this arrangement.
- A charge  $q_0$  is brought to the centre of the square, the four charges being held fixed. How much extra work is needed to do this? [CBSE (F) 2015]

- Q.38** A network of four  $10 \mu\text{F}$  capacitors is connected to a 500 V supply as shown in the figure. Determine the
- equivalent capacitance of the network and
  - charge on each capacitor. [CBSE Guwahati 2015]

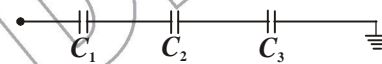


- Q.39** Two capacitors of unknown capacitances  $C_1$  and  $C_2$  are connected first in series and then in parallel across a battery of 100 V. If the energy stored in the two combinations is 0.045 J and 0.25 J respectively, determine the value of  $C_1$  and  $C_2$ . Also calculate the charge on the each capacitor in parallel combination. [CBSE Delhi 2015]

- Q.40** In the given circuit in the steady state, obtain the expression for (a) the potential drop (b) the charge and (c) the energy stored in the capacitor, C. [CBSE (F) 2015]



- Q.41** Calculate the potential difference and the energy stored in the capacitor  $C_2$  in the circuit shown in the figure. Given potential at A is 90 V,  $C_1 = 20 \mu\text{F}$ ,  $C_2 = 30 \mu\text{F}$ ,  $C_3 = 15 \mu\text{F}$ . [CBSE Allahabad 2015]



- Q.42** A 600 pF capacitor is charged by a 200 V supply. It is then disconnected from the supply and is connected to another uncharged 600 pF capacitor. Calculate how much electrostatic energy is lost in the process. What is the source of energy loss? [CBSE Chennai 2015]

- Q.43** A  $200 \mu\text{F}$  parallel plate capacitor having plate separation of 5 mm is charged by a 100 Vdc source. It remains connected to the source. Using an insulated handle, the distance between the plates is doubled and a dielectric slab of thickness 5 mm and dielectric constant 10 is introduced between the plates. Explain with reason, how the (i) capacitance, (ii) electric field between the plates (iii) energy density of the capacitor will change? [CBSE 2019]

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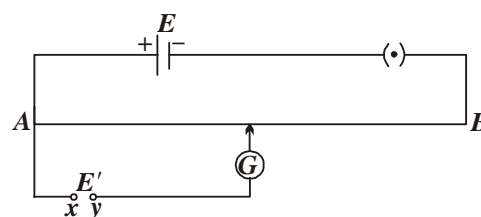
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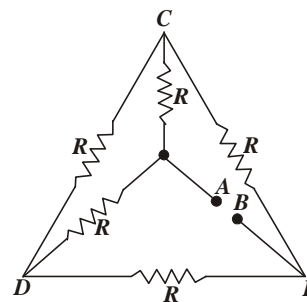
- Q.1** Define current density. [CBSE 2001]
- Q.2** A cell of e.m.f. 2V and internal resistance  $0.1 \Omega$  is connected to a  $3.9\Omega$  external resistance. What will be the potential difference across the terminals of the cell? [CBSE 2001]
- Q.3** Derive an expression for drift velocity of the free electrons in a conductor in terms of relaxation time of electron. [CBSE 2002, 2009]
- Q.4** A voltage of 30 V is applied across a carbon resistor with first, second and third rings of blue, black and yellow colors respectively. Calculate the value of current in mA, through the resistor. [CBSE (AI) 2002]
- Q.5** A wire of resistivity  $\rho$  is stretched to double of its length. What will be its new resistivity? [CBSE 2003]
- Q.6** What happens to power dissipation if value of current passing through a conductor of constant resistance is doubled? [CBSE 2003, 2005]
- Q.7** Define conductivity and current density of a conductor. Give its SI unit. [CBSE 2003, 2019]
- Q.8** State Principle of working a potentiometer. [CBSE 2005, 2010]
- Q.9** Draw a graph showing the variation of resistivity with temperature for a typical semiconductor. [CBSE 2005]
- Q.10** What is the S.I. unit of resistivity? [CBSE 2005]
- Q.11** Draw a circuit diagram to compare the e.m.f. of two primary cells. Write the formula used. How can the sensitivity of a potentiometer be increased? [CBSE 2005, 2008, 2013]
- Q.12** Given  $n$  resistors each of resistance  $R$ , how will you combine them to get (i) maximum (ii) minimum effective resistance? What is the ratio of maximum to minimum resistance? [CBSE 2006]
- Q.13** With the help of circuit diagram explain how a meter bridge can be used to find the unknown resistance of a given wire? [CBSE 2006]
- Q.14** For the potentiometer circuit shown in the given figure, points  $X$  and  $Y$  represent the two terminals of an unknown e.m.f.  $E'$ . A student observed that when the jockey is moved from the end  $A$  to the end  $B$  of the potentiometer wire, the deflection in the galvanometer remains in the same direction.



What may be the two possible faults in the circuit that could result in this observation?

In the galvanometer, deflection at the end  $B$  is (i) more, (ii) less than at the end  $A$ , which of the two faults, listed above, would be there in the circuit? Give reason in support of your answer in each case.

- [CBSE (AI) 2007]
- Q.15** A cylindrical metallic wire is stretched to increase its length by 10%. Calculate the percentage increase in its resistance. [CBSE Delhi 2007]
- Q.16** Derive condition of balanced Wheatstone bridge. [CBSE, 2007, 2013, 2015]
- Q.17** (i) Calculate the equivalent resistance of the given electrical network between points  $A$  and  $B$ .  
(ii) Also calculate the current through  $CD$  and  $ACB$  if a 10V dc source is connected between points  $A$  and  $B$  and the value of  $R = 2\Omega$ . [CBSE (AI) 2008]



- Q.18** Prove that electric current through a conductor is proportional to the drift velocity of the electron. [CBSE 2008, 2013]
- Q.19** Prove that the current density of a metallic conductor is directly proportional to the drift speed of electrons. [CBSE 2008]
- Q.20** Two wires  $X$ ,  $Y$  have the same resistivity but their cross-sectional areas are in the ratio 2:3 and lengths in the ratio 1:2. They are first connected in series and then in parallel to a dc source. Find out the ratio of the drift speeds of the electrons in the two wires for the two cases. [CBSE (AI) 2008]

**Q.21** Define resistivity of a conductor. Plot a graph showing the variation of resistivity with temperature for a metallic conductor. How does one explain such a behaviour, using the mathematical expression of the resistivity of a material. [CBSE Delhi 2008]

**Q.22** Explain the variation of conductivity with temperature for (i) a metallic conductor and (ii) ionic conductors. [CBSE Delhi 2008]

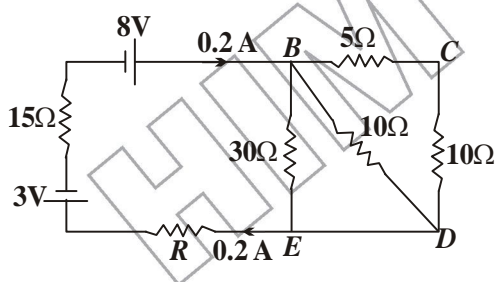
**Q.23** Using the mathematical expression for the conductivity of a material, explain how it varies with temperature for (i) semiconductor (ii) good conductors. [CBSE (AI) 2008]

**Q.24** Define resistivity of a conductor. Plot a graph showing the variation of resistivity with temperature for a metallic conductor. How does one explain such a behaviour, using the mathematical expression of the resistivity of a material. [CBSE 2008]

**Q.25** What is the current flowing in the circuit when  $n$  cells each of *e.m.f.*  $E$  and internal resistance  $r$  are connected in series with an external resistance  $R$ . [CBSE 2008]

**Q.26** A resistance  $R = 4\Omega$  is connected to one of the gaps in a meter bridge, which uses a wire of length 1 m. An unknown resistance  $X > 4\Omega$  is connected in the other gap as shown in the figure. The balance point is noticed at '1' cm from the positive end of the battery. One interchanging  $R$  and  $X$ , it is found that the balance point further shifts by 20 cm (away from the end A). Neglecting the end correction, calculate the value of unknown resistance ' $X$ ' used. [CBSE (AI)2008]

**Q.27** Calculate the value of the resistance  $R$  in the circuit shown in the figure so that the current in the circuit is 0.2 A. What would be the potential difference between points B and E? [CBSE (AI) 2008, 2012]



**Q.28** What is principle of potentiometer? [CBSE 2010]

**Q.29** What is drift velocity? [CBSE 2011, 2013]

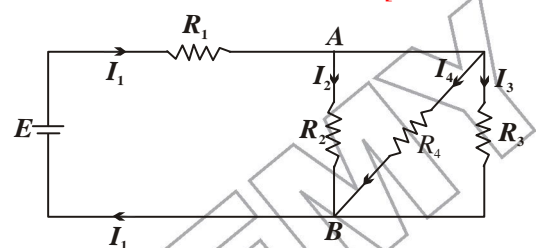
**Q.30** Define relaxation time or mean free time ( $\tau$ ). [CBSE 2011, 2013]

**Q.31** Two conducting wire  $x$  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 two wires. [CBSE 2011]

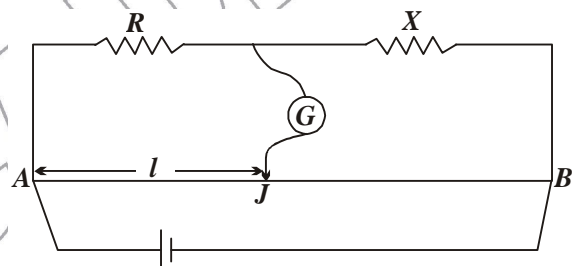
**Q.32** Write the characteristics of manganin which make it suitable for making standard resistance. [CBSE 2011]

**Q.33** Two heating elements of resistance  $R_1$  and  $R_2$  when operated at a constant supply of voltage,  $V$ , consume powers  $P_1$  and  $P_2$  respectively. Deduce the expression for the power of their combination when they are, in turn, connected in (i) series and (ii) parallel across the same voltage supply. [CBSE (AI) 2011]

**Q.34** In the circuit shown,  $R_1 = 4\Omega$ ,  $R_2 = R_3 = 15\Omega$ ,  $R_4 = 30\Omega$  and  $E = 10V$ . Calculate the equivalent resistance of the circuit and the current in each resistor. [CBSE Delhi 2011]



**Q.35** In the meter bridge experiment, balance point was observed at  $J$  with  $AJ = l$ .



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

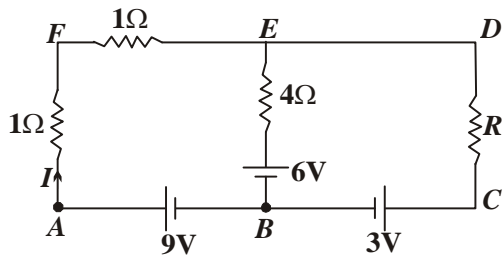
ii) If the galvanometer and battery are interchanged at the balance position, how will the balance point get affected? [CBSE (AI) 2011]

**Q.36** A conductor of length ' $l$ ' is connected to a dc source of potential ' $V$ '. If the length of the conductor is tripled by gradually stretching it, keeping ' $V$ ' constant, how will (i) drift speed of electrons and (ii) resistance of the conductor affected? Justify your answer. [CBSE (F) 2012]

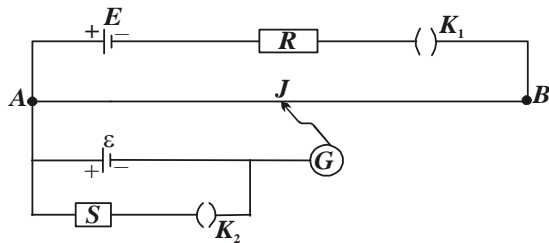
**Q.37** Two wires one of manganin and the other of copper have equal length and equal resistance. Which one of these wires will be thicker? [CBSE (AI) 2012]

**Q.38** The *e.m.f.* of a cell is always greater than its terminal voltage. Why? [CBSE Delhi 2012]

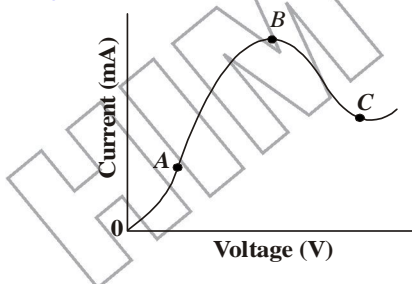
**Q.39** Using Kirchoff's rules determine the value of unknown resistance  $R$  in the resistance. Also find the potential difference between A and D. [CBSE Delhi 2012]



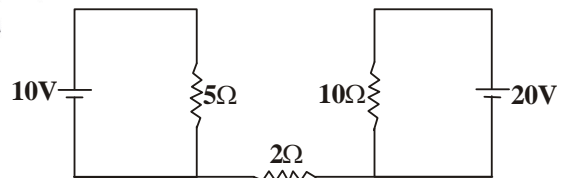
- Q.40** Two students 'X' and 'Y' perform an experiment on potentiometer separately using the circuit given. Keeping other parameters unchanged, how will the position of the null point be affected if
- 'X' increases the value of resistance  $R$  in the set-up by keeping the key  $K_1$  closed and the key  $K_2$  open?
  - 'Y' decreases the value of resistance  $S$  in the set-up, while the key  $K_2$  remain open and the key  $K_1$  closed? Justify your answer in each case.
- [CBSE (F) 2012]



- Q.41** Write the microscopic form of ohm's law. [CBSE 2013]
- Q.42** The graph shown in the figure represents a plot of current versus voltage for a given semiconductor. Identify the region, if any, over which the semiconductor has a negative resistance. [CBSE 2013]



- Q.43** Plot a graph showing the variation of resistance of a conducting wire as a function of its radius, keeping the length of the wire and its temperature as constant. [CBSE (F) 2013]
- Q.44** Two materials Si and Cu, are cooled from 300 K to 60 K. What will be the effect on their resistivity? [CBSE (F) 2013]
- Q.45** A heating element is marked 210 V, 630 W. What is the value of the current drawn by the element when connected to a 210 V dc source? [CBSE Delhi 2013]
- Q.46** Two identical cells, each of *e.m.f.*  $E$ , having negligible internal resistance, are connected in parallel with each other across an external resistance  $R$ . What is the current through this resistance? [CBSE (AI) 2013]
- Q.47** State Kirchoff's junction law. [CBSE 2014, 2013]
- Q.48** What is the basis of Kirchoff's junction rule [CBSE 2014, 2013]
- Q.49** A cell of *e.m.f.*  $E$  and internal resistance ' $r$ ' draws a current ' $I$ '. Write the relation between terminal voltage  $V$  in terms of  $E$ ,  $I$  and  $r$ . [CBSE 2013]
- Q.50** Generally the terminal potential difference  $V < E$  is *i.e.* *e.m.f.* of the cell. In which case  $V > E$ ? [CBSE 2013]
- Q.51** What will be the value of current through the  $2\Omega$  resistance for the circuit shown in the figure? Give reason to support your answer. [CBSE (F) 2013]



- Q.52** Using meter bridge, it is advised to obtain the null point in the middle of the wire. Why? [CBSE 2013]
- Q.53** Write two possible causes for one sided deflection in the potentiometer experiment. [CBSE 2013]
- Q.54** Define mobility ( $\mu$ ) of a current carrier. [CBSE 2014]
- Q.55** Write the S.I. unit of mobility. [CBSE 2014]

# 333

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**Q.56** Estimate the average drift speed of conduction electrons in a copper wire of cross-sectional area  $1.0 \times 10^{-7} \text{ m}^2$  carrying a current of 1.5 A. Assume the density of conduction electrons to be  $9 \times 10^{28} \text{ m}^{-3}$ .

[CBSE (AI) 2014]

**Q.57** Estimate the average drift speed of conducting electrons in a copper wire of cross-sectional area  $2.5 \times 10^{-7} \text{ m}^2$  carrying a current of 1.8A. Assume the density of conduction electrons to be  $9 \times 10^{28} \text{ m}^{-3}$ .

[CBSE (AI) 2014]

**Q.58** Plot a graph showing variation of current versus voltage for the material GaAs.

[CBSE Delhi 2014]

**Q.59** What is the basis of Kirchoff's second law or loop law?

[CBSE 2014]

**Q.60** Answer the following:

- Why are the connections between the resistors in a meter bridge made of thick copper strips?
- Why is it generally preferred to obtain the balance point in the middle of the meter bridge wire?
- Which material is used for the meter bridge wire and why?

[CBSE (AI) 2014]

**Q.61** A potentiometer wire of length 1.0 m has a resistance of  $15 \Omega$ . It is connected to a 5V battery in series with a resistance of  $5 \Omega$ . Determine the *emf* of the primary cell which gives a balance point at 60 cm.

[CBSE Delhi 2014]

**Q.62** A potential difference  $V$  is applied across the ends of copper wire of length  $l$  and diameter  $D$ . What is the effect on drift-velocity of electrons if  $V$  is halved.

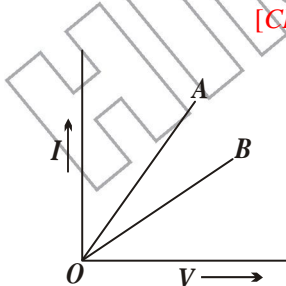
[CBSE Ajmer 2015]

**Q.63** Where Ohm's law is obeyed.

[CBSE Delhi 2015]

**Q.64**  $I$ - $V$  graph for two identical conductors of different materials A and B is shown in the figure. Which one of the two has higher resistivity?

[CBSE Chennai 2015]



**Q.65** Two wires, one of copper and the other of manganin, have same resistance and equal thickness. Which wire is longer? Justify your answer.

[CBSE Guwahati 2015]

**Q.66** During a thunderstorm the 'live' wire of the transmission line fell down on the ground from the pole in the street. A group of boys, who passed through,

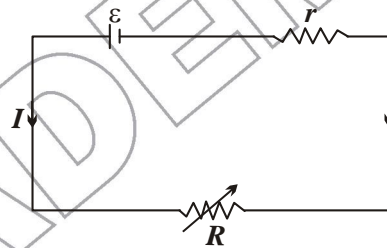
noticed it and some of them wanted to place the wire by the side. As they were approaching the wire and trying to lift the cable, Anuj noticed it and immediately pushed them away, thus preventing them from touching the live wire. During pushing some of them got hurt. Anuj took them to a doctor to get them medical aid.

Based on the above paragraph, answer the following questions:

- Write the two values which Anuj displayed during the incident.
- Why is it that a bird can sit on a suspended 'live' wire without any harm whereas touching it on the ground can give a fatal shock?
- The electric power from a power plant is set up to a very high voltage before transmitting it to distant consumers. Explain, why.

[CBSE Patna 2015]

**Q.67** A cell of *e.m.f.* ( $\epsilon$ ) and internal resistance ( $r$ ) is connected across a variable external resistance ( $R$ ). Plot graphs to show variation of



i)  $E$  with  $R$ .

ii) Terminal p.d. of the cell ( $V$ ) with  $R$ .

Or

A cell of *e.m.f.* ' $E$ ' and internal resistance ' $r$ ' is connected across a variable load resistor  $R$ . Draw the plots of the terminal voltage  $V$  versus (i)  $R$  and (ii) the current  $I$ .

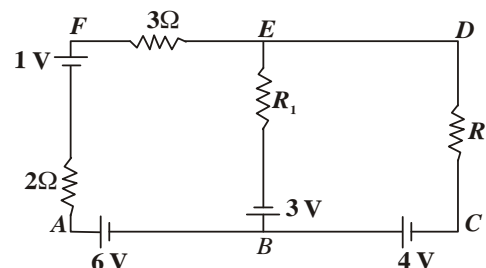
[CBSE Delhi 2015]

**Q.68** A variable resistor  $R$  is connected across a cell of *e.m.f.*  $\epsilon$  and internal resistance  $r$  as shown in the figure. Draw a plot showing the variation of (i) terminal voltage  $V$  and (ii) the current  $I$ , as a function of  $R$ .

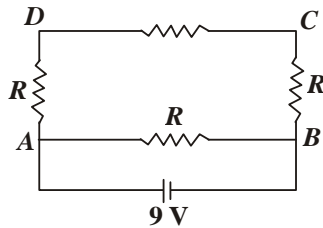
[CBSE Ajmer 2015]

**Q.69** Use Kirchoff's rules to determine the potential difference between the points A and D when no current flows in the arm BE of the electric network shown in the figure.

[CBSE Allahabad 2015]



- Q.70** A  $16\ \Omega$  resistance wire is bent to form a square. A source of *e.m.f.*  $9\ \text{V}$  is connected across one of its sides as shown.

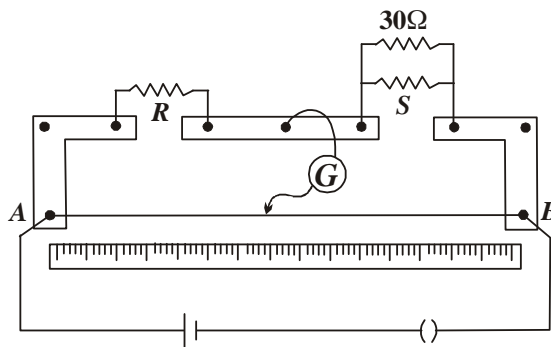


Calculate the current drawn from the source. Find the potential difference between the ends *C* and *D*.

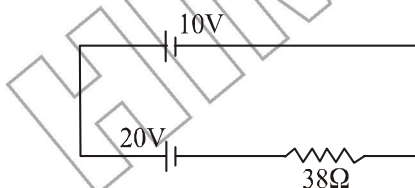
If the wire is now stretched uniformly to double the length and once again the same cell is connected in the same way, across one side of the square formed, what will now be the potential difference across one of its diagonals? [CBSE Guwahati 2015]

- Q.71** In a meter bridge, the null point is found at a distance of  $40\ \text{cm}$  from *A*. If a resistance of  $30\ \Omega$  is connected in parallel with *S*, the null point occurs at  $50.0\ \text{cm}$  from *A*. Determine the values of *R* and *S*.

[CBSE Delhi 2016]



- Q.72** A  $10\ \text{V}$  cell of negligible resistance is connected in parallel across a battery of *e.m.f.*  $200\ \text{V}$  and internal resistance  $38\ \Omega$  as shown in the figure. Find the value of the current in the circuit.



In a potentiometer arrangement for determining the *emf* of a cell, the balance point of the cell in the open circuit is  $350\ \text{cm}$ . When a resistance of  $9\ \Omega$  is used in the external circuit of the cell, the balance point shifts to  $300\ \text{cm}$ .

Determine the internal resistance of the cell.

[CBSE 2018]

- Q.73** Define relaxation time of the free electrons drifting in a conductor. How is it related to the drift velocity of free electrons? Using this relation deduce the expression for electric resistivity of the material.

Or

Using the concept of free electrons in a conductor, derive the expression for the conductivity of a wire in terms of number density and relaxation time. Hence obtain the relation between current density and the applied electric field *E*.

[CBSE 2018]

- Q.74** Two electric bulbs whose resistance are in the ratio  $1:2$  are connected in (i) parallel (ii) series to a source of constant voltage. What will be the ratio of power dissipation in these wires?

[CBSE 2018]

- Q.75** How does the mobility of electrons in a conductor change, if the potential difference applied across the conductor is doubled, keeping the length and temperature of the conductor constant?

[CBSE 2019]

- Q.76** A set of '*n*' identical resistors, each of resistance '*R*' when connected in parallel, their effective resistance becomes '*Y*'. Find out the product of *X* and *Y*.

[CBSE 2019]

- Q.77** Two bulbs are rated ( $P_1, V$ ) and ( $V_2, V$ ). If they are connected (i) in series and (ii) in parallel across a supply *V*, Find the power dissipated in the two combinations in terms of  $P_1$  and  $P_2$ .

[CBSE 2019]

- Q.78** Define the term 'mobility' of charge carriers in a current carrying conductor. Obtain the relation for mobility in terms of relaxation time.

[CBSE 2020]

- Q.79 a)** Derive the condition of balance for Wheatstone bridge.

[CBSE 2020]

**b)** Draw the circuit diagram of a meter bridge to explain how it is based on Wheatstone bridge.

[CBSE 2020]

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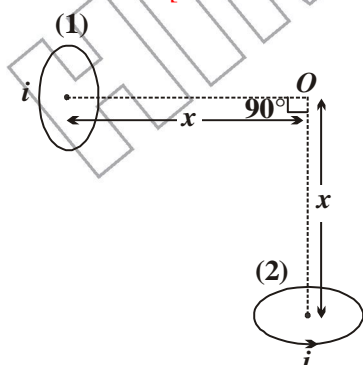
Eligibility: +2 Appearing/ +2 Pass

Course Duration: Till JEE/NEET/Other Competitive Exams

# HIM ACADEMY

HAMIRPUR (HP)  
98160 21400

- Q.1** Which of the following will describe the smallest circle when projected with the same velocity  $v$  perpendicular to the magnetic field (i)  $\alpha$ -particle and (ii)  $\beta$ -particle?  
[CBSE Delhi 2002C]
- Q.2** An electron is moving along positive  $X$ -axis in the presence of uniform magnetic field along positive  $Y$ -axis. What is the direction of force acting on it?  
[CBSE (AI) 2007]
- Q.3** Write the expression for the force on a charge moving in a magnetic field. Use this expression to define the S.I. unit of magnetic field.  
[CBSE 2008]
- Q.4** If a particle of charge  $q$  is moving with velocity  $v$  along  $X$ -axis and the magnetic field  $B$  is acting along  $Y$ -axis, use the expression  $\vec{F} = q(\vec{v} \times \vec{B})$  to find the direction of force  $\vec{F}$  acting on it.  
[CBSE (AI) 2008]
- Q.5** What is the direction of force acting on a charged particle  $q$  moving with a velocity  $\vec{v}$  in a uniform magnetic field  $\vec{B}$ ?  
[CBSE Delhi 2008]
- Q.6** State and explain Biot-Savart's law. Using this law, derive an expression for the magnetic field.  
[CBSE 2008]
- Q.7** Derive an expression for magnetic field due to straight long wire carrying current, using Biot-Savart's law, at a point 'a' metre away from it.  
[CBSE 2008]
- Q.8** Two small identical circular loops, marked (1) and (2), carrying equal current, are placed with the geometrical axes perpendicular to each other as shown in the figure. Find the magnitude and direction of the net magnetic field produced at the point  $O$ .  
[CBSE Delhi 2008; (F) 2013]



- Q.9** A straight thick long wire of uniform circular cross-section of radius 'a' is carrying a steady current  $I$ . The current is uniformly distributed across the cross-

section. Use Ampere's circuital law to obtain a relation showing the variation of the magnetic field ( $B_r$ ) inside and outside the wire with distance  $r$ , ( $r \leq a$ ) of the field point from the centre of its cross-section. What is the magnetic field at the surface of this wire? Plot a graph showing the nature of this variation.

[CBSE (AI) 2008C, Delhi 2010, Chennai 2015,]

- Q.10** Using Ampere's circuital law, derive an expression for the magnetic field along the axis of a toroidal solenoid.  
[CBSE 2008, 2013]
- Q.11** Derive an expression for magnetic moment of a revolving electron in an atom.  
[CBSE 2008]
- Q.12** A solenoid of length 1.0 m, radius 1 cm and total turns 1000 wound on it, carries a current of 5A. Calculate the magnitude of the axial magnetic field inside the solenoid. If an electron was to move with a speed of  $10^4 \text{ ms}^{-1}$  along the axis of this current carrying solenoid, what would be the force experienced by this electron?  
[CBSE Delhi 2008]
- Q.13** Obtain an expression for the force between two long straight parallel current carrying conductors. What is the direction of force?  
[CBSE 2009, 2012, 2015]
- Q.14** Deduce an expression for magnetic dipole moment of an electron revolving around a nucleus in a circular orbit. Indicate the direction of magnetic dipole moment? Use the expression to derive the relation between the magnetic moment of an electron moving in a circle and its related angular momentum?  
[CBSE (F) 2009, (AI) 2010]
- Q.15** Derive an expression for torque acting on a rectangular current carrying loop kept in a uniform magnetic field  $B$ . Indicate the direction of torque acting on the loop.  
[CBSE (F) 2009, Delhi 2013]

Or

Deduce the expression for the torque  $\vec{\tau}$  acting on a planar loop of area  $\vec{A}$  and carrying current placed in a uniform magnetic field  $\vec{B}$ .

If the loop is free to rotate, what would be its orientation in stable equilibrium?  
[CBSE Ajmer 2015]

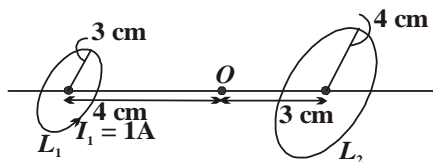
- Q.16** State two reasons, why a galvanometer can not be used as such to measure current in a given circuit.  
[CBSE Delhi 2010]
- Q.17** Write the expression for the magnetic moment ( $\vec{m}$ ) due to a planar square loop of side 'l' carrying a steady current  $I$  in a vector form.

In the given figure this loop is placed in a horizontal plane near a long straight conductor carrying a steady current  $I_1$  at a distance  $l$  as shown. Give reasons to explain that the loop will experience a net force but no torque. Write the expression for this force acting on the loop. [CBSE Delhi 2010]

**Q.18** Write the expression for Lorentz magnetic force on a particle of charged ' $q$ ' moving with velocity  $\vec{v}$  a magnetic field  $\vec{B}$ . Show that no work is done by this force on the charge particle. [CBSE (AI) 2011]

**Q.19** A narrow beam of protons and deuterons, each having the same momentum, enters a region of uniform magnetic field directed perpendicular to their direction of momentum. What would be the ratio of the circular paths described by them? [CBSE (F) 2011]

**Q.20** Two co-axial circular loops  $L_1$  and  $L_2$  of radii 3 cm and 4 cm are placed as shown. What should be the magnitude and direction of the current in the loop  $L_2$  so that the net magnetic field at the point  $O$  be zero? [CBSE (F) 2011]



Or

State Biot-Savart law, derive the mathematical expression for it.

Use this law to derive the expression for the magnetic field due to a circular coil carrying current at point along its axis.

How does a circular loop carrying current behave as a magnet?

[CBSE Delhi 2011, (AI) 2013, Panchkula 2015]

**Q.21** A parallel plate capacitor is being charged by a time varying current. Explain briefly how Ampere's circuital law is generalized to incorporate the effect due to the displacement current. [CBSE (AI) 2011]

**Q.22 a)** In what respect is a toroid different from a solenoid? Draw and compare the pattern of the magnetic field lines in the two cases.

**b)** How is the magnetic field inside a given solenoid made strong? [CBSE (AI) 2011]

**Q.23** Two long and parallel straight wires carrying currents of 2 A and 5 A in the opposite directions separated by a distance of 1 cm. Find the nature and magnitude of the magnetic force between them. [CBSE (F) 2011]

**Q.24** What is a galvanometer? [CBSE 2011]

**Q.25** Kamal's uncle was advised by his doctor to undergo an MRI scan test of his chest who also gave him an estimate of the cost. Not knowing much about the significance of this test and finding it to be too

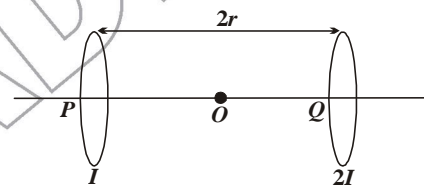
expensive, he first hesitated. When Kamal learnt about this, he decided to take help of his family friends and neighbours and arranged for the money. He convinced his uncle to undergo this test so as to enable the doctor to diagnose the disease. He got the test done and the resulting information greatly helped the doctor to give him proper treatment.

**a)** What, according to you, are the values displayed by Kamal, his family, friends and neighbours?

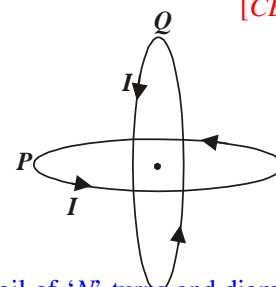
**b)** Assuming that the MRI scan test involved a magnetic field 0.1 T, find the maximum and minimum values of the force that this field could exert on a proton moving with a speed of  $10^4 \text{ ms}^{-1}$ . State the condition under which the force can be minimum.

**c)** Suggest one method by which these values can be inculcated in individuals. [CBSE (F) 2012]

**Q.26** Two identical circular loops,  $P$  and  $Q$ , each of radius  $r$  and carrying currents  $I$  and  $2I$  respectively are lying in parallel planes such that they have a common axis. The direction of current in both the loops is clockwise as seen from  $O$  which is equidistant from the both loops. Find the magnitude of the net magnetic field at point  $O$ . [CBSE (AI) 2012]



**Q.27** Two identical circular wires  $P$  and  $Q$  each of radius  $R$  and carrying current ' $I$ ' are kept in perpendicular planes such that they have a common centre as shown in the figure. Find the magnitude and direction of the net magnetic field at the common centre of the two coils. [CBSE Delhi 2012]



**Q.28** A circular coil of ' $N$ ' turns and diameter ' $d$ ' carries a current ' $I$ '. It is unwound and rewound to make another coil of diameter ' $2d$ ', current ' $I$ ' remaining the same. Calculate the ratio of the magnetic moments of the new coil and the original coil. [CBSE (AI) 2012]

**Q.29** A short bar magnet of magnetic moment 0.9 J/T is placed with its axis at  $30^\circ$  to a uniform magnetic field. It experiences a torque of 0.063 J.

- i*) Calculate the magnitude of the magnetic field.  
*ii*) In which orientation will the bar magnet be in stable equilibrium in the magnetic field? [CBSE (F) 2012]
- Q.30** A magnetised needle of magnetic moment  $4.8 \times 10^{-2} \text{ J T}^{-1}$  is placed at  $30^\circ$  with the direction of a uniform magnetic field of magnitude  $3 \times 10^{-2} \text{ T}$ . Calculate the torque acting on the needle. [CBSE (F) 2012]
- Q.31** A circular coil of  $N$  turns and radius  $R$  carries a current  $I$ . It is unwound and rewound to make another coil of radius  $R/2$ , current  $I$  remaining the same. Calculate the ratio of the magnetic moments of the new coil and the original coil. [CBSE (AI) 2012]
- Q.32** With the help of a schematic diagram, explain, how a galvanometer can be converted into ammeter? [CBSE 2012]
- Q.33** In a certain region, electric field  $\vec{E}$  and magnetic field  $\vec{B}$  are perpendicular to each other. An electron enters into the region perpendicular to the directions of both  $\vec{B}$  and  $\vec{E}$  and move undeflected. Find the velocity of the electron. [CBSE (F) 2013]
- Q.34** A long straight wire carries a steady current  $I$  along the positive  $Y$ -axis in a coordinate system. A particle of charge  $+Q$  is moving with a velocity  $\vec{v}$  along the  $X$ -axis. In which direction will the particle experience a force? [CBSE (F) 2013]
- Q.35** When a charged particle moving with velocity  $\vec{v}$  is subjected to magnetic field  $\vec{B}$ , the force acting on it is non-zero. Would the particle gain any energy? [CBSE (F) 2013]
- Q.36** A proton and a deuteron having equal momenta enter in a region of uniform magnetic field at right angle to the direction of the field. Find the ratio of the radii of curvature of the path of the particle. [CBSE Delhi 2013]
- Q.37** What is the maximum energy gained by a charged particle of charge  $q$ ? [CBSE 2013]
- Q.38** What is a cyclotron? [CBSE 2013]
- Q.39** Find the magnetic field at a point on the axis of a circular coil carrying current. [CBSE 2013]
- Q.40** Obtain an expression for the magnetic field of solenoid. [CBSE 2013]
- Q.41** *a*) *i*) Circular loop of area  $\vec{A}$ , carrying a current  $I$  is placed in a uniform magnetic field  $\vec{B}$ . Write the expression for the torque  $\vec{\tau}$  acting on it in a vector form.  
*ii*) If the loop is free to turn, what would be its orientation of stable equilibrium? Show that in this orientation, the flux of net field (external field + the field produced by the loop) is maximum.
- b*) Find out the expression for the magnetic field due to a long solenoid carrying a current  $I$  and having  $n$  number of turns per unit length. [CBSE (F) 2013]
- Q.42** Write the expression, in a vector form, for the Lorentz magnetic force  $\vec{F}$  due to a charge moving with velocity  $\vec{v}$  in a magnetic field  $\vec{B}$ . What is the direction of the magnetic force? [CBSE Delhi 2014]
- Q.43** Explain the working of cyclotron. [CBSE 2014]
- Q.44** What is the principle of cyclotron? [CBSE 2014]
- Q.45** Write two uses of cyclotron. [CBSE 2004]
- Q.46** A cyclotron's oscillator frequency is 10 MHz. What should be the operating magnetic field for accelerating protons? If the radius of its 'dees' is 60 cm, calculate the kinetic energy (in MeV) of the proton beam produced by the acceleration. [CBSE Ajmer 2015]
- Q.47** Write any two important points of similarities and difference each between Coulomb's law for the electrostatic field and Biot-Savart's law for the magnetic field. [CBSE (F) 2015]
- Q.48** A closely wound solenoid of 2000 turns and cross-sectional area  $1.6 \times 10^{-4} \text{ m}^2$  carrying a current of 4.0 A is suspended through its centre allowing it to turn in a horizontal plane. Find (i) the magnetic moment associated with the solenoid, (ii) magnitude and direction of the torque on the solenoid if a horizontal magnetic field of  $7.5 \times 10^{-2} \text{ T}$  is set up at an angle of  $30^\circ$  with the axis of the solenoid. [CBSE (AI) 2015(C)]
- Q.49** Two infinitely long straight parallel wires. '1' and '2', carrying steady currents  $I_1$  and  $I_2$  in the same direction are separated by a distance  $d$ . Obtain the expression for the magnetic field due to the wire '1' acting on wire '2'. Hence find out, with the help of a suitable diagram, magnitude and direction of this force per unit length on wire '2' due to wire '1'. How does nature of this force change if the currents are in opposite direction? Use this expression to define the SI unit of current. [CBSE Patna 2015]
- Q.50** What is S.I. unit of current sensitivity? [CBSE 2015]
- Q.51** Define voltage sensitivity of a galvanometer. [CBSE 2015]
- Q.52** What is the S.I. unit of voltage sensitivity? [CBSE 2015]
- Q.53** What is the importance of radial magnetic field in moving coil galvanometer? [CBSE 2015]
- Q.54** A galvanometer of resistance  $G$  is converted into a voltmeter to measure upto  $V$  volts by connecting resistance  $R_1$  in series with the coil. If a resistance  $R_2$  is connected in series with it, then it can measure upto

$V/2$  volts. Find the resistance, in terms of  $R_1$  and  $R_2$ , required to be connected to convert it into a voltmeter that can read upto 2 V. Also find the resistance  $G$  of the galvanometer in terms of  $R_1$  and  $R_2$ .

[CBSE Delhi 2015]

**Q.55** Deepika and Ruchika were asked by their teacher to perform an experiment using a galvanometer. Before doing the experiment, they were very keen to know the different parts of the galvanometer which was given to them in the form of a small box. They approached the teacher and asked for the permission. The teacher thought it would be a good ideal if the galvanometer be opened before the whole class and explained its construction and working to all of them.

Based on the above paragraph, answer the following question :

- What, in your opinion, were the qualities displayed by Deepika, Ruchika and the teacher?
- State briefly the working principle of the galvanometer.
- What is the shape of the magnets used and why is it so designed?

[CBSE Chennai 2015]

**Q.56** An iron ring of relative permeability  $\mu_r$  has windings of insulated copper wire of  $n$  turns per metre. When the current in the windings is  $I$ , find the expression for the magnetic field in the ring.

[CBSE 2018]

**Q.57** A proton, a deuteron and an alpha particle, are accelerated through the same potential difference and then subjected to a uniform magnetic field  $\vec{B}$ , perpendicular to the direction of their motions. Compare (i) their kinetic energies, and (ii) if the radius of the circular path described by proton is 5 cm, determine the radii of the paths described by deuteron and alpha particle.

[CBSE 2019]

**Q.57** An electron is released from rest in a region of uniform electric and magnetic fields acting parallel to each other. The electron will

- move in a straight line.
- move in a circle.
- remain stationary.
- move in a helical path.

[CBSE 2020]

**Q.58** A conducting rod of length  $l$  is kept parallel to a uniform magnetic field  $\vec{B}$ . It is moved along the magnetic field with a velocity  $\vec{v}$ . What is the value of  $e.m.f.$  induced in the conductor ?

[CBSE 2020]

**Q.59** A circular loop of radius  $R$  carries a current  $I$ . Obtain an expression for the magnetic field at a point on its axis at a distance  $x$  from its centre.

[CBSE 2020]

**Q.60** Obtain the expression for the deflecting torque acting on the current carrying rectangular coil of a galvanometer in a uniform magnetic field. Why is a radial magnetic field employed in the moving coil galvanometer ?

[CBSE 2020]

प्रदेश की सर्वश्रेष्ठ किताबें

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लाओ  
सफलता  
पाओ



**OMEGA PARKASHAN PVT. LTD.**  
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**Q.1** Derive an expression for the induced *e.m.f.* produced by changing the area of a rectangular coil placed perpendicular to a uniform magnetic field.  
[CBSE 1992]

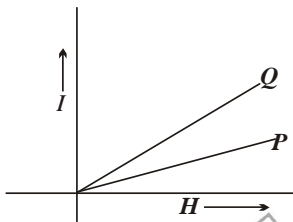
**Q.2** Name three elements required to completely specify the earth's magnetic field at a given place. Draw a labelled diagram to define these elements. Explain briefly how these elements are determined to find out the magnetic field at a given place on the surface of the earth.  
[CBSE 2008 C]

**Q.3** Name two elements, one having positive susceptibility and the other having negative susceptibility. What does negative susceptibility signify? [CBSE Delhi 2008]

**Q.4** The given graphs show the variation of intensity of magnetization *I* with strength of applied magnetic field *H* for two magnetic materials *P* and *Q*.

*i)* Identify the materials *P* and *Q*.

*ii)* For material *P*, plot the variation of intensity of magnetisation with temperature. Justify your answer.



[CBSE 2008]

**Q.5** What are diamagnetic substances? [CBSE 2008]

**Q.6** What are paramagnetic materials? [CBSE 2008]

**Q.7 a)** If  $\chi$  stands for the magnetic susceptibility of a given material, identify the class of materials for which  
(i)  $-1 \leq \chi < 0$

(ii)  $0 < \chi < e$  (*e* is small positive number).

Write the range of relative magnetic permeability of these materials.

*b)* Draw the pattern of the magnetic field lines when these materials are placed on a strong magnetic field.  
[CBSE Delhi 2008 C]

**Q.8** Explain the following:

*i)* Why do magnetic field lines form continuous closed loops?

*ii)* Why are the magnetic field lines repelled (expelled) when a diamagnetic material is placed in an external uniform magnetic field? [CBSE (F) 2011]

**Q.9** Where on the earth's surface is the value of angle of dip maximum? [CBSE 2011]

**Q.10** Where on the earth's surface is the value of the vertical component of earth's magnetic field zero? [CBSE 2011]

**Q.11** A magnetic needle free to rotate in a vertical plane parallel to the magnetic meridian has its north pole at  $60^\circ$  with the horizontal. The horizontal component of the earth's magnetic field at the place is known to be 0.4 G. Determine the magnitude of the earth's magnetic field at that place. [CBSE Delhi 2011]

**Q.12** Which of the following substances are diamagnetic? *Bi, Al, Na, Cu, Ca* and *Ni*. [CBSE 2013, 2011]

**Q.13** The susceptibility of a magnetic materials is  $-4.2 \times 10^{-6}$ . Name the type of magnetic materials it represents. [CBSE Delhi 2011]

**Q.14** What is the angle of dip at a place where the horizontal and vertical component of earth's magnetic field are equal? [CBSE 2012]

**Q.15** A magnetic needle, free to rotate in a vertical plane, orients itself vertically at a certain place on the Earth. What are the values of (i) horizontal component of Earth's magnetic field and (ii) angle of dip at this place? [CBSE (F) 2012]

**Q.16** The horizontal component of the earth's magnetic field at a place is *B* and angle of dip is  $60^\circ$ . What is the value of vertical component of earth's magnetic field at equator? [CBSE Delhi 2012]

**Q.17** A small magnet is pivoted to move freely in the magnetic meridian. At what place on earth's surface will the magnet be vertical? [CBSE (F) 2012]

**Q.18** The susceptibility of a magnetic material is  $2.6 \times 10^{-5}$ . Identify the type of magnetic material and state its two properties. [CBSE Delhi 2012]

**Q.19** The susceptibility of a magnetic material is  $-1.6 \times 10^{-5}$ . Identify the type of magnetic material and state its two properties. [CBSE Delhi 2012]

**Q.20** What are permanent magnets? Give one example. [CBSE 2013]

**Q.21** A compass needle, free to turn in a vertical plane orients itself with its axis vertical at a certain place on the earth. Find out the values of (i) horizontal component of earth's magnetic field and (ii) angle of dip at the place. [CBSE Delhi 2013]

**Q.22** Show diagrammatically the behaviour of magnetic field lines in the presence of (i) paramagnetic and

(ii) diamagnetic substances. How does one explain this distinguishing feature? [CBSE (AI) 2014]

**Q.23** A bar magnet of magnetic moment  $6\text{J/T}$  is aligned at  $60^\circ$  with uniform external magnetic field of  $0.44\text{T}$ . Calculate (a) the work done in turning the magnet to align its magnetic moment (i) normal to the magnetic field, (ii) opposite to the magnetic field, and (b) the torque on the magnet in the final orientation in case (ii) [CBSE 2018]

**Q.24** The magnetic susceptibility of magnesium at  $300\text{K}$  is  $1.2 \times 10^5$ . At what temperature will its magnetic susceptibility become  $1.44 \times 10^5$ ? [CBSE 2019]

**Q.25** The magnetic susceptibility  $\chi$  of a given material is  $-0.5$ . Identify the magnetic material. [CBSE 2019]

**Q.26** Do the diamagnetic substances have resultant magnetic moment in an atom in the absence of external magnetic field? [CBSE 2019]

**Q.27** Above Curie temperature, a [CBSE 2020]

- (A) ferromagnetic material becomes diamagnetic.
- (B) ferromagnetic material becomes paramagnetic.
- (C) paramagnetic material becomes ferromagnetic.
- (D) paramagnetic material becomes diamagnetic.

**6**

**CHAPTER**

## Electromagnetic Induction

**Q.1** Name the factors on which value of mutual inductance depends. [CBSE 1994]

**Q.2** State two applications of eddy currents. [CBSE 2000]

**Q.3** Write SI unit of magnetic flux. Is magnetic flux a scalar or a vector quantity? [CBSE 2003]

**Q.4** Define one henry [CBSE 2003]

**Q.5** Write an expression for the energy stored in an inductor of inductance ' $L$ ', when a steady current is passed through it. Is it a electric energy or magnetic energy. [CBSE 2004]

**Q.6** A circular copper disc  $10\text{cm}$  in radius rotates at  $20\pi$  rad/s about an axis through its centre perpendicular to disc. A uniform magnetic field of  $0.2\text{T}$  acts perpendicular to the disc.

i) Calculate the potential difference developed between the axis of the disc and the rim.

ii) What is the induced current in the circuit whose terminals are connected between centre of disc and point of rim and the resistance of the circuit is  $2\Omega$ .

[CBSE (F) 2007]

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# HIM ACADEMY

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**Q.7** When current in a coil changes with time, how is the back *e.m.f.* induced in the coil related to it?

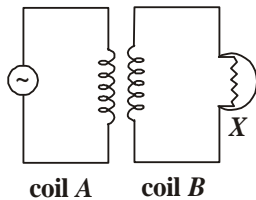
[CBSE (AI) 2008]

**Q.8** Fig shows an arrangement by which current flows through the bulb (X) connected with coil B, when ac is passed through coil A.

*i)* Name the phenomenon involved.

*ii)* If a copper sheet is inserted in the gap between the coils, explain how the brightness of the bulb would change.

[CBSE 2008]



**Q.9** State Faraday's laws of electromagnetic induction.

[CBSE 2009]

**Q.10** What are eddy currents? Give an experiment to explain their origin.

[CBSE 2009]

**Q.11** Deduce an expression for the mutual inductance of two long coaxial solenoids but having different radii and different number of turns.

[CBSE 2009]

**Q.12** Derive expression for self inductance of a long air-cored solenoid of length  $l$ , cross-sectional areas and having number of turns  $N$ .

[CBSE Delhi 2009, 2012]

**Q.13** Figure shows planar loops of different shapes moving out of or into a region of magnetic field which is directed normal to the plane of loops downwards. Determine the direction of induced current in each loop using Lenz's Law.

[CBSE (AI) 2010]

**Q.14** Two identical loops, one of copper and other of aluminium, are rotated with the same angular speed in the same magnetic field. Compare *i)* the induced *e.m.f.* and *ii)* the current produced in the two coils. Justify your answer.

[CBSE 2010]

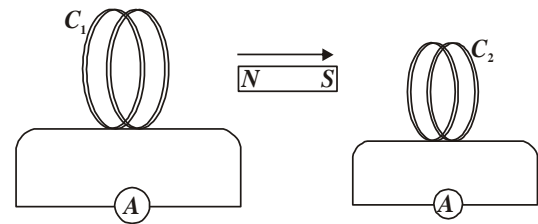
**Q.15** Figure shows a rectangular conductor PQRS in which the conductor PQ is free to move in a uniform magnetic field  $B$  perpendicular to plane of paper. The field extended from  $x = 0$  to  $x = b$  and is zero for  $x > b$ . Assume that only the arm PQ possesses resistance  $r$ . When the arm PQ is pulled outward from  $x = 0$  to  $x = 2b$  and is then moved backward to  $x = 0$  with speed  $v$ . Obtain expression for flux and induced *e.m.f.* Sketch the variations of these quantities with distance  $0 \leq x \leq 2b$ .

[CBSE 2010]

**Q.16** A magnet is quickly moved in the direction indicated by an arrow between two coils  $C_1$  and  $C_2$  as shown in the figure. What will be the direction of induced current

in each coil as seen from the magnet? Justify your answer.

[CBSE Delhi 2011]



**Q.17** What is an A.C. generator?

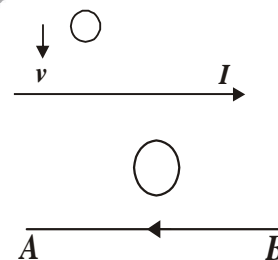
[CBSE 2011]

**Q.18** State the working of a.c. generator with the help of a labelled diagram. The coil of an a.c. generator having  $N$  turns, each of area  $A$ , is rotated with a constant angular velocity  $\omega$ . Deduce the expression for the alternating *e.m.f.* generated in the coil. What is the source of energy generated in this device? Obtain the expression for *emf* induced in a coil having  $N$ -turns each of  $X$ -sectional area  $A$ , rotating with constant angular speed  $\omega$  in a magnetic field  $\vec{B}$ , directed  $\perp r$  to the axis of rotation.

[CBSE 2011, 2018]

**Q.19** Predict the direction of induced current in a metal ring when the ring is moved towards a straight conductor with constant speed  $v$ . The conductor is carrying  $I$  in the direction shown in the figure.

[CBSE Delhi 2012]

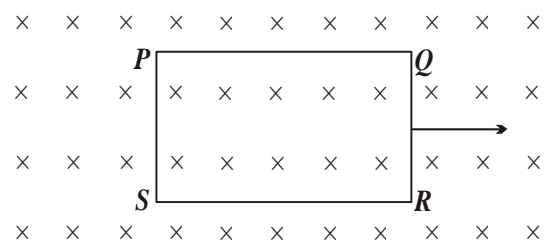


**Q.20** The closed loop PQRS is moving into a uniform magnetic field acting at right angles to the plane of the paper as shown. State the direction of the induced current in the loop.

[CBSE (AI) 2012]

**Q.21** The closed loop (PQRS) of wire is moved out of a uniform magnetic field at right angles to the plane of the paper as shown in the figure. Predict the direction of the induced current in the loop.

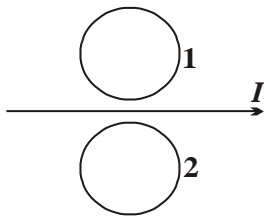
[CBSE (F) 2012]



**Q.22** Define self induction. [CBSE 2012]

**Q.23** In an experimental arrangement of two coils  $C_1$  and  $C_2$  placed coaxially parallel to each other, find out the expression for the *e.m.f.* induced in the coil  $C_1$  (of  $N_1$  turns) corresponding to the change current  $I_2$  in the coil  $C_2$  (of  $N_2$  turns). [CBSE Chennai 2012]

**Q.24** Predict the directions of induced currents in metal rings 1 and 2 lying the same plane where current  $I$  in the wire is increasing steadily. [CBSE 2012]



**Q.25** On what factors does the magnitude of *e.m.f.* induced in the circuit due to magnetic flux depend? [CBSE 2013]

**Q.26** State Lenz's law of electromagnetic induction. [CBSE 2013]

**Q.27** A metallic rod held horizontally along east-west direction, is allowed to fall under gravity. Will there be an emf induced at its ends? Justify your answer. [CBSE Delhi 2013]

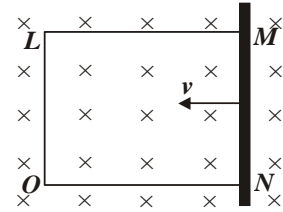
**Q.28** A wheel with 8 metallic spokes each 50 cm long is rotated with a speed of 120 rev/min in a plane normal to the horizontal component of the Earth's magnetic field. The Earth's magnetic field at the plane is 0.4 G and the angle of dip is  $60^\circ$ . Calculate the *e.m.f.* induced between the axle and the rim of the wheel. How will the value of *e.m.f.* be affected if the number of spokes were increased? [CBSE Delhi 2013]

**Q.29** The motion of copper plate is damped when it is allowed to oscillate between the two poles of a magnet. If slots are cut in the plate, how will the damping be affected? [CBSE 2013]

**Q.30** How does the mutual inductance of a pair of coils change when [CBSE 2013]

- i) distance between the coils is decreased and
- ii) number of turns in the coils is decreased.

**Q.31** A rectangular conductor  $LMNO$  is placed in a uniform magnetic field of 0.5 T. The field is directed perpendicular to the plane of the conductor. When the arm  $MN$  of length of 20 cm is moved towards left with a velocity of  $10 \text{ ms}^{-1}$ , calculate the emf induced in the arm. Given the resistance of the arm to be 5  $\Omega$  (assuming that other arms are of negligible resistance) find the value of the current in the arm. [CBSE (AI) 2013]



**Q.32** The motion of copper plate is damped when it is allowed to oscillate between the two poles of a magnet. What is the cause of this damping? [CBSE 2013]

**Q.33** Two spherical bobs, one metallic and the other of glass, of the same size and allowed to fall freely from same height above the ground. Which of the two would reach earlier and why? [CBSE Delhi 2014]

**Q.34 a)** Describe a simple experiment (or activity) to show that the polarity of emf induced in a coil is always such that it tends to produce an induced current which opposes the change of magnetic flux that produces it.

**b)** The current flowing through an inductor of self inductance  $L$  is continuously increasing. Plot a graph showing the variation of

- i) Magnetic flux versus the current
- ii) Induced emf versus  $dI/dt$
- iii) Magnetic potential energy stored versus the current. [CBSE Delhi 2014]

**Q.35** A toroidal solenoid with air core has an average radius of 15 cm, area of cross-section  $12 \text{ cm}^2$  and has 1200 turns. Calculate the self-inductance of the toroid. Assume the field to be uniform across the cross-section of the toroid. [CBSE (F) 2014]

**Q.36** Hari is a student of Class X in a school near his village. His uncle gifted him a bicycle with a dynamo fitted in it. He was thrilled to find that while cycling during night, he could light the bulb and see the objects on the road clearly. He, however, did not know how this device works. He asked this question to his teacher. The teacher considered it an opportunity and explained the working of a dynamic to the whole class.

Answer the following questions:

- i) State the principle and working of a dynamo.
- ii) Write two values each displayed by Hari and his Science teacher. [CBSE Guwahati 2015]

**Q.37** Two concentric circular coils, one of small radius  $r_2$  and the other of large radius  $r_1$ , such that  $r_2 \ll r_1$  are placed co-axially with centres coinciding. Obtain the mutual inductance of the arrangement. [CBSE Chennai 2015]

**Q.38** One morning an old man walked bare foot to replace the fuse wire in kit kat fitted with the power supply mains for his house. Suddenly he screamed and

collapsed on the floor. His wife cried loudly for help. His neighbour's son Anil heard the cries and rushed to the place with shoes on. He took a wooden baton and used it to switch off the main supply.

Answer the following questions:

- What is the voltage and frequency of mains supply in India?
- These days most of the electrical devices we use require a.c. voltage. Why?
- Can a transformer be used to step up d.c. voltage?
- Write two qualities displayed by Anil by his action.

[CBSE Allahabad 2015]

**Q.39** An aeroplane is flying horizontally from west to east with a velocity of 900 km/hour. Calculate the potential difference developed between the ends of its wings having a span of 20m. The horizontal component of the Earth's magnetic field is  $5 \times 10^{-4} \text{T}$  and the angle of dip is  $30^\circ$ . [CBSE 2018]

**Q.40** A 0.5 m long solenoid of 10 turns/cm has area of cross-section  $1 \text{ cm}^2$ . Calculate the voltage induced across its ends if the current in the solenoid is changed from 1A to 2A in 0.1s. [CBSE 2019]

**Q.41** Define mutual inductance and write its SI units. [CBSE 2019]

**Q.42** A cell of internal resistance  $r$  connected across an external resistance  $R$  can supply maximum current when [CBSE 2020]

(A)  $R = r$  (B)  $R > r$

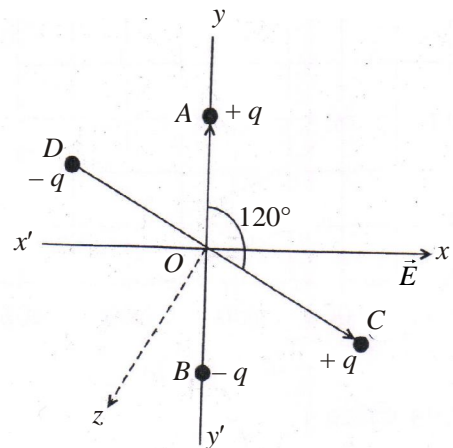
(C)  $R = \frac{r}{2}$  (D)  $R = 0$

**Q.43** In a current carrying conductor, the ratio of the electric field and the current density at a point is called,

(A) Resistivity (B) Conductivity  
(C) Resistance (D) Mobility [CBSE 2020]

**Q.44** If the electric flux entering and leaving a closed surface in air are  $\phi_1$  and  $\phi_2$  respectively, the electric charge enclosed within the surface is \_\_\_\_\_. [CBSE 2020]

**Q.45** Two small identical electric dipoles  $AB$  and  $CD$ , each of dipole moment  $\vec{p}$  are kept at an angle of  $120^\circ$  to each other in an external electric field  $\vec{E}$  pointing along the  $x$ -axis as shown in the figure. Find the  
a) dipole moment of the arrangement, and  
b) magnitude and direction of the net torque acting on it. [CBSE 2020]

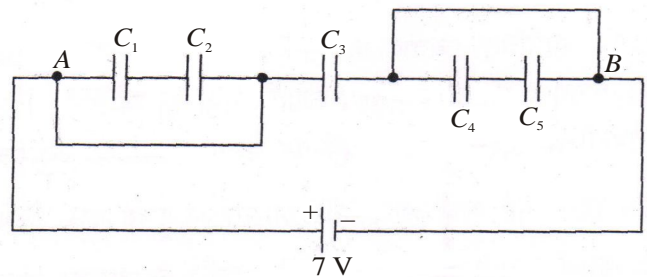


In the figure given below, find the

a) equivalent capacitance of the network between point A and B.

Given :  $C_1 = C_5 = 8 \mu\text{F}$ ,  $C_2 = C_3 = C_4 = 4 \mu\text{F}$ .

b) maximum charge supplied by the battery, and  
c) total energy stored in the network.



**Q.46** Use Gauss's law to show that due to a uniformly charged spherical shell of radius  $R$ , the electric field at any point situated outside the shell at a distance  $r$  from its centre is equal to the electric field at the same point, when the entire charge on the shell were concentrated at its centre. Also plot the graph showing the variation of electric field with  $r$ , for  $r \leq R$  and  $r \geq R$

[CBSE 2020]

**Q.47** Two point charges of  $+1$  and  $+4 \mu\text{C}$  are kept 30 cm apart. How far from the  $+1 \mu\text{C}$  charge on the line joining the two charges, will the net electric field be zero? [CBSE 2020]

**Q.48** Two point charges  $q_1$  and  $q_2$  are kept  $r$  distance apart in a uniform external electric field  $\vec{E}$ . Find the amount of work done in assembling this system of charges.

[CBSE 2020]

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- Q.1** Sketch a graph showing the variation of reactance of a capacitor with the frequency of applied voltage. [CBSE 1995]
- Q.2** Draw the graph showing the variation of reactance of an inductor with frequency of an A.C. circuit. [CBSE 1998]
- Q.3** The instantaneous voltage from an A.C. source is given by  $E = 300 \sin 314 t$ . What is the r.m.s. voltage of the source? [CBSE 2000]
- Q.4** An alternating *e.m.f.* is applied across a capacitor. Show mathematically that current in it leads the applied *e.m.f.* by a phase angle of  $\frac{\pi}{2}$ . What is the capacitive reactance? Draw the time and phasor diagrams. What is the power dissipated?  
Or  
A device *X* is connected across an a.c. source of voltage  $V = V_0 \sin \omega t$ . The current through *X* is given as  
$$I = I_0 \sin \left( \omega t + \frac{\pi}{2} \right)$$
- Identify the device *X* and write the expression for reactance.
  - Draw graphs showing variation of voltage and current with time over one cycle of a.c., for *X*.
  - Draw the phasor diagram for the device *X*. [CBSE 2018, 2003]
- Q.5** A bulb and a capacitor are connected in series to an A.C. source of variable frequency. How will the brightness of the bulb change on increasing the frequency of the A.C. source? Give reasons. [CBSE 2005]
- Q.6** The power factor of an A.C. circuit is 0.5. What will be the phase difference between voltage and current in this circuit? [CBSE 2005]
- Q.7** What is the phase relationship between current and voltage in a pure capacitor? [CBSE 2006]
- Q.8** Distinguish between the terms 'effective value' and peak value of alternating current. [CBSE Delhi 2007]
- Q.9** An alternating current from a source is represented by  
$$I = 10 \sin 314 t$$
  
Write the corresponding values of  
*i*) its 'effective value' and  
*ii*) frequency of the source. [CBSE Delhi 2007]
- Q.10** What is the phase relationship between current and voltage in an inductor? [CBSE 2007]
- Q.11** In a series *LCR* circuit, the voltage across an inductor, a capacitor and a resistor are 30 V, 30 V and 60 V respectively. What is the phase difference between the applied voltage and current in the circuit? [CBSE (AI) 2007]
- Q.12** Explain the term inductive reactance. Show graphically the variation of inductive reactance with frequency of the applied alternating voltage. An A.C. voltage  $V = V_0 \sin \omega t$  is applied across a pure inductor of inductance *L*. Find an expression for the current *i*, flowing in the circuit and show mathematically that the current flowing through it lags behind the applied voltage by a phase angle of  $\pi/2$ . Also draw (i) phasor diagram (ii) graphs of *v* and *i* versus  $\omega t$  for the circuit. [CBSE 2008]
- Q.13** Define the term capacitive reactance. Show graphically the variation of capacitive reactance with frequency of applied alternating voltage.  
An A.C. voltage  $V = V_0 \sin \omega t$  is applied across a pure capacitor of capacitance *C*. Find an expression for current flowing through it. Show mathematically the current flowing through it leads the applied voltage by angle  $\pi/2$ . [CBSE 2008, 2018]
- Q.14** Draw a plot showing the variation of peak current ( $i_m$ ) with frequency of the A.C. source used. Define the quality factor of the circuit. [CBSE 2008]
- Q.15** An ac source of voltage  $V = V_m \sin \omega t$  is connected, one by one, to three circuit elements, *X*, *Y* and *Z*. It is observed that the current flowing in them  
*a*) is in phase with applied voltage for element *X*.  
*b*) lags the applied voltage, in phase, by angle  $\pi/2$  for element *Y*.  
*c*) leads the applied voltage, in phase, by angle  $\pi/2$ .  
Identify the three circuit elements.  
Find an expression for the current flowing in the circuit, when the same A.C. source is connected across a series combination of the elements *X*, *Y* and *Z*.  
If the frequency of the applied voltage is varied, set up the condition of the frequency when the current amplitude in the circuit is maximum. Write expression for this current amplitude. [CBSE Delhi 2008C]
- Q.16** What is the power dissipated by an ideal inductor in an A.C. circuit? Explain. [CBSE 2008]
- Q.17** Prove that an ideal capacitor in an A.C. circuit does not dissipate power. [CBSE 2008]

**Q.18** Explain the principle, and working of a transformer. What are the various energy losses in transformer ?

[CBSE 2008,2011]

**Q.19** What is the principle of a transformer? [CBSE 2011]

**Q.20** State the principle of working of a transformer. Can a transformer be used to step up or step down a D.C. voltage? Justify your answer. [CBSE 2011]

**Q.21** An A.C. voltage  $V = V_m \sin \omega t$  is applied across is:

*i)* series  $RC$  circuit in which capacitive reactance is 'a' time the resistance in the circuit.

*ii)* series  $RL$  circuit in which inductive reactance is 'b' time the resistance in the circuit.

Find the value of power factor of the circuit in each case. [CBSE (AI) 2008C]

**Q.22** An electric lamp connected in series with a capacitor and an source is glowing with of certain brightness. How does the brightness of the lamp change on reducing the *(i)* capacitance and *(ii)* frequency?

[CBSE Delhi 2010]

**Q.23** What are the conditions of resonance? Derive an expression for resonant frequency. [CBSE 2010]

**Q.24** Define power factor, state the conditions under which it is *(i)* maximum and *(ii)* minimum. [CBSE 2010]

**Q.25** The current flowing through a pure inductor of inductance 2 mH is  $i = 15 \cos 300 t$  ampere. What is the *(i)* rms and *(ii)* average value of current for a complete cycle? [CBSE (F) 2011]

**Q.26** An A.C. voltage  $V = V_m \sin \omega t$  is applied across an inductance  $L$ . Show that in an inductance, voltage leads

the current by  $90^\circ$  or  $\frac{\pi}{2}$ . [CBSE 2011]

**Q.27** Determine the current quality factor at resonance for a series  $LCR$  circuit with  $L = 1.00$  mH,  $1.00$  nF and  $R = 100 \Omega$  connected to an A.C. source having peak voltage of 100 V. [CBSE (F) 2011]

**Q.28 a)** An alternating voltage  $V = V_m \sin \omega t$  applied to a series  $LCR$  circuit drives a current given by  $i = i_m \sin (\omega t + \phi)$ . Deduce an expression for the average power dissipated over a cycle.

*b)* For circuits used for transporting electric power, a low power factor implies large power loss in transmission. Explain. [CBSE (F) 2011]

Or

A voltage  $V = V_0 \sin \omega t$  is applied to a series  $LCR$  circuit. Derive the expression for the average power dissipated over a cycle.

Under what condition is *(i)* no power dissipated even though the current flows through the circuit, *(ii)* maximum power dissipated in the circuit?

[CBSE (AI) 2014]

**Q.29** The figure shows a series  $LCR$  circuit with  $L = 5.0$  H,  $C = 80 \mu\text{F}$ ,  $R = 40 \Omega$  connected to a variable frequency 240 V source. Calculate. [CBSE Delhi 2012]

**Q.30** A series circuit contains  $L$ ,  $C$  and  $R$  as circuit elements. Discuss current-voltage relation when A.C. is passed through such circuit and hence find the expression for the impedance of the circuit and resonant frequency of the circuit. [CBSE 2012]

**Q.31** Mention the two characteristics properties of the material suitable for making core of a transformer. [CBSE 2012]

**Q.32** State the underlying principle of a transformer. How is the large scale transmission of electric energy over long distances done with the use of transformers? [CBSE 2012]

**Q.33 a)** For a given A.C.,  $i = i_m \sin \omega t$ , show that the average power dissipated in a resistor  $R$  over a complete cycle is  $\frac{1}{2} i_m^2 R$ .

*b)* A light bulb is rated at 125W for a 250V A.C. supply. Calculate the resistance of the bulb. [CBSE 2013]

**Q.34** A series  $LCR$  circuit is connected to an A.C. source (200 V, 50 Hz). The voltages across the resistor, capacitor and inductor are respectively 200 V, 250 V and 250 V.

*i)* The algebraic sum of the voltages across the three elements is greater than the voltage of the source. How is this paradox resolved?

*ii)* Given the value of the resistance of  $R$  is  $40 \Omega$ , calculate the current in the circuit. [CBSE (F) 2013]

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**Q.35** An inductor  $L$  of reactance  $X_L$  is connected in series with a bulb  $B$  to an a.c. source as shown in figure. Explain briefly how does the brightness of the bulb change when (i) number of turns of the inductor is reduced and (ii) a capacitor of reactance  $X_C = X_L$  is included in the circuit. [CBSE Delhi 2014]

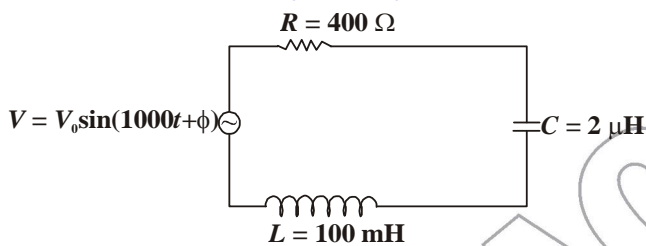
**Q.36** In a series  $LCR$  circuit with an ac source of effective voltage 50 V, frequency  $\nu = 50/\pi$  Hz,  $R = 300\Omega$ ,  $C = 20 \mu\text{F}$  and  $L = 1.0$  H. Find the rms current in the circuit. [CBSE (F) 2014]

**Q.37** In a series  $LCR$  circuit,  $V_L = V_C \neq V_R$ . What is the value of power factor for this circuit? [CBSE Panchkula 2015]

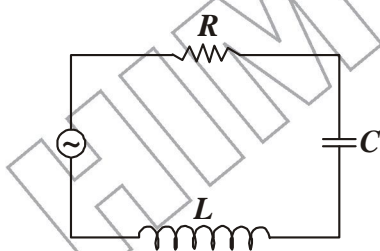
**Q.38** A resistor of  $100\Omega$  and a capacitor of  $100/\pi \mu\text{F}$  are connected in series to a 220V, 50 Hz A.C. supply.

- Calculate the current in the circuit.
- Calculate the (rms) voltage across the resistor and the capacitor. Do you find the algebraic sum of these voltages more than the source voltage? If yes, how do you resolve the paradox? [CBSE Chennai 2015]

**Q.39 a)** Determine the value of phase difference between the current and the voltage in the given series  $LCR$  circuit.



- Calculate the value of the additional capacitor which may be joined suitably to the capacitor  $C$  that would make the power factor of the circuit unity. [CBSE Allahabad 2015]



- The angular frequency of the source which drives the circuit at resonance.
- The current at the resonating frequency.
- The r.m.s. potential drop across the capacitor at resonance.

**Q.40** A group of students while coming from the school noticed a box marked "Danger H.T. 2200 V" at a substation in the main street. They did not understand the utility of a such a high voltage, while they argued, the supply was only 220 V. They asked their teacher this question the next day. The teacher thought it to be

an important question and therefore explained to the whole class.

Answer the following questions:

- What device is used to bring the high voltage down to low voltage of A.C. current and what is the principle of its working?
- Is it possible to use this device for bringing down the high D.C. voltage to the low voltage? Explain.
- Write the values displayed by the students and the teacher. [CBSE Delhi 2015]

**Q.41** Draw a schematic arrangement for winding of primary and secondary coils in a transformer with the two coils on separate limbs of the core. State its underlying principle and find the relation between the primary and secondary voltages in terms of the number of turns of the primary and secondary windings. How are the currents in the primary and secondary coils related to the voltages in the case of an ideal transformer? [CBSE 2016]

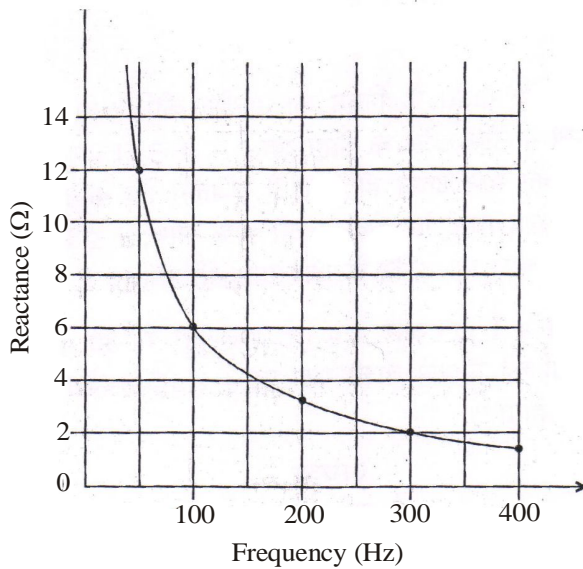
**Q.42** The teachers of Geeta's school took the students on a study trip to a power generating station, located nearly 200 km away from the city. The teacher explained that electrical energy is transmitted over such a long distance to their city, in the form of alternating current (ac) raised to a high voltage. At the receiving end in the city, the voltage is reduced to operate the devices. As a result the power loss is reduced. Geeta listened to the teacher and asked questions about how the ac is converted to a higher or lower voltage.

- Name the device used to change the alternating voltage to a higher or lower value. State one cause for power dissipation in this device.
- Explain with an example, how power loss is reduced if the energy is transmitted over long distances as an alternating current rather than a direct current.
- Write two values each shown by teachers and Geeta. [CBSE 2018]

**Q.43 a)** Draw the diagram of a device which is used to decrease high ac voltage into a low ac voltage and state its working principle. Write four sources of energy loss in this device.

- A small town with a demand of 1200 kW of electric power at 220 V is situated 20 km away from an electric plant generating power at 440V. The resistance of the two wire line carrying power is  $0.5 \Omega$  per km. The town gets the power from the line through a 4000-220V step-down transformer at a sub-station in the town. Estimate the line power loss in the form of heat. [CBSE 2019]

**Q.46** The figure shows the graphical variation of the reactance of a capacitor with frequency of *ac* source.



- Find the capacitance of the capacitor.
- An ideal inductor has the same reactance at 100 Hz frequency as the capacitor has at the same frequency. Find the value of inductance of the inductor.
- Draw the graph showing the variation of the reactance of this inductor with frequency.

[CBSE 2020]

**Q.44** What is the impedance of a capacitor of capacitance *C* in an *ac* circuit using source of frequency *n* Hz ?

[CBSE 2020]

*Or*

What is the value of impedance of a resonant series *LCR* circuit ?

[CBSE 2020]

**Q.45** Draw the graph showing variation of the value of the induced *e.m.f.* as a function of rate of change of current flowing through an ideal inductor.

[CBSE 2020]

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- Q.1** What is the ratio of speed of  $\gamma$ -rays and radiowaves in vacuum? [CBSE 2001]
- Q.2** What is the ratio of speed of  $\gamma$ -rays and radiowaves in vacuum? [CBSE 2001]
- Q.3** Which part of the electromagnetic spectrum is used in operating a RADAR? [CBSE 2004, 2010]
- Q.4** Find the wavelength of electromagnetic waves of frequency  $5 \times 10^9$  Hz in free space. Give its two application. [CBSE 2004]
- Q.5** Why are microwaves used in RADAR? [CBSE 2004]
- Q.6** Find the wavelength of electromagnetic waves of frequency  $6 \times 10^{12}$  Hz in free space. Give its two applications. [CBSE 2004, 2011]
- Q.7** Name the part of electromagnetic spectrum which is used for taking photographs of earth under foggy conditions from great heights. [CBSE 2004]
- Q.8** Name the electromagnetic waves that have frequency greater than those of ultraviolet light but less than those of gamma rays? [CBSE 2004]
- Q.9** Name the part of the electromagnetic spectrum of wavelength  $10^2$  m and mention its one application. [CBSE 2005, 2008]
- Q.10** What is meant by the transverse nature of electromagnetic waves? Draw a diagram showing the propagation of an electromagnetic wave along X-direction, indicating clearly the direction of oscillating electric and magnetic field associating with it. [CBSE 2008]
- Q.11** The oscillating magnetic field in a plane electromagnetic wave is given by  

$$B_y = (8 \times 10^{-6}) \sin[2 \times 10^{11} t + 300 \pi x] T$$
**i)** Calculate the wavelength of the electromagnetic wave.  
**ii)** Write down the expression for the oscillating electric field. [CBSE Delhi 2008]
- Q.12** The oscillating magnetic field in a plane electromagnetic wave is given by  

$$B_y = (8 \times 10^{-6}) \sin [2 \times 10^{11}, t + 300 \pi x] T$$
**i)** Calculate the wavelength of the electromagnetic wave.  
**ii)** Write down the expression for the oscillating electric field. [CBSE Delhi 2008]
- Q.13** Identify the part of the electromagnetic spectrum to which the following wavelengths belong :
- i)**  $10^{-1}$  m      **ii)**  $10^{-12}$  m      [CBSE 2008]
- Q.14** Name the part of the electromagnetic spectrum of wavelength  $10^{-2}$  m and mention its own application. [CBSE 2008]
- Q.15** Identify the following electromagnetic radiation as per the wavelengths given below  
**a)**  $10^{-3}$  m      **b)**  $10^{-3}$  nm      **c)** 1 nm  
 Write one application of each. [CBSE 2008]
- Q.16** Identify the following electromagnetic radiations as per the frequencies given below:  
**a)**  $10^{20}$  Hz      **b)**  $10^9$  Hz      **c)**  $10^{11}$  Hz.  
 Write one application of each. [CBSE 2008]
- Q.17** Name the part of the electromagnetic spectrum of wavelength  $10^{-2}$  m and mention its one application. [CBSE 2008]
- Q.18** Name the part of the electromagnetic spectrum of wavelength  $10^2$  m and mention its one application. [CBSE 2005, 2008]
- Q.19** Special devices, like the klystron valve or the magnetron valve, are used for production of electromagnetic waves. Name the waves and also write one of its application. [CBSE 2008]
- Q.20** Answer the following questions :
- a)** Long distance radio broadcasts use short wave bands. Why ?  
**b)** It is necessary to use satellite for long distance T. V. transmission. Why ?  
**c)** Optical and radio telescopes are built on ground but X-ray astronomy is possible only from the satellite orbiting the earth. Why ? [CBSE 2009]  
**d)** The small ozone layer on top of the stratosphere is crucial for human survival. Why ? [CBSE 2009]  
**e)** If the earth did not have any atmosphere, would its average surface temperature be higher or lower than what it is now ?
- Q.21** Write the following radiation in ascending order in respect of their frequency: x-rays, microwave, ultraviolet rays and radiowaves and gamma rays. [CBSE 2010]
- Q.22** Which of the following have shortest wavelength? Microwaves, X-rays, ultraviolet rays. [CBSE 2010]
- Q.23** Which part of the electromagnetic spectrum is absorbed from the sunlight by ozone layer? [CBSE 2010]

- Q.24** Which part of the electromagnetic spectrum is absorbed from sunlight by ozone layer? [CBSE Delhi 2010]
- Q.25** Name the part of the electromagnetic spectrum whose wavelength lies in the range  $10^{-10}$ m. Give its one use. [CBSE (AI) 2010]
- Q.26** A parallel plate capacitor is being charged by a time varying current. Explain briefly how Ampere's circuital law is generalized to incorporate the effect due to the displacement current. [CBSE 2011]
- Q.27** A plane electromagnetic wave travels in vacuum along z-direction. What can you say about the direction of electric and magnetic field vectors? [CBSE 2011]
- Q.28** Name the electromagnetic radiations used for studying the crystal structure of solids? [CBSE 2011]
- Q.29** a) How are infrared waves produced? Why are these referred to as heat waves?  
b) What do you understand by the statement. "Electromagnetic waves transport momentum"? [CBSE 2008, 2011]
- Q.30** When an ideal capacitor is charged by a d.c. battery. How does one explain this based on the concept of displacement current? [CBSE 2012]
- Q.31** Explain briefly how electromagnetic waves are produced by an oscillating charge. How is the frequency of the e.m. waves produced related to that of the oscillating charge? [CBSE 2012]
- Q.32** What are the directions of electric and magnetic field vectors relative to each other and relative to the direction of propagation of electromagnetic waves? [CBSE 2012]
- Q.33** The speed of an electromagnetic wave in a material medium is given by  $v = \frac{1}{\sqrt{\mu\epsilon}}$ ,  $\mu$  being the permeability of the medium and  $\epsilon$  its permittivity. How does its frequency change? [CBSE (AI) 2012]
- Q.34** Name the physical quantity which remains same for microwaves of wavelength 1mm UV radiations of 1600 Å in vacuum. [CBSE 2012]
- Q.35** A capacitor, made of two parallel plates each of plate area  $A$  and separation  $d$ , is being charged by an external ac source. Show that the displacement current inside the capacitor is the same as the current charging the capacitor. [CBSE 2013]
- Q.36** A capacitor has been charged by a d.c. source. What are the magnitudes of conduction and displacement currents, when it is fully charged? [CBSE 2013]
- Q.37** How are the magnitudes of electric and magnetic field related to the velocity of the e.m. wave? [CBSE 2013]
- Q.38** a) How are electromagnetic wave produced by oscillating charges?  
b) State clearly how a microwave oven works to heat up a food item containing water molecules.  
c) Why are microwaves found useful for the radar systems in aircraft navigation? [CBSE (F) 2013]
- Q.39** Welders wear special goggles or face masks with glass windows to protect their eyes from electromagnetic radiations. Name the radiations and write the range of their frequency. [CBSE 2013]
- Q.40** Why are microwaves found useful for the radar systems in aircraft navigation? [CBSE 2013]
- Q.41** Considering the case of a parallel plate capacitor being charged, show how one is required to generalise Ampere's circuital law to include the term due to displacement current. [CBSE (AI) 2014]
- Q.42** a) How does oscillating charge produce electromagnetic waves?  
b) Sketch a schematic diagram depicting oscillating electric and magnetic fields of an em wave propagating along +z-direction. [CBSE(F) 2014]
- Q.43** To which part of the electromagnetic spectrum does a wave of frequency  $5 \times 10^{19}$  Hz belong? [CBSE (AI) 2014]
- Q.44** Answer the following:  
a) Name the em waves which are suitable for radar systems used in aircraft navigation. Write the range of frequency of these waves.  
b) If the earth did not have atmosphere, would its average surface temperature be higher or lower than what it is now? Explain.  
c) An em wave exerts pressure on the surface on which it is incident. Justify. [CBSE Delhi 2014]
- Q.45** Answer the following:  
a) Name the em waves which are used for the treatment of certain forms of cancer. Write their frequency range.  
b) Thin ozone layer on top of stratosphere is crucial for human survival. Why?  
c) Why is the amount of the momentum transferred by the em waves incident on the surface so small? [CBSE Delhi 2014]
- Q.46** Why does a galvanometer when connected in series with a capacitor show a momentary deflection, when it is being charged or discharged?  
How does this observation lead to modifying the Ampere's circuital law? Hence write the generalised expression of Ampere's law. [CBSE (F) 2015]

**Q.47** Write the expression for the generalised form of Ampere's circuital law. Discuss its significance and describe briefly how the concept of displacement current is explained through charging/discharging of a capacitor in an electric circuit.

[CBSE Allahabad 2015]

**Q.48** Arrange the following electromagnetic waves in the order of their increasing wavelength:

- i)  $\gamma$  - rays                      ii) Microwaves  
iii) x-rays                          iv) Radio waves

How are infra-red waves produced? What role does infra-red radiation play in (i) maintaining the earth's warmth and (ii) physical therapy? [CBSE 2015]

**Q.49 a)** Which one of the following electromagnetic radiations has least frequency:

UV radiations, X-rays, Microwaves?

**b)** How do you show that electromagnetic waves carry energy and momentum?

**c)** Write the expression for the energy density of an electromagnetic wave propagating in free space.

[CBSE Bhubaneshwer 2015]

**Q.50** Name the parts of the electromagnetic spectrum which is

- i) suitable for radar systems used in aircraft navigation.  
ii) used to treat muscular strain.  
iii) used as a diagnostic tool in medicine.

Write in brief, how these waves can be produced.

[CBSE Delhi 2015]

**Q.51** Name the electromagnetic radiations used for

- a) Water purification and b) Eye surgery.

[CBSE 2018]

**Q.52** Do electromagnetic waves carry energy and momentum ?

[CBSE 2019]

**Q.53 i)** How are infrared waves produced ? Write their one important use.

ii) The thin ozone layer on top of the stratosphere is crucial for human survival. Why ? [CBSE 2019]

**Q.54** Displacement current exists only when

- (A) electric field is changing.  
(B) magnetic field is changing.  
(C) electric field is not changing.  
(D) magnetic field is not changing. [CBSE 2020]

**Q.55** Electromagnetic waves used as a diagnostic tool in medicine are

- (A) X-rays.                              (B) ultraviolet rays.  
(C) infrared radiation.              (D) ultrasonic

[CBSE 2020]

**Q.56** Which of the following electromagnetic waves has (a) minimum frequency ? Write one use of each of these two waves.

Infrared waves, Microwaves,  $\gamma$ -rays and X-rays.

[CBSE 2020]

# HIM ACADEMY HAMIRPUR (HP)

## Selections -2019

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**13 Selections in MBBS-2020**

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**NIT 17**

PANKAJ IIT Hyderabad Mechanical, AVISHRANT NIT-HMR Qualified JEE Advanced, RISHAV NIT-HMR, ANANYA NIT-HMR, RAJESH NIT-HMR, ANCHAL NIT-HMR, NISHANT NIT-HMR, NIKHIL NIT-HMR, KANAL NIT-HMR, AKSHAT NIT-HMR, AVINASH NIT-HMR, AJMAN NIT-HMR, SHEETAL NIT-HMR

**MBBS 21**

SANCHITA MBBS-GMC, AKHIL MBBS-GMC, APPORVA MBBS-GMC, KAVITA MBBS-TMC, RAJAT MBBS-TMC, ANUJ MBBS-HMR, MRIDUL MBBS-HMR, CHIRANJEEV MBBS-HMR, RITIKA MBBS-HMR, ANUSH NIT-HMR, ADITYA MBBS-HMR, PRIYA MBBS-HMR, GANESH MBBS-HMR, SAKSHI MBBS-HMR, MUSKAN MBBS-HMR, SHWALI MBBS-HMR, SHWETA MBBS-HMR, ONLY MBBS-HMR, YASHIKA MBBS-HMR, SHREYAS MBBS-HMR

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**Q.1** Derive mirror formula. [CBSE 1997]

**Q.2** The refractive index of a material of a concave lens is  $n_1$ . It is immersed in a medium of refractive index  $n_2$ . A parallel beam of light is incident on the lens. Trace the path of emergent ray when

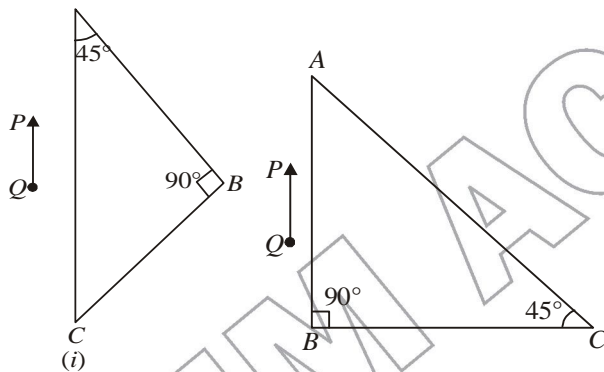
- i)  $n_1 = n_2$       ii)  $n_2 > n_1$       iii)  $n_2 < n_1$ .  
[CBSE 2001]

**Q.3** Draw a graph to show variation of angle of deviation  $\delta$  with that of angle of incidence  $i$  for a monochromatic ray of light passing through a glass prism of reflecting

angle  $A$ . Hence deduce the relation  $\mu = \frac{\sin\left(\frac{A + \delta_m}{2}\right)}{\sin A/2}$ .

[CBSE 2003, 2009]

**Q.4** A right-angled crown glass prism with critical angle  $41^\circ$  is placed before an object,  $PQ$  in two positions as shown in the figures (i) and (ii). Trace the paths of the rays from  $P$  and  $Q$  passing through the prisms in the two cases. [CBSE (AI) 2005]



**Q.5** A ray of light passing through an equilateral triangular prism from air undergoes minimum deviation when angle of incidence is  $\frac{3}{4}$ th of the angle of prism. Calculate the speed of light in the prism. [CBSE Delhi 2008]

**Q.6** In the fig. given below, three light rays red ( $R$ ), green ( $G$ ) and blue ( $B$ ) are incident on an isosceles right-angled prism  $abc$  at face  $ab$ . Explain with reason, which ray of light will be transmitted through the face  $ac$ . The refractive index of the prism for red, green, blue light are 1.39, 1.44, 1.47 respectively. Trace the path of rays after passing through face  $ab$ .

[CBSE (AI) 2008, Delhi 2009, 2011, 2013]

**Q.7** Two lenses of power 10 D and  $-5$  D are placed in contact.

- i) Calculate the power of lens combination.  
ii) Where should an object be held from the lens, so as to obtain a virtual image of magnification 2?

[CBSE (AI) 2008 C]

**Q.8** An object is placed at the principal focus of a concave lens of focal length  $f$ . Where will its image be formed? [CBSE (AI) 2008]

**Q.9** A converging lens of refractive index 1.5 is kept in a liquid medium having same refractive index. What is the focal length of the lens in this medium? [CBSE Delhi 2008]

**Q.10** A diverging lens of focal length ' $F$ ' is cut two into two identical parts, each forming a plano concave lens. What is the focal length of each part? [CBSE (AI) 2008]

**Q.11** A ray of light falls on a triangular glass prism in such a way that the deviation of the emergent ray is minimum for the prism.

Draw the ray diagram for this case and write the relation between the angle of incidence and angle of emergence.

[CBSE Delhi 2008 C]

**Q.12** Define magnifying power of a compound microscope. Draw a ray diagram to show the image formation in a compound microscope. Find an expression for its magnifying power. [CBSE 2008]

**Q.13** What is telescope? Draw a ray diagram for astronomical telescope showing the formation of final image at infinity and obtain expression for magnifying power in normal adjustment position. [CBSE, 2008, 2009, 2012, 2013]

**Q.14** Draw a plot showing the variation of power of a lens with the wavelength of the incident light.

[CBSE (AI) 2008]

**Q.15** A compound microscope consists of an objective lens of focal length 2.0 cm and an eyepiece of focal length 6.25 cm separated by a distance of 15 cm. How far from the objective should an object be placed in order to obtain the final image at (i) the least distance of distinct vision ( $D = 25$  cm) and (ii) infinity.

What is the magnifying power of the microscope in each case?

[CBSE (AI) 2008]

**Q.16** Why must both the objective and eye-piece of a compound microscope have short focal lengths?

[CBSE (F) 2008, (AI) 2010]

**Q.17** When viewing through a compound microscope, our eyes should be positioned not on the eye-piece but a short distance away from it for best viewing, why? How much should be that short distance between the eye and eye-piece? [CBSE (F) 2008]

**Q.18** You are given following three lenses. Which two lenses will you use as eyepiece and as an objective to construct an astronomical telescope?

Lenses	Power	Aperture
$L_1$	3 D	8 cm
$L_2$	6 D	1 cm
$L_3$	10 D	1 cm

[CBSE Delhi 2009]

**Q.19** Draw a ray diagram for formation of image of a point object by a thin double convex lens having radii of curvature  $R_1$  and  $R_2$ . Hence derive lens maker's formula for a double convex lens. State the assumptions made and sign convention used. [CBSE 2013, 2009]

**Q.20** A converging lens has a focal length of 20 cm in air. It is made of a material of refractive index 1.5. If it is immersed in water of refractive index  $4/3$ , what will be the new focal length? [CBSE (F) 2010]

**Q.21** A converging and a diverging lens of equal focal lengths are placed co-axially in contact. Find the power and the focal length of the combination. [CBSE (AI) 2010]

**Q.22** The radii of curvature of the faces of a double convex lens are 10 cm and 15 cm. If the focal length of the lens is 12 cm, find the refractive index of the material of the lens. [CBSE Delhi 2010]

**Q.23** An illuminated object and a screen are placed 90 cm apart. Determine the focal length and nature of the lens required to produce a clear image on the screen, twice the size of the object. [CBSE (AI) 2010]

**Q.24** Out of blue and red light which is deviated more by a prism? Give reason. [CBSE 2010]

**Q.25** An astronomical telescope uses two lenses of powers 10 D and 1 D. What is its magnifying power in normal adjustment? [CBSE (AI) 2010]

**Q.26** When monochromatic light travels from one medium to another, its wavelength changes but frequency remains the same. Explain. [CBSE Delhi 2011]

**Q.27** A convex lens made up of glass of refractive index 1.5 is dipped, in turn, in (i) a medium of refractive index 1.65, (ii) a medium of refractive index 1.33.

a) Will it behave as a converging or a diverging lens in the two cases? [CBSE (AI) 2011]

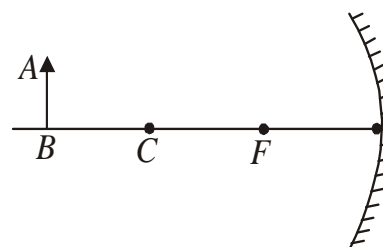
b) How will its focal length change in the two media? [CBSE (AI) 2011]

**Q.28** Two convex lenses of same focal length but of aperture  $A_1$  and  $A_2$  ( $A_2 < A_1$ ), are used as the objective lenses in two astronomical telescopes having identical eyepieces. What is the ratio of their resolving power? Which telescope will you prefer and why? Give reason. [CBSE Delhi 2011]

**Q.29** A compound microscope uses an objective lens of focal length 4 cm and eyepiece lens of focal length 10 cm. An object is placed at 6 cm from the objective lens. Calculate the magnifying power of the compound microscope. Also calculate the length of the microscope. [CBSE (AI) 2011]

**Q.30** Mention one practical application of optical fibres? [CBSE 2011]

**Q.31** An object AB is kept in front of a concave mirror as shown in the figure. [CBSE (AI) 2012]



i) Complete the ray diagram showing the image formation of the object.

ii) How will the position and intensity of the image be affected if the lower half of the mirror's reflecting surface is painted black?

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**Q.32** Deduce the relation  $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$  for two thin lenses kept in contact coaxially. [CBSE 2012]

**Q.33** How does focal length of a lens change when red light incident on it is replaced by violet light? Give reason for your answer. [CBSE (F) 2012]

**Q.34** You are given three lenses  $L_1$ ,  $L_2$  and  $L_3$  each of focal length 20 cm. An object is kept at 40 cm in front of  $L_1$ , as shown. The final real image is formed at the focus 'F' of  $L_3$ . Find the separations between  $L_1$ ,  $L_2$  and  $L_3$ . [CBSE (AI) 2012]

**Q.35** Trace the path of a ray of light passing through a glass prism (ABC) as shown in the figure. If the refractive index of glass is  $\sqrt{3}$ , find out of the value of the angle of emergence from the prism. [CBSE (F) 2012]

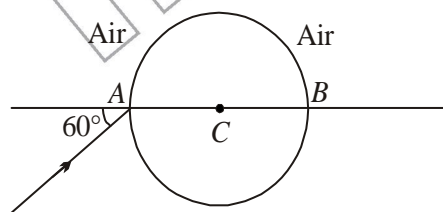
**Q.36** How is the working of a telescope different from that of a microscope? [CBSE Delhi 2012]

**Q.37** A small telescope has an objective lens of focal length 150 cm and an eye piece of focal length 5cm. If this telescope is used to view a 100m high tower 3 km away, find the height of the final image when it is formed 25 cm away from the eye piece. [CBSE Delhi 2012]

**Q.38** A ray of monochromatic light passes from medium (1) to medium (2). If the angle of incidence in medium (1) is  $\theta$  and the corresponding angle of refraction in medium (2) is  $\theta/2$ , which of the two media is optically denser? Give reason. [CBSE Delhi (F) 2013]

**Q.39** Write the relation between refractive index and critical angle for a given pair of optical media. [CBSE 2013]

**Q.40** A ray of light falls on a transparent sphere with centre C as shown in the figure. The ray emerges from the sphere parallel to the line AB. Find the angle of refraction at A if refractive index of the material of the sphere is  $\sqrt{3}$ .



[CBSE (F) 2014]

**Q.41** A biconvex lens made of a transparent material of refractive index 1.25 is immersed in water of refractive index 1.33. Will the lens behave as a converging lens? Give reason. [CBSE (AI) 2014]

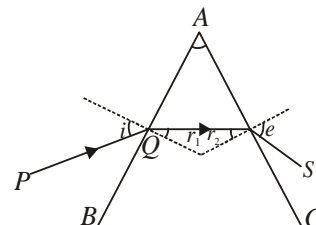
**Q.42** A convex lens of focal length 20 cm is placed coaxially with a convex mirror of radius of curvature 20 cm. The two are kept at 15 cm from each other. A point object lies 60 cm in front of the convex lens. Draw a ray diagram to show the formation of the image by the combination. Determine the nature and position of the image formed. [CBSE (AI) 2014]

**Q.43** A convex lens of focal length 20 cm is placed coaxially with a convex mirror of radius of curvature 20 cm. The two are kept 15 cm apart. A point object is placed 40 cm in front of the convex lens. Find the position of the image formed by this combination. Draw the ray diagram showing the image formation. [CBSE (AI) 2014]

**Q.44** A convex lens of focal length 20 cm is placed coaxially with a concave mirror of focal length 10 cm at a distance of 50 cm apart from each other. A beam of light coming parallel to the principal axis is incident on the convex lens. Find the position of the final image formed by this combination. Draw the ray diagram showing the formation of the image. [CBSE (AI) 2014]

**Q.45** A convex lens is placed in contact with a plane mirror. A point object at a distance of 20 cm on the axis of this combination has its image coinciding with itself. What is the focal length of the lens? [CBSE (Delhi) 2014]

**Q.46** Figure shows a ray of light passing through a prism. If the refracted ray QR is parallel to the base BC, show that (i)  $r_1 = r_2 = A/2$ , (ii) angle of minimum deviation,  $D_m = 2i - A$ . [CBSE (F) 2014]



**Q.47** A compound microscope has an objective of focal length 1.25 cm and eyepiece of focal length 5 cm. A small object is kept at 2.5 cm from the objective. If the final image formed is at infinity, find the distance between the objective and the eyepiece. [CBSE (F) 2014]

**Q.48** The total magnification produced by a compound microscope is 20. The magnification produced by the eye piece is 5. The microscope is focussed on a certain object. The distance between the objective and eyepiece is observed to be 14 cm. If least distance of distinct vision is 20 cm, calculate the focal length of the objective and the eye piece. [CBSE Delhi 2014]

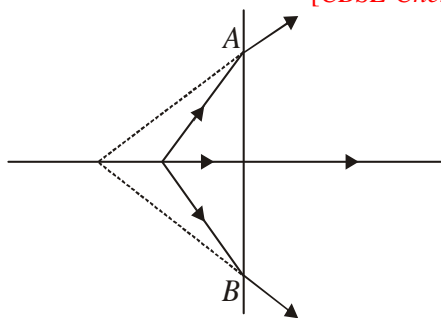
**Q.49** Light of wavelength 5000 Å propagating in air gets partly reflected from the surface of water. How will

the wavelengths and frequencies of the reflected and refracted light be affected? [CBSE Delhi 2015]

**Q.50** Use mirror equation to show that convex mirror always produces a virtual image independent of the location of the object. [CBSE Patna 2015]

**Q.51** When light travels from an optically denser medium to a rarer medium, why does the critical angle of incidence depend on the colour of light? [CBSE Ajmer 2015]

**Q.52** The line  $AB$  in the ray diagram represents a lens. State whether the lens is convex or concave. [CBSE Chennai 2015]

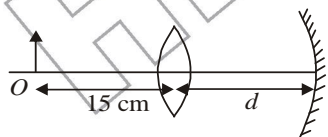


**Q.53** A biconvex lens of glass of refractive index 1.5 having focal length 20 cm is placed in a medium of refractive index 1.65. Find its focal length. What should be the value of the refractive index of the medium in which of lens should be placed so that it acts as a plane sheet of glass? [CBSE Bhubaneswar 2015]

**Q.54** The focal length of an equiconvex lens is equal to the radius of curvature of either face. What is the value of refractive index of the material of the lens? [CBSE Panchkula 2015]

**Q.55** A concave lens of refractive index 1.5 is immersed in a medium of refractive index 1.65. What is the nature of the lens? [CBSE Delhi 2015]

**Q.56** Calculate the distance  $d$ , so that a real image of an object at  $O$ , 15 cm in front of a convex lens of focal length 10 cm be formed at the same point  $O$ . The radius of curvature of the mirror is 20 cm. Will the image be inverted or erect?



Or

An object is placed 15 cm in front of a convex lens of focal length 10 cm. Find the nature and position of the image formed. Where should a concave mirror of radius of curvature 20 cm be placed so that the final image is formed at the position of the object itself? [CBSE Panchkula 2015]

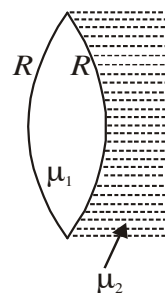
**Q.57** 1.25 cm and 5 cm to design a compound microscope. If it is desired to have a magnification of 30, find out the separation between the objective and the eyepiece. [CBSE Allahabad 2015]

**Q.58** The radii of curvature of both are surfaces of a lens are equal. If one of the surfaces is made plane by grinding, then will the focal length of lens change? Will the power change? [CBSE Guwahati 2015]

**Q.59** An object is placed 40 cm from a convex lens of focal length 30 cm. If a concave lens of focal length 50 cm is introduced between the convex lens and image formed such that it is 20 cm from the convex lens, find the change in the position of the image. [CBSE Chennai 2015]

**Q.60** A convex lens of focal length  $f_1$  is kept in contact with a concave lens of focal length 50 cm introduced between the convex lens and the image formed such that it is 20 cm from the convex lens, find the change in the position of the image. [CBSE Chennai 2015]

**Q.61** A biconvex lens with its two faces of equal radius of curvature  $R$  is made of a transparent medium of refractive index  $\mu_1$ . It is kept in contact with a medium of refractive index  $\mu_2$  as shown in the figure.



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- a) Find the equivalent focal length of the combination.  
 b) Obtain the condition when this combination acts as a diverging lens.  
 c) Draw the ray diagram for the case  $\mu_1 > (\mu_2 = 1)/2$ , when the object is kept far away from the lens. Point out the nature of the image formed by the system.

[CBSE Patna 2015]

**Q.62** Draw a ray diagram to show how a right isosceles prism made of crown glass can be used to obtain the inverted image. [CBSE Guwahati 2015]

**Q.63** A ray of light incident on one of the faces of a glass prism of angle 'A' has angle of incidence  $2A$ . The refracted ray in the prism strikes the opposite face which is silvered, the reflected ray from it retracing its path. Trace the ray diagram and find the relation between the refractive index of the material of the prism and the angle of the prism. [CBSE Chennai 2015]

**Q.64 a)** A ray of light is incident normally on the face  $AB$  of a right-angled glass prism of refractive index  $\mu_g = 1.5$ . The prism is partly immersed in a liquid of unknown refractive index. Find the value of refractive index of the liquid so that the ray grazes along the face  $BC$  after refraction through the prism.

b) Trace the path of the rays if it were incident normally on the face  $AC$ . [CBSE Ajmer 2015]

**Q.65 a)** Draw a ray diagram showing image formation in a compound microscope. Define the term 'limit of resolution' and name the factors on which it depends. How is it related to resolving power of a microscope?

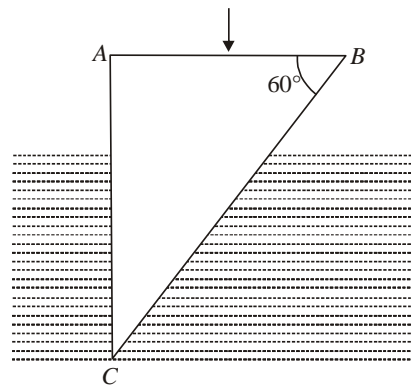
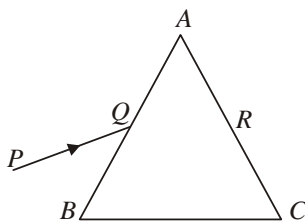
b) Suggest two ways by which the resolving power of a microscope can be increased.

c) "A telescope resolves whereas a microscope magnifies." Justify this statement.

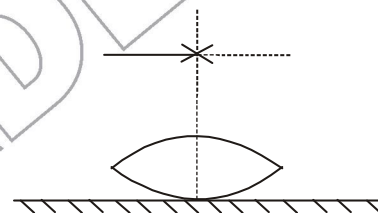
[CBSE (F) 2015]

**Q.66** A ray  $PQ$  incident on the face  $AB$  of a prism  $ABC$ , as shown in the figure, emerges from the face  $AC$  such that  $AQ = AR$ . Draw the ray diagram showing the passage of the ray through the prism. If the angle of the prism is  $60^\circ$  and refractive index of the material of the prism is  $\sqrt{3}$ , determine the values of angle of incidence and angle of deviation.

[CBSE Panchkula 2015]



**Q.67** A symmetric biconvex lens of radius of curvature  $R$  and made of glass of refractive index 1.5, is placed on a layer of liquid placed on top of a plane mirror as shown in figure. An optical needle with its tip on the principal axis of the lens is moved along the axis until its real, inverted image coincides with the needle itself. The distance of the needle from the lens is measured to be  $x$ . On removing the liquid layer and repeating the experiment, the distance is found to be  $y$ . Obtain the expression for the refractive index of the liquid in terms of  $x$  and  $y$ . [CBSE 2018]



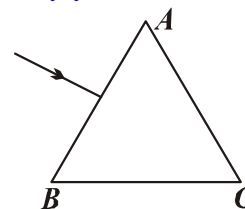
**Q.68 a)** Draw a ray diagram to show image formation when the concave mirror produces a real, inverted and magnified image of the object.

b) Obtain the mirror formula and write the expression for linear magnification. [CBSE 2018]

**Q.69** The figure shows a ray of light falling normally on the face  $AB$  of an equilateral glass prism having refractive

index  $\frac{3}{2}$  placed in water of refractive index  $\frac{4}{3}$ . Will

this ray suffer total internal reflection on striking the face  $AC$ . Justify your answer. [CBSE 2018]



**Q.70** How does the angle of minimum deviation of a glass prism vary if the incident violet light is replaced by red light? [CBSE 2019]

**Q.71** For paraxial rays, show that the focal length of a spherical mirror is one-half of its radius of curvature. [CBSE 2019]

- Q.72** An object is kept in front of a concave mirror of focal length 15 cm. The image formed is real and three times the size of the object. Calculate the distance of the object from the mirror. [CBSE 2019]
- Q.73** Calculate the radius of curvature of an equi-concave lens of refractive index 1.5, when it is kept in a medium of refractive index 1.4, to have a power of  $-5D$  ? [CBSE 2019]
- Q.74** An equilateral glass prism has a refractive index 1.6 in air. Calculate the angle of minimum deviation of the prism, when kept in a medium of refractive index  $4\sqrt{2}/5$ . [CBSE 2019]
- Q.75** For a higher resolving power of a compound microscope, the wavelength of light used should be \_\_\_\_\_. [CBSE 2020]
- Q.76** Out of red, blue and yellow lights, the scattering of \_\_\_\_\_ light is maximum. [CBSE 2020]
- Q.77** An object is kept 20 cm in front of a concave mirror of radius of curvature 60 cm. Find the nature and position of the image formed. [CBSE 2020]
- Q.78** What is the difference in the construction of an astronomical telescope and a compound microscope ? The focal lengths of the objective and eyepiece of a compound microscope are 1.25 cm and 5.0 cm, respectively. Find the position of the object relative to the objective in order to obtain an angular magnification of 30 when the final image is formed at the near point. [CBSE 2020]
- Q.79** a) Derive lens maker's formula for a biconvex lens.  
b) A point object is placed at a distance of 12 cm on the principal axis of a convex lens of focal length 10 cm. A convex mirror is placed coaxially on the other side of the lens at a distance of 10 cm. If the final image coincides with the object, sketch the ray diagram and find the focal length of the convex mirror. [CBSE 2020]

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- Q.1** Why is interference pattern not detected, when the two coherent sources are far apart ? [CBSE 1998]
- Q.2** No interference pattern is detected when two coherent sources are infinitely close to each other. Why ? [CBSE 1998]
- Q.3** In Young's doubled slit experiment, explain with reason in each case, how the interference pattern changes when  
*i)* width of the slits is doubled  
*ii)* separation between the slits is increased and  
*iii)* screen is moved away from the plane of slits. [CBSE 2004]
- Q.4** The distance between two slits in Young's interference experiment is 0.03 cm. The fourth bright fringe is obtained at a distance of 1 cm from central fringe on a screen placed at a distance of 1.5 m from slits. Calculate the wavelength of light used. [CBSE Delhi 2005]
- Q.5** Two polaroids are placed  $90^\circ$  to each other and the transmitted intensity is zero. What happens when one more polaroid is placed between these two bisecting the angle between them. Take intensity of unpolarised light  $I_0$ . How will the intensity of transmitted light vary on further rotating the third polaroid? [CBSE Delhi 2005, 2008]
- Q.6** What are coherent sources of light? Why are coherent sources required to produce interference of light? Give an example of interference in every day life. [CBSE Delhi 2007]
- Q.7** A slit of width ' $a$ ' is illuminated by light of wavelength, 700 nm. What will be the value of slit width ' $a$ ' when  
*a)* first minimum falls at an angle of diffraction  $30^\circ$ ?  
*b)* first maximum falls at an angle of diffraction  $30^\circ$ ? [CBSE Delhi 2007]
- Q.8** Draw the diagram to show the behaviour of plane wavefronts as they pass through  
*a)* Thin prism and *b)* a thin convex lens. [CBSE 2008]
- Q.9** If a plane wave front is incident on the prism, lens and concave mirror, then what is the nature of wavefront emerging out of these ? Explain. [CBSE 2008]
- Q.10** How is a wavefront defined? Using Huygen's construction draw a figure showing the propagation of a plane wave reflecting at the interface of the two media. Show that the angle of incidence is equal to angle of reflection. [CBSE Delhi 2018, 2008]
- Q.11** Can two identical and independent sodium lamps act as coherent sources? Give reason for your answer. [CBSE 2008]
- Q.12** A parallel beam of monochromatic light falls normally on a single narrow slit. How does the angular width of the principal maximum in the resulting diffraction pattern depend on the width of the slit? [CBSE (AI) 2008C]
- Q.13** How will the angular separation and visibility of fringes in Young's double slit experiment change when  
*i)* screen is moved away from the plane of the slits?  
*ii)* width of source slit is increased? [CBSE (AI) 2008]
- Q.14** A parallel beam of light of wavelength 600 nm is incident normally on a slit of width ' $a$ '. If the distance between the slit and the screen is 0.8 m and the distance of 2nd order maximum from the centre of the screen is 1.5 mm, calculate the width of the slit. [CBSE (AI) 2008]
- Q.15** 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. [CBSE Delhi 2008]
- Q.16** *a)* The light from a clear blue portion of the sky shows a rise and fall of intensity when viewed through a polaroid which is rotated. Describe, with the help of a suitable diagram, the basic phenomenon/process which occurs to explain this observation.  
*b)* Show how light reflected from a transparent medium gets polarised. Hence deduce Brewster's law.  
 Or  
 An unpolarised light is incident on the boundary between two transparent media. State the condition when the reflected wave is totally plane polarised. Find out the expression for the angle of incidence in this case. [CBSE (AI) 2008, Delhi 2014, Bhubneshwar 2015,]
- Q.17** State and explain Huygen's principle. [CBSE PSEB 2009, 2010, 2011, 2012]
- Q.18** If the angle between the pass axes of a polariser and analyser is  $45^\circ$ . Write the ratio of the intensities of original light and the transmitted light after passing through the analyser. [CBSE Delhi 2009]
- Q.19** What happens to the intensity of light when it is polarised ? [CBSE 2009]
- Q.20** A parallel beam of light of wavelength 500 nm falls on a narrow slit and the resulting diffraction pattern is observed on a screen 1 metre away. It is observed that the first minimum is at a distance of 2.5 mm from the centre of the screen, find the width of the slit. [CBSE (F) 2010]

**Q.21** Prove that for diffraction at a single slit, width of central maximum is twice as that of secondary maximum. What is the essential condition for diffraction of wave ?

Or

Prove that the central maxima is twice as wide as any other secondary maxima in diffraction at a single slit.

[CBSE 2011]

**Q.22** In the experiment on diffraction due to a single slit, show that

- i) the intensity of diffraction fringes decreases as the order (n) increases.
- ii) angular width of the central maximum is twice that of the first order secondary maximum.

[CBSE (F) 2011]

**Q.23** i) Light passes through two polaroids  $P_1$  and  $P_2$  with axis of  $P_2$  making an angle  $\theta$  with the pass axis of  $P_1$ . For what value of  $\theta$  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  $\beta$  with the pass axis of  $P_1$ . Find a value of  $\beta$  for which the intensity of

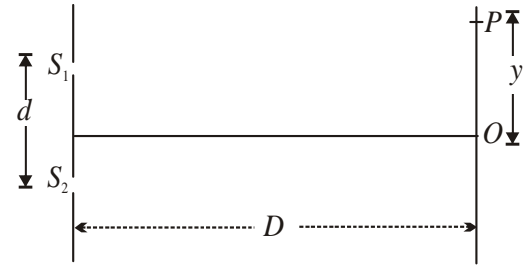
light emerging from  $P_2$  is  $\frac{I_0}{8}$ , where  $I_0$  is the intensity

of light on the polaroid  $P_1$ . [CBSE (F) 2011]

**Q.25** 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  $\frac{I_0}{4}$ .

[CBSE (F) 2011, 2012]



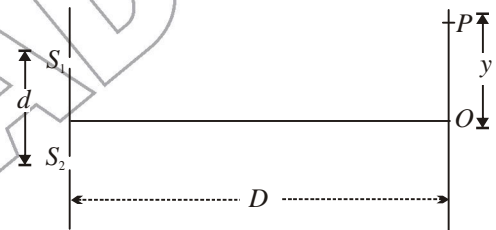
**Q.26a)** Describe briefly, with the help of suitable diagram, how the transverse nature of light can be demonstrated by the phenomenon of polarization of light. [CBSE (AI) 2014]

b) When unpolarized light passes from air to a transparent medium, under what condition does the reflected light get polarised? [CBSE Delhi 2011]

**Q.27** 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  $\frac{I_0}{4}$ .

[CBSE 2012, (F) 2011]



प्रदेश की सर्वश्रेष्ठ किताबें

333

लाओ  
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- Q.28** Use Huygen's geometrical construction to show the behaviour of a plane wavefront.  
*i)* passing through a biconvex lens  
*ii)* reflected by a concave mirror. [CBSE 2012]
- Q.29** Derive the conditions for constructive and destructive interference. [CBSE 2012]
- Q.30** Use Huygen's principle to explain the formation of diffraction pattern due to a single slit illuminated by a monochromatic source of light.  
 When the width of slit is made double the original width, how this affect the size and intensity of the central diffraction band? [CBSE Delhi 2012]
- Q.31** *a)* Why are coherent sources necessary to produce a sustained interference pattern?  
*b)* In Young's double slit experiment using monochromatic light of wavelength  $\lambda$ , the intensity of light at a point on screen is  $K$  units. Find out the intensity of light at a point where path difference is  $\lambda/3$ . [CBSE Delhi 2012]
- Q.32** A beam of light consisting of two wavelengths, 800 nm and 600 nm is used to obtain the interference fringes in a Young's double slit experiment on a screen placed 1.4 m away. If the two slits are separated by 0.28 mm, calculate the least distance from the central bright maximum where the bright fringes of the two wavelength coincide. [CBSE (AI) 2012]
- Q.33** How does the angular separation between fringes in single-slit diffraction experiment change when the distance of separation between the slit and screen is doubled? [CBSE 2012]
- Q.34** 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? [CBSE (AI) 2012,2018]
- Q.35** What is diffraction of light? Draw a graph showing the variation of intensity with angle in a single slit diffraction experiment. Write one feature which distinguishes the observed pattern from the double slit interference pattern. How would the diffraction pattern of a single slit be affected when:  
*i)* the width of the slit is decreased?  
*ii)* the monochromatic source of light is replaced by a source of white light? [CBSE 2013]
- Q.36** In what way is diffraction from each slit related to the interference pattern in a double slit experiment? [CBSE 2013]
- Q.37** Two wavelengths of sodium light 590 nm are used, in turn, to study the diffraction taking place at a single slit of aperture  $2 \times 10^{-4}$  m. The distance between the slit and the screen is 1.5 m. Calculate the separation between the positions of the first maximum of the diffraction pattern obtained in the two cases. [CBSE Delhi 2013]
- Q.38** Which of the following waves can be polarized *(i)* Heat waves *(ii)* Sound waves? Give reason to support your answer. [CBSE Delhi 2013]
- Q.39** *a)* What is linearly polarized light? Describe briefly using a diagram how sunlight is polarised.  
*b)* Unpolarised light is incident on a polaroid. How would the intensity of transmitted light change when the polaroid is rotated? [CBSE (AI) 2013]
- Q.40** *a)* How is a wavefront defined? Distinguish between a plane wavefront and a spherical wavefront. Using Huygen's constructions draw a figure showing the propagation of a plane wave refracting at a plane surface separating two media. Hence verify Snell's law of refraction.  
*b)* When a light wave travels from rarer to denser medium, explain the following, giving reasons:  
*i)* Is the frequency of reflected and refracted light same as the frequency of incident light?  
*ii)* Does the decrease in speed imply a reduction in the energy carried by light wave? [CBSE Delhi 2013]
- Q.41** A parallel beam of light of 500 nm falls on a narrow slit and the resulting diffraction pattern is observed on a screen 1 m away. It is observed that the first minimum is at a distance of 2.5 mm from the centre of the screen. Calculate the width of the slit. [CBSE (AI) 2013,(F) 2014]
- Q.42** For a single slit of width " $a$ ", the first minimum of the interference pattern of a monochromatic light of wavelength  $\lambda$  occurs at an angle of  $\frac{\lambda}{a}$ . At the same angle of  $\frac{\lambda}{a}$ , we get a maximum for two narrow slits separated by a distance " $a$ ". Explain. [CBSE (Delhi) 2014]
- Q.43** *a) i)* 'Two independent monochromatic sources of light cannot produce a sustained interference pattern'. Give reason.  
*ii)* Light waves each of amplitude " $a$ " and frequency " $\omega$ ", emanating from two coherent light sources superpose at a point. If the displacements due to these waves is given by  $y_1 = a \cos \omega t$  and  $y_2 = a \cos(\omega t + \phi)$  where  $\phi$  is the phase difference between the two, obtain the expression for the resultant intensity at the point. [CBSE (Delhi) 2014]
- Q.44** Use Huygen's principle to show how a plane wavefront propagates from a denser to rarer medium. Hence, verify Snell's law of refraction. [CBSE Allahabad 2015]
- Q.45** Intensity of light coming out of a polaroid does not

change irrespective of the orientation of the pass axis of the polaroid. Explain why? [CBSE 2015]

**Q.46 a)** Write the necessary conditions to obtain sustained interference fringes. [CBSE Patna 2015]

Also write the expression for the fringe width.

**b)** In Young's double slit experiment, plot a graph showing the variation of fringe width versus the distance of the screen from the plane of the slits keeping other parameters same. What information can one obtain from the slope of the curve?

**c)** What is the effect on the fringe width if the distance between the slits is reduced keeping other parameters same?

**Q.47** Find an expression for intensity of transmitted light when a polaroid sheet is rotated between two crossed polaroids. In which position of the polaroid sheet will the transmitted intensity be maximum? [CBSE Delhi 2015]

**Q.48** In the wave picture of light, intensity of light is determined by the square of the amplitude of the wave. What determines the intensity in the photon picture of light? [CBSE 2016]

**Q.49 i)** Derive Snell's law on the basis of Huygen's wave theory when light is travelling from a denser to a rarer medium.

**ii)** Draw the sketches to differentiate between plane wavefront and spherical wavefront. [CBSE 2016]

**Q.50** Define the term wave front. State Huygen's principle. Consider a plane wave front incident on a thin convex lens. Draw a proper diagram to show how the incident wave front traverses through the lens and after refraction focuses on the focal point of the lens, giving the shape of the emergent wave front.

*Or*

Explain the following, giving reasons :

**i)** When monochromatic light is incident on a surface separating two media, the reflected and refracted light both have the same frequency as the incident frequency.

**ii)** When light travels from a rarer to a denser medium, the speed decreases. Does this decrease in speed imply a reduction in the energy carried by the wave ?

**iii)** In the wave picture of light, intensity of light is determined by the square of the amplitude of the wave. What determines the intensity in the photon picture of light ? [CBSE 2016]

**Q.51 a)** In Young's double slit experiment, two slits are 1 mm apart and the screen is placed 1 m away from the slits. Calculate the fringe width when light of wavelength 500 nm is used.

**b)** What should be the width of each slit in order to obtain 10 maxima of the double slits pattern within

the central maximum of the single slit pattern ? [CBSE 2016]

**Q.52 a)** State Huygen's principle. Explain, using this principle, how a diffraction pattern is obtained on a screen due to a narrow slit on which a monochromatic beam coming from a source of light is incident normally.

**b)** Show that the angular width of the first diffraction band is half of that of the central band.

**c)** If monochromatic source of light is replaced by white light, what change would you observe in the diffraction pattern ? [CBSE 2016]

**Q.53 i)** State law of Malus.

**ii)** Draw a graph showing the variation of intensity ( $I$ ) of polarised light transmitted by an analyser with angle ( $\nu$ ) between polariser and analyser.

**iii)** What is the value of refractive index of a medium of polarising angle  $60^\circ$  ? [CBSE 2016]

**Q.54 a)** Explain why the intensity of light coming out of a polaroid does not change irrespective of the orientation of the pass axis of the polaroid.

**b)** State, using a proper diagram, the condition when unpolarized light incident on the boundary between two transparent media produces polarised light. Explain briefly.

Hence show that the angle of incidence ' $i_p$ ' is related to the refractive index  $\mu$  by the relation,  $\mu = \tan i_p$ .

[CBSE 2016]

**Q.55** How does an unpolarised light get linearly polarised when passed through a polaroid ? Explain briefly. When linearly polarised light is viewed through a second polaroid which is rotated through  $2\pi$ , show that the two maxima and minima can be seen. [CBSE 2016]

**Q.56** An unpolarised light is incident on the boundary between two transparent media. State the condition when the reflected wave is totally plane polarised. Find out the expression for angle of incidence in this case.

*Or*

Show using proper diagram how unpolarised light can be linearly polarised by reflection from a transparent glass surface. [CBSE 2018]

**Q.57** What kind of fringes do you expect to observe if white light is used instead of monochromatic light? [CBSE 2018]

**Q.58** If one of two identical slits producing interference is Young's experiment is covered with glass, so that the light intensity passing through it is reduced to 50%, find the ratio of the maximum and minimum intensity of the fringe in the interference pattern. [CBSE 2018]

**Q.59** What is wavefront ? State its relation with ray of light. [CBSE 2018]

- Q.60** Deduce the laws of reflection on the basis of Huygen's principle or wave theory. [CBSE 2018]
- Q.61** When a tiny circular obstacle is placed in the path of light from a distant source, a bright spot is seen at the centre of the obstacle. Explain why? [CBSE 2018]
- Q.62** In the diffraction due to a single slit experiment, the aperture of the slit is 3 mm. If monochromatic light of wavelength 620 nm is incident normally on the slit, calculate the separation between the first order minima and the 3<sup>rd</sup> order maxima on one side of the screen. The distance between the slit and the screen is 1.5 m [CBSE 2019]
- Q.63** Define the term wavefront. Using Huygen's wave theory, verify the law of reflection. [CBSE 2019]
- Q.64** In Young's double slit experiment, the path difference between two interfering waves at a point on the screen is  $\frac{5\lambda}{2}$ ,  $\lambda$  being wavelength of the light used. The \_\_\_\_\_ dark fringe will lie at this point. [CBSE 2020]

**Or**

- If one of the slits in Young's double slit experiment is fully closed, the new pattern has \_\_\_\_\_ central maximum in angular size. [CBSE 2020]
- Q.65** Unpolarised light passes from a rarer into a denser medium. If the reflected and the refracted rays are mutually perpendicular, the reflected light is linearly polarised \_\_\_\_\_ to the plane of incidence. [CBSE 2020]
- Q.66** A parallel beam of light of wavelength 500 nm falls on a narrow slit and the resulting diffraction pattern is obtained on a screen 1 m away. If the first minimum is formed at a distance of 2.5 mm from the centre of the screen, find the (i) width of the slit, and (ii) distance of first secondary maximum from the centre of the screen. [CBSE 2020]
- Q.67** What is a wavefront? How does it propagate? Using Huygens' principle, explain reflection of a plane wavefront from a surface and verify the laws of reflection. [CBSE 2020]

# 11

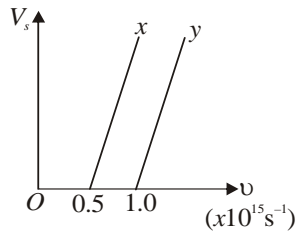
## CHAPTER

# Dual Nature of Radiation and Matter

- Q.1** What is the stopping potential applied to a photocell if the maximum kinetic energy of a photoelectron is 5eV? [CBSE 2001, 2000]
- Q.2** Does the stopping potential in photoelectric emission depend upon (i) the intensity of the incident radiation? (ii) the frequency of incident light. [CBSE 2005]
- Q.3** An  $\alpha$ -particle and a proton are accelerated from the state of rest through the same potential difference  $V$ . Find the ratio of de-Broglie wavelengths associated with them. [CBSE 2005]
- Q.4** With what purpose was famous Davisson - Germer experiment with electron performed? [CBSE 2006]
- Q.5** Radiations of frequency  $10^{15}$  Hz are incident on two photosensitive surfaces A and B. Following observations are recorded:  
Surface A : No photoemission takes place.  
Surface B : Photoemission takes place but photoelectrons have zero energy.  
Explain the above observations on the basis of Einstein's photoelectric equation. How will the observation with surface B change when wavelength of incident light is decreased? [CBSE Delhi 2007]
- Q.6** In a plot of photoelectric current versus anode potential, how does
- the saturation current vary with anode potential for incident radiations of different frequencies but same intensity?
  - the stopping potential vary for incident radiations of different intensities but same frequency?
  - the photoelectric current vary for different intensities but same frequency of incident radiations?
- [CBSE Delhi 2007]
- Q.7** Describe Davisson and Germer's experiment to demonstrate the wave nature of electrons. Draw a labelled diagram of apparatus used. [CBSE (AI) 2007, (F) 2014]
- Q.8** An electromagnetic wave of wavelength  $\lambda$  is incident on a photosensitive surface of negligible work function. If the photoelectrons emitted from the surface have the same de Broglie wavelength  $\lambda_B$ , prove that  $\lambda = \left(\frac{2mc}{h}\right)\lambda_B^2$ . [CBSE Delhi 2008]
- Q.9** How does the stopping potential applied to a photocell change, if the distance between the light source and the cathode of the cell is doubled? [CBSE (AI) 2008]
- Q.10** The following graph shows the variation of stopping potential  $V_s$  with the frequency ( $\nu$ ) of the incident radiation for two photosensitive metals X and Y.
- Which of the metals has larger threshold wavelength? Give reasons.
  - Explain giving reason which metal give out electrons having larger kinetic energy, for the same wavelength of the incident radiation.

iii) If the distance between the light source and metal X is halved, what will be the kinetic energy of electrons emitted due to this change? Give reason.

[CBSE 2008]



**Q.11** An electron and a proton has the same de Broglie wavelength associated with them. How are their kinetic energies related to each other? [CBSE Delhi 2008]

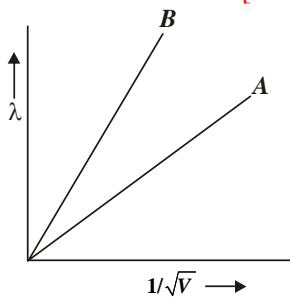
**Q.12** An electron and an alpha particle have the same de-Broglie wavelength associated with them. How are their kinetic energies related to each other? [CBSE 2008]

**Q.13** In Davisson and Germer experiment, state the observations which led to (i) show the wave nature of electrons and (ii) confirm the de-Broglie relation.

[CBSE 2008]

**Q.14** Two lines A and B shown in the graph represent the de Broglie wavelength ( $\lambda$ ) as a function of  $\frac{1}{\sqrt{V}}$  ( $V$  is the accelerating potential) for two particles having the same charge. Which of the two represents the particle of smaller mass?

[CBSE (AI) 2008]

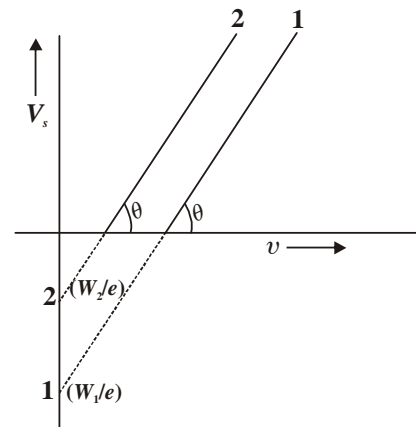


**Q.15** Deduce de Broglie wavelength of electron accelerated by a potential of  $V$  volt. Draw a schematic diagram of a localized wave describing the wave nature of moving electron.

[CBSE 2014, (F) 2009]

**Q.16** Plot a graph showing the variation of stopping potential with the frequency of incident radiation for two different photosensitive materials having work functions  $W_1$  and  $W_2$  ( $W_1 > W_2$ ). On what factors does the (i) slope and (ii) intercept of the lines depend?

[CBSE Delhi 2010]



**Q.17** Write Einstein's photoelectric equation. State clearly the three salient features observed in photoelectric effect which can be explained on the basis of this equation.

[CBSE (AI) 2010]

**Q.18** An electron is accelerated through a potential difference of 100 V. What is the de Broglie wavelength associated with it? To which part of the electromagnetic spectrum does this value of wavelength correspond?

[CBSE Delhi 2010]

**Q.19** Define the term 'threshold frequency' in relations to photoelectric effect.

[CBSE 2011]

**Q.20** Show the variation of photocurrent with collector plate potential for different frequencies but same intensity of incident radiation.

[CBSE 2011]

**Q.21** Draw a plot showing the variation of photoelectric current with collector plate potential for two different frequencies,  $\nu_1 > \nu_2$ , of incident radiation having the same intensity. In which case will the stopping potential be higher? Justify your answer.

[CBSE (AI) 2011]

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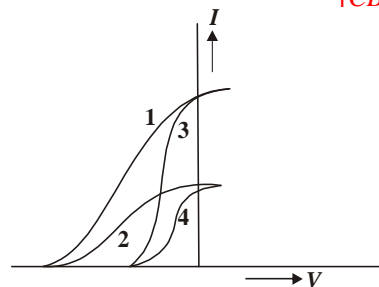
Eligibility: +2 Appearing/ +2 Pass

Course Duration: Till JEE/NEET/Other Competitive Exams

# HIM ACADEMY

HAMIRPUR (HP)  
98160 21400

- Q.22** An electron and a photon, each has a wavelength of 1.00 nm. Find  
 (a) their momenta (b) the energy of the photon and  
 (c) kinetic energy of electron. [CBSE Delhi 2011]
- Q.23** Show graphically, the variation of the de Broglie wavelength ( $\lambda$ ) with the potential ( $V$ ) through which an electron is accelerated from rest. [CBSE Delhi 2011]
- Q.24** Show the variation of photo electric current with collector plate potential for different intensity but same frequency of incident radiation. [CBSE 2011, 2018]
- Q.25** Draw a graph between the frequency of incident radiation ( $\nu$ ) and the maximum kinetic energy of the electron emitted from the surface of a photosensitive material. [CBSE 2012]
- Q.26** Define the terms (i) 'cut off voltage' and (ii) threshold frequency in relation to the phenomenon of photoelectric effect. Using Einstein's photoelectric equation show how the cut-off voltage and threshold frequency for a given photosensitive material can be determined with the help of a suitable plot/graph. [CBSE 2012]
- Q.27** A proton and an electron have same velocity. Which one has greater de-Broglie wavelength and why? [CBSE (AI) 2012]
- Q.28** State de-Broglie hypothesis. [CBSE 2012]
- Q.29** Show on a graph the variation of the de-Broglie wavelength ( $\lambda$ ) associated with an electron, with the square root of accelerating potential ( $V$ ). [CBSE (F) 2012]
- Q.30** How does the value of work function influence the kinetic energy of electrons liberated during photoelectron emission? [CBSE Delhi (AI) 2013]
- Q.31** The graph given alongside shows the variation of photoelectric current ( $I$ ) with the applied voltage ( $V$ ) for two different photosensitive materials and for two different intensities of the incident radiations. Identify the pairs of curves that correspond to different materials but same intensity of incident radiations. [CBSE Delhi 2013]
- Q.32** What is photoelectric effect? Derive Einstein's photoelectric equation. Explain two laws of photoelectric effect on the basis of this relation. Explain the effect of increase in frequency of incident light on the velocity of photoelectrons ejected. [CBSE 2013]
- Q.33** Write Einstein's photoelectric equation and point out any two characteristic properties of photons on which this equation is based. [CBSE (AI) 2013]
- Q.34** Write the basic features of photon picture of electromagnetic radiation on which Einstein's photoelectric equation is based. [CBSE 2013]
- Q.35** An electron and a proton, each have de Broglie wavelength of 1.00 nm.  
 (a) Find the ratio of their momenta.  
 (b) Compare the kinetic energy of the proton with that of the electron. [CBSE (F) 2013]
- Q.36** Write the expression for the de-Broglie wavelength associated with a charged particle having charge ' $q$ ' and mass ' $m$ ' when it is accelerated by a potential  $V$ . [CBSE 2013]
- Q.37** Ultraviolet light of wavelength 2271 Å from a 100 W mercury source irradiates a photocell made of molybdenum metal. If the stopping potential is  $-1.3V$ , estimate the work function of the metal. How would the photocell respond to a high intensity ( $\sim 10^5 \text{ Wm}^{-2}$ ) red light of wavelength 6328 Å produced by a He-Ne laser? ( $h = 6.63 \times 10^{-34} \text{ Js}$ ,  $c = 3 \times 10^8 \text{ m/s}$ ) [CBSE (F) 2013]
- Q.38** In photoelectric effect, why should the photoelectric current increases as the intensity of monochromatic radiation incident on a photosensitive surface is increased? Explain. [CBSE (F) 2014]
- Q.39** Plot a graph showing variation of photoelectric current with collector plate potential at a given frequency and intensity of incident radiation. What does the intercept of the graph with potential axis signify? [CBSE (F) 2014]



- Q.40** Define intensity of radiation on the basis of photon picture of light. Write its SI unit. [CBSE (AI) 2014]
- Q.41** Draw a plot showing the variation of photoelectric current versus the intensity of incident radiation on a photosensitive surface. [CBSE Delhi 2014]
- Q.42** A proton and a deuteron are accelerated through the same accelerating potential. Which one of the two has  
 (i) greater value of de-Broglie wavelength associated with it, and  
 (ii) less momentum?  
 Give reasons to justify your answer. [CBSE Delhi 2014]
- Q.43** An electron microscope uses electrons accelerated by a voltage of 50 kV. Determine the de Broglie wavelength associated with the electrons. If other factors (such

as numerical aperture, etc.) are taken to be roughly the same, how does the resolving power of an electron microscope compare with that of an optical microscope which uses yellow light ( $\lambda_y = 5.9 \times 10^{-7}$  m).

[CBSE (AI) 2014]

- Q.44** a) Define the term 'intensity of radiation' in terms of photon picture of light.  
 b) Two monochromatic beams, one red and the other blue, have the same intensity. In which case (i) the number of photons per unit area per second is large, (ii) the maximum kinetic energy of the photoelectrons is more? Justify your answer.

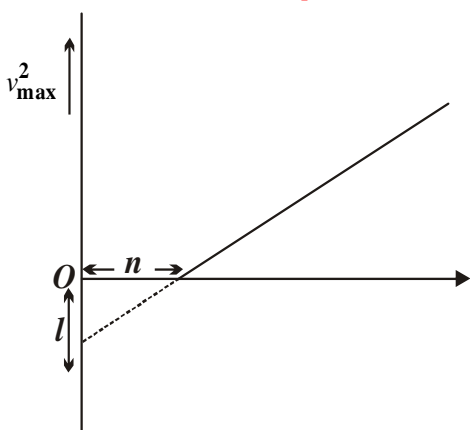
[CBSE Patna 2015]

- Q.45** a) Give a brief description of the basic elementary process involved in the photoelectric emission in Einstein's picture.

- b) When a photosensitive material is irradiated with the light of frequency  $\nu$ , the maximum speed of electrons is given by  $V_{\max}$ . A plot of  $V_{\max}^2$  is found to vary with frequency  $\nu$  as shown in the figure.

Use Einstein's photoelectric equation to find the expressions for (i) Planck's constant and (ii) work function of the given photosensitive material, in terms of the parameters  $l$ ,  $n$  and mass  $m$  of the electron.

[CBSE Chennai 2015]



- Q.46** A beam of monochromatic radiation is incident on a photosensitive surface. Answer the following questions giving reasons:

- i) Do the emitted photoelectrons have the same kinetic energy?  
 ii) Does the kinetic energy of the emitted electrons depend on the intensity of incident radiation?  
 iii) On what factors does the number of emitted photoelectrons depend?

[CBSE(F)2015]

- Q.47** Monochromatic light of frequency  $6 \times 10^{14}$  Hz is produced by a laser. The power emitted is  $2.0 \times 10^{-3}$  W. How many photons per second on an average are emitted by the source?

[CBSE Guwahati 2015]

- Q.48** When the electron orbiting in hydrogen atom in its ground state moves to the third excited state, show how the de-Broglie wavelength associated with it would be affected.

[CBSE Ajmer 2015]

- Q.49** A proton and an  $\alpha$ -particle have the same de-Broglie wavelength. Determine the ratio of (i) their accelerating potentials (ii) their speeds.

[CBSE Delhi 2015]

- Q.50** The wavelength of light from the spectral emission line of sodium is 589 nm. Find the kinetic energy at which (a) an electron and (b) a neutron, would have the same de-Broglie wavelength.

[CBSE Guwahati 2015]

- Q.51** When an electron in hydrogen atom jumps from the third excited state to the ground state, how would the de Broglie wavelength associated with the electron? Justify your answer.

[CBSE Allahabad 2015]

i.e. the wavelength in the ground state will decrease.

- Q.52** Determine the value of the de Broglie wavelength associated with the electron orbiting in the ground state of hydrogen atom (Given  $E_n = - (13.6/n^2)$  eV and Bohr radius  $r_0 = 0.53 \text{ \AA}$ ). How will the de Broglie wavelength change when it is in the first excited state?

[CBSE Bhubaneswar 2015]

- Q.53** If light of wavelength 412.5 nm is incident on each of the metals given below, which ones will show photoelectric emission and why?

[CBSE 2018]

Metal	Work function (eV)
Na	1.92
K	2.15
Ca	3.20
Mo	4.17

- Q.54** An  $\alpha$ -particle and a proton of the same kinetic energy are in turn allowed to pass through a magnetic field  $\vec{B}$ , acting normal to the direction of motion of the particles. Calculate the ratio of radii of the circular paths described by them.

[CBSE 2019]

- Q.55** What is the wavelength of a photon of energy  $3.3 \times 10^{-19}$  J ?

[CBSE 2020]

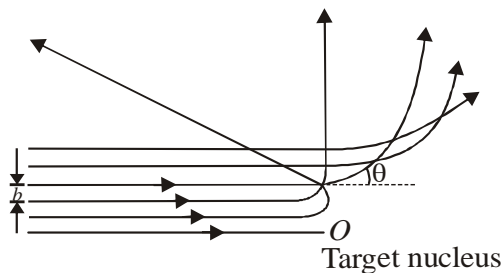
- Q.56** Define the term 'threshold frequency' in photoelectric emission.

[CBSE 2020]

- Q.57** The maximum kinetic energy of the photoelectrons emitted is doubled when the wavelength of light incident on the photosensitive surface changes from  $\lambda_1$  to  $\lambda_2$ . Deduce expressions for the threshold wavelength and work function for the metal surface in terms of  $\lambda_1$  and  $\lambda_2$ .

[CBSE 2020]

- Q.1** What is the longest wavelength photon that can ionize a hydrogen atom in its ground state? Specify the type of radiation. [CBSE Delhi 2007]
- Q.2** The trajectories, traced by different  $\alpha$ -particles, in Geiger-Marsden experiment were observed as shown in the figure.



- a) What names are given to the symbols 'b' and ' $\theta$ ' shown here?
- b) What can we say about the values of b for (i)  $\theta = 0^\circ$  (ii)  $\theta = \pi$  radians? [CBSE Delhi 2008 C]
- Q.3** In Bohr's theory of hydrogen atom, calculate the energy of the photon emitted during a transition of the electron from the first excited state to the ground state. Write in which region of the electromagnetic spectrum this transition lies. [CBSE Delhi 2008C]
- Q.4** The ground state energy of hydrogen atom is  $-13.6$  eV.
- i) What is the kinetic energy of an electron in the second excited state?
- ii) If the electron jumps to the ground state from the second excited state, calculate the wavelength of the spectral line emitted. [CBSE (AI) 2008]
- Q.5** The energy level diagram of an element is given below. Identify, by doing necessary calculations, which transition corresponds to the emission of a spectral line of wavelength 102.7 nm.

[CBSE Delhi 2008]

- Q.6** Show that Bohr's second postulate, 'the electron revolves around the nucleus only in certain fixed orbits without radiating energy' can be explained on the basis of de-Broglie hypothesis of wave nature of electron. [CBSE 2008]

- Q.7** Draw a schematic arrangement of Geiger-Marsden experiment for studying  $\alpha$ -particle scattering by a thin foil of gold. Describe briefly, by drawing trajectories of the scattered  $\alpha$ -particles. How this study can be used to estimate the size of the nucleus? [CBSE Delhi 2010]

- Q.8** Write the expression for Bohr's radius in hydrogen atom. [CBSE 2010]

- Q.9** The radius of innermost electron orbit of a hydrogen atom is  $5.1 \times 10^{-11}$  m. What is the radius of orbit in the second excited state? [CBSE 2010]

- Q.10** The ground state energy of hydrogen atom is  $-13.6$  eV. What are the kinetic and potential energy of electron in this state? [CBSE (AI) 2010, 2011]

- Q.11** Define ionisation energy. What is its value for hydrogen atom? [CBSE 2010]

- Q.12** Using postulate of Bohr's model of hydrogen atom, obtain an expression for the frequency of radiation emitted when atom make a transition from the higher energy state with quantum number  $n_i$  to the lower energy state with quantum number  $n_f$  ( $n_i > n_f$ ). [CBSE 2010, 2011, 2012]

- Q.13** The ground state energy of hydrogen atom is  $-13.6$  eV. If an electron makes a transition from an energy level  $-0.85$  eV to  $-3.4$  eV, calculate the wavelength of the spectral line emitted. To which series of hydrogen spectrum does this wavelength belong? [CBSE (AI) 2012]

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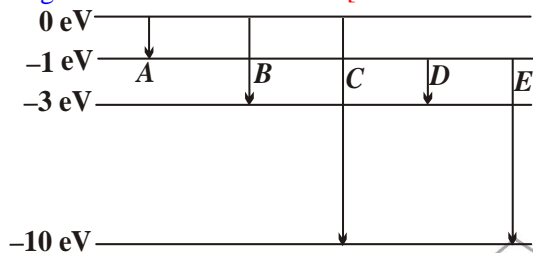
**Q.14** In an experiment on  $\alpha$ -particle scattered by a thin foil of gold, draw a plot showing the number of particles scattered versus scattering angle  $\theta$ . Why is it that a very small fraction of the particle are scattered at  $\theta > 90^\circ$ ? [CBSE 2013]

**Q.15** Using Bohr's postulates, obtain the expression for total energy of electrons in the stationary state of the hydrogen atom. Hence draw the energy level diagram showing how the line spectra corresponding to Balmer's series occurs due to transition between energy level. [CBSE 2013]

**Q.16** A 12.3 eV electron beam is used to bombard gaseous hydrogen at room temperature. Upto which energy level the hydrogen atoms would be excited? Calculate the wavelength of the second member of Lyman series and second member of Balmer series. [CBSE Delhi 2014]

**Q.17** Determine the distance of closest approach when an alpha particle of kinetic energy 4.5 MeV strikes a nucleus of  $Z = 80$ , stops reverses its direction. [CBSE Ajmer 2015]

**Q.18** The energy levels of an atom are given below in the diagram. [CBSE Chennai 2015]



Which of the transitions belong to Lyman and Balmer series? Calculate the ratio of the shortest wavelengths of the Lyman and the Balmer series of the spectra.

**Q.19** Show mathematically how Bohr's postulate of quantization of orbital angular momentum in hydrogen atom is explained by *de*-Broglie's hypothesis. [CBSE 2016]

**Q.20** A hydrogen atom initially in the ground state absorbs a photon, which excites it to the  $n = 4$  level. Determine the wavelength and frequency of photon. [CBSE 2018]

**Q.21** State Bohr's postulate to define stable orbits in hydrogen atom. How does *de*-Broglie's hypothesis explain the stability of these orbits? [CBSE 2018]

**Q.22** A photon emitted during the de-excitation of electron from a state  $n$  to the first excited state in a hydrogen atom, irradiates a metallic cathode of work function 2 eV, in a photo cell, with a stopping potential of 0.55 V. Obtain the value of the quantum number of the state  $n$ . [CBSE 2019]

**Q.23** A hydrogen atom in the ground state is excited by an electron beam of 12.5 eV energy. Find out the maximum number of lines emitted by the atom from its excited state. [CBSE 2019]

# TEST SERIES

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# HIM ACADEMY

HAMIRPUR (HP)  
**98160 21400**

- Q.1** Compare the radii of two nuclei with mass numbers 1 and 27 respectively. [CBSE Delhi 2000, 2009]
- Q.2** a) Among alpha, beta and gamma radiations, which get affected by electric field? [CBSE 2004]  
b) What is the nuclear radius of  $^{125}\text{Fe}$  if that of  $^{27}\text{Al}$  is 3.6 fermi? [CBSE (AI) 2008]
- Q.3** A nucleus of mass number  $A$ , has a mass defect  $\Delta m$ . Give the formula, for the binding energy per nucleon of this nucleus. [CBSE 2004]
- Q.4** Give the mass number and atomic number of elements on the right hand side of the decay process.  
$$^{220}_{86}\text{Ru} \rightarrow \text{Po} + \text{He} \quad \text{[CBSE 2004]}$$
- Q.5** Draw the graph showing the variation of binding energy per nucleon with the mass number for a large number of nuclei  $2 < A < 240$ . What are the main inferences from the graph? How do you explain the constancy of binding energy in the range  $30 < A < 170$  using the property that the nuclear force is short-ranged? Explain with the help of this graph of release of energy in the processes of nuclear fission and fusion.  
*Or*  
Explain the processes of nuclear fission and nuclear fusion by using the plot of binding energy per nucleon (BE/A) versus the mass number  $A$ . [CBSE 2007, 2011, 2015, (AI) 2018,]
- Q.6** Write two characteristic features of nuclear force, which distinguish it from coulomb's force. [CBSE 2007, 2011]
- Q.7** Draw a graph showing the variation of potential energy between a pair of nucleons as a function of their separation. Indicate the regions in which the nuclear force is (i) attractive, (ii) repulsive. Write two important conclusions which you can draw regarding the nature of the nuclear forces. [CBSE 2007, 2009, 2010, 2012 (AI) 2015,]
- Q.8** The radioactive isotope  $D$ -decay according to the sequence  
$$D \xrightarrow{\alpha} D_1 \xrightarrow{\beta^-} D_2$$
  
If the mass number and atomic number of  $D_2$  are 176 and 71 respectively, what is the i) mass number ii) atomic number of  $D$ . [CBSE 2007, 2010]
- Q.9** Define isotopes, isobars and isotones [CBSE 2008]
- Q.10** Distinguish between isotopes and isobars. Give one example for each of the species. [CBSE 2008]
- Q.11** Assuming the nuclei to be spherical in shape, how does the surface of a nucleus of mass number  $A_1$  compare with that of a nucleus of mass number  $A_2$ ? [CBSE 2008]
- Q.12** A radioactive isotope has a half-life of 5 years. After how much time is its activity reduced to 3.125% of its original activity? [CBSE (AI) 2008]
- Q.13** A radio nuclide sample has  $N_0$  nuclei at  $t = 0$ . Its number of undecayed nuclei get reduced to  $\frac{N_0}{e}$  at  $t = \tau$ . What does the term  $t$  stand for? Write in terms of  $\tau$ , the time interval ' $T$ ' in which half of the original number of nuclei of this radio nuclide would have got decayed. [CBSE Delhi 2008C]
- Q.14** Define the term 'Activity' of a radioactive substance. State its SI unit. Give a plot of activity of a radioactive species versus time. [CBSE Delhi (AI) 2009, 2010]
- Q.15** Find the nuclear reactions for  
i)  $\alpha$ -decay of  $^{226}_{88}\text{Ra}$  ii)  $\alpha$ -decay of  $^{242}_{94}\text{Pu}$   
iii)  $\beta^-$ -decay of  $^{32}_{15}\text{P}$  iv)  $\beta^-$ -decay of  $^{210}_{83}\text{Bi}$  [CBSE 2010]
- Q.16** When four hydrogen nuclei combine to form a helium nucleus, estimate the amount of energy in MeV released in this process of fusion. (Neglect the masses of electrons and neutrinos) Given:  
i) mass of  $^1_1\text{H} = 1.007825 \text{ u}$   
ii) mass of helium nucleus = 4.002603 u,  $1 = 931 \text{ MeV}/c^2$ . [CBSE(F) 2011]
- Q.17** What are nuclear forces? Give their properties. [CBSE 2011]
- Q.18** Plot a graph showing the number ( $N$ ) of undecayed. Nuclei as a function of time ( $t$ ) for a given radioactive sample having half life  $T_{1/2}$ . Depict in the plot the number of undecayed nuclei at  
i)  $t = 3 T_{1/2}$  and ii)  $t = 5 T_{1/2}$  [CBSE 2011]
- Q.19** How is the mean life of a radioactive sample related to its half life? [CBSE 2011]
- Q.20** Write the relationship between the size of a nucleus and its mass number ( $A$ ). [CBSE 2012]
- Q.11** After one  $\alpha$  and two  $\beta$  emissions, what happens to mass number? [CBSE 2012]
- Q.22** In a given sample, two radioisotopes,  $A$  and  $B$ , are initially present in the ratio of 1:4. The half lives of  $A$

and  $B$  are respectively 100 years and 50 years. Find the time after which the amounts of  $A$  and  $B$  become equal. [CBSE (F) 2012]

**Q.23** Draw the graph showing variation of binding energy per nucleon with mass number. Write two main inferences drawn from this graph. [CBSE 2013]

**Q.24** Define activity of a radioactive substance. Give its relation with half life. [CBSE 2013]

**Q.25** Give units for measuring radioactivity. [CBSE 2013]

**Q.26** Derive the expression for the law of radioactive decay of a given sample having initially  $N_0$  nuclei decaying to the number  $N$  present at any subsequent time  $t$ . Plot a graph showing the variation of the number of nuclei versus the time  $t$  lapsed. Mark a point on the plot in terms of  $T_{1/2}$  value when the number present  $N = N_0/16$ . [CBSE (F) 2013, Delhi 2014]

**Q.27** Why is it found experimentally difficult to detect neutrinos in nuclear  $\beta$ -decay? [CBSE (AI) 2014]

**Q.28** In both  $\beta^-$  decay processes, the mass number of a nucleus remains same whereas the atomic number  $Z$  increases by one in  $\beta^-$  decay and decreases by one in  $\beta^+$  decay. Explain by giving reason. [CBSE (F) 2014]

**Q.29** i) Write symbolically the process expressing the  $\beta^+$  decay of  ${}^{22}_{11}\text{Na}$ . Also write the basic nuclear process underlying this decay.

ii) Is the nucleus formed in the decay of the nucleus  ${}^{22}_{11}\text{Na}$ , an isotope or isobar? [CBSE Delhi 2014]

**Q.30** a) Write the  $\beta$ -decay of tritium in symbolic form.  
b) Why is it experimentally found difficult to detect neutrinos in this process? [CBSE (F) 2015]

**Q.31** The radionuclide  ${}^{11}_6\text{C}$  decays according to  

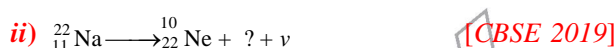
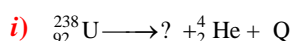
$${}^{11}_6\text{C} \longrightarrow {}^{11}_5\text{B} + e^+_{(\text{positron})} + \nu + Q, T_{1/2} = 20.3 \text{ min.}$$
 The maximum energy of the emitted positron is 0.960 MeV. Given the mass values  
 $m({}^{11}_6\text{C}) = 11.0114344 \text{ u}$  and  $m({}^{11}_5\text{B}) = 11.009305 \text{ u}$ .  
 Calculate  $Q$  and compare it with the maximum energy of the positron emitted. [CBSE Panchkula 2015]

**Q.32** A radioactive isotope has a half-life of  $T$  (10) years. How long will it take the activity to reduce

- a) 3.125 %  
b) 1% of its original value? [CBSE 2018]

**Q.33** Four nuclei of an element undergo fusion to form a heavier nucleus, with release of energy. Which of the two-parent or the daughter nucleus-would have higher binding energy per nucleon? [CBSE 2018]

**Q.34** a) Write two distinguishing features of nuclear forces.  
b) Complete the following nuclear reactions for  $\alpha$  and  $\beta$  decay



**Q.35** Draw a graph showing the variation of potential energy between a pair of nucleons as a function of their separation. Indicate the regions in which the nuclear force is (i) attractive, (ii) repulsive.

Write two important conclusions which you can draw regarding the nature of the nuclear forces.

[CBSE 2019]

**Q.36** When two nuclei ( $A \leq 10$ ) fuse together to form a heavier nucleus, the

- (A) binding energy per nucleon increases.  
(B) binding energy per nucleon decreases.  
(C) binding energy per nucleon does not change.  
(D) total binding energy decreases.

[CBSE 2020]

**Q.37** In  $\beta^-$  decay, a

- (A) neutron converts into a proton emitting antineutrino.  
(B) neutron converts into a proton emitting neutrino.  
(C) proton converts into a neutron emitting antineutrino.  
(D) proton converts into a neutron emitting neutrino.

[CBSE 2020]

**Q.38** a) Differentiate between half-life and average life of a radioactive substance.

b) A radioactive substance decays for an interval of time equal to its mean life. Find the fraction of the amount of the substance which is left undecayed after this time interval. [CBSE 2020]

# CRASH COURSE JEE/NEET/NDA

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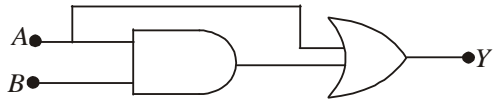
98160 21400

- Q.1** How does the conductance of a semiconducting material change with rise in temperature ? [CBSE 1998]
- Q.2** How does the energy gap in a semiconductor vary, when doped with a pentavalent impurity? [CBSE 2000]
- Q.3** What is meant by the term doping of an intrinsic semiconductor ? How does it affect the conductivity of a semiconductor? [CBSE 2001]
- Q.4** With the help of a circuit diagram, explain the use of zener diode as a voltage stabilizer. [CBSE 2001]
- Q.5** Draw the characteristics of a *p-n* junction. [CBSE 2001,2013]
- Q.6** Give the ratio of number of holes and number of conduction electrons in an intrinsic semiconductor. [CBSE 2003]
- Q.7** Draw energy band diagram of a *p*-type semiconductor. [CBSE 2004]
- Q.8** Draw energy band diagram of an *n*-type semiconductor. [CBSE 2004]
- Q.9** What is an ideal diode? Draw the output wave form across *R* for the input waveform given below. [CBSE 2005]
- Q.10** A photodiode is fabricated from a semiconductor with band gap of 2.8 eV. Can it detect a wavelength of 6000 nm? Justify? [CBSE Delhi 2005]
- Q.11** A photodiode is fabricated from a semiconductor with band gap of 2.8 eV. Can it detect a wavelength of 6000 Å? Justify. [CBSE Delhi 2005]
- Q.12** Draw the circuit diagram to study the characteristic of npn transistor in common emitter configuration. Sketch typical (i) input characteristics (ii) output characteristics for such a configuration. Explain how the current gain of transistor is calculated from output characteristics. [CBSE 2006, (AI) 2007, Delhi 2009]

Or

Draw the circuit arrangement for studying the input and output characteristics of an *n-p-n* transistor in CE configuration. With the help of these characteristics define (i) input resistance, (ii) current amplification factor. [CBSE, (AI) 2010, (F) 2013, Delhi 2015]

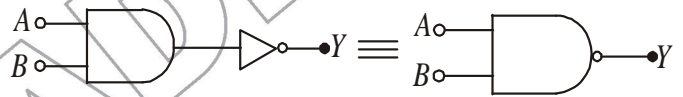
- Q.13** The energy gaps in the energy band diagrams of a conductor, semiconductor and insulator are  $E_1$ ,  $E_2$  and  $E_3$ . Arrange them in increasing order. [CBSE (AI) 2007]
- Q.14 a)** Write the truth table of the following gate.



- b)** What will be the values of input *A* and *B* for the Boolean expression  $\overline{(A+B)} \cdot \overline{(A \cdot B)} = 1$  [CBSE Delhi 2007]

- Q.15** What will be the values of input *A* and *B* for the Boolean expression  $\overline{(A+B)} \cdot \overline{(AB)} = 1$ . [CBSE 2007]

- Q.16** The out of a 2-input AND gate is fed to a NOT gate. Draw the logic circuit of this combination of gates and write its truth table. [CBSE Delhi 2007]



- Q.17** The output of an OR gate is connected to both the inputs to a NAND gate. Draw the logic circuit of this combination of gates and write its truth table. [CBSE Delhi 2007]

- Q.18** With the help of a circuit diagram, explain the working principle of a full wave rectifier. Draw the input and output waveforms. [CBSE 2008, 2018]

- Q.19** Discuss the V-I characteristics of Zener diode. [CBSE 2008]

- Q.20** State with reason why a photodiode is usually operated at a reverse bias. [CBSE 2008]

- Q.21** State the factor, which controls (i) wavelength of light and (ii) intensity of light, emitted by a LED. [CBSE (AI) 2008]

- Q.22** State the reason, why GaAs is most commonly used in making a solar cell. [CBSE (AI) 2008]

- Q.23** The given inputs *A* and *B* are fed to 2-inputs NAND gate. Draw the output wavefront of the gate. [CBSE Delhi 2008]

Or

Draw the necessary energy band diagrams to distinguish between conductors, semiconductors and insulators. How does the change in temperature affect the

behaviour of these materials? Explain briefly.

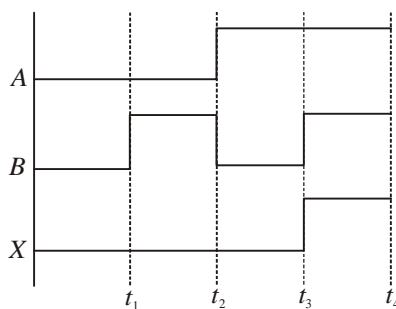
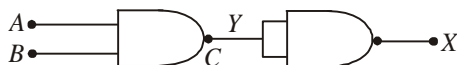
[CBSE Patna 2015]

**Q.24** Drawing a labelled circuit diagram, explain the working of common emitter amplifier using  $n-p-n$  transistor. What is the phase relationship between input and output signals? [CBSE 2009,2010]

**Q.25** Name the three semiconductor regions in the transistor? [CBSE PSEB 2011,2015]

**Q.26** Draw a labelled circuit diagram of a common emitter amplifier using a  $p-n-p$  transistor. Define the term voltage gain and write an expression for it. Explain how the input and output voltages are out of phase by  $180^\circ$  for a common-emitter transistor amplifiers. [CBSE (AI) 2008]

**Q.27** Draw the output waveform at X, using the given inputs A, B for the logic circuit shown alongside. Also identify the gate. [CBSE, 2008, Delhi 2011]



**Q.28** The input 'A' shown here is used with another unknown input 'B' in this set-up. If the output 'Y' has the form shown, give the intervals over which the input 'B' is in its 'high' state. [CBSE Delhi 2008C]

**Q.29** Two signals A, B are given below, are applied as input to (i) AND (ii) NOR and (iii) NAND gates. Draw the output waveform in each case. [CBSE (AI) 2008]

**Q.30** At what temperature would an intrinsic semiconductor behave like a perfect insulator? [CBSE 2009]

**Q.31** Explain the formation of  $p-n$  junction. [CBSE 2009]



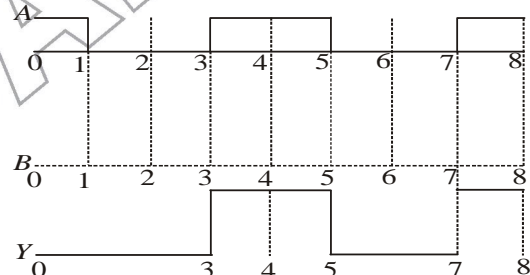
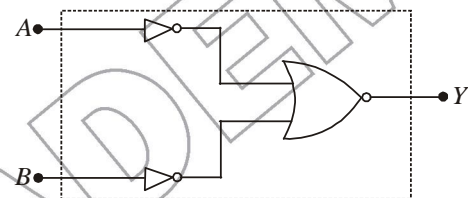
**Q.32** Draw logic symbol of NOR gate. [CBSE 2009]

**Q.33** Draw logic symbol of NAND gate. [CBSE 2009, 2018]

**Q.34** How does one understand the temperature dependence of resistivity of a semiconductor? [CBSE(F)2010]

**Q.35** How does one understand the temperature dependence of resistivity of a semiconductor? [CBSE 2010]

**Q.36** Identify the gate equivalent to the 'dotted box' shown here and given its symbol and truth table. [CBSE 2010, 2011, (AI)2013, (F) 2014]



**Q.37** Name the important process that occurs during the formation of a  $p-n$  junction. Explain briefly, with the help of a suitable diagram, how a  $p-n$  junction is formed. Define the term 'barrier potential'. [CBSE (F) 2011]

**Q.38** What happens to the width of depletion layer of a  $p-n$  junction when it is (i) forward biased, (ii) reverse biased? [CBSE (AI) 2011]

# 333

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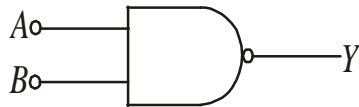
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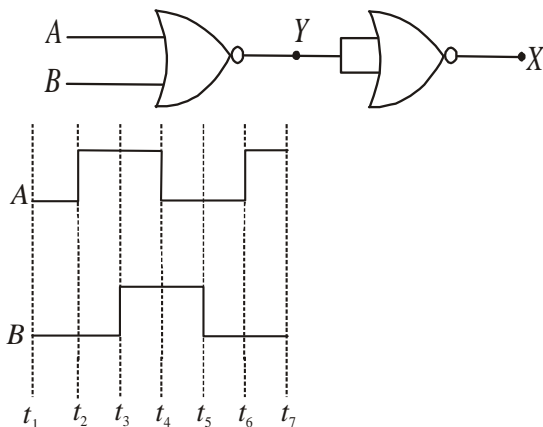
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**Q.39** In a transistor, doping level in base is increased slightly. How will it affect. *i*) collector current *ii*) base current. [CBSE 2011]

**Q.40** Name the logic gate shown in fig. and write its truth table. [CBSE (F) 2011]



**Q.41** Draw the output waveform at X, using the given inputs A and B for the logic circuit shown below. Also, identify the logic operation performed by this circuit. [CBSE Delhi 2011]

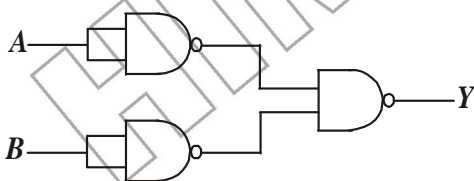


**Q.42** Draw the transfer characteristics of a base biased transistor in common emitter configuration. Explain briefly the meaning of the term active region in these characteristics. For what practical use, do we use the transistor in this active region?

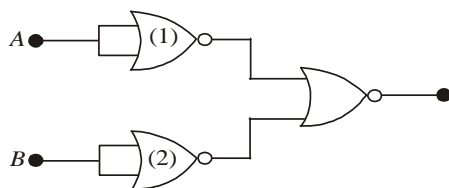
Explain clearly how the active region of the  $V_0$  versus  $V_i$  curve in a transistor is used as an amplifier.

[CBSE Delhi 2011]

**Q.43** Write the truth table for the logic circuit shown below and identify the logic operation performed by this circuit. [CBSE, (AI) 2011, Delhi (F) 2014]



**Q.44** The inputs A and B are inverted by using two NOT gates and their outputs are fed to the NOR gate as shown below. [CBSE (AI) 2011, (F) 2014]



Analyse the action of the gates (1) and (2) and identify the logic gate of complete circuitry so obtained. Give its symbol and truth table.

**Q.45** In the figure given alongside, is (i) the emitter and (ii) the collector forward or reverse biased? With the help of a circuit diagram explain the action of npn transistor. [CBSE (AI) 2012]

**Q.46** Draw a simple circuit of a CE transistor amplifier.

Explain its working. Show that the voltage gain  $A_V$  of

the amplifier is given by  $A_V = -\frac{\beta_{ac} R_L}{r_i}$ , where  $\beta_{ac}$  is the current gain,  $R_L$  is the load resistance and  $r_i$  is the input resistance of the transistor. What is the significance of the negative sign in the expression for the voltage gain?

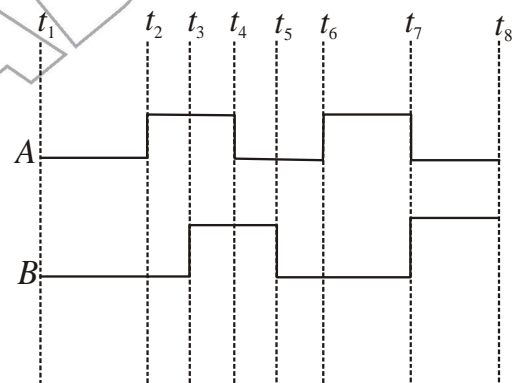
Or

**a)** Draw the circuit diagram of a full wave rectifier using *p-n* junction diode. Explain its working and show the output, input waveforms.

**b)** Show the output waveforms (Y) for the following input A and B of

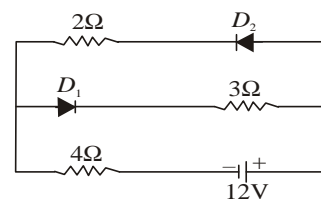
**i)** OR gate **ii)** Show the output

[CBSE Delhi 2012]

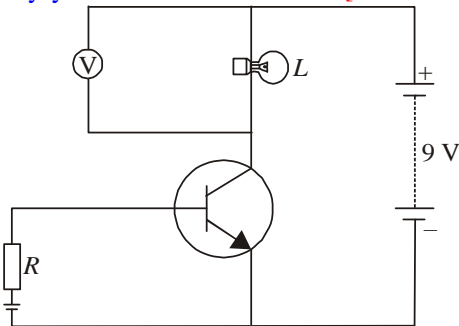


**Q.47** Explain, how the heavy doping of both *p*- and *n*-sides of a *p-n* junction diode results in the electric field of the junction being extremely high even with a reverse bias voltage of a few volts. [CBSE (F) 2013]

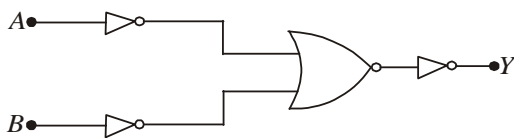
**Q.48** The circuit shown in the figure has two oppositely connected ideal diodes connected in parallel. Find the current flowing through each diode in the circuit. [CBSE (F) 2013]



**Q.49** In the given circuit diagram, a voltmeter 'V' is connected across a lamp 'L'. How would (i) the brightness of the lamp and (ii) voltmeter reading 'V' be affected, if the value of resistance 'R' is decreased? Justify your answer. [CBSE Delhi 2013]



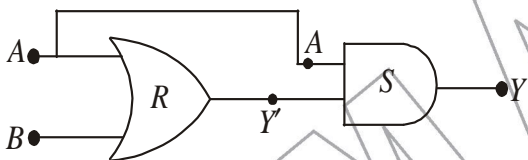
**Q.50** In the circuit shown in the figure, identify the equivalent gate of the circuit and make its truth table. [CBSE AI 2013]



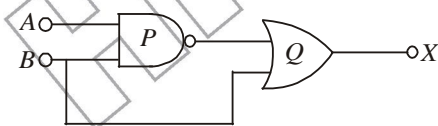
**Q.51** Using the necessary circuit diagrams, show how the V-I characteristics of a p-n junction are obtained in  
 (i) Forward biasing  
 (ii) Reverse biasing

How are these characteristics made use of in rectification? [CBSE Delhi 2014]

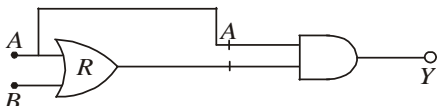
**Q.52** Write the truth table for the combination of the gates shown. Name the gates used. [CBSE Delhi 2014]



**Q.53** Identify the logic gates marked P and Q in the given logic circuit. Write the truth table for the combination. [CBSE Delhi 2014]



**Q.54** Write the truth table for the combination of the gates shown. Name the gates used. [CBSE Delhi 2014]



**Q.55** How is a zener diode fabricated? What causes the setting up of high electric field even for small reverse bias voltage across the diode? [CBSE 2015]

**Q.56** Describe briefly using the necessary circuit diagram, the three basic processes which take place to generate the e.m.f. in a solar cell when light falls on it. Draw the I-V characteristics of a solar cell. Write two important criteria required for the selection of a material for solar cell fabrication. [CBSE Guwahati 2015]

**Q.57** Using truth tables of AND gate and NOT gate, show that NAND gate is an AND gate followed by a NOT gate. Hence write the truth table of NAND gate. [CBSE Guwahati 2015]

**Q.58** Discuss common emitter characteristics of a transistor. Show how these characteristics can be used to determine (a) the input resistance ( $r_i$ ), and (b) current amplification factor ( $\beta$ ). [CBSE 2018]

$$\beta = \left( \frac{\Delta I_C}{\Delta I_B} \right)$$

**Q.59** Give Boolean expression and truth table of NAND gate. [CBSE 2018]

**Q.60** At equilibrium, in a p-n junction diode the net current is

- (A) due to diffusion of majority charge carriers.
- (B) due to drift of minority charge carriers.
- (C) zero as diffusion and drift currents are equal and opposite.
- (D) zero as no charge carriers cross the junction.

[CBSE 2020]

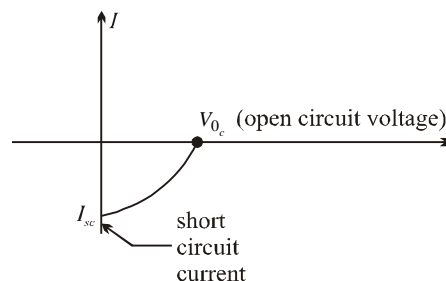
**Q.61** In a n-type semiconductor, the donor energy level lies

- (A) at the centre of the energy gap.
- (B) just below the conduction band.
- (C) just above the valance band.
- (D) in the conduction band.

[CBSE 2020]

**Q.62** Draw V-I characteristics of a p-n junction diode. Explain, why the current under reverse bias is almost independent of the applied voltage up to the critical voltage. [CBSE 2020]

**Q.63** What is the function of a solar cell? Briefly explain its working and draw its I-V characteristic curve. IV characteristics [CBSE 2020]



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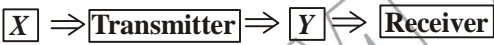
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# HIM ACADEMY

HAMIRPUR (HP)  
**98160 21400**

- Q.1** State two factors by which the range of TV signal can be increased? [CBSE 2001]
- Q.2** Why ground waves are not suited for very long range communication ? [CBSE 2003]
- Q.3** Name the type of communications that uses carrier signals having frequencies in the range  $10^{12}$  Hz to  $10^{16}$  Hz. [CBSE 2004]
- Q.4** Name the type of radiowave propagation involved when TV signals broadcast by a tall antenna are intercepted directly by the receiver antenna. [CBSE 2004]
- Q.5** What is the type of communication in which signal is discrete and binary coded version of the message (or information)? [CBSE Delhi 2006]
- Q.6** A message signal has a bandwidth of 5 MHz. Suggest a possible communication channel for its transmission. [CBSE (F) 2007]
- Q.7** What is the purpose of modulation in transmitting a signal? [CBSE 2007]
- Q.8** Why is the frequency modulation preferred over amplitude modulation? [CBSE Delhi 2007]
- Q.9** What should be the length of dipole antenna for a carrier wave of frequency  $6 \times 10^8$  Hz? [CBSE (AI) 2007]
- Q.10** Identify the parts *X* and *Y* in the following block diagram of a generalised communication system.
- 
- [CBSE 2008]
- Q.11** What does the term 'LOS communication' mean? Name the types of waves that are used for this communication. Give typical examples, with the help of a suitable figure of communication systems that use space wave mode propagation. [CBSE 2008]
- Q.12** Draw a plot of variation of amplitude versus  $\omega$  for an amplitude modulated wave. Define modulation index. State its importance for effective amplitude modulation. [CBSE 2008]
- Q.13** Why high frequency carrier waves are employed for transmission of audio signals? [CBSE 2008]
- Q.14** Draw a block diagram of a simple amplitude modulation, explaining briefly how amplitude modulation is achieved. [CBSE 2008]
- Q.15** What does the process of detection of amplitude

modulated wave mean?

The amplitude modulate carrier wave of angular frequency  $\omega_c$ ,  $(\omega_c + \omega_m)$  and  $(\omega_c - \omega_m)$ , where  $\omega_m$  is the angular frequency of the modulating signal. Discuss, in brief, with the help of a block diagram the essential details of a simple method used for 'detecting' the modulating signal from this modulated carrier wave.

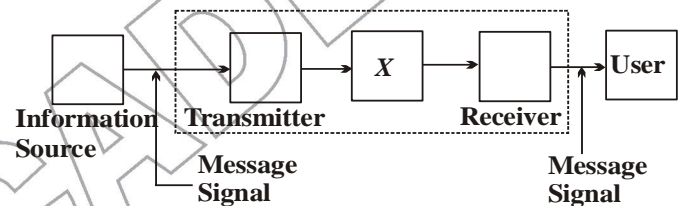
[CBSE (AI) 2008C]

Or

Draw a block diagram of a detector for AM signal and show, using necessary processes and the waveforms, how the original message signal is detected from the input AM wave.

[CBSE Delhi 2015]

- Q.16** The figure given below shows the block diagram of a generalised communication system. Identify the element labelled 'X' and write its function.



[CBSE 2009, Delhi 2011]

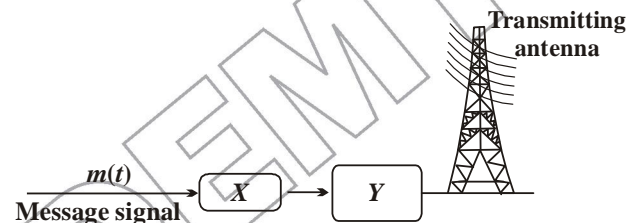
- Q.17** Define the term
- i) transducer ii) electrical transducer [CBSE 2009]
- Q.18** By what percentage will the transmission range of a TV tower be affected when the height of the tower is increased by 21%? [CBSE Delhi 2009]
- Q.19** What is sky wave propagation? [CBSE 2009, 2011]
- Q.20** What is space wave propagation? [CBSE 2009]
- Q.21** Explain in detail the need of modulation. [CBSE 2009]
- Q.22** What is the range of frequencies used for T.V. transmission? What is common between these waves and light waves? [CBSE Delhi 2010]
- Q.23** Explain the function of a repeater in a communication system. [CBSE 2010, 2011]
- Q.24** A transmitting antenna at the top of a tower has a height of 32 m and the height of the receiving antenna is 50 m. What is the maximum distance between them, for satisfactory communication in LOS mode? (Radius of earth = 6400 km). [CBSE Delhi 2010]

- Q.25** Give two examples of communication system which use space wave mode. [CBSE 2010]
- Q.26** Why is communication using line of sight mode limited to frequencies above 40 MHz? [CBSE 2010]
- Q.27** A carrier wave of peak voltage 12 V is used to transmit a message signal. What should be the peak voltage of the modulating signal in order to have a modulation index of 75%? [CBSE (AI) 2010]
- Q.28** What is the function of a transducer? [CBSE 2011]
- Q.29** What is ground wave communication? On what factors does the maximum range of propagation in this mode depend? [CBSE 2011]
- Q.30** What is space wave communication? Write the range of frequencies suitable for space wave communication. Give two examples of space wave of propagation is used. [CBSE (AI) 2011, 2013, Delhi (F) 2014]
- Q.31** What is modulation? What are its types? [CBSE 2011]
- Q.32** Why is the amplitude of modulating signal kept less than the amplitude of carrier wave? [CBSE Delhi 2011]
- Q.33** What is sky wave communication? Why is this mode of propagation restricted to the frequencies only up to few MHz? [CBSE 2011, 2013]
- Q.34** What is ground wave communication? On what factors does the maximum range of propagation in this mode depend? [CBSE (AI) 2011]
- Or*
- What is ground communication? Explain why this mode cannot be used for long distance communication using high frequencies. [CBSE Patna 2015]
- Q.35** Mention the function of the following used in communication system.  
i) Repeater    ii) Transmitter    iii) Bandpass filter. [CBSE 2012]
- Q.36** Distinguish between 'Analog and Digital signals'. [CBSE Panchkula 2015, Delhi 2012]

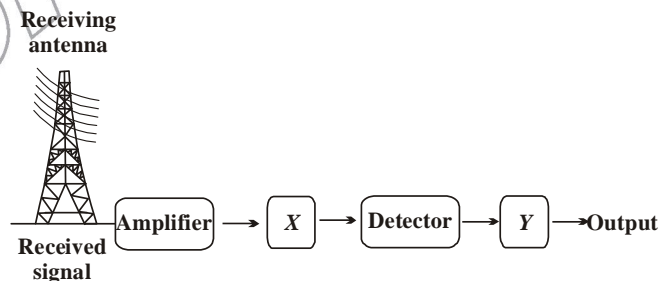
- Q.37** Define modulation index. Give its physical significance. [CBSE (F) 2012]
- Q.38** Name the three different modes of propagation of electromagnetic waves. Explain, using a proper diagram the mode of propagation used in the frequency range above 40 MHz. [CBSE Delhi 2012]
- Q.39** Figure shows a block diagram of a detector for amplitude modulated signal. Identify the boxes 'X' and 'Y' and write their functions. [CBSE (F) 2012]



- Q.40** Figure shows a block diagram of a transmitter. Identify the boxes 'X' and 'Y' and write their functions. [CBSE (F) 2012]



- Q.41** In the given block diagram of a receiver, identify the boxes labelled as X and Y and write their functions. [CBSE 2012, 2013]



- Q.42** Why are broadcast frequencies (carrier waves) sufficiently spaced in amplitude modulated wave? [CBSE (F) 2013]

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# HIM ACADEMY

HAMIRPUR (HP)  
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- Q.43** Give reasons for the following
- For ground wave transmission, size of antenna should be comparable to the wavelength of signal *e.g.*  $\lambda/4$ .
  - Audio signals converted into electromagnetic waves are not transmitted as such directly.
  - The amplitude of modulating signal is kept less than that of the carrier wave. [CBSE 2013]
- Q.44** Write three important factors which justify the need of modulating a message signal. Show diagrammatically how an amplitude modulated wave is obtained when a modulating signal is superimposed on a carrier wave. [CBSE Delhi 2013, Panchkula, 2015, 2018]
- Q.45** Explain briefly the principle of transmitting signals using a satellite. State two main advantages of using a satellite for transmitting signals. [CBSE 2014]
- Q.46** Write two basic modes of communication. Explain the process of amplitude modulation. Draw a schematic sketch showing how amplitude modulated signal is obtained by superposing a modulating signal over a sinusoidal carrier wave. [CBSE (A) 2014]
- Q.47** Write the functions of the following is communication systems:
- Modulator
  - Demodulator
- [CBSE (AI) 2014]
- Q.48** Which basic mode of communication is used for telephonic communication? [CBSE Allahabad 2015]
- Q.49** What are three basic units in communication systems? Write their function briefly. [CBSE Patna 2015]
- Q.50** Define bandwidth and describe briefly its importance in communicating signals. [CBSE (F) 2015]
- Q.51** State three important factors showing the need for translating a low frequency signal into a high frequency wave before transmission. [CBSE 2015, 2018]
- Q.52** Which basic mode of communication is used in satellite communication? Which type of wave propagation is used in this mode? Write the expression for the maximum line of sight distance  $d$  between two antennas having heights  $h_1$  and  $h_2$ . [CBSE Guwahati 2015]
- Q.53** State briefly why do the electromagnetic waves with frequency range from a few MHz upto 30 MHz can reflect back to the earth. What happens when the frequency range exceeds this limit? [CBSE Ajmer 2015]
- Q.54** Out of A.M. modulation and F.M. modulation which gives
- better quality transmission
  - has a large coverage.
- Q.55** How are side bands produced? [CBSE Delhi 2015]
- Q.56** What is the function of a band pass filter used in modulator for obtaining AM signal? [CBSE Ajmer 2015]
- Q.57** Explain briefly two commonly used application of the internet: [CBSE 2015]
- Q.58** For an amplitude modulated wave, the maximum amplitude is found to be 10V while the minimum amplitude is 2V. Determine the value of modulation index  $\mu$ . What would be the value of  $\mu$  if the minimum amplitude is zero volt? Why is  $\mu$  generally kept less than 1? [CBSE Chennai 2015]
- Q.59** A carrier wave of frequency 1.5 MHz and amplitude 50 V is modulated by a sinusoidal wave of frequency 10 kHz producing 50% amplitude modulation. Calculate the amplitude of the AM wave and frequencies of the side bands produced. [CBSE Allahabad 2015]
- Q.60** Explain briefly how communication takes place using mobile telephony. [CBSE Guwahati 2015]
- Q.61** Draw a sketch of a sinusoidal carrier wave along with a modulating signal and show how these are superimposed to obtain the resultant amplitude modulated wave. [CBSE 2015, 2018]
- Q.62** A carrier wave of peak voltage 15V is used to transmit a message signal. Find the peak voltage of the modulating signal in order to have a modulation index of 60%. [CBSE 2018]
- Q.63** Which mode of propagation is used by short wave broadcast services? [CBSE 2018]

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