SAMPLE PAPER TEST 05 FOR BOARD EXAM 2025

(QUESTION PAPER)

SUBJECT: PHYSICS **MAX. MARKS : 70**
CLASS : XII **DURATION: 3 HRS**

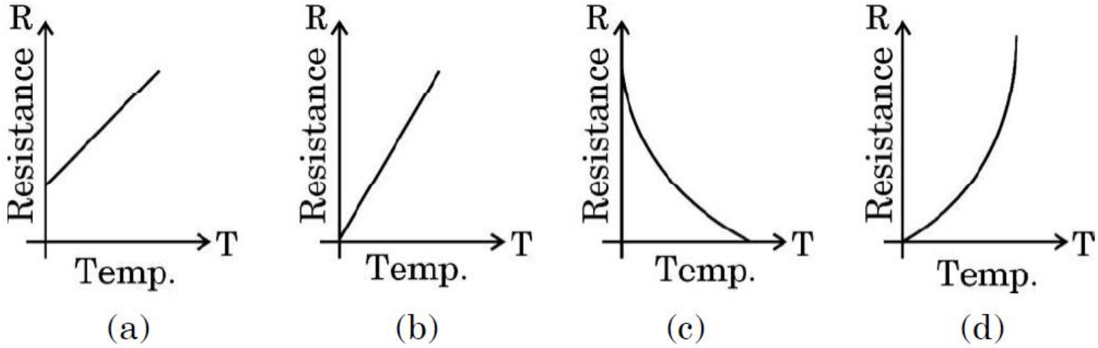
General Instructions:

1. There are 33 questions in all. All questions are compulsory
2. This question paper has five sections: Section A, Section B, Section C, Section D and Section E. All the sections are compulsory.
3. **Section A** contains sixteen questions, twelve MCQ and four Assertion-Reasoning based questions of 1 mark each, **Section B** contains five questions of two marks each, **Section C** contains seven questions of three marks each, **Section D** contains two case study based questions of 4 marks each and **Section E** contains three long questions of five marks each.
4. There is no overall choice. However, an internal choice has been provided in section B, C, D and E. You have to attempt only one of the choices in such questions.
5. Use of calculators is not allowed.

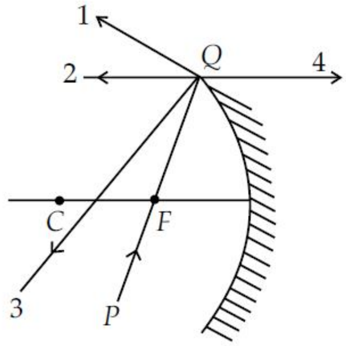
SECTION – A

Questions 1 to 16 carry 1 mark each.

1. For a metallic conductor, the correct representation of variation of resistance R with temperature T is:



2. The direction of ray of light incident on a concave mirror is shown by PQ while directions in which the ray would travel after reflection is shown by four rays marked 1, 2, 3 and 4 (figure). Which of the four rays correctly shows the direction of reflected ray:



(a) 1 (b) 2 (c) 3 (d) 4

3. The potential difference across a cell in an open circuit is 8 V. It falls to 4 V when a current of 4 A is drawn from it. The internal resistance of the cell is :

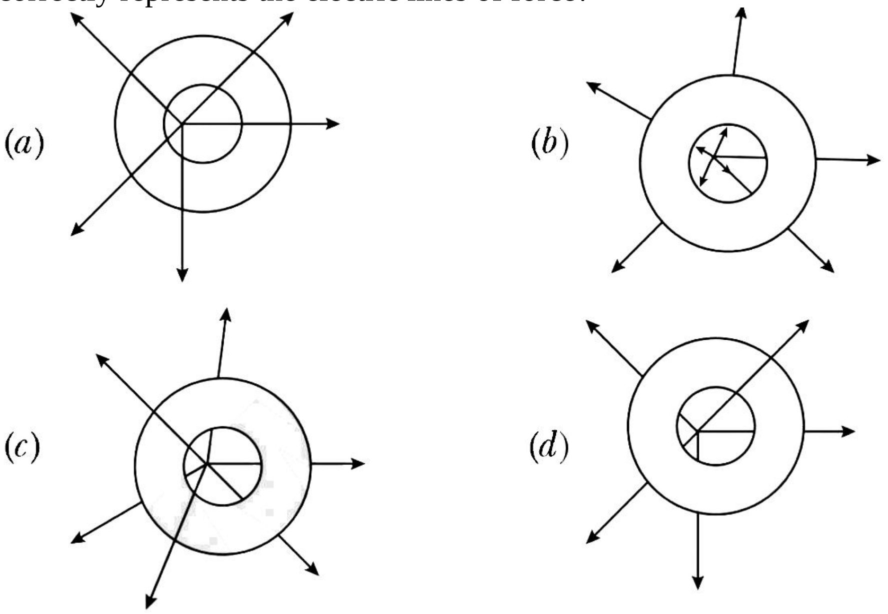
(a) 4Ω (b) 3Ω (c) 2Ω (d) 1Ω

4. A proton, a neutron, an electron and an α-particle have the same energy. Then their de Broglie wavelengths compare as

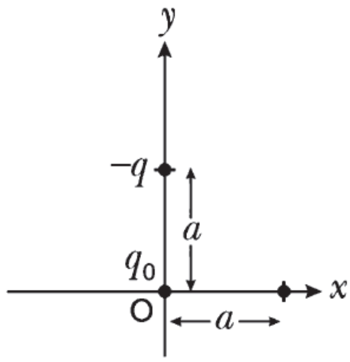
(a) $\lambda p = \lambda n > \lambda e > \lambda\alpha$ (b) $\lambda\alpha < \lambda p = \lambda n < \lambda e$
(c) $\lambda e < \lambda p = \lambda n > \lambda\alpha$ (d) $\lambda e = \lambda p = \lambda n = \lambda\alpha$

5. In a Young's double-slit experiment the source is white light. One of the holes is covered by a red filter and another by a blue filter. In this case,
(a) there shall be alternate interference patterns of red and blue.
(b) there shall be an interference pattern for red distinct from that for blue.
(c) there shall be no interference fringes.
(d) there shall be an interference pattern for red mixing with one for blue.

6. A metallic shell has a point charge q kept inside a cavity. Which one of the following diagrams correctly represents the electric lines of force?



7. Three charges q, -q and q_0, are placed as shown in figure. The magnitude of the net force on the charge q_0, at point O is $\left[k = \frac{1}{4\pi\varepsilon_0}\right]$

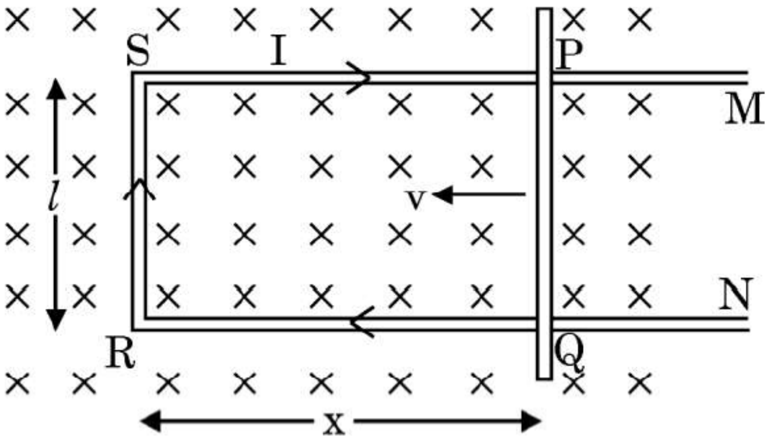


(a) 0 (b) $\frac{2kqq_0}{a^2}$ (c) $\frac{\sqrt{2}kqq_0}{a^2}$ (d) $\frac{1}{\sqrt{2}}\frac{kqq_0}{a^2}$

8. A silver wire has a resistance of 2.1 Ω at 27.5 °C, and a resistance of 2.7 Ω at 100 °C. What is the temperature coefficient of resistivity of silver?
(a) 0.0059 (b) 0.0039 (c) 0.0129 (d) 0.0159

9. A metal rod of length 10 cm and a rectangular cross-section of 1 cm × 1/2 cm is connected to battery across opposite faces. The resistance will be
(a) maximum when the battery is connected across 1 cm × 1/2 cm faces
(b) maximum when the battery is connected across 10 cm × 1 cm faces
(c) maximum when the battery is connected across 10 cm × 1/2 cm faces
(d) same irrespective of the three faces

10. Figure shows a rectangular conductor PSRQ in which movable arm PQ has a resistance 'r' and resistance of PSRQ is negligible. The magnitude of emf induced when PQ is moved with a velocity $\vec{v}$ does not depend on :



(a) magnetic field ($\vec{B}$) (b) velocity ($\vec{v}$) (c) resistance (r) (d) length of PQ

11. Consider sunlight incident on a slit of width 104 Å. The image seen through the slit shall:
(a) be a fine sharp slit white in colour at the centre.
(b) a bright slit white at the centre diffusing to zero intensities at the edges.
(c) a bright slit white at the centre diffusing to regions of different colours.
(d) only be a diffused slit white in colour. 1

12. The electrostatic potential on the surface of a charged conducting sphere is 100 V. Two statements are made in this regard:
S_1 : At any point inside the sphere, electric intensity is zero.
S_2 : At any point inside the sphere, the electrostatic potential is 100 V.
Which of the following is a correct statement?
(a) S_1 is true but S_2 is false.
(b) Both S_1 and S_2 are false.
(c) S_1 is true, S_2 is also true and S_1 is the cause of S_2.
(d) S_1 is true, S_2 is also true but the statements are independent.

ASSERTION-REASON BASED QUESTIONS

In the following questions, a statement of assertion (A) is followed by a statement of Reason (R). Choose the correct answer out of the following choices.
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

13. Assertion (A): In an electromagnetic wave, electric field vector and magnetic field vector are mutually perpendicular.
Reason (R): Electromagnetic waves are transverse.

14. Assertion (A): Magnetic field lines always form closed loops.
Reason (R): Moving charges or currents produce a magnetic field.

15. Assertion (A): The drift velocity of electrons in a metallic conductor decreases with rise of temperature of conductor.
Reason (R): On increasing temperature, the collision of electrons with lattice ions increases; this hinders the drift of electrons.

16. **Assertion (A):** In series LCR resonance circuit, the impedance is equal to the ohmic resistance.
Reason (R): At resonance, the inductive reactance exceeds the capacitive reactance.

SECTION – B

Questions 17 to 21 carry 2 marks each.

17. A proton and a deuteron are accelerated through the same accelerating potential. Which one of the two has:
(a) greater value of de-Broglie wavelength associated with it, and
(b) less momentum?
Give reasons to justify your answer.

18. Differentiate between intrinsic and extrinsic semiconductors. Give reason why a p-type semiconductor crystal is electrically neutral, although $n_h >> n_e$.

19. State Bohr postulate of hydrogen atom that gives the relationship for the frequency of emitted photon in a transition.

OR

Write the shortcomings of Rutherford atomic model. Explain how these were overcome by the postulates of Bohr's atomic model.

20. Two monochromatic radiations of frequencies ν_1 and ν_2 ($\nu_1 > \nu_2$) and having the same intensity are, in turn, incident on a photosensitive surface to cause photoelectric emission. Explain, giving reason, in which case (i) more number of electrons will be emitted and (ii) the maximum kinetic energy of the emitted photoelectrons will be more.

21. Draw the energy band diagram when intrinsic semiconductor (Ge) is doped with impurity atoms of Antimony (Sb). Name the extrinsic semiconductor so obtained and majority charge carriers in it.

SECTION – C

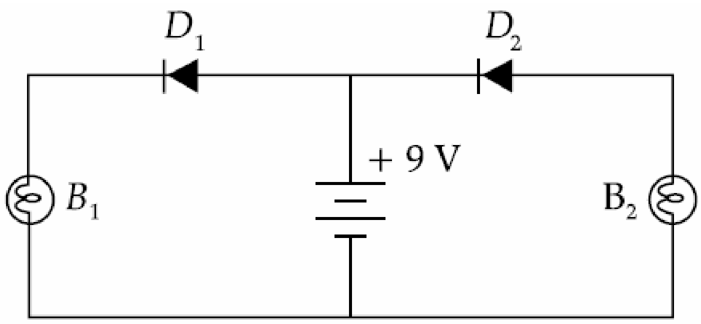
Questions 22 to 28 carry 3 marks each.

22. A coil of wire enclosing an area 100 cm^2 is placed with its plane making an angle 60° with the magnetic field of strength 10^{-1} T.
What is the flux through the coil? If magnetic field is reduced to zero in 10^{-3} s, then find the induced emf.

23. Explain the formation of potential barrier and depletion region in a p–n junction diode. What is effect of applying forward bias on the width of depletion region?

OR

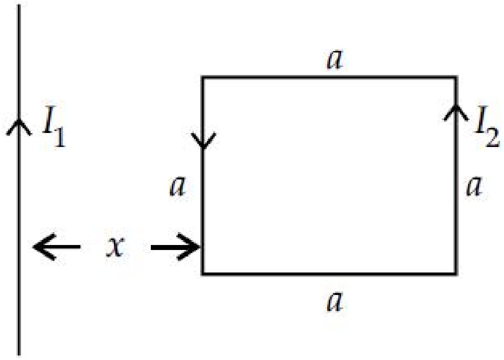
(a) In the following diagram, which bulb out of B_1 and B_2 will glow and why?



(b) Draw a diagram of an illuminated p-n junction solar cell.
(c) Explain briefly the three processes due to which generation of emf takes place in a solar cell.

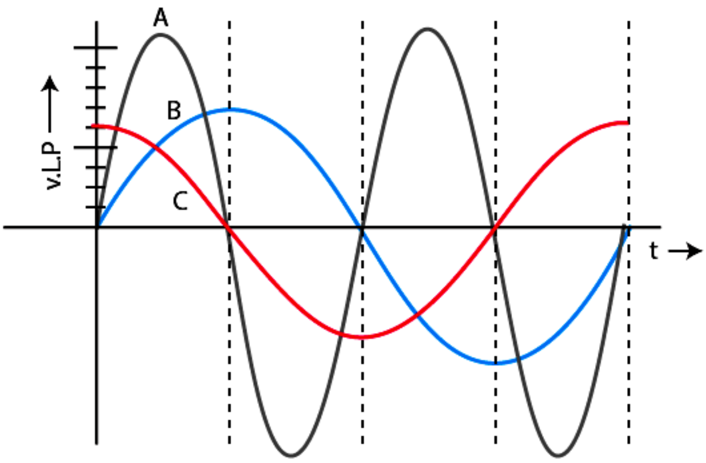
24. A 200 μF parallel plate capacitor having plate separation of 5 mm is charged by a 100 V dc source. It remains connected to the source. Using an insulated handle, the distance between the plates is doubled and a dielectric slab of thickness 5 mm and dielectric constant 10 is introduced between the plates. Explain with reason, how the (i) capacitance, (ii) electric field between the plates, (iii) energy density of the capacitor will change?

25. (a) Define mutual inductance and write its S.I. unit.
(b) A square loop of side 'a' carrying a current I2 is kept at distance x from an infinitely long straight wire carrying a current I1 as shown in the figure. Obtain the expression for the resultant force acting on the loop.



26. Draw the energy level diagram for hydrogen atom. Mark the transitions corresponding to the series lying in the ultraviolet region, visible region and infrared region.

27. A device 'X' is connected to an a.c source. The variation of voltage, current and power in one complete cycle is shown in the below figure.
(a) Which curve shows power consumption over a full cycle?
(b) What is the average power consumption over a cycle?
(c) Identify the device 'X'.



OR

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?

28. Name the type of EM waves having a wavelength range of 0.1 m to 1 mm. How are these waves generated? Write their two uses.

OR

What should be the width of each slit to obtain 10 maxima of double slit pattern within the central maxima of single slit pattern?

SECTION – D (Case Study Based Questions)

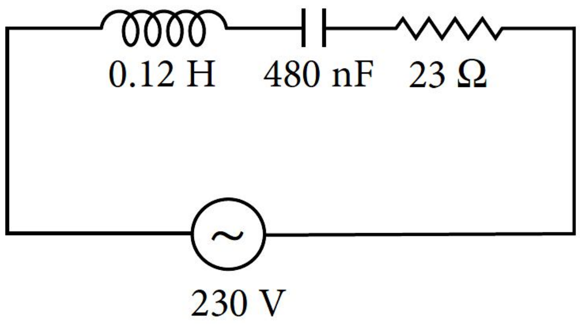
Questions 29 to 30 carry 4 marks each.

29. Case-Study 1:

Read the following paragraph and answer the questions.

Resonant Series LCR Circuit

When the frequency of ac supply is such that the inductive reactance and capacitive reactance become equal, the impedance of the series LCR circuit is equal to the ohmic resistance in the circuit. Such a series LCR circuit is known as resonant series LCR circuit and the frequency of the ac supply is known as resonant frequency. Resonance phenomenon is exhibited by a circuit only if both L and C are present in the circuit. We cannot have resonance in a RL or RC circuit.
A series LCR circuit with L = 0.12 H, C = 480 nF, R = 23 Ω is connected to a 230 V variable frequency supply.



(i) Find the value of source frequency for which current amplitude is maximum.
(a) 222.32 Hz (b) 550.52 Hz (c) 663.48 Hz (d) 770 Hz

(ii) The value of maximum current is
(a) 14.14 A (b) 22.52 A (c) 50.25 A (d) 47.41 A

(iii) At resonance which of the following physical quantity is maximum?
(a) Impedance (b) Current (c) Both (a) and (b) (d) Neither (a) nor (b)

(iv) The value of maximum power is
(a) 2200 W (b) 2299.3 W (c) 5500 W (d) 4700 W

OR

(v) What is the Q-factor of the given circuit?
(a) 25 (b) 42.21 (c) 35.42 (d) 21.74

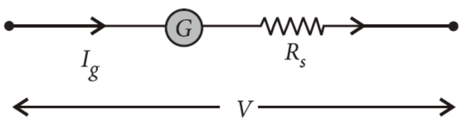
30. Case-Study 2:

Read the following paragraph and answer the questions

A galvanometer can be converted into voltmeter of given range by connecting a suitable resistance Rs in series with the galvanometer, whose value is given by

$$R_s = \frac{V}{I_g} - G$$

where V is the voltage to be measured, Ig is the current for full scale deflection of galvanometer and G is the resistance of galvanometer.



Series resistor (R_s) increases range of voltmeter and the effective resistance of galvanometer. It also protects the galvanometer from damage due to large current.
Voltmeter is a high resistance instrument and it is always connected in parallel with the circuit element across which potential difference is to be measured. An ideal voltmeter has infinite resistance.
In order to increase the range of voltmeter n times the value of resistance to be connected in series with galvanometer is $R_s = (n-1)G$.

(i) 10 mA current can pass through a galvanometer of resistance 25 Ω. What resistance in series should be connected through it, so that it is converted into a voltmeter of 100 V?
(a) 0.975 Ω (b) 99.75 Ω (c) 975 Ω (d) 9975 Ω.

(ii) There are 3 voltmeter A, B, C having the same range but their resistance are 15,000 Ω, 10,000 Ω and 5,000 Ω respectively. The best voltmeter amongst them is the one whose resistance is
(a) 5000 Ω (b) 10, 000 Ω (c) 15, 000 Ω (d) all are equally good

(iii) A milliammeter of range 0 to 25 mA and resistance of 10 Ω is to be converted into a voltmeter with a range of 0 to 25 V. The resistance that should be connected in series will be
(a) 930 Ω (b) 960 Ω (c) 990 Ω (d) 1010 Ω

(iv) To convert a moving coil galvanometer (MCG) into a voltmeter
(a) a high resistance R is connected in parallel with MCG
(b) a low resistance R is connected in parallel with MCG
(c) a low resistance R is connected in series with MCG
(d) a high resistance R is connected in series with MCG

OR

(v) The resistance of an ideal voltmeter is
(a) zero (b) low (c) high (d) infinity

SECTION – D

Questions 31 to 33 carry 5 marks each.

31. (a) Define the term wavefront.
(b) Use Huygens' geometrical construction to show how a plane wave front at t = 0 propagates and produces a wave front at a later time. Using Huygen's wave theory, verify the law of reflection.

OR

Answer the following questions:
(a) 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?
(b) In what way is diffraction from each slit related to the interference pattern in a double-slit experiment?
(c) 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 shadow of the obstacle. Explain why?
(d) Two students are separated by a 7 m partition wall in a room 10 m high. If both light and sound waves can bend around obstacles, how is it that the students are unable to see each other even though they can converse easily.
(e) Ray optics is based on the assumption that light travels in a straight line. Diffraction effects (observed when light propagates through small apertures/slits or around small obstacles) disprove this assumption. Yet the ray optics assumption is so commonly used in understanding location and several other properties of images in optical instruments. What is the justification?

32. (i) Describe briefly the process of transferring the charge between the two plates of a parallel plate capacitor when connected to a battery. Derive an expression for the energy stored in a capacitor.

(ii) A parallel plate capacitor is charged by a battery to a potential difference V. It is disconnected from battery and then connected to another uncharged capacitor of the same capacitance. Calculate the ratio of the energy stored in the combination to the initial energy on the single capacitor.

OR

A capacitor of capacitance C_1 is charged to a potential V_1 while another capacitor of capacitance C_2 is charged to a potential difference V_2. The capacitors are now disconnected from their respective charging batteries and connected in parallel to each other.

(a) Find the total energy stored in the two capacitors before they are connected.

(b) Find the total energy stored in the parallel combination of the two capacitors.

(c) Explain the reason for the difference of energy in parallel combination in comparison to the total energy before they are connected.

33. (a) In Rutherford scattering experiment, draw the trajectory traced by a-particles in the coulomb field of target nucleus and explain how this led to estimate the size of the nucleus.

(b) Describe briefly how wavelength is related to kinetic energy?

(c) Estimate the ratio of de-Broglie wavelengths associated with deuterons and a-particles when they are accelerated from rest through the same accelerating potential V.

OR

(a) Using Bohr's postulates, derive the expression for the total energy of the electron in the stationary states of the hydrogen atom.

(b) Using Rydberg formula, calculate the wavelengths of the spectral lines of the first member of the Lyman series and of the Balmer series.

SAMPLE PAPER TEST 05 FOR BOARD EXAM 2025

(ANSWERS)

SUBJECT: PHYSICS | **MAX. MARKS : 70**

CLASS : XII | **DURATION: 3 HRS**

General Instructions:

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2. This question paper has five sections: Section A, Section B, Section C, Section D and Section E. All the sections are compulsory.
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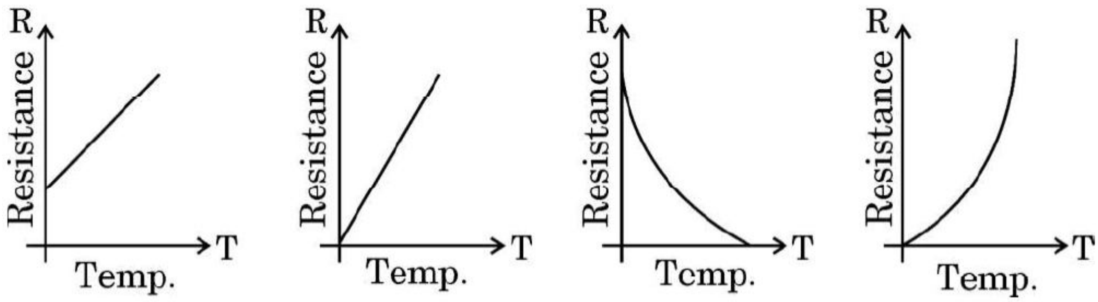
SECTION – A

Questions 1 to 16 carry 1 mark each.

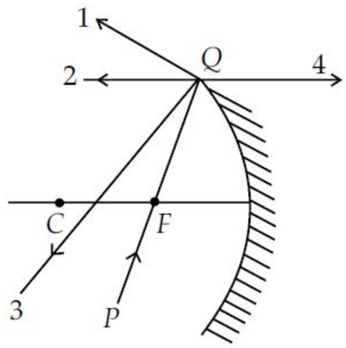
1. For a metallic conductor, the correct representation of variation of resistance R with temperature T is:



(a) (b) (c) (d)

Ans: (d)

2. The direction of ray of light incident on a concave mirror is shown by PQ while directions in which the ray would travel after reflection is shown by four rays marked 1, 2, 3 and 4 (figure). Which of the four rays correctly shows the direction of reflected ray:



(a) 1 (b) 2 (c) 3 (d) 4

Ans: (b) 2

3. The potential difference across a cell in an open circuit is 8 V. It falls to 4 V when a current of 4 A is drawn from it. The internal resistance of the cell is :

(a) 4Ω (b) 3Ω (c) 2Ω (d) 1Ω

Ans: (d) 1Ω

4. A proton, a neutron, an electron and an α-particle have the same energy. Then their de Broglie wavelengths compare as

(a) $\lambda p = \lambda n > \lambda e > \lambda\alpha$ (b) $\lambda\alpha < \lambda p = \lambda n < \lambda e$

(c) $\lambda e < \lambda p = \lambda n > \lambda\alpha$ (d) $\lambda e = \lambda p = \lambda n = \lambda\alpha$

Ans: (b) $\lambda\alpha < \lambda p = \lambda n < \lambda e$

5. In a Young's double-slit experiment the source is white light. One of the holes is covered by a red filter and another by a blue filter. In this case,

(a) there shall be alternate interference patterns of red and blue.

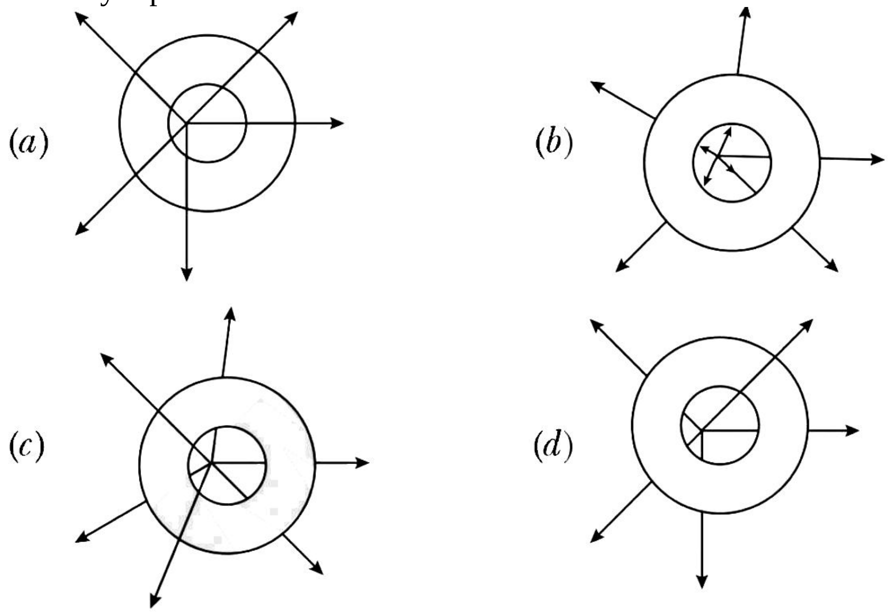
(b) there shall be an interference pattern for red distinct from that for blue.

(c) there shall be no interference fringes.

(d) there shall be an interference pattern for red mixing with one for blue.

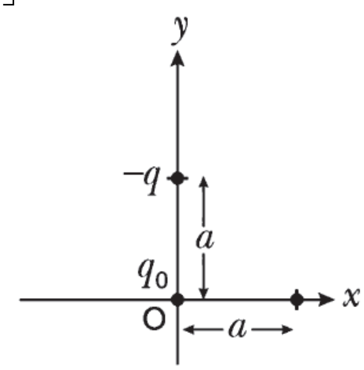
Ans: (c) there shall be no interference fringes.

6. A metallic shell has a point charge q kept inside a cavity. Which one of the following diagrams correctly represents the electric lines of force?



Ans: (b) Electric field is zero within the metal, so there should be no line of force within metal and lines are always normal to equipotential surface.

7. Three charges q, -q and q_0, are placed as shown in figure. The magnitude of the net force on the charge q_0, at point O is $\left[k = \frac{1}{4\pi\varepsilon_0}\right]$



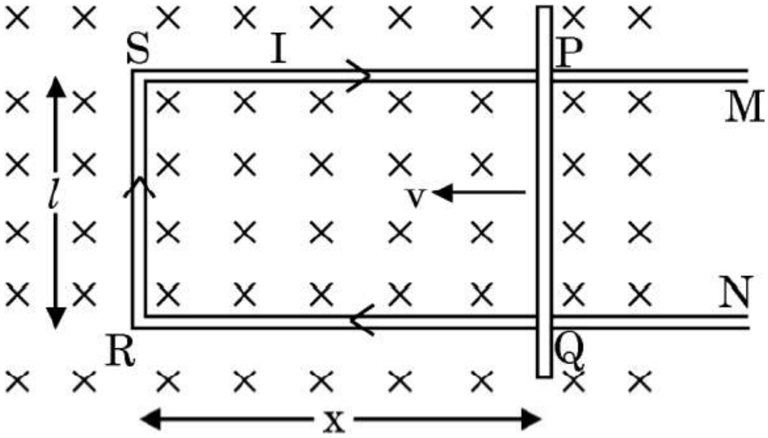
(a) 0 (b) $\frac{2kqq_0}{a^2}$ (c) $\frac{\sqrt{2}kqq_0}{a^2}$ (d) $\frac{1}{\sqrt{2}}\frac{kqq_0}{a^2}$

Ans: (c) $\frac{\sqrt{2}kqq_0}{a^2}$

8. A silver wire has a resistance of 2.1 Ω at 27.5 °C, and a resistance of 2.7 Ω at 100 °C. What is the temperature coefficient of resistivity of silver?
(a) 0.0059 (b) 0.0039 (c) 0.0129 (d) 0.0159
Ans: (b) 0.0039

9. A metal rod of length 10 cm and a rectangular cross-section of 1 cm × 1/2 cm is connected to battery across opposite faces. The resistance will be
(a) maximum when the battery is connected across 1 cm × 1/2 cm faces
(b) maximum when the battery is connected across 10 cm × 1 cm faces
(c) maximum when the battery is connected across 10 cm × 1/2 cm faces
(d) same irrespective of the three faces
Ans: (a) maximum when the battery is connected across 1 cm × 1/2 cm faces

10. Figure shows a rectangular conductor PSRQ in which movable arm PQ has a resistance 'r' and resistance of PSRQ is negligible. The magnitude of emf induced when PQ is moved with a velocity $\vec{v}$ does not depend on :



(a) magnetic field ($\vec{B}$) (b) velocity ($\vec{v}$) (c) resistance (r) (d) length of PQ
Ans: (c) resistance (r)

11. Consider sunlight incident on a slit of width 104 Å. The image seen through the slit shall:
(a) be a fine sharp slit white in colour at the centre.
(b) a bright slit white at the centre diffusing to zero intensities at the edges.
(c) a bright slit white at the centre diffusing to regions of different colours.
(d) only be a diffused slit white in colour. 1
Ans: (a) be a fine sharp slit white in colour at the centre.

12. The electrostatic potential on the surface of a charged conducting sphere is 100 V. Two statements are made in this regard:
S_1 : At any point inside the sphere, electric intensity is zero.
S_2 : At any point inside the sphere, the electrostatic potential is 100 V.
Which of the following is a correct statement?
(a) S_1 is true but S_2 is false.
(b) Both S_1 and S_2 are false.
(c) S_1 is true, S_2 is also true and S_1 is the cause of S_2.
(d) S_1 is true, S_2 is also true but the statements are independent.
Ans: (c) S_1 is true, S_2 is also true and S_1 is the cause of S_2.

ASSERTION-REASON BASED QUESTIONS

In the following questions, a statement of assertion (A) is followed by a statement of Reason (R). Choose the correct answer out of the following choices.
(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

13. Assertion (A): In an electromagnetic wave, electric field vector and magnetic field vector are mutually perpendicular.
Reason (R): Electromagnetic waves are transverse.
Ans: (b) Both A and R are true but R is not the correct explanation of A.

14. Assertion (A): Magnetic field lines always form closed loops.
Reason (R): Moving charges or currents produce a magnetic field.
Ans: (b) Both A and R are true but R is not the correct explanation of A.

15. Assertion (A): The drift velocity of electrons in a metallic conductor decreases with rise of temperature of conductor.
Reason (R): On increasing temperature, the collision of electrons with lattice ions increases; this hinders the drift of electrons.
Ans: (a) Both A and R are true and R is the correct explanation of A.

16. Assertion (A): In series LCR resonance circuit, the impedance is equal to the ohmic resistance.
Reason (R): At resonance, the inductive reactance exceeds the capacitive reactance.
Ans: (c) A is true but R is false.

SECTION – B

Questions 17 to 21 carry 2 marks each.

17. A proton and a deuteron are accelerated through the same accelerating potential. Which one of the two has:
(a) greater value of de-Broglie wavelength associated with it, and
(b) less momentum?
Give reasons to justify your answer.

Ans: (a) de-Broglie wavelength is given by $\lambda = \frac{h}{\sqrt{2mqV}}$

As mass of proton < mass of deuteron
and $q_p = q_d$ and V is same.
$\therefore \lambda_p > \lambda_d$ for same accelerating potential.

(b) Momentum = $\frac{h}{\lambda}$

$\because \lambda_p > \lambda_d$
$\therefore$ Momentum of proton will be less than that of deuteron.

18. Differentiate between intrinsic and extrinsic semiconductors. Give reason why a p-type semiconductor crystal is electrically neutral, although $n_h >> n_e$.
Ans:

Intrinsic semiconductor	**Extrinsic semiconductor**
1. Pure semiconductor.	Semiconductor is Doped with impurities.
2. Low conductivity at room temperature.	High conductivity at room temperature.
3. ne = nh	ne ≠ nh

p-type semiconductor is electrically neutral because every atom, whether it is of pure semiconductor (Ge or Si) or of impurity (Al) is electrically neutral.

19. State Bohr postulate of hydrogen atom that gives the relationship for the frequency of emitted photon in a transition.

Ans: Bohr's third postulate: It states that an electron might make a transition from one of its specified non-radiating orbits to another of lower energy. When it does so, a photon is emitted having energy equal to the energy difference between the initial and final states.

The frequency of the emitted photon is given by $h\nu = E_i - E_f$

where E_i and E_f are the energies of the initial and final states and $E_i > E_f$.

OR

Write the shortcomings of Rutherford atomic model. Explain how these were overcome by the postulates of Bohr's atomic model.

Ans: Rutherford proposed planetary model of an atom in which electrons revolve around the nucleus. An electron revolving around the nucleus has an acceleration directed towards the nucleus. Such accelerated electron must radiate electromagnetic radiation. But, if a revolving electron radiates energy, the total energy of the system must decrease. In such situation, the electron must come closer to the nucleus and hit the nucleus. Also, the radiation spectrum of emitted electromagnetic waves should be continuous.

However, this does not happen in an atom. Atom is not unstable and the spectrum is not continuous. Rutherford atomic model cannot explain these two observations. These are the shortcomings of Rutherford atomic model.

To overcome this discrepancy, Neils Bohr put forward three postulates combining classical Physics and Planck's quantum hypothesis. Bohr's 1st postulate provides stability to the atomic model. Bohr's 2nd postulate provides justification that electrons may revolve in stationary orbit. Bohr's 3rd postulate provides the explanation of line spectrum.

20. Two monochromatic radiations of frequencies ν_1 and ν_2 ($\nu_1 > \nu_2$) and having the same intensity are, in turn, incident on a photosensitive surface to cause photoelectric emission. Explain, giving reason, in which case (i) more number of electrons will be emitted and (ii) the maximum kinetic energy of the emitted photoelectrons will be more.

Ans: (i) Intensity of incident radiation $I = nh\nu$, where, n is the number of photons incident per unit time per unit area. For same intensity of two monochromatic radiations of frequency ν_1 and ν_2.

$n_1 h\nu_1 = n_2 h\nu_2$

As, $\nu_1 > \nu_2 \Rightarrow n_2 > n_1$

Therefore, the number of electrons emitted for monochromatic radiation of frequency ν_2, will be more than that for radiation of frequency ν_1.

(ii) $h\nu = \phi_0 + K_{max}$

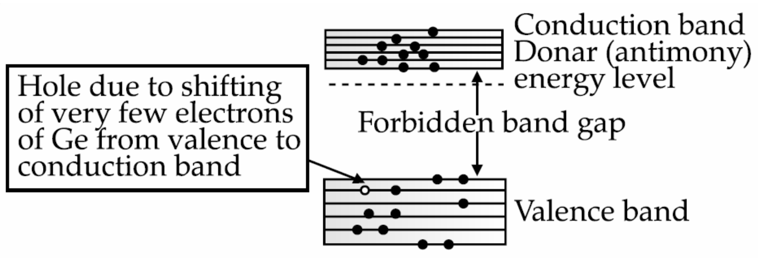
$\therefore$ For given ϕ_0 (work function of metal),

K_{max} increases with ν.

$\therefore$ The maximum kinetic energy of emitted photoelectrons will be more for monochromatic light of frequency ν_1 (as $\nu_1 > \nu_2$).

21. Draw the energy band diagram when intrinsic semiconductor (Ge) is doped with impurity atoms of Antimony (Sb). Name the extrinsic semiconductor so obtained and majority charge carriers in it.

Ans:



This is an n-type extrinsic semiconductor.
Majority carriers are electrons.

SECTION – C

Questions 22 to 28 carry 3 marks each.

22. A coil of wire enclosing an area 100 cm^2 is placed with its plane making an angle 60° with the magnetic field of strength 10^{-1} T.
What is the flux through the coil? If magnetic field is reduced to zero in 10^{-3} s, then find the induced emf.
Ans: $\phi = BA\cos\theta$, $B = 10^{-1}$ T, $A = 100\ cm^2 = 10^{-2}\ m^2$

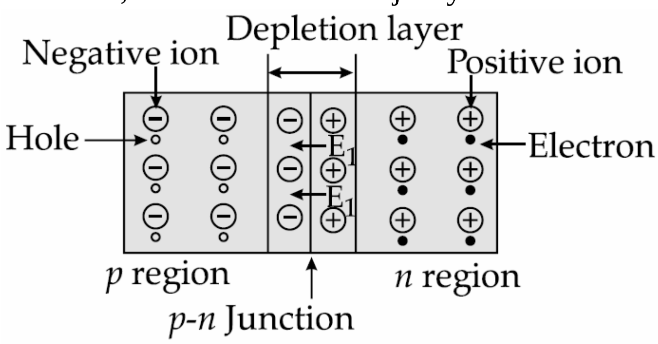
$$\cos\theta = \cos(90° - 60°) = \cos 30^0 = \frac{\sqrt{3}}{2}$$

$$\therefore \phi = 10^{-1} \times 10^{-2} \times \frac{\sqrt{3}}{2}$$

$$\therefore \phi = \frac{\sqrt{3}}{2} \times 10^{-3}\ \text{Wb}$$

$$\text{Induced emf} = |\varepsilon| = d\phi/dt = \frac{\frac{\sqrt{3}}{2}\times 10^{-3}}{10^{-3}} = \frac{\sqrt{3}}{2}V$$

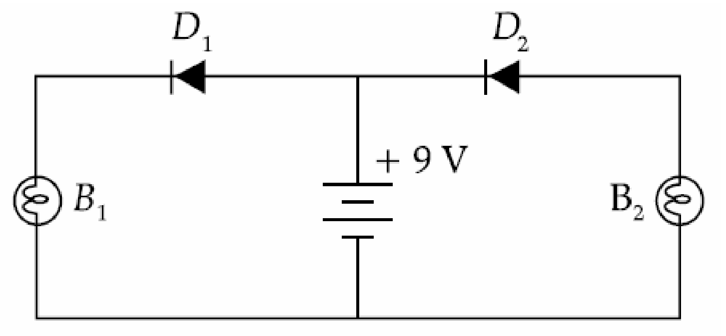
23. Explain the formation of potential barrier and depletion region in a p–n junction diode. What is effect of applying forward bias on the width of depletion region?
Ans: Formation of depletion region: In the p-type semiconductor, holes are the majority carrier and in the n-type semiconductor, electrons are the majority carrier.



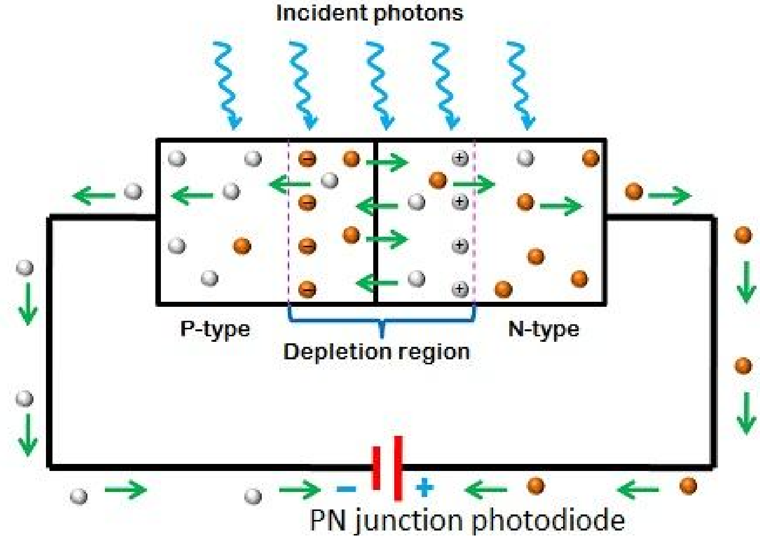
When a p–n junction is formed, some of the electrons from the n-region which have reached the conduction band are free to diffuse across the junction and combine with holes.
Filling a hole, makes a negative ion in p-side and a positive ion in the n-side. Thus, free charges get depleted and a depletion region is formed, which inhibits any further electron transfer.

OR

(a) In the following diagram, which bulb out of B_1 and B_2 will glow and why?



(b) Draw a diagram of an illuminated p-n junction solar cell.
(c) Explain briefly the three processes due to which generation of emf takes place in a solar cell.
Ans: (a) In the diagram, diode D_1 is in forward bias and diode D_2 is in reverse bias, So current will flow through D_1 and D_2 will not allow flowing the current, So bulb B_1 will glow and bulb B_2 will not glow.
(a)



(c) When the photodiode is illuminated with light, with energy greater than the energy gap of the semiconductor, then electron-hole pairs are generated due to the absorption of photons, in or near the depletion region. Due to the electric field of the junction, electrons and holes are separated before the recombine electrons reach n-side and holes reach p-side. Electrons are collected on n-side and holes are collected on p-side giving rise to an emf. When connected to an external load is current flows, whose magnitude depends on the intensity of incident light. The photodiode can be used as a photodetector to detect optical signals.

24. A 200 μF parallel plate capacitor having plate separation of 5 mm is charged by a 100 V dc 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?
Ans: Given: Capacitance of the capacitor, C= 200 μF
Potential of dc source, V = 100 V
Let 'A' be the area of the plate and 'd' be the separation between the plates,
The capacitance of the capacitor is given as,

$$C = \frac{\varepsilon_0 A}{d} \Rightarrow \varepsilon_0 A = Cd \qquad ...(i)$$

When the capacitor remains connected with the dc source, then there will be no change in potential difference.
(i) Now, according the problem

Separation between the plates = 2d
Thickness of dielectric slab, t = 5 mm = 5.0×10^{-3} m
Dielectric constant, K = 10

New capacitance of the capacitor, $C' = \dfrac{A\varepsilon_0}{(d'-t)+\dfrac{t}{K}}$

Here, d' = 2d and t = d

$$C' = \frac{A\varepsilon_0}{(2d-d)+\dfrac{d}{K}} = \frac{A\varepsilon_0}{d+\dfrac{d}{K}} = \frac{A\varepsilon_0}{d\left(1+\dfrac{1}{K}\right)}$$

$$\Rightarrow C' = \frac{KC}{K+1} = \frac{10\times 200\mu F}{(10+1)} = 182\mu F$$

Hence, new capacitance of the capacitor will decrease.
(ii) Since, there in no change in the potential difference.
Hence, there would not be any change in electric field.

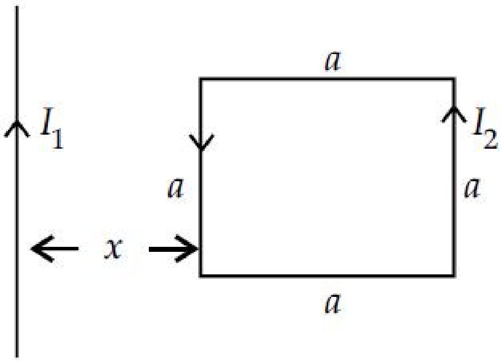
It will be $\dfrac{100}{5.5\times 10^{-3}} = 18{,}182\ \text{V/m}$.

(iii) The energy will decrease because:

$E = \dfrac{1}{2}CV^2 \Rightarrow E \propto C$ [∵ V is constant]

Hence, the energy density will also decrease.

25. (a) Define mutual inductance and write its S.I. unit.
(b) A square loop of side 'a' carrying a current I2 is kept at distance x from an infinitely long straight wire carrying a current I1 as shown in the figure. Obtain the expression for the resultant force acting on the loop.



Ans: (a) Mutual inductance equals the magnetic flux associated with a coil when unit current flows in its neighbouring coil. Alternatively, mutual inductance equals the induced emf in ac coil when the rate of change of current in its neighbouring coil is one ampere/second.
S.I unit: Henry (H) or weber/ampere (or any other correct SI unit)

(b) Force per unit length between two parallel straight conductors, $F = \dfrac{\mu_0 2I_1I_2}{4\pi d}$

Force on the part of the loop which is parallel to infinite straight wire and at a distance x from it.

$F_1 = \dfrac{\mu_0}{4\pi}\dfrac{I_1I_2}{x}$ (away from the, infinite straight wire)

Force on the part of the loop which is at a distant (x + a) from it

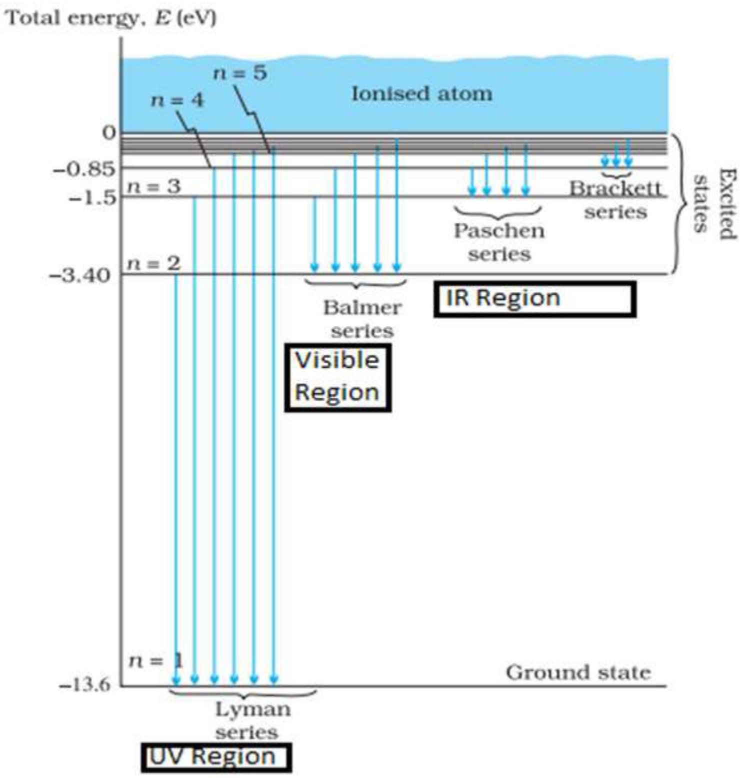
$F_2 = \dfrac{\mu_0}{2\pi}\dfrac{I_1I_2a}{(x+a)}$ (towards the infinite straight wire)

Net force F = F₁ – F₂ $\Rightarrow F = \frac{\mu_0}{4\pi}\frac{I_1 I_2}{x} - \frac{\mu_0}{2\pi}\frac{I_1 I_2 a}{(x+a)} = \frac{\mu_0 I_1 I_2 a}{4\pi}\left[\frac{1}{x} - \frac{1}{x+a}\right]$

$\Rightarrow F = \frac{\mu_0}{2\pi}\frac{I_1 I_2 a^2}{x(x+a)}$ (away from the infinite straight wire)

26. Draw the energy level diagram for hydrogen atom. Mark the transitions corresponding to the series lying in the ultraviolet region, visible region and infrared region.

Ans:

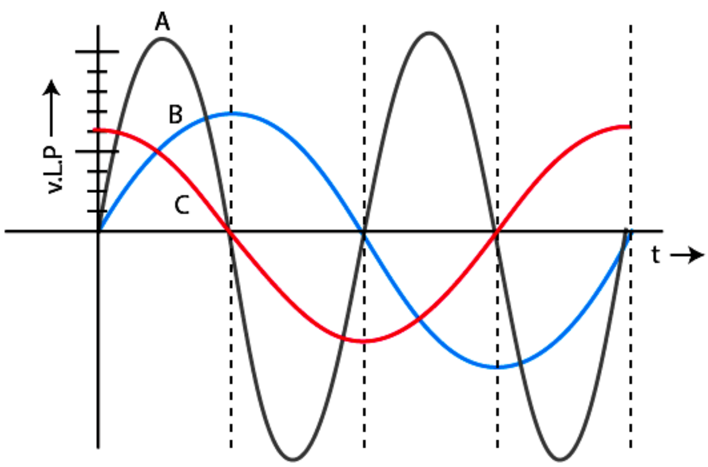


27. A device 'X' is connected to an a.c source. The variation of voltage, current and power in one complete cycle is shown in the below figure.

(a) Which curve shows power consumption over a full cycle?

(b) What is the average power consumption over a cycle?

(c) Identify the device 'X'.



Ans: (a) The curve of power will have maximum amplitude and the is equal to the product of amplitudes of voltages and current. Therefore, curve A represents power.

(b) The average power consumption over a cycle is zero as the full cycle in the graph consists of one positive and one negative symmetrical area.

(c) X might be an inductor or capacitor or a combination of both.

OR

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?

Ans: A transformer is based on the principle of mutual induction which states that due to continuous change in the current in the primary coil, an emf gets induced across the secondary coil. Electric power generated at the power station, is stepped-up to very high voltages by means of a step-up transformer and transmitted to a distant place. At receiving end, it is stepped down by a step-down transformer.

28. Name the type of EM waves having a wavelength range of 0.1 m to 1 mm. How are these waves generated? Write their two uses.

Ans: Type of electromagnetic waves having wavelength range 0.1 m to 1 mm is microwaves and are produced by klystron valve or magnetron valve.

These are produced by vacuum tubes devices that operate on the ballistic motion of electron controlled by magnetic or electric fields. They can also be produced by traveling wave tube(TWT) and gyrotron.

These waves work in density modulated mode rather than current modulated mode.

Uses of microwaves electromagnetic waves are (any two)

1) Used for point to point telecommunications.

2) Used for high data transmission.

3) T.V. and telephone communications are transmitted long distances by microwaves.

4) Microwaves are also employed in microwave ovens and in radar technology.

5) They are also be used in navigation and radio signals

OR

What should be the width of each slit to obtain 10 maxima of double slit pattern within the central maxima of single slit pattern?

Ans: Let the width of each slit is a.

Linear separation between 10 fringes is given by $x = 10\beta = 10\frac{\lambda D}{d}$

Corresponding angular separation is $\theta_1 = \frac{x}{D} = \frac{10\lambda}{d}$

Now the angular width of central maximum in the diffraction pattern of a single slit is given by $\theta_2 = \frac{2\lambda}{a}$

Since $\theta_2 = \theta_1$,

$$\therefore \frac{2\lambda}{a} = \frac{10\lambda}{d} \Rightarrow a = \frac{2d}{10} \Rightarrow a = \frac{d}{5} = \frac{1.00}{5} = 0.2\,mm$$

SECTION – D (Case Study Based Questions)

Questions 29 to 30 carry 4 marks each.

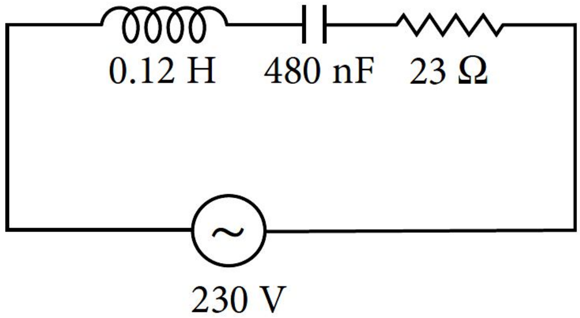
29. Case-Study 1:

Read the following paragraph and answer the questions.

Resonant Series LCR Circuit

When the frequency of ac supply is such that the inductive reactance and capacitive reactance become equal, the impedance of the series LCR circuit is equal to the ohmic resistance in the circuit. Such a series LCR circuit is known as resonant series LCR circuit and the frequency of the ac supply is known as resonant frequency. Resonance phenomenon is exhibited by a circuit only if both L and C are present in the circuit. We cannot have resonance in a RL or RC circuit.

A series LCR circuit with L = 0.12 H, C = 480 nF, R = 23 Ω is connected to a 230 V variable frequency supply.



(i) Find the value of source frequency for which current amplitude is maximum.
(a) 222.32 Hz (b) 550.52 Hz (c) 663.48 Hz (d) 770 Hz

(ii) The value of maximum current is
(a) 14.14 A (b) 22.52 A (c) 50.25 A (d) 47.41 A

(iii) At resonance which of the following physical quantity is maximum?
(a) Impedance (b) Current (c) Both (a) and (b) (d) Neither (a) nor (b)

(iv) The value of maximum power is
(a) 2200 W (b) 2299.3 W (c) 5500 W (d) 4700 W

OR

(v) What is the Q-factor of the given circuit?
(a) 25 (b) 42.21 (c) 35.42 (d) 21.74

Ans. (i) (c) Here, L = 0.12 H, C = 480 nF = 480 × 10^{-9} F, R = 23 Ω, V = 230 V
$V_0 = \sqrt{2} \times 230 = 325.22$ V

$$I_0 = \frac{V_0}{\sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}}$$

At resonance, $\omega L - \frac{1}{\omega C} = 0$

$$\omega = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{0.12 \times 480 \times 10^9}} = 4166.67 \text{ rad s}^{-1}$$

$$\upsilon_R = \frac{4166.67}{2 \times 3.14} = 663.48 \text{ Hz}$$

(ii) (a) Current, $I_0 = \frac{V_0}{R} = \frac{325.22}{23} = 14.14A$

(iii) (b) Current

(iv) (b) Maximum power, $P_{max} = \frac{1}{2}(I_0)^2 R = \frac{1}{2} \times (14.14)^2 \times 23 = 2299.3$ W

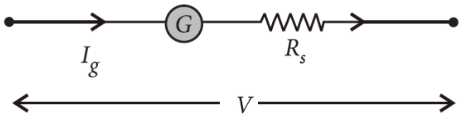
OR

(v) (d) Quality factor, $Q = \frac{X_L}{R} = \frac{\omega_r L}{R} = \frac{4166.67 \times 0.12}{23} = 21.74$

30. Case-Study 2:
Read the following paragraph and answer the questions
A galvanometer can be converted into voltmeter of given range by connecting a suitable resistance Rs in series with the galvanometer, whose value is given by

$$R_s = \frac{V}{I_g} - G$$

where V is the voltage to be measured, Ig is the current for full scale deflection of galvanometer and G is the resistance of galvanometer.



Series resistor (R_s) increases range of voltmeter and the effective resistance of galvanometer. It also protects the galvanometer from damage due to large current.
Voltmeter is a high resistance instrument and it is always connected in parallel with the circuit element across which potential difference is to be measured. An ideal voltmeter has infinite resistance.
In order to increase the range of voltmeter n times the value of resistance to be connected in series with galvanometer is R_s = (n – 1)G.

(i) 10 mA current can pass through a galvanometer of resistance 25 Ω. What resistance in series should be connected through it, so that it is converted into a voltmeter of 100 V?
(a) 0.975 Ω (b) 99.75 Ω (c) 975 Ω (d) 9975 Ω.

(ii) There are 3 voltmeter A, B, C having the same range but their resistance are 15,000 Ω, 10,000 Ω and 5,000 Ω respectively. The best voltmeter amongst them is the one whose resistance is
(a) 5000 Ω (b) 10, 000 Ω (c) 15, 000 Ω (d) all are equally good

(iii) A milliammeter of range 0 to 25 mA and resistance of 10 Ω is to be converted into a voltmeter with a range of 0 to 25 V. The resistance that should be connected in series will be
(a) 930 Ω (b) 960 Ω (c) 990 Ω (d) 1010 Ω

(iv) To convert a moving coil galvanometer (MCG) into a voltmeter
(a) a high resistance R is connected in parallel with MCG
(b) a low resistance R is connected in parallel with MCG
(c) a low resistance R is connected in series with MCG
(d) a high resistance R is connected in series with MCG

OR

(v) The resistance of an ideal voltmeter is
(a) zero (b) low (c) high (d) infinity

Ans. (i) (d) A galvanometer can be converted into a voltmeter of given range by connecting a suitable high resistance R in series of galvanometer, which is given by

$$R_s = \frac{V}{I_g} - G = \frac{100}{10\times10^{-3}} - 25 = 10000 - 25 = 9975\Omega$$

(ii) (c) An ideal voltmeter should have a very high resistance.

(iii) (c) Resistance of voltmeter = $\frac{25}{25\times10^{-3}} = 1000\Omega$

$\therefore\ X = 1000 - 10 = 990\ \Omega$

(iv) (d) To convert a moving coil galvanometer into a voltmeter, it is connected with a high resistance in series. The voltmeter is connected in parallel to measure the potential difference. As the resistance is high, the voltmeter itself does not consume current.
(v) (d) The resistance of an ideal voltmeter is infinity.

SECTION – D

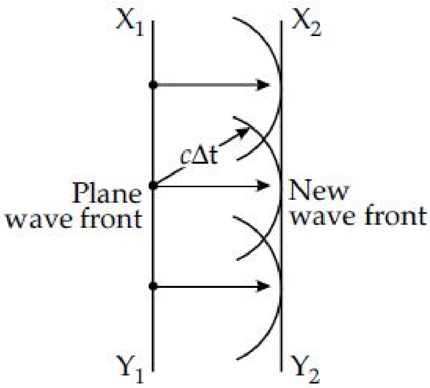
Questions 31 to 33 carry 5 marks each.

31. (a) Define the term wavefront.

(b) Use Huygens' geometrical construction to show how a plane wave front at t = 0 propagates and produces a wave front at a later time. Using Huygen's wave theory, verify the law of reflection.

Ans: (a) Wave front is a surface of constant phase. Alternatively, it is the locus of all those points which are in the same phase of disturbance.

(b) Let us consider a plane wavefront X_1Y_1 at t = 0. According to Huygen's principle each point on this wavefront may be considered as a point source. Points are considered for the convenience of drawing. 3 circular arcs are drawn centring each point with radius $c\Delta t$ where c is the velocity of light and Δt is the time difference. A common tangent is drawn to these 3 arcs which gives the new wavefront X_2Y_2 parallel to X_1Y_1 after time Δt.

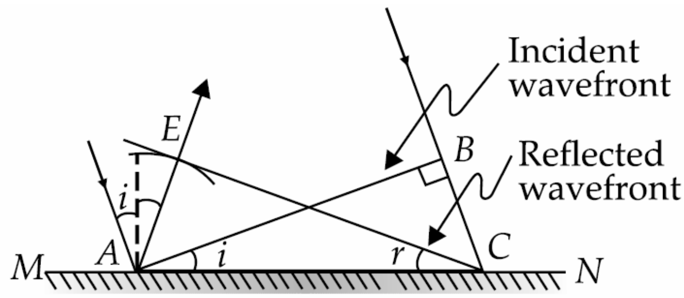


Consider a plane wave AB incident at an angle 'i' on a reflecting surface MN

let t = time taken by the wave front to advance from B to C.

∴ BC = vt

Let CE represent the tangent plane drawn from the point E to the sphere of radius 'vt' having A as its center.



then AE = BC = *vt*

it follows that ΔEAC ≅ ΔBAC

Hence, ∠i = ∠r (cpct)

∴ Angle of incidence = angle of reflection

OR

Answer the following questions:

(a) 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?

(b) In what way is diffraction from each slit related to the interference pattern in a double-slit experiment?

(c) 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 shadow of the obstacle. Explain why?

(d) Two students are separated by a 7 m partition wall in a room 10 m high. If both light and sound waves can bend around obstacles, how is it that the students are unable to see each other even though they can converse easily.

(e) Ray optics is based on the assumption that light travels in a straight line. Diffraction effects (observed when light propagates through small apertures/slits or around small obstacles) disprove this assumption. Yet the ray optics assumption is so commonly used in understanding location and several other properties of images in optical instruments. What is the justification?

Ans: (a) In a single-slit diffraction experiment, if the width of the slit is made double the original width, then the size of the central diffraction band reduces to half and the intensity of the central diffraction band increases up to four times.

(b) The interference pattern in a double-slit experiment is modulated by diffraction from each slit. The pattern is the result of the interference of the diffracted wave from each slit.

(c) 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 shadow of the obstacle. This is because light waves are diffracted from the edge of the circular obstacle, which interferes constructively at the centre of the shadow. This constructive interference produces a bright spot.

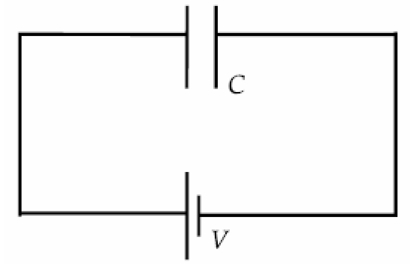
(d) Bending of waves by obstacles by a large angle is possible when the size of the obstacle is comparable to the wavelength of the waves. On the one hand, the wavelength of the light waves is too small in comparison to the size of the obstacle. Thus, the diffraction angle will be very small. Hence, the students are unable to see each other. On the other hand, the size of the wall is comparable to the wavelength of the sound waves. Thus, the bending of the waves takes place at a large angle. Hence, the students are able to hear each other.

(e) The justification is that in ordinary optical instruments, the size of the aperture involved is much larger than the wavelength of the light used.

32. (i) Describe briefly the process of transferring the charge between the two plates of a parallel plate capacitor when connected to a battery. Derive an expression for the energy stored in a capacitor.

(ii) A parallel plate capacitor is charged by a battery to a potential difference V. It is disconnected from battery and then connected to another uncharged capacitor of the same capacitance. Calculate the ratio of the energy stored in the combination to the initial energy on the single capacitor.

Ans: (a)Let us consider, an uncharged capacitor of capacitance $'c'$ which is connected with a battery of e.m.f $'e'$. Potential Difference across the capacitor will build up. Such that, the plate with positive terminal of the battery will lose electrons and the other plate will gain the electron. There is no transfer of charge in between the plates.



When the emf of the battery becomes equal to the potential difference across the capacitor, then the capacitor would be fully charged and will act as an open switch.

Derivation : Let the charge on the capacitor is increased by dq amount then,

Then, the work done:-

$$dU = V dQ' = \frac{Q'}{C} dQ'$$

On integrating it, we have

$$\int_o^U dU = \frac{1}{C}\int_o^Q Q' d\,Q'$$

$$U = \frac{1}{2}\left[\frac{Q^2}{C}\right]_o^Q$$

$$U = \frac{1}{2}\frac{Q^2}{C}$$

We know, $c = \frac{q}{v}$

$$U = \frac{1}{2}CV^2$$

$$U = \frac{1}{2}QV$$

$\therefore$ This is the work done is stored as energy on the capacitor

(b) We know, the energy stored by the capacitor when it is charged is given as :

$$U_i = \frac{1}{2}CV^2$$

$Q = CV$, is the charge on the capacitor.

Now, when the capacitor is connected to the other Capacitor, they both get some charge in equilibrium.

Hence, the total charge remains the same, the charge on each capacitor is :

$$Q_f = \frac{Q}{2}$$

Now, the energy stored is -

$$U_f = \frac{1}{2}\frac{Q^2}{C} + \frac{1}{2}\frac{Q^2}{C}$$

$$U_f = \frac{1}{4}\frac{Q^2}{C}$$

$$U_f = \frac{1}{4}CV^2$$

Hence, the Ratio is

$$\frac{U_i}{U_f} = \frac{\frac{1}{2}CV^2}{\frac{1}{4}CV^2} = \frac{\frac{1}{2}}{\frac{1}{4}}$$

$$\frac{U_i}{U_f} = 2$$

OR

A capacitor of capacitance C_1 is charged to a potential V_1 while another capacitor of capacitance C_2 is charged to a potential difference V_2. The capacitors are now disconnected from their respective charging batteries and connected in parallel to each other.

(a) Find the total energy stored in the two capacitors before they are connected.

(b) Find the total energy stored in the parallel combination of the two capacitors.

(c) Explain the reason for the difference of energy in parallel combination in comparison to the total energy before they are connected.

Ans:

(a) Total energy before they are connected.

$$E = \frac{1}{2}C_1V_1^2 + \frac{1}{2}C_2V_2^2$$

(b) Let v be the potential across the parallel combination

Applying conservation of charge, we can write

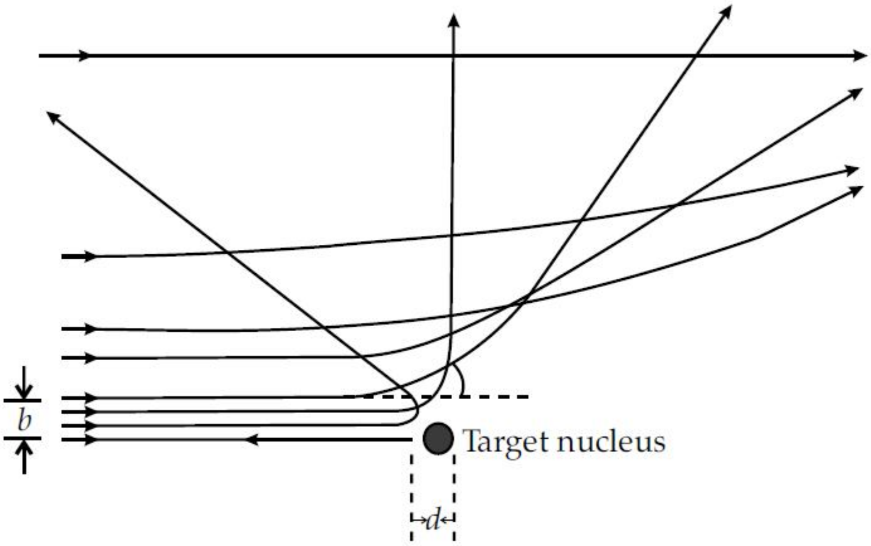
$$(C_1 + C_2)V = C_1V_1 + C_2V_2 \Rightarrow V = \frac{C_1V_1 + C_2V_2}{C_1 + C_2}$$

The total energy stored in parallel combination is $E = \frac{1}{2}CV^2$

$$\Rightarrow E = \frac{1}{2}(C_1 + C_2)\left[\frac{C_1V_1 + C_2V_2}{C_1 + C_2}\right]^2 \Rightarrow E = \frac{1}{2}\frac{(C_1V_1 + C_2V_2)^2}{C_1 + C_2}$$

(c) The total energy of the parallel combination is different (less) from the total energy before the capacitors are connected. This is because some energy gets used up due to the movement of charges.

33. (a) In Rutherford scattering experiment, draw the trajectory traced by a-particles in the coulomb field of target nucleus and explain how this led to estimate the size of the nucleus.
(b) Describe briefly how wavelength is related to kinetic energy?
(c) Estimate the ratio of de-Broglie wavelengths associated with deuterons and a-particles when they are accelerated from rest through the same accelerating potential V.
Ans: (a) The trajectory, traced by the a-particles in the Coulomb field of target nucleus, has the form as shown below:



The size of the nucleus was estimated by observing the distance (d) of closest approach, of the α-particles. This distance is given by $d = \frac{1}{4\pi\varepsilon_0}.\frac{2eZe}{K}$

where, K = kinetic energy of the a-particles when they are far away from the target nuclei.
(b) There is inverse relation between wavelength and kinetic energy. Mathematically, $\lambda = \frac{h}{\sqrt{2mK}}$

(c) $\lambda = \frac{h}{p} \Rightarrow \lambda = \frac{h}{mv} \Rightarrow \lambda = \frac{h}{\sqrt{2mqV}}$

$$Hence, \frac{\lambda_d}{\lambda_\alpha} = \frac{\frac{h}{\sqrt{2m_d q_d V}}}{\frac{h}{\sqrt{2m_\alpha q_\alpha V}}} = \sqrt{\frac{m_\alpha q_\alpha}{m_d q_d}}$$ (accelerated potential is same for both particles)

$$\therefore \frac{\lambda_d}{\lambda_\alpha} = \sqrt{\frac{4\times 2}{2\times 1}} = 2$$

OR

(a) Using Bohr's postulates, derive the expression for the total energy of the electron in the stationary states of the hydrogen atom.
(b) Using Rydberg formula, calculate the wavelengths of the spectral lines of the first member of the Lyman series and of the Balmer series.

Ans: (a) $mvr = \frac{nh}{2\pi} \Rightarrow v = \frac{nh}{2\pi mr}$

$$\frac{mv^2}{r} = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r^2} \Rightarrow r = \frac{e^2}{4\pi\varepsilon_0 mv^2}$$

$$\Rightarrow r = \frac{e^2}{4\pi\varepsilon_0\left(\frac{nh}{2\pi mr}\right)^2} \Rightarrow r = \frac{\varepsilon_0 n^2 h^2}{\pi me^2}$$

Potential Energy, $U = \frac{1}{4\pi\varepsilon_0}\frac{e^2}{r} = -\frac{me^4}{4\varepsilon_0{}^2 n^2 h^2}$

Kinetic Energy, $K.E. = \frac{1}{2}mv^2 = \frac{1}{2}m\left(\frac{nh}{2\pi mr}\right)^2 = \frac{n^2h^2\pi^2m^2e^4}{8\pi^2 m\varepsilon_0{}^2 n^4 h^4}$

$$\Rightarrow K.E. = \frac{me^4}{8\varepsilon_0{}^2 n^2 h^2}$$

Total Energy = K.E. + P.E. $= -\frac{me^4}{8\varepsilon_0{}^2 n^2 h^2}$

(b) Rydberg's formula: For first member of Lyman series,

$$\frac{1}{\lambda} = R\left(\frac{1}{1^2} - \frac{1}{2^2}\right) \Rightarrow \frac{1}{\lambda} = R\left(1 - \frac{1}{4}\right) = R\frac{3}{4} \Rightarrow \lambda = \frac{4}{3R} = \frac{4}{3}\times 912\,\mathring{A} = 1216\,\mathring{A}$$

For first member of Balmer Series.

$$\frac{1}{\lambda} = R\left(\frac{1}{2^2} - \frac{1}{3^2}\right) \Rightarrow \frac{1}{\lambda} = R\left(\frac{1}{4} - \frac{1}{9}\right) = R\frac{5}{36}$$

$$\Rightarrow \lambda = \frac{36}{5R} = \frac{36}{5}\times 912\,\mathring{A} = 6566.4\,\mathring{A}$$