NAMMA NOTES

II PUC PHYSCS PREPARATORY PAPERS OF ALL DISTRICTS 2024-25

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U K DISTRICT PREPARATORY EXAMINATION - 2025

II PUC - PHYSICS (33)

Time: 3 hours **Max Marks: 70** **No of questions: 45**

General Instructions:

1. All parts (A to D) are compulsory.

2. For Part – A questions, first written-answer will be considered for awarding marks.

3. Answers without relevant diagram / figure / circuit wherever necessary will not carry any marks.

4. Direct answers to numerical problems without relevant formula and detailed solutions will not carry any marks.

PART – A

I. Pick the correct option among the four given options for ALL of the following questions: $15 \times 1 = 15$

1. The law which gives the relation between electric flux through a closed surface and charge enclosed is

(A) Gauss's law in electrostatics (B) Gauss's law in magnetism

(C) Ohm's law (D) Coulomb's law electrostatics

2. The electric potential at a point due to an electric dipole at a large distance '*r*' varies as

(A) $\frac{1}{r}$ (B) $\frac{1}{r^2}$ (C) $\frac{1}{r^3}$ (D) r

3. Resistance of a metallic wire is independent of

(A) its length (B) its resistivity (C) its cross sectional area (D) current flowing through it.

4. Different current carrying objects (specific positions are given in brackets) are listed in column I and the expressions for magnetic fields produced by them are listed in column II. The symbols have their usual meaning. Identify the correct match.

Column I	Column II
(i) Circular loop of radius R (at the centre)	(a) $B = \mu_0 n I$
(ii) Infinitely long thin straight conductor (at a distance R)	(b) $B = \frac{\mu_o I}{2R}$
(iii) Solenoid (at the centre)	(c) $B = \frac{\mu_o I}{2\pi R}$

(A) (i) - (b), (ii) - (c), (iii) - (a) (B) (i) - (c), (ii) - (b), (iii) - (a)

(C) (i) - (a), (ii) - (b), (iii) - (c) (D) (i) - (c), (ii) - (a), (iii) - (b)

5. The following are the statements related to magnetism:

Statement-I: The net magnetic flux through any closed surface is zero.

Statement-II: The number of magnetic field lines leaving the surface is balanced by the number of lines entering it.

(A) Both the statements I and II are correct and statement-II is the correct explanation for statement-I.

(B) Both the statements I and II are correct and statement-II is not the correct explanation for statement-I.

(C) Statement I is wrong but the statement II is correct.

(D) Statement I is correct but the statement II is wrong.

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6. Lenz's law is the consequence of the law of conservation of _____

(A) mass (B) charge (C) energy (D) momentum

7. In a transformer, the core is made up of soft iron to reduce the energy loss due to _____

(A) eddy currents (B) resistance of the windings (C) flux leakage (D) hysteresis

8. The current due to time varying electric flux is called

(A) conduction current (B) displacement current (C) eddy current (D) induced current

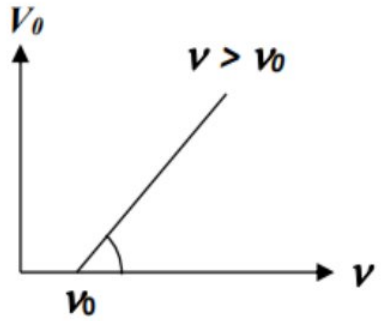
9. If the angle of incidence for a ray of light incident on a refracting surface of a prism is increased, then the angle of deviation produced by the prism _____.

(A) decreases continuously (B) increases (C) remains same (D) first decreases then increases

10. Which of the following phenomenon of light proves the transverse nature of light?

(A) Interference (B) Diffraction (C) Polarisation (D) Reflection

11. In photoelectric effect experiment, what is the slope of the straight line obtained by plotting stopping potential (V_0) versus frequency (ν) of incident light ?



(A) h

(B) h/e

(C) eh

(D) e/h (where h = Planck's constant and e = basic unit of charge)

12. For head-on collision of alpha (α) particle with gold nucleus in Geiger-Marsden scattering experiment, the angle of scattering is

(A) 0^0 (B) 90^0 (C) 120^0 (D) 180^0

13. Identify the wrong statement among the following.

(A) Nuclear force is short ranged forced and hence saturated.

(B) Nuclear force is strongest force in nature.

(C) Nuclear force is charge independent.

(D) Nuclear force is always attractive.

14. The source of energy generation in stars is mainly due to

(A) nuclear fission (B) nuclear fusion (C) chemical reaction (D) radioactive decay

15. An extrinsic semiconductor with electrons as majority carriers can be obtained by doping silicon with

(A) Bismuth (B) Boron (C) Indium (D) Gallium

II. Fill in the blanks by choosing appropriate answer given in the bracket for ALL the following questions: $5 \times 1 = 5$

(zero, spherical, quantised, ac generator, unity, magnetisation)

16. The net magnetic dipole moment per unit volume of a substance is called _____.

17. The device which works on the principle of electromagnetic induction is _____.

18. The average power dissipated by a pure inductive AC circuit over a complete cycle is _____.

19. A point source at a finite distance gives _____ wavefront.

20. Millikan's oil drop experiment established that electric charge is _____.

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PART – B

III. Answer any FIVE of the following questions: **5 × 2 = 10**

21. State and explain Coulomb's law in electrostatics.

22. Mention any two factors on which the capacitance of a parallel plate capacitor depends.

23. Define mobility of electrons. Give its SI unit.

24. How do you convert a moving coil galvanometer into a voltmeter? Give a suitable circuit diagram.

25. A circular coil of radius **10 cm** and **100** turns is rotated about its vertical diameter with an angular speed of **100π** rad/s in a uniform horizontal magnetic field of **0.314 T**. Find the maximum value of emf induced in the coil.

26. Name the electromagnetic waves used for the following applications.

(a) Bone fracture detection (b) LASIK eye surgery.

27. Give two limitations of Bohr's atom model.

28. Classify the conductors and insulators on the basis of energy bands.

PART – C

IV. Answer any FIVE of the following questions: **5 × 3 = 15**

29. Write three properties of electric field lines.

30. Establish the relation between electric field and electric potential.

31. State and explain Biot-Savart's law with a relevant diagram.

32. Distinguish between diamagnetic and paramagnetic materials.

33. Describe the coil-magnet experiment to demonstrate the phenomenon of electromagnetic induction along with a suitable diagram.

34. Derive the relation between radius of curvature and focal length in case of a concave mirror.

35. What are matter waves? Give de Broglie relation for de Broglie wavelength. Explain the terms.

36. An element has 13 protons and 14 neutrons. Assuming R_0 = **1.2 fm**, find its nuclear radius.

PART – D

V. Answer any THREE of the following questions: **3 × 5 = 15**

37. Obtain an expression for the electric field at a point on the axial line of an electric dipole.

38. Using Kirchhoff's rules, arrive at the expression for the balancing condition of Wheatstone bridge.

39. Derive an expression for force per unit length on two infinitely long thin parallel straight conductors carrying currents and hence define '***ampere***'.

40. (a) Give any three differences between interference and diffraction of light. **(3)**

(b) Write two uses of polaroids. **(2)**

41. (a) What is a full-wave rectifier? **(1)**

(b) Draw the circuit diagram and input-output waveforms for a full-wave rectifier. **(2)**

(c) Explain the working of the full-wave rectifier. **(2)**

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VI. Answer any TWO of the following questions: **$2 \times 5 = 10$**

42. ABCD is a square of side **20 cm**. Three point charges **+2 μC**, **–3 μC** and **+4 μC** are placed at the corners A, B and C respectively. Calculate the work done in transferring a charge of **+5 nC** from corner D to the centre O of the square.

43. Two cells of emfs **3 V** and **4 V** and their internal resistances **1 Ω** and **2 Ω** respectively are connected in parallel so as to send the current in the same direction through an external resistance **6 Ω.** Determine the current through **6 Ω** resistor and potential difference across **6 Ω** resistor.

44. An inductor of unknown value of inductance, a capacitor of **100 μF** and a resistor of **10 Ω** are connected in series to a **220 V, 50 Hz** ac source. It is found that the power factor of the circuit is unity. Calculate the inductance of the inductor and the amplitude of current in the circuit.

45. Double-convex lenses are to be manufactured from a glass of refractive index **1.55**, with both faces of the same radius of curvature. (a) If the focal length is to be **20 cm,** find the radius of curvature. (b) Calculate the power of the lens when the lens is immersed in water (refractive index **1.33**).

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UTTARA KANNADA DISTRICT P U COLLEGES PRINCIPALS ASSOCIATION

PREPARATORY EXAMINATION : SCHEME OF EVALUATION & SOLUTION

Time: 3 hours **II PUC - PHYSICS (33)** **Max Marks: 70**

General Instructions:

1. *All parts are compulsory.*
2. *For Part – A questions, first written-answer will be considered for awarding marks.*
3. *Answers without relevant diagram / figure / circuit wherever necessary will not carry any marks.*
4. *Direct answers to numerical problems without relevant formula and detailed solutions will not carry any marks.*

PART – A

I. Pick the correct option among the four given options for ALL of the following questions: 15 × 1 = 15

1.	**The law which gives the relation between electric flux through a closed surface and charge enclosed is** (A) Gauss's law in electrostatics (B) Gauss's law in magnetism (C) Ohm's law (D) Coulomb's law electrostatics	
Ans	(A) Gauss's law in electrostatics	**1**
2.	**The electric potential at a point due to an electric dipole at a large distance 'r' varies as** ((A) $\frac{1}{r}$ (B) $\frac{1}{r^2}$ (C) $\frac{1}{r^3}$ (D) r	
Ans	(B) $\frac{1}{r^2}$	**1**
3.	**Resistance of a metallic wire is independent of** (A) its length (B) its resistivity (C) its cross sectional area (D) current flowing through it.	
Ans	(D) current flowing through it.	**1**
4.	**Different current carrying objects (specific positions are given in brackets) are listed in column I and the expressions for magnetic fields produced by them are listed in column II. The symbols have their usual meaning. Identify the correct match.**	

Column I	Column II
(i) Circular loop of radius R (at the centre)	(a) $B = \mu_0 n I$
(ii) Infinitely long thin straight conductor (at a distance R)	(b) $B = \frac{\mu_o I}{2R}$
(iii) Solenoid (at the centre)	(c) $B = \frac{\mu_o I}{2\pi R}$

(A) (i) - (b), (ii) - (c), (iii) - (a) (B) (i) - (c), (ii) - (b), (iii) - (a)
(C) (i) - (a), (ii) - (b), (iii) - (c) (D) (i) - (c), (ii) - (a), (iii) - (b)

Ans	(A) (i) - (b), (ii) - (c), (iii) - (a)	**1**
5.	**The following are the statements related to magnetism:** **Statement-I: The net magnetic flux through any closed surface is zero.** **Statement-II: The number of magnetic field lines leaving the surface is balanced by the number of lines entering it.** (A) Both the statements I and II are correct and statement-II is the correct explanation for statement-I. (B) Both the statements I and II are correct and statement-II is not the correct explanation for statement-I. (C) Statement I is wrong but the statement II is correct. (D) Statement I is correct but the statement II is wrong.	
Ans	(A) Both the statements I and II are correct and statement-II is the correct explanation for statement-I.	**1**

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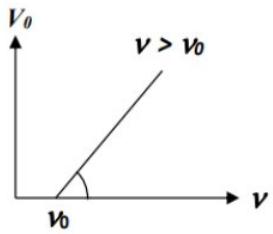
6.	**Lenz's law is the consequence of the law of conservation of _____** (A) mass (B) charge (C) energy (D) momentum	
Ans	(C) energy	**1**
7.	**In a transformer, the core is made up of soft iron to reduce the energy loss due to _____** (A) eddy currents (B) resistance of the windings (C) flux leakage (D) hysteresis	
Ans	(D) hysteresis	**1**
8.	**The current due to time varying electric flux is called** (A) conduction current (B) displacement current (C) eddy current (D) induced current	
Ans	(B) displacement current	**1**
9.	**If the angle of incidence for a ray of light incident on a refracting surface of a prism is increased, then the angle of deviation produced by the prism _____.** (A) decreases continuously (B) increases (C) remains same (D) first decreases then increases	
Ans	(D) first decreases then increases	**1**
10.	**Which of the following phenomenon of light proves the transverse nature of light?** (A) Interference (B) Diffraction (C) Polarisation (D) Reflection	
Ans	(C) Polarisation	**1**
11.	**In photoelectric effect experiment, what is the slope of the straight line obtained by plotting stopping potential (V_0) versus frequency (ν) of incident light ?** (A) h (B) h/e (C) eh D) e/h (where h = Planck's constant and e = basic unit of charge) 	**1**
Ans	(B) h/e	**1**
12.	**For head-on collision of alpha (α) particle with gold nucleus in Geiger-Marsden scattering experiment, the angle of scattering is** (A) 0^0 (B) 90^0 (C) 120^0 (D) 180^0	
Ans	(D) 180^0	**1**
13.	**Identify the wrong statement among the following.** (A) Nuclear force is short ranged forced and hence saturated. (B) Nuclear force is strongest force in nature. (C) Nuclear force is charge independent. (D) Nuclear force is always attractive.	
Ans	(D) Nuclear force is always attractive.	**1**
14.	**The source of energy generation in stars is mainly due to** (A) nuclear fission (B) nuclear fusion (C) chemical reaction (D) radioactive decay	
Ans	(B) nuclear fusion	**1**
15.	**An extrinsic semiconductor with electrons as majority carriers can be obtained by doping silicon with** (A) Bismuth (B) Boron (C) Indium (D) Gallium	
Ans	(A) Bismuth	**1**

II. Fill in the blanks by choosing appropriate answer given in the brackets for ALL the following questions: $5 \times 1 = 5$

(zero, spherical, quantised, ac generator, unity, magnetisation)

16.	**The net magnetic dipole moment per unit volume of a substance is called** magnetisation.	**1**
17.	**The device which works on the principle of electromagnetic induction is** ac generator.	**1**
18.	**The average power dissipated by a pure inductive AC circuit over a complete cycle is** zero.	**1**
19.	**A point source at a finite distance gives** spherical **wavefront.**	**1**
20.	**Millikan's oil drop experiment established that electric charge is** quantised.	**1**

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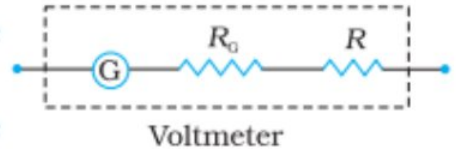
PART – B

III. Answer any FIVE of the following questions: **5 × 2 = 10**

21.	**State and explain Coulomb's law in electrostatics.**	
Ans	**Statement:** The electrostatic force of attraction or repulsion between two stationary point charges is directly proportional to the product of the magnitude of the two charges and inversely proportional to the square of the distance between the charges.	1
	Explanation: If q_1 , q_2 are the two point charges at rest separated by a distance 'r' in vacuum, then electrostatic force, $F \propto \frac{\lvert q_1 q_2 \rvert}{r^2} \Rightarrow F = k\frac{\lvert q_1 q_2 \rvert}{r^2} = \frac{1}{4\pi\varepsilon_0}\frac{\lvert q_1 q_2 \rvert}{r^2}$; ε_0 is called permitivity of vacuum	1
22.	**Mention any two factors on which the capacitance of a parallel plate capacitor depends.**	
Ans	• Area of each plate. • Distance between the plates. • Dielectric constant of the medium between the plates. **(ANY TWO)**	1 1
23.	**Define mobility of electrons. Give its SI unit.**	
Ans	The magnitude of the drift velocity per unit electric field is called as mobility. SI unit of mobility is $\mathbf{m^2\ V^{-1}\ s^{-1}}$ OR $C\ s\ kg^{-1}$	1 1
24.	**How do you convert a moving coil galvanometer into a voltmeter? Give a suitable circuit diagram.**	
Ans	 A galvanometer can be converted into a voltmeter by connecting a **high resistance in series** with it. **CIRCUIT DIAGRAM**	1 1
25.	**A circular coil of radius 10 cm and 100 turns is rotated about its vertical diameter with an angular speed of 100π rad/s in a uniform horizontal magnetic field of 0.314 T.** **Find the maximum value of emf induced in the coil.**	
Ans	Maximum value of the emf: $\varepsilon_0 = N\ A\ B\ \omega$ $\varepsilon_0 = 100 \times (\pi \times 0.1^2) \times 0.314 \times 100\pi =$ **310 V**	1 1
26.	**Name the electromagnetic waves used for the following applications.** **(a) Bone fracture detection (b) LASIK eye surgery.**	
Ans	(a) X-rays (b) Ultraviolet(UV) rays	2
27.	**Give two limitations of Bohr's atom model.**	
Ans	• Bohr's model is applicable only to hydrogenic (single electron) atoms. It cannot be extended to even two electron atoms such as helium. • This model is also unable to explain for the relative intensities of the frequencies emitted even by hydrogenic atoms.	1 1
28.	**Classify the conductors and insulators on the basis of energy bands.**	
Ans	**Conductors**: In case of conductors, valence band and conduction band overlap (OR partially filled valence band will be present). Therefore, no forbidden gap will be present (i.e., $E_g = 0$). **Insulators**: In insulators, the valence band is completely filled and conduction band is completely empty. The valence band and conductions band are separated by large energy gap ($E_g > 3eV$)	1 1

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PART – C

IV. Answer any FIVE of the following questions: 5 × 3 = 15

29. Write three properties of electric field lines.

Ans

- Electric field lines start from positive charge and end at negative charge. For a single charge, they may start or end at infinity. **1**
- In a charge-free region, electric field lines are continuous curves without any break. **1**
- Two field lines can never cross each other (never intersect each other). **1**
- A tangent drawn to a field line at any point gives the direction of electric field at that point.
- Electrostatic field lines do not form any closed loops. **(ANY THREE)**

30. Establish the relation between electric field and electric potential.

Ans

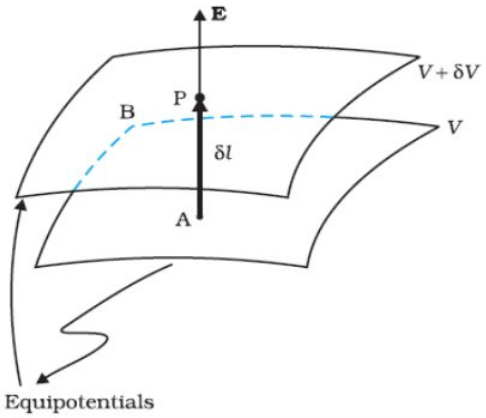


DIAGRAM **1**

Work done to move unit positive charge from P to A is

$$W = F\,\delta l$$

For unit positive charge, q = 1 C, force F = E,

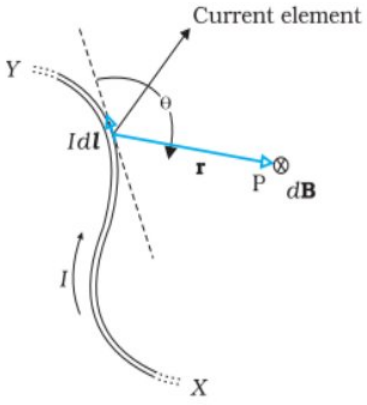
$$W = E\,\delta l$$ **1**

Also, work done $W = q(V_A - V_B) = [V-(V+\delta V)] = -\delta V$

Thus, $E\,\delta l = -\delta V \quad \therefore \quad E = -\frac{\delta V}{\delta l}$ **1**

31. State and explain Biot-Savart's law with a relevant diagram.

Ans



Statement: Magnetic field at a point due to a current element is directly proportional to the current I, length of the element dl, and inversely proportional to the square of the distance r of the point from the current element. **1**

Explanation: The magnetic field dB due to this element is to be determined at a point P which is at a distance r from it.

Let θ be the angle between dl and the displacement vector r.

The magnitude of magnetic field in vacuum: $\left|d\vec{B}\right| = \frac{\mu_0}{4\pi} \times \frac{I\,dl\,\sin\theta}{r^2}$ **1**

where μ_0 the ***permeability*** of free space (or vacuum) and

$\frac{\mu_0}{4\pi} = 10^{-7}$ Tm/A **DIAGRAM** **1**

32. Distinguish between diamagnetic and paramagnetic materials.

Ans

	Diamagnetic substances	Paramagnetic substances	
1	These are repelled by a magnet.	These are attracted by a magnet.	1
2	The magnetic susceptibility is negative, $\chi < 0$	The magnetic susceptibility is positive, $\chi > 0$	1
3	The magnetic susceptibility (or magnetisation) does not depend on the temperature.	The susceptibility (or magnetisation) depends on the temperature.	1
4	Magnetic field lines are expelled out, when the diamagnetic substance is placed in an external magnetic field.	Magnetic field lines enter inside when the diamagnetic substance placed in an external magnetic field.	
5	Relative permeability is less than one, $\mu_r < 1$	Relative permeability is more than one, $\mu_r > 1$.	

(ANY THREE)

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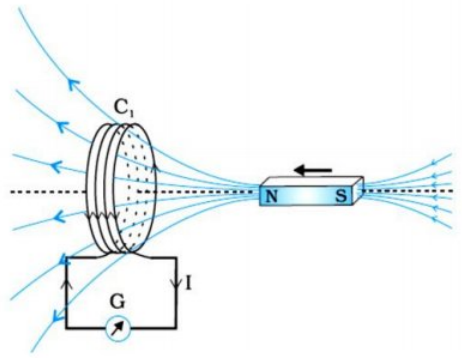
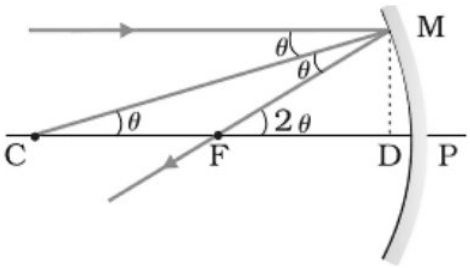
33.	**Describe the coil-magnet experiment to demonstrate the phenomenon of electromagnetic induction along with a suitable diagram.**	
Ans	 Let a coil C_1 connected to a galvanometer G. **(DIAGRAM)** When the North-pole of a bar magnet is pushed towards the coil, the pointer in the galvanometer deflects. The deflection lasts as long as the bar magnet is in motion. When the magnet is pulled away from the coil, the galvanometer shows deflection in the opposite direction, which indicates reversal of the current's direction. When the South-pole of the bar magnet is moved towards or away from the coil, the deflections in the galvanometer are opposite to that observed with the North-pole for similar movements. The deflection (and hence current) is found to be larger when the magnet is pushed towards or pulled away from the coil faster. **Conclusion:** "The relative motion between the magnet and the coil is responsible for the generation (induction) of electric current in the coil". **(ANY TWO CORRECT OBSERVATIONS – 2 M)**	1 1 1
34.	**Derive the relation between radius of curvature and focal length in case of a concave mirror.**	
Ans	 **LABELLED DIAGRAM WITH ARROWS** $\angle MCP = \theta$ and $\angle MFP = 2\theta$. $\tan\theta = \frac{MD}{CD}$ and $\tan 2\theta = \frac{MD}{FD}$. For small angle θ, $\tan\theta \approx \theta$ and $\tan 2\theta \approx 2\theta$. $\therefore 2\theta = \frac{MD}{FD}$, $2\frac{MD}{CD} = \frac{MD}{FD} \Rightarrow FD = \frac{CD}{2}$ For small θ , the point D is very close to the point P. Therefore, FD = – f and CD = – R Focal length: $f = \frac{R}{2}$	1 1 1
35.	**What are matter waves? Give de Broglie relation for de Broglie wavelength. Explain the terms.**	
Ans	The waves associated with the moving material particles are called matter waves or de Broglie waves. de Broglie wavelength: $\lambda = \frac{h}{p}$ OR $\lambda = \frac{h}{mv}$ h– Planck's constant, p – momentum of the particle, m – mass of the particle, v – speed of the particle	1 1 1
36.	**An element has 13 protons and 14 neutrons. Assuming R_0 = 1.2 fm, find its nuclear radius.**	
Ans	Mass number of the element: A = Z + N = 13 +14 = 27 Radius of the nucleus is $\mathbf{R = R_0 A^{1/3}}$ $R = 1.2 \times 10^{-15} \times 27^{1/3} = 3.6 \times 10^{-15}$ m **OR** 3.6 fm	1 1 1

PART – D

V. Answer any THREE of the following questions: 3 × 5 = 15

37.	**Obtain an expression for the electric field at a point on the axial line of an electric dipole.**	

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Ans

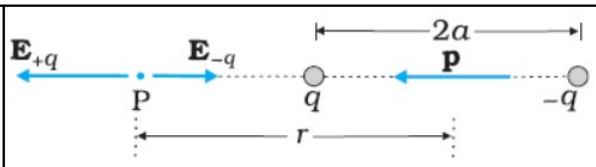


DIAGRAM 1

The electric field at P due to the charge '$+q$', $\vec{E}_{+q} = \dfrac{q}{4\pi\varepsilon_0 (r-a)^2}\,\hat{p}$ 1

The electric field at P due to the charge '$-q$', is $\vec{E}_{-q} = \dfrac{-q}{4\pi\varepsilon_0 (r+a)^2}\,\hat{p}$ 1

where $\hat{p}$ is the unit vector along the dipole axis (from $-q$ to $+q$) and $\vec{E}_{-q}$ and $\hat{p}$ are opposite in direction.

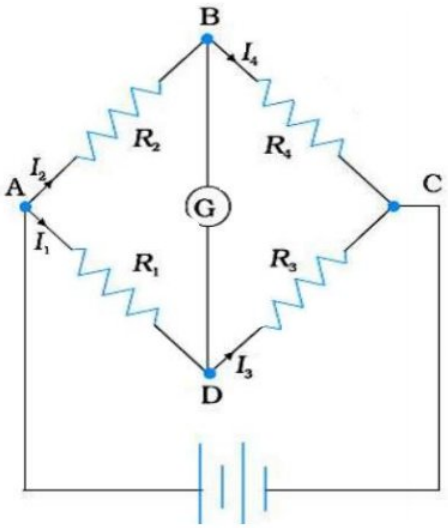
The total electric field at P is,

$$\vec{E} = \vec{E}_{+q} + \vec{E}_{-q} = \frac{q}{4\pi\varepsilon_0 (r-a)^2}\,\hat{p} + \frac{-q}{4\pi\varepsilon_0 (r-a)^2}\,\hat{p}\ \frac{q}{4\pi\varepsilon_0}\left(\frac{1}{(r-a)^2} - \frac{1}{(r+a)^2}\right)\hat{p}$$ 1

$$\vec{E} = \frac{q}{4\pi\varepsilon_0}\frac{4ar}{(r^2-a^2)^2}\,\hat{p} = \frac{1}{4\pi\varepsilon_0}\frac{2r\vec{p}}{(r^2-a^2)^2} \qquad \because \text{Dipole moment } \vec{p} = (2aq)\,\hat{p}$$ 1

38. **Using Kirchhoff's rules, arrive at the expression for the balancing condition of Wheatstone bridge.**

Ans



LABELLED DIAGRAM 1

When the bridge is balanced, no current flows through galvanometer G, i.e., $\mathbf{I_g = 0}$. 1

Applying Kirchhoff's junction rule to the junctions D and B when $I_g = 0$, $I_1 = I_3$ and $I_2 = I_4$.

Taking $I_g = 0$ and p.d. across G is 0.

Applying Kirchhoff's loop rule to the first loop (ADBA) gives, $-I_1 R_1 + 0 + I_2 R_2 = 0$

$$I_2R_2 = I_1R_1 \Rightarrow \frac{I_1}{I_2} = \frac{R_2}{R_1} \quad \text{..... (1)}$$ 1

The second loop (CBDC) gives, $I_4 R_4 + 0 - I_3 R_3 = 0$

Using $I_3 = I_1$ and $I_4 = I_2$

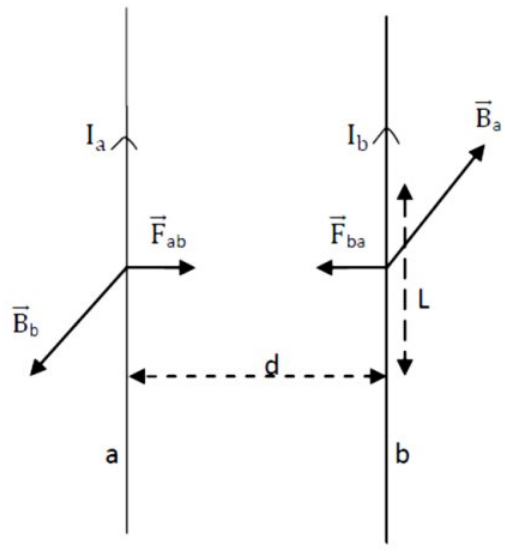
$$I_2 R_4 - I_1 R_3 = 0$$

$$I_2 R_4 = I_1 R_3 \Rightarrow \frac{I_1}{I_2} = \frac{R_4}{R_3} \quad \text{..... (2)}$$ 1

From (1) and (2), $\dfrac{R_2}{R_1} = \dfrac{R_4}{R_3}$ 1

39. **Derive an expression for force per unit length on two infinitely long thin parallel straight conductors carrying currents and hence define '*ampere*'.**

Ans



LABELLED DIAGRAM 1

The magnetic field at the location of 'b' produced by the conductor 'a' is, $B_a = \dfrac{\mu_0 I_a}{2\pi d}$ .....(1) 1

The magnetic force on a segment L of the conductor 'b' due to 'a' is $F_{ba} = B_a I_b L \sin\theta$

$\theta = 90^\circ$ and using equn(1), $F_{ba} = \dfrac{\mu_0 I_a I_b L}{2\pi d}$ 1

This force F_{ba} is towards conductor 'a'.

Similarly, F_{ab} is the magnetic force on a segment L of the conductor 'a' due to 'b'.

The force F_{ab} is equal in magnitude to F_{ba}, and directed towards 'b' OR $\vec{F}_{ba} = -\vec{F}_{ab}$

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The force per unit length on each conductor is $f_{ba} = \frac{F_{ba}}{L} = \frac{\mu_0 I_a I_b}{2\pi d}$ — 1

Definition of ampere: One ampere is that steady current which, when maintained in each of the two very long, straight, parallel conductors of negligible cross-section and placed one metre apart in vacuum (free space/air), would produce a force of 2×10^{-7} newton per metre length on each other. — 1

40. **(a) Give any three differences between interference and diffraction of light.** — 3

(b) Write two uses of polaroids. — 2

Ans **(a) Differences between interference and diffraction:**

	INTERFERENCE	DIFFRACTION	
1	Interference fringes have equal width.	Diffraction bands have unequal width.	1
2	Interference is due to the superposition of two waves originating from two coherent sources	It is due to the superposition of secondary wavelets originating from different parts of single slit.	1
3	Intensity of all bright fringes is equal and Intensity of dark fringes is zero.	Intensity of central maximum is highest, Intensity of secondary maxima decreases with increase in order.	1
4	At an angle $\theta = \lambda/a$, maximum intensity for two narrow slits separated by a distance 'a' is found.	At an angle $\theta = \lambda/a$, the first minimum of the diffraction pattern occurs for a single slit of width a.	
5	In interference pattern there is a good contrast between dark and bright fringes.	In a diffraction pattern the contrast between the less bright band and dark band is poor. **(ANY 3)**	

(b) Polaroids are used to control the intensity of light in sunglasses, windowpanes, in photographic cameras and 3D movie cameras. **(ANY TWO)** — 2

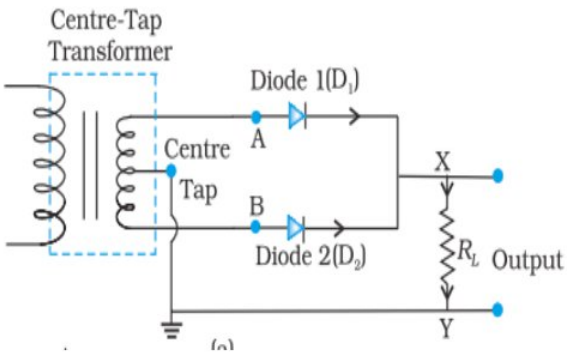
41. **(a) What is a full-wave rectifier?** **(1)**

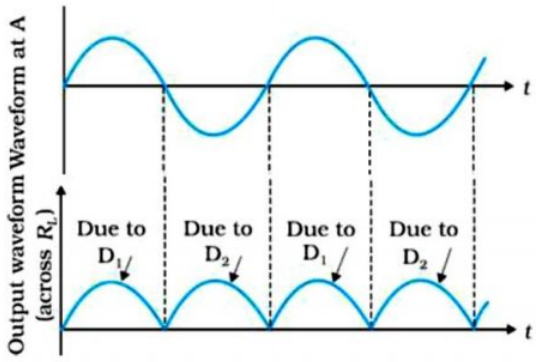
(b) Draw the circuit diagram and input-output waveforms for a full-wave rectifier. **(2)**

(c) Explain the working of the full-wave rectifier. **(2)**

Ans (a) The circuit which gives rectified output voltage corresponding to both positive and negative half cycles of AC is known as full-wave rectifier. — 1

(b) <u>Circuit diagram</u> **<u>Waveform</u>** — 2





(c) During positive half cycle of AC input the diode D_1 is forward biased and conducts, while D_2 reverse biased, does not conduct. So the current flows through R_L as shown in the figure. The output voltage is obtained across load resistor. — 1

During negative half cycle of AC input, D_2 is forward biased and conducts while D_1 is reverse biased, does not conduct. Again the current flows through R_L as shown in the figure. The output voltage is obtained across load resistor. — 1

Thus, there is current flow through R_L over the complete cycle of AC input in the same direction.

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VI. Answer any TWO of the following questions: 2 × 5 = 10

42. **ABCD is a square of side 20 cm. Three point charges +2 μC, –3 μC and +4 μC are placed at the corners A, B and C respectively. Calculate the work done in transferring a charge of +5 nC from corner D to the centre O of the square.**

Sides: AD = CD = a = 20 cm = 0.2 m, Diagonal: BD = $a\sqrt{2} = 0.2\sqrt{2}$ m and AO=BO=CO= $0.1\sqrt{2}$ m

Electric potential at a distance r from a point charge q is $V = \frac{1}{4\pi\varepsilon_0}\frac{q}{r}$ — 1

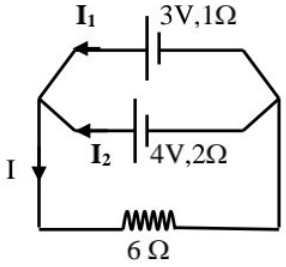
Electric potential at O is, $V_O = \frac{1}{4\pi\varepsilon_0}\left[\frac{q_1}{AO} + \frac{q_2}{BO} + \frac{q_3}{CO}\right] = 9\times10^9\left[\frac{2-3+4}{0.1\sqrt{2}}\right]\times10^{-6} = 191\times10^3$ V — 1

Electric potential at D is, $V_D = \frac{1}{4\pi\varepsilon_0}\left[\frac{q_1}{AD} + \frac{q_2}{BD} + \frac{q_3}{CD}\right] = 9\times10^9\left[\frac{2}{0.2} - \frac{3}{0.2\sqrt{2}} + \frac{4}{0.2}\right]\times10^{-6} = 175\times10^3$ V — 1

Work done : $W = q'(V_O - V_D) = 5\times10^{-9}\times16\times10^3 = \mathbf{80\times10^{-6}\ J}$ — 2

43. **Two cells of emfs 3 V and 4 V and their internal resistances 1 Ω and 2 Ω respectively are connected in parallel so as to send the current in the same direction through an external resistance 6 Ω. Determine the current through 6 Ω resistor and potential difference across 6 Ω resistor.**

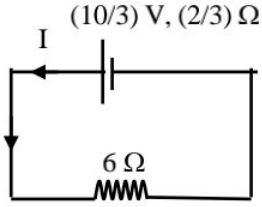
Ans



Equivalent emf : $\varepsilon_{eq} = \frac{\varepsilon_1 r_2 + \varepsilon_2 r_1}{r_1 + r_2} = \frac{(3\times2)+(4\times1)}{2+1} = \frac{10}{3}$ V — 1

Equivalent internal resistance: $r_{eq} = \frac{r_1 r_2}{r_1 + r_2} = \frac{1\times2}{1+2} = \frac{2}{3}\Omega$ — 1

The current through 6 Ω resistor is $I = \frac{\varepsilon_{eq}}{R + r_{eq}}$ — 1



$I = \frac{10/3}{6 + 2/3} = \frac{10}{20} = \mathbf{0.5\ A}$ — 1

P.D. across 6 Ω resistor is, V= I R = 0.5 ×6 = **3 V** — 1

ALTERNATE METHOD (USING KIRCHHOFF'S RULES):

Current through 6 Ω resistor : $I = I_1 + I_2$

KLR to the loop-1: $-(1\times I_1) + (2\times I_2) + 3 - 4 = 0 \Rightarrow -I_1 + 2I_2 = 1$ --------(1) — 1

KLR to the loop-2: $-(2\times I_2) - (6\times I) + 4 = 0 \Rightarrow -6I_1 - 8I_2 = -4$ ----------(2) — 1

Solving the two KLR equations, $4\times$ eq(1) + eq(2) gives, $I_1 = 0$, $I_2 = 0.5\ A$ and $I = \mathbf{0.5\ A}$ — 2

P.D. across 6 Ω resistor is, V= I R = 0.5 ×6 = **3 V** — 1

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44.	**An inductor of unknown value of inductance, a capacitor of 100 μF and a resistor of 10 Ω are connected in series to a 220 V, 50 Hz ac source. It is found that the power factor of the circuit is unity. Calculate the inductance of the inductor and the amplitude of current in the circuit.**	
Ans	Power factor is unity. Hence the given LCR circuit is at resonance.	**1**
	$\therefore X_L = X_C \Rightarrow \omega L = \frac{1}{\omega C} \Rightarrow L = \frac{1}{\omega^2 C}$	**1**
	$L = \frac{1}{4\pi^2 \nu^2 C} = \frac{1}{4(3.14)^2 (50)^2 (100\times10^{-6})} = \mathbf{0.1014\ H}$	**1**
	At resonance, Z = R and hence RMS current : $I = \frac{220}{10} = \mathbf{22\ A}$	**1**
	Amplitude of current: $i_m = I\sqrt{2} = 22\ (1.414) = \mathbf{31.1\ A}$	**1**
45.	**Double-convex lenses are to be manufactured from a glass of refractive index 1.55, with both faces of the same radius of curvature.** **(a) If the focal length is to be 20 cm, find the radius of curvature.** **(b) Calculate the power of the lens when the lens is immersed in water (refractive index 1.33).**	
Ans	(a) $\frac{1}{f_1} = (n_g - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$; $f_1 = 20$ cm, $R_1 = +R$ and $R_2 = -R$	**1**
	$\Rightarrow \quad \frac{1}{20} = (1.55 - 1)\left(\frac{1}{R} - \frac{1}{-R}\right)$	
	$\Rightarrow \quad 0.05 = (0.55)\left(\frac{2}{R}\right) \quad \Rightarrow \quad \mathbf{R = 22\ cm}$	**1**
	(b) When lens is immersed in water, $\frac{1}{f_2} = \left(\frac{n_g}{n_w} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$	
	$\Rightarrow \quad \frac{1}{f_2} = \left(\frac{1.55}{1.33} - 1\right)\left(\frac{1}{22} - \frac{1}{-22}\right)$	**1**
	$\Rightarrow \quad \frac{1}{f_2} = (0.1654)\left(\frac{2}{22}\right) \quad \Rightarrow \quad f_2 = 66.5\ \text{cm} = 0.665\ \text{m}$	**1**
	Power of the lens: $P = \frac{1}{f_2} = \frac{1}{0.665} = \mathbf{1.5\ D}$	**1**

Note: Any other alternate correct method/answer should be considered.

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GOVERNMENT OF KARNATAKA Register Number : [ ][ ][ ][ ][ ][ ]

DEPUTY DIRECTOR, DEPT. OF SCHOOL EDUCATION (PRE-UNIVERSITY)

PUC-II YEAR PREPARATORY EXAMINATION-2025

Time : 3 Hours | SUBJECT : PHYSICS (33) | MARKS :70

PART-A

I. Pick the correct option among the four given options for all of the following questions : 15X1=15

1) Some physical quantities are listed in column 1 & the SI units are listed in column 2. Identify the correct match.

Column 1	Column 2
i. Electric field	a) Cm^{-1}
ii. Electric flux	b) Nm^{-2}
iii. Linear charge density	c) Nm^2C^{-1}

A) i - a, ii - b, iii - c
B) i - b, ii - a, iii - c
C) i - c, ii - b, iii - a
D) i - b, ii - c, iii - a

2) The capacitance of a parallel plate capacitor can be increased by
A) decreasing the area of the plates
B) increasing the distance of separation between the plates
C) decreasing the distance of separation between the plates
D) any of the above methods

3) Statement I : When a wire is not connected to a battery, then no current flows.
Statement II : In the absence of electric field, free electrons moves randomly or does not move in a particular direction
A) Both statements I & II are true and Statement II is a correct explanation of the statement I.
B) Both statements I & II are true but statement II is not a correct explanation of the statement I.
C) Statement I is true but statement II is false.
D) Both statements I & II are false.

4) A moving proton produces
A) only electric field B) only magnetic field
C) both electric field & magnetic field D) neither electric field nor magnetic field

5) Magnetisation of a sample is
A) magnetic moment per unit length B) magnetic moment per unit area
C) magnetic moment per unit volume D) None of these

6) The phenomenon in which an emf is induced in a coil due to change in the current in the same coil is
A) electromagnetic induction B) self induction
C) Mutual induction D) All the above

S2 Physics

7) An AC generator converts
A) electrical energy into mechanical energy B) magnetic energy into mechanical energy
C) mechanical energy into magnetic energy D) mechanical energy into electrical energy

8) The principle behind the working of a transformer is
A) eddy currents B) self induction C) mutual induction D) hysteresis

9) Displacement current is produced due to
A) changing electric field B) constant electric field
C) changing magnetic field D) constant magnetic field

10) Power of a lens depends on
A) object distance B) image distance C) size of object D) focal length

11) The bonding of light around the corners of an obstacle is called
A) Interference B) Diffraction C) Polarisation D) refraction

12) The de Broglie wavelength of a moving particle is independent of _____ of the particle
A) mass B) velocity C) momentum D) charge

13) Rutherford's alpha particles scattering experiment determines the size of
A) nucleus B) proton C) electron D) neutron

14) Energy generation in stars is mainly due to
A) nuclear fission B) nuclear fusion C) radioactivity D) Dispersion

15) The P-type extrinsic semiconductor is
A) positively charged B) negatively charged C) neutral D) semicharged

(P.T.O)

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II. Fill in the blanks by appropriate answer given in the bracket for all the following questions : 5X1=5

(unity, Huygen, hydrogen, closed, spherical, photon)

16) An example for non-polar molecule is .....

17) Magnetic field lines are continuous ..... curves.

18) The power factor for a purely resistive circuit is .....

19) A wavefront coming from a point source of light is a ..... wavefront.

20) In interaction with matter, light behaves as if it is made up of packet of energy called .....

PART-B

III. Answer ANY FIVE of the following questions. 5X2=10

21) State & explain Gauss law in electrostatics.

22) Give any two limitations of ohm's law.

23) A long straight wire carries a current of 35A. What is the magnitude of the magnetic field at a point 1m from the wire.

24) State Lenz's law. What is the significance of Lenz's law.

25) Give any two uses of ultraviolet rays.

26) Write the conditions to obtain total internal reflection.

27) Write lens maker's formula & explain the terms used.

28) Distinguish between intrinsic semiconductor and extrinsic semiconductors.

PART-C

IV. Answer ANY FIVE of the following questions. 5X3=15

29) Mention the basic properties of electric charges.

30) Derive an expression for effective capacitance of two capacitors connected in series.

31) Explain how to convert a galvanometer into an ammeter.

32) Distinguish between diamagnetic materials & ferromagnetic materials.

33) Derive an expression for motional emf when a rod is moved in a uniform magnetic field.

34) Mention the experimental observations of photoelectric effect.

35) Write three postulates of Bohr's atom model.

36) Calculate the binding energy per nucleon of oxygen nucleus $^{16}_{8}O$ by using following data.
mass of proton = 1.007825 u
mass of neutron = 1.008665 u
mass of oxygen nucleus = 15.995 u

PART-D

V. Answer ANY THREE of the following questions : 3X5=15

37) Derive an expression for electric field due to an electric dipole along the axial point.

38) Derive an expression for electrical conductivity of a conductor.

39) Derive an expression for magnetic field at a point along the axis of a circular coil carrying current.

40) a) With schematic diagram explain Young's double slit experiment on interference of light. (3M)
b) Write the conditions for constructive interference & destructive interference interms of path difference. (2M)

41) What is rectification ? Describe with a circuit diagram, the working of a semiconductor diode as a full wave rectifier. Draw input & output waveforms.

VI. Answer ANY TWO of the following questions. 2X5=10

42) Two charges $5\times10^{-8}C$ & $-3\times10^{-8}C$ are located 16 cm apart. At what point(s) on the line joining the two charges is electric potential zero ? Take the potential at infinity to be zero.

43) Two cells of emf 2V & 4V and internal resistance 1Ω & 2Ω respectively are connected in parallel so as to send current in the same direction through an external resister of 20Ω. Find the potential difference across 20Ω resistor.

44) A source of alternating emf of 220V, 50Hz is connected in series with a resistor of 200Ω, an inductor of 100mH & a capacitor of 30μF. Does the current lead or lag the voltage & by what angle ?

45) A small candle 2.5 cm in size is placed at 27cm infront of a concave mirror of radius of curvature 36 cm. At what distance from the mirror should a screen be placed in order to obtain a sharp image ? Describe the nature & size of the image.

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2 PU Preparatory Examination 2024-25

PHYSICS (33)

Date : 17-01-2025 **Time:** 3 hours **Max Marks:** 70

General Instructions:

1. *All parts are compulsory.*
2. *For Part – A questions, only the first written answer will be considered for awarding marks.*
3. *Answers without relevant diagram / figure / circuit wherever necessary will not carry any marks.*
4. *Direct answers to numerical problems without detailed solutions will not carry any marks.*

PART – A

I. Pick the correct option among the four given options for ALL of the following questions: $15 \times 1 = 15$

1. The SI unit of electric flux is

   (A) NC^{-1} (B) weber

   (C) $NC^{-1}m^2$ (D) $Nm^{-2}C$

2. The electric energy density between the plates of charged capacitor is given by

   (A) $\frac{1}{2}CV^2$ (B) $\frac{1}{2}\varepsilon_0 V^2$

   (C) $\frac{1}{2}\varepsilon_0 E^2$ (D) $\frac{1}{2}QV$

3. In a conductor, the drift velocity v_d varies with electric field E as

   (A) $v_d \alpha E$ (B) $v_d \alpha \frac{1}{E}$

   (C) $v_d \alpha E^2$ (D) $v_d \alpha \frac{1}{E^2}$

4. For the motion of a charged particle in a region of magnetic field, if θ is the angle between $\vec{v}$ and $\vec{B}$, then pick the correct match in the following

Path of the charged particle	Angle θ
i) helical	a) 90^0
ii) linear	b) 45^0
iii) circular	c) 0^0

   (A) i) – a, ii) – b, iii) - c (B) i) – a, ii) – c, iii) - b

   (C) i) – b, ii) – a, iii) - c (D) i) – b, ii) – c, iii) - a

5. A bar magnet is kept in a uniform magnetic field. It experiences

   (A) torque but not force (B) force but not torque

   (C) both force and torque (D) neither force nor torque

6. If only the number of turns per unit length of a solenoid coil is doubled, then the self-

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(A) remains unchanged
(B) be doubled
(C) be halved
(D) becomes four times

7. Capacitive reactance is
(A) inversely proportional to frequency of AC
(B) directly proportional to frequency of AC
(C) inversely proportional to square root of frequency
(D) directly proportional to square root of frequency

8. The displacement current is produced due to
(A) constant electric field
(B) constant magnetic field
(C) changing electric field
(D) changing magnetic field

9. The focal length of a spherical mirror is
(A) equal to the radius of curvature
(B) two times the radius of curvature
(C) half of the radius of curvature
(D) does not depend on radius of curvature

10. The transverse nature of light is confirmed by the phenomenon of
(A) polarization of light
(B) diffraction of light
(C) dispersion of light
(D) refraction of light

11. Photons are not deflected by electric and magnetic fields since photons are
(A) Positively charged
(B) negatively charged
(C) massless
(D) electrically neutral

12. The energy of the electron in the first orbit of hydrogen atom is
(A) +13.6 eV
(B) -3.4 eV
(C) -13.6 eV
(D) +3.4 eV

13. The source of energy output in the interior of the star is
(A) Fission reaction
(B) β-deacy
(C) Thermonuclear fusion
(D) radioactive decay

14. Below are the statements related to observations of α-ray scattering experiments.

Statement I: α-particle close to the center of an atom suffers large angle scattering and for head-on collision the α-particle rebounds.

Statement II: The mass and positive charge of the atom is concentrated in a small volume of an atom

(A) Both **I** and **II** are true and **II** is the correct explanation of **I**
(B) Both **I** and **II** are true and **II** is not the correct explanation of **I**
(C) **I** is true but **II** is false
(D) both **I** and **II** are false

15. In n-type semiconductors,
(A) $n_h \gg n_e$
(B) $n_e \gg n_h$
(C) $n_h = n_e$
(D) $n_h n_e \leq 1$

(P.T.O.)

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II. Fill in the blanks by choosing appropriate answer given in the brackets for ALL the following questions: $5 \times 1 = 5$

(maximum, kinetic energy, increases, magnetic intensity, minimum, decreases)

16. The degree to which a magnetic field can magnetize a material is _____.
17. The peak emf generated in an AC generator _____ with decrease of frequency of rotation of the coil.
18. In a series LCR circuit, at resonance the impedance is _____.
19. In Young's Double Slit experiment, if the blue light is replaced by red light, then the fringe width _____.
20. Stopping potential is a measure of _____ of the liberated photoelectrons.

PART - B

III. Answer any FIVE of the following questions: $5 \times 2 = 10$

21. Define electric dipole moment. Give its direction.
22. Write the expression for potential energy of two charge system in the absence of external field and explain the terms.
23. What is resistivity of a conductor? Write its unit.
24. A tightly wound 100 turn coil of radius 10 cm carries a current of 1 A. What is the magnitude of magnetic field at the center of the coil?
25. State and explain Lenz's law of electromagnetic induction.
26. How X-rays are generated and detected?
27. Mention two postulates of Bohr model of Hydrogen atom.
28. Write two differences between intrinsic and extrinsic semiconductors.

PART - C

IV. Answer any FIVE of the following questions: $5 \times 3 = 15$

29. Mention the basic properties of electric charge.
30. Establish the relation between electric field and electric potential.
31. How do you convert a moving coil galvanometer in to an ammeter? Explain with a circuit diagram.
32. List out three properties of magnetic field lines.
33. The magnetic flux through a coil of 10 turns changes with time as $\emptyset_B(t) = t^2 - 2t + 4$ Wb. Find the magnitude of induced emf at t = 2 s.
34. Draw the ray diagram of image formation in compound microscope. Write the expression for magnification for image at near point distance.
35. Write Einstein's photoelectric equation and explain two experimental results of photoelectric effect using the equation.
36. Write a curve of binding energy per nucleon as a function of mass number and explain the main features of the curve.

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PART - D

V. Answer any THREE of the following questions: $3 \times 5 = 15$

37. a) Derive an expression for capacitance of a parallel plate capacitor. (3)

    b) Mention two differences between series and parallel combination of capacitors. (2)

38. Deduce an expression for equivalent emf and equivalent internal resistance when two cells of different emfs and internal resistances are connected in parallel.

39. Arrive at the expression for the force between two parallel conductors carrying current and hence define an ampere.

40. a) Using Huygen's principle arrive at Snell's law of refraction of light (3)

    b) Give two applications of polaroids. (2)

41. What is a full wave rectifier? Explain the construction and working of a full-wave rectifier with the help of a circuit diagram.

VI. Answer any TWO of the following questions: $2 \times 5 = 10$

42. Two point charges 6μC and -6μC are located 20 cm apart in vacuum.
    a) What is the electric field at the midpoint of the line joining the two charges?

    b) If a negative test charge of magnitude 1.5×10^{-9}C is placed at this point, what is the force experienced by the test charge?

43. The radius of a copper wire is 0.8 mm and it is carrying a current of 3A. The number density of free electrons in copper conductor estimated is 2.5×10^{28} m^{-3}. Calculate the drift velocity of conduction electrons. How long does an electron take to drift from one end of the wire to its other end if the length of the wire is 3 m. Given electronic charge $e = 1.602 \times 10^{-19}$C

44. A resistor of 200 Ω and a capacitor of 15 μF are connected in series to a 220 V, 50 Hz AC source. a) Calculate the current in the circuit.

    b) Calculate the voltage (rms) across the resistor and the capacitor.

45. An equilateral prism made of glass shows a minimum deviation of 40° for an oblique incident ray. What is the refractive index of the material of the prism? Also calculate the angle of incidence.

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DISTRICT LEVEL II PUC PREPARATORY EXAM, JANUARY – 2025

Time: 3 Hours **Sub: PHYSICS (33)** **Max. Marks: 70**

General Instructions:

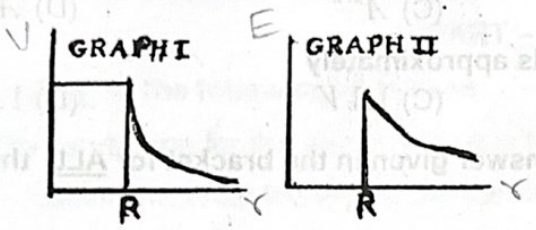
1. ***All Parts (A to D)*** are compulsory. ***Part – E*** is only for visually challenged students.
2. ***For Part – A questions, first written answer*** will be considered for awarding marks.
3. ***Answers without relevant diagram / figure / circuit*** wherever necessary will not carry any marks.
4. ***Direct answers to the numerical problems without detailed solutions*** will not carry any marks.

PART – A

I. Pick the correct option among the four given options for ALL of the following questions: $15 \times 1 = 15$

1. **Dipole moment is a vector quantity, which is pointing from**
   (A) $-q$ *to* $+q$ along the axis of an electric dipole (B) infinity to $+q$
   (C) $+q$ *to* $-q$ along the axis of an electric dipole (D) $+q$ to infinity

2. **The following graphs show the variations of two physical quantities with distance 'r' from the centre of a uniformly charged spherical shell. Identify the graphs.**



   (A) First graph shows variation of *E* versus *r* and second is *V* versus *r*
   (B) First graph shows variation *V* versus *r* and second is *E* versus *r*
   (C) Both graphs shows the variation of *V* versus *r*
   (D) Both graphs shows the variation of *E* versus *r*

3. **The relaxation time in conductors**
   (A) Increase with the increase of temperature (B) Decreases with the increase of temperature
   (C) It does not depend on temperature (D) All of sudden changes at 400K

4. **Ohm's law is valid when the temperature of conductor is**
   (A) very low (B) very high (C) constant (D) varying

5. **Match the physical quantities of Column – I with their units in Column – II.**

Column – I	Column – II
(i) Current sensitivity	(a) Am^{-1}
(ii) Intensity of magnetic field	(b) Am^2
(iii) Magnetic Dipole Moment	(c) $div\ A^{-1}$

   (A) (i)=(c), (ii)=(b), (iii)=(a) (B) (i)=(c), (ii)=(a), (iii)=(b)
   (C) (i)=(a), (ii)=(c), (iii)=(b) (D) (i)=(b), (ii)=(a), (iii)=(c)

6. **The phenomena of induction of an emf in a coil due to change in current through the same coil is called:**
   (A) Mutual induction (B) Self induction
   (C) Motional emf (D) Induction of magnetic field

7. **Power factor for a purely resistive circuit is:**
   (A) Zero (B) Unity (C) Infinity (D) 0.5

8. **Electromagnetic waves are**
   (A) Longitudinal wave (B) Matter wave (C) Transverse wave (D) All are correct

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9. **Snell's law of refraction not valid for angle of incidence**
(A) 0^0 (B) 45^0 (C) 60^0 (D) 90^0

10. **Two converging lenses of equal lengths are placed in contact. The focal length of combination is**
(A) $f/2$ (B) $1/2f$ (C) $2/f$ (D) $2f$

11. **The shape of wavefront obtained from a point source of finite distance**
(A) Spherical (B) Plane (C) Cylindrical (D) None

12. **Photon having highest energy is**
(A) Red photon (B) Blue photon (C) Indigo photon (D) Violet photon

13. **The perpendicular distance between the initial velocity and central line of nucleus is called**
(A) Radius of atom (B) Radius of nucleus
(C) Radius of molecule (D) Impact parameter

14. **The radius of nuclei depends on mass number (A) as**
(A) A (B) $A^{1/2}$ (C) $A^{2/3}$ (D) $A^{3/2}$

15. **The cut – in voltage for Silicon diode is approximately**
(A) $0.2\ V$ (B) $0.7\ V$ (C) $1.1\ V$ (D) $1.4\ V$

II. **Fill in the blanks choosing appropriate answer given in the bracket for ALL the following questions:** **5 × 1 = 5**

(diffraction, optical fiber, zero, decreases, increases, electroscope)

16. Instrument used to detect electric charge is _____.
17. As the speed of a conducting rod moving perpendicular to a uniform magnetic field decreases, the motional emf induced across it _____.
18. At resonance of series *LCR* circuit, the voltage across combination of *L* and *C* is _____.
19. _____ works on principle of total internal reflection.
20. The phenomenon of bending of light around the edges of an obstacle is called _____.

PART – B

III. **Answer any FIVE of the following questions:** **5 × 2 = 10**

21. State and explain Kirchhoff's loop rule.
22. Is any work is done by a magnetic field on a moving charge? Justify your answer.
23. What are the conditions for (i) stable equilibrium and (ii) unstable equilibrium for a compass needle in terms of its magnetic moment and the uniform magnetic field?
24. Lenz's law in accordance to principle of conservation of energy. Briefly explain.
25. Give any two applications of X–rays.
26. Mention two uses of polaroids.
27. Write two limitations of Bohr's atom model.
28. What is forward bias and reverse bias of semiconductor diode?

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PART – C

IV. **Answer any FIVE of the following questions:** $5 \times 3 = 15$

29. Write three properties of electric field lines.
30. Mention any three factors on which the capacitance of a parallel plate capacitor depends.
31. A metal cube of edge $2\,cm$ is drawn into a uniform wire of length $2\,m$. What is the resistance of the wire? Given: resistivity of wire is $0.5\ \mu\Omega m$.
32. Write the three differences between diamagnetic and ferromagnetic materials.
33. Obtain the expression for energy stored in an inductor.
34. Prove that, the focal length of a spherical mirror is half of its radius of curvature.
35. What is interference of light? Write the conditions for constructive interference and destructive interference in terms of path difference.
36. Mention any three differences between nuclear fission and nuclear fusion.

PART – D

V. **Answer any THREE of the following questions:** $3 \times 5 = 15$

37. Arrive at the expression for the electric field due to a thin spherical shell at a point outside the shell using Gauss law. Write the expression for electric field on its surface.
38. (a) Derive an expression for drift velocity of free electrons in conductor. [3M]
    (b) Name the mobile charge carriers in (i) metals (ii) electrolyte. [2M]
39. Derive the expression for magnetic field at a point on the axis of a circular current loop.
40. Derive lens maker's formula.
41. (a) Give Einstein's explanation of photoelectric effect. [3M]
    (b) What is the resistance of an ideal diode when
    (i) forward biased and
    (ii) reverse biased? [2M]

VI. **Answer any TWO of the following questions:** $2 \times 5 = 10$

42. Charges $+2\,nC$, $+4nC$ and $+6\,nC$ are placed at the corners ABC respectively of a square of side $0.1\,m$. Calculate the work done to transfer a charge of $+2\ \mu C$ from the corner D to the center of the square.
43. A galvanometer of resistance $50\ \Omega$ requires a current of $2\ mA$ for full scale deflection. How do you convert it into
    (a) an ammeter for range $0-3\,A$
    (b) a voltmeter of range $0-5\,V$.

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44. A sinusoidal voltage of peak value $283V$ and frequency $50\,Hz$ is applied to a series LCR circuit in which $R = 3\Omega$, $L = 25.48\,mH$, and $C = 796\,\mu F$. Find

(a) The impedance of the circuit.

(b) The phase difference between the voltage across the source and the current.

(c) The power dissipated in the circuit and

(d) The power factor.

45. The work function of Caesium metal is $2.14\,eV$. When light of frequency $6 \times 10^{14}\,Hz$ is incident on the metal surface, photoemission of electron occurs. Find:

(a) Energy of incident photon

(b) Maximum kinetic energy of photoelectrons.

PART – E

(For Visually Challenged Students Only)

2. **Equal charges are given to the two spheres of different radii. The potential will**

(A) Be more on bigger sphere

(B) Be more on smaller sphere

(C) Be equal on both spheres

(D) Depend on the nature of the material of the spheres

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AS

SECOND PUC PREPARATORY EXAMINATION – JANUARY - 2025
Sub: PHYSICS (33)

No. of Questions : 45

Time: 3 Hrs. **Total Marks: 70**

General Instructions:

(i) All parts A to D are compulsory.

(ii) For Part A questions, the first written answer will be considered for awarding marks.

(iii) Answers without relevant diagrams/figures/circuits wherever necessary will not carry any marks.

(iv) Direct answers to numerical problems without relevant formulas and detailed solutions will not carry any marks.

PART – A

I. Pick the correct option among the four given options for ALL the following questions. $15 \times 1 = 15$

1. Coulomb's law of electrostatics agrees with the:

   (a) Amperes law (b) Newton's third law of motion

   (c) Ohm's law (d) Faraday's law

2. Statement I: The magnitude of electric field is given by the change in magnitude of potential per unit displacement.

   Statement II: Electric field is in the direction in which the potential decreases steepest.

   (a) Both statements are correct (b) Only statement I is correct

   (c) Both statements are wrong (d) Only statement II is correct

3. Current through unit area normal to the current in a conductor is

   (a) Drift velocity (b) Current density (c) mobility (d) conductivity

4. The substances which have tendency to move from stronger to weaker part of external magnetic field is

   (a) Ferro magnetic substance (b) Para magnetic substance

   (c) both ferro or pare magnetic substance (d) diamagnetic substance

5. Lenz's law is analogous to the law of conservation of

   (a) energy (b) charge (c) Mass (d) both mass and energy

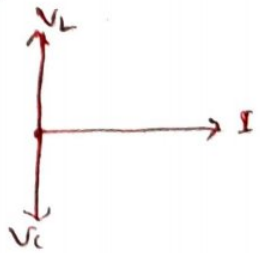
6. S.I. unit of self-inductance is:

   (a) ohm (b) farad (c) ampere (d) henry

7. The electrical resonance phenomenon is exhibited by

   (a) L and C ac circuit (b) R and C ac circuit

   (c) R and L ac circuit (d) none of these



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8. Electromagnetic waves with highest frequency are:

(a) Microwaves (b) u v rays (c) radio waves (d) gamma rays

9. Expression for magnification of simple microscope is:

(a) $m = 1 + \frac{D}{f}$ (b) $m = 1 + \frac{f}{D}$ (c) $m = 1 - \frac{D}{f}$ (d) $m = \frac{1}{\frac{D}{f}}$

10. Which of the following is not a use of Polaroids?

(a) To control the intensity of light (b) to produce maximum intensity of light,

(c) In photographic cameras (d) In 3 D movie cameras

11. Light of a filament bulb is viewed through by holding two blades to form a single narrow slit shows:

(a) Clear diffraction pattern (b) Dark Shadow of the blades

(c) a single bright band (d) interference bands

12. The minimum energy required to free the electron from ground state of hydrogen atom is

(a) 27.2 eV (b). 10.2 eV (c) 13.6 eV (d) 3.40 eV

13. Nuclides with same atomic number and different mass number are called:

(a) Isotones (b) Isobars (c) Isotopes (d) Isomers

14. The term Hole in a semiconductor is used for:

(a) An antiparticle of electron

(b) A Vacancy created when an electron leaves covalent bond.

(c) Absence of free electron.

(d) An artificially created particle.

15. Identify the correct match in the following:

	Column I		Column II
i	a n- type semiconductor	a	is tetravalent
ii	a p- type semiconductor	b	has donor impurity
iii	a pure semiconductor	c	has acceptor impurity

(a) i – a, ii – b, iii – c (b) i – c, ii – a, iii – b (c) i – b, ii – c, iii – a (d) i – c, ii – b, iii - a

II. Fill in the blanks by choosing appropriate answer given in the brackets for ALL the following.

5 × 1 = 5

[Transformer, low resistance, magnetic field lines, rectifier, relative refracting index, high resistance]

16. A galvanometer is converted into an ammeter by connecting _____ in parallel.

17. _____ do not intersect each other.

18. Hysteresis loss is the loss of energy in a ____.

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19. Refractive index of glass with respect to water is called _____.

20. Semiconductor pn junction diodes used in _____ circuit.

PART – B

III. Answer any FIVE of the following questions: **5 × 2 = 10**

21. What is the direction of net electrostatic force on an electric dipole when (i) its $\vec{p}$ is parallel to $\vec{E}$ and (ii) its $\vec{p}$ is anti-parallel to $\vec{E}$, in a non-uniforms electric field E?

22. Mention factors on which the capacitance of a parallel plate capacitor depends.

23. Define (i) Electric polarization of a dielectric and (ii) dielectric strength.

24. Draw a graph of resistivity versus temperature of (i) metallic conductor (ii) semiconductor.

25. Write expression for Lorentz's force acting on a charged particle moving in uniform magnetic field and electric field and explain the terms.

26. Mention principle of an ac generator. Write an expression for instantaneous emf of ac generator.

27. What is meant by displacement current? Write its expression.

28. The threshold frequency of a photo sensitive metal is 5×10^{14} Hz. Find its work function. ($h = 6.625 \times 10^{-34}$ Js)

PART – C

IV. Answer any FIVE of the following questions: **5 × 3 = 15**

29. Mention basic properties ci electric charge.

30. Derive an expression for magnetic field due to long straight conductor carrying current using Ampere's circuital law.

31. Define (a) magnetic susceptibility (b) magnetic relative permeability and write the relation between them.

32. Explain magnet and coil experiment to demonstrate the electromagnetic induction.

33. Define critical angle and mention conditions for total internal reflection of light.

34. Write any three Hallwatch's and Lenard's observations of photo electric effect.

35. Draw schematic arrangement of the Geiger - Marsden α - scattering experiment. What is meant by impact parameter?

36. Find the energy equivalent of one atomic mass unit in joules and in MeV. Given: speed of tight in vacuum = 3×10^8 ms^{-1}, one atomic mass unit = 1.66×10^{-27} kg and magnitude of charge of electron = 1.6×10^{-19} C.

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PART – D

V. Answer any THREE of the following questions: **3 × 5 = 15**

37. Derive an expression for electric field at a point outside a charged thin spherical shell using Gauss's law.
38. Obtain an expression for conductivity of free electrons in conductor when an electric field established across it.
39. Deduce an expression for force between two parallel current carrying conductors and hence define ampere.
40. (a) Prove law of refraction of light when a plane wave front passes from rarer medium to denser medium.

    (b) Give any two differences between constructive and destructive interference of light.
41. Define (i) valance band and (ii) conduction band. Explain classification of solids using band theory.

PART – E

VI. Answer any TWO of the following: **2 × 5 = 10**

42. Three capacitor 3 μF, 4 μF and 6 μF are connected in series. (a) determine the effective capacitance of the combination.

    (b) find the potential across 4 μF capacitor if the combination is connected to 100 volt supply.
43. Two cells 2V, 1Ω and 4V, 2Ω are connected across a 5Ω external resistor in parallel, such that they send currents in same direction through external resistor. Find the current and potential difference across the external resistor.
44. A resistor 200 Ω and a capacitor of 15.0 μF are connected in series across a 220 V, 50 Hz ac source. (a) Find Impedance of the circuit. (b) calculate the rms current in the circuit.
45. A glass double convex lens of refractive Index 1.5 and have radii of curvature of the faces are 10 cm and 15 cm. Find its focal length. What will be new focal length if it is immersed completely in water of refractive index $\frac{4}{3}$?

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DHARWAD DISTRICT II PUC PREPARATORY EXAMINATION 2024-25

Time : 3-00 hrs. **PHYSICS (33)** **Max Marks- 70**

Instruction : 1) All parts A to D are compulsory. Part-E is only for visually challenged students.
2) For Part – A questions, only the first written answer will be considered for awarding marks.
3) Answers without relevant diagram / figure /circuit wherever necessary will not carry any marks.
4) Direct answers to the numerical problems without detailed solutions will not carry any marks.

PART – A

I) Pick the correct option among the four given options for ALL of the following questions. **15 x 1 = 15**

1) A region surrounded by a stationary electric charge has
(A) only magnetic field (B) only electric field
(C) both electric and magnetic field (D) neither electric nor magnetic field

2) Below are the two statements related to equipotential surfaces :
Statement I : Electric field at every point is normal to the equipotential surface passing through that point.
Statement II: If the electric field were not normal to the equipotential surface, work has to be done in moving a test charge on the surface.
(A) Both the statements I and II are correct and II is the correct explanation for I
(B) Both the statements I and II are correct and II is not the correct explanation for I
(C) Statement I is correct and the statement II is wrong.
(D) Statement I is wrong and the statement II is correct.

3) A practical device which works on the principle of Wheatstone's bridge is
(A) ammeter (B) voltmeter (C) galvanometer (D) metre bridge

4) The mathematical form of Ampere's circuital law is
(A) $\oint \vec{E} \cdot d\vec{A} = \frac{Q}{\varepsilon_o}$ (B) $\oint \vec{B} \cdot d\vec{A} = 0$ (C) $\oint \vec{B} \cdot d\vec{l} = \mu_o I$ (D) $\oint \vec{E} \cdot d\vec{l} = -\frac{d\emptyset_B}{dt}$

5) The SI unit of magnetization is
(A) A m^{-1} (B) A m^{-2} (C) A m (D) Am^{-3}

6) Lenz's law is in accordance with law of conservation of
(A) linear momentum (B) charge
(C) energy (D) angular momentum

7) An AC generator converts
(A) mechanical energy in to electrical energy
(B) mechanical energy in to light energy
(C) electrical energy in to mechanical energy
(D) mechanical energy in to chemical energy

8) The phenomenon of electrical resonance is exhibited by an electrical circuit if it contains
(A) resistor and a diode (B) resistor and a capacitor
(C) inductor and a capacitor (D) resistor and an inductor

9) Which of the following rays has lowest wavelength?
(A) Radio waves (B) Micro waves (C) X- rays (D) Gamma rays

10) For the refraction through prism, as angle of incidence increases, the angle of deviation:
(A) first decreases then increases (B) first increases then decreases
(C) increases continuously (D) decreases continuously

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11) Which of the following phenomenon confirms the transverse nature of light waves?
(A) Diffraction of light (B) Polarization of light
(C) Interference of light (D) Dispersion of light

12) In interaction of radiation with matter, radiation behaves as if it is made up of particles called
(A) electrons (B) protons (C) photons (D)neutrons

13) In Geiger -Marsden scattering experiment, the trajectory traced by an alpha particle depends on
(A) number of collisions (B) number of scattered alpha particles
(C) kinetic energy of alpha particles (D) impact parameter of the collision

14) The energy generation in stars is mainly due to
(A) fusion of light nuclei (B) fusion of heavy nuclei
(C) fission of heavy nuclei (D) chemical reaction

15) The column-I is the list of materials and the column-II is the list of energy gaps (E_g)of corresponding materials. Identify the correct match.

Column-I	Column-II
(i) Dimond (C)	(a) E_g=1.1 eV
(ii) Silicon (Si)	(b) E_g=5.4 eV
(iii) Germanium (Ge)	(c) E_g=0.7 eV

(A) (i) - (a), (ii)-(b), (iii)-(c) (B) (i) - (b), (ii)-(a), (iii)-(c)
(C) (i) - (c), (ii)-(a), (iii)-(b) (D) (i) - (b), (ii)-(c), (iii)-(a)

II) Fill in the blanks by choosing appropriate answer given in the brackets for ALL the following questions. 5 x 1 = 5

(laminated core, wavelength,non -polar,matter waves,polar, zero)

16) Oxygen molecule is an example for _____dielectrics.
17) The net magnetic flux through any closed surface is _____.
18) The energy loss due to eddy current in a transformer is minimized by using_____.
19) In diffraction of light, the _____of light is much smaller than the dimensions of the obstacle.
20) _____ are the waves associated with material particles.

PART – B

III) Answer any FIVE of the following questions. 5 x 2 = 10

21) Write any two basic properties of electric charge.
22) How does the resistance of a conductor depend on its length and area of cross-section?
23) When the force experienced by a moving charge in a magnetic field becomes:
(i) minimum and (ii) maximum?
24) The current in a coil of inductance 5 mH changes from 2.5 A to 2 A in 0.01 s. Calculate the induced emf.
25) What is displacement current? Give its expression.
26) Mention the two conditions for total internal reflection of light.
27) Name the objective used in: (a) refracting type telescope and (b) reflecting type telescope.
28) Give any two differences between p type and n type semiconductors.

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PART – C

IV) Answer any FIVE of the following questions. **5 x 3 = 15**

29) Obtain an expression for torque on an electric dipole placed in a uniform electric field.

30) Derive an expression for the effective capacitance of two capacitors connected in series.

31) Explain with a relevant circuit diagram, how a galvanometer is converted in to an ammeter.

32) Write any three difference between diamagnetic and ferromagnetic materials.

33) Describe the coil and magnet experiment of electromagnetic induction.

34) Give any three experimental observations of photoelectric effect.

35) State the three Bohr's postulates of hydrogen atom.

36) Calculate the binding energy of a nitrogen nucleus ${}_7N^{14}$ N from the following data:
(i) Mass of proton 1.00783 u, (ii) Mass of neutron 1.00867 u (iii) Rest mass of nitrogen nucleus 14.00307 u.

PART – D

V) Answer any THREE of the following questions. **3 x 5 = 15**

37) State Gauss's law in electrostatics. Using the law, derive an expression for electric field at a point near the surface of a charged spherical shell.

38) Assuming the expression for drift velocity, derive the expression for electrical conductivity of a material $\sigma = \frac{ne^2\tau}{m}$. Where symbols have their usual meanings.

39) Obtain an expression for force per unit length between two long straight parallel conductors carrying currents and hence define 'ampere'.

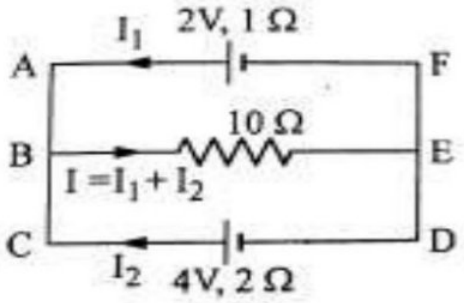
40) (a) State Huygen's principle for wave theory of light. (2)
(b) Using Huygen's wave theory of light, show that the angle of incidence is equal to the angle of reflection during a plane wave is reflected by a plane surface. (3)

41) (a) What is rectification? (1)
(b) Using p-n junction diode explain the working of full wave rectifier with circuit diagram. (3)
(c) Draw its input and output waveforms. (1)

VI) Answer any TWO of the following questions. **2 x 5 = 10**

42) A point charge of 20 μC is situated at a point O. A and B are the two points 0.05 m and 0.15 m away from this charge on the same side. Find the potentials at A and B. Also find the work done to move a point charge of 1.6×10^{-19} C from B to A. $\left(Given : \frac{1}{4\pi\varepsilon_0} = 9\times10^9 \ Nm^2C^{-2} \right)$

43) Find the potential difference across 10 Ω resistor in the given electrical network.



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44) A 20 Ω resistor, 1.5 H inductor and 35 μF capacitor are connected in series with a 220 V, 50 Hz AC supply. Calculate the impedance in the circuit.Does the current leads or lags the voltage?

45) A double convex lens of refractive index 1.56 has both radii of curvature 20 cm. If an object is placed at a distance of 10 cm from the lens. Calculate the power of a lens and also find the position of the image formed.

PART – E
(For Visually Challenged Students Only)

43) Two cells of emf 2 V and 4 V and internal resistances 1 Ω and 2 Ω respectively are connected in parallel so as to send the current in the same direction through an external resistance of 10 Ω. Find the potential difference across 10 Ω resistor.

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II PUC PREPARATORY EXAMINATION -2024-2025

Date: 18-01-2025 | **DHARWAD DISTRICT** | **Code: JJ**

CLASS: PUC-II | **Sub: PHYSICS (33)** | **No. of Questions: 45**

Time: 3 Hrs. | **Max. Marks: 70**

General Instructions:

1. *All part A to D are compulsory. Part-E is only for visually challenged students.*
2. *For Part –A questions, only the first written answer will be considered for awarding marks.*
3. *Answers without relevant diagram/figure/circuit wherever necessary will not carry any marks.*
4. *Direct answers to numerical problems without detailed solutions will not carry any marks.*

SCHEME OF EVALUATION

Q.No.	PART-A	Marks
I	**Pick the correct option among the four given options for ALL of the following questions: 15 X 1 = 15**	
1.	A region surrounded by a stationary electric charge has (A) only magnetic field (B) only electric field (C) both electric and magnetic field (D) neither electric nor magnetic field	
	(B) only electric field	1
2.	Below are the two statements related to equipotential surfaces **Statement I:** Electric field at every point is normal to the equipotential surface passing through that point. **Statement II:** If the electric field were not normal to the equipotential surface, work has to be done in moving a test charge on the surface. (A) Both the statements I and II are correct and II is the correct explanation for I (B) Both the statements I and II are correct and II is not the correct explanation for I (C) Statement I is correct and the statement II is wrong (D) Statement I is wrong and the statement II is correct	
	(A) Both the statements I and II are correct and II is the correct explanation for I	1
3.	A practical device which works on the principle of Wheatstone's bridge is (A) ammeter (B) voltmeter (C) galvanometer (D) metre bridge	
	(D) metre bridge	1
4.	The mathematical form of Ampere's circuital law is (A) $\oint \vec{E} \cdot d\vec{A} = \frac{Q}{\varepsilon_o}$ (B) $\oint \vec{B} \cdot d\vec{A} = 0$ (C) $\oint \vec{B} \cdot d\vec{l} = \mu_o I$ (D) $\oint \vec{E} \cdot d\vec{l} = -\frac{d\emptyset_B}{dt}$	
	(C) $\oint \vec{B} \cdot d\vec{l} = \mu_o I$	1
5.	The SI unit of magnetization is (A) $A\,m^{-1}$ (B) $A\,m^{-2}$ (C) $A\,m$ (D) Am^{-3}	
	(A) $A\,m^{-1}$	1
6.	Lenz's law is in accordance with law of conservation of (A) linear momentum (B) charge (C) energy (D) angular momentum	
	(C) energy	1
7.	An AC generator converts (A) mechanical energy in to electrical energy (B) mechanical energy in to light energy (C) electrical energy in to mechanical energy (D) mechanical energy in to chemical energy	
	(A) mechanical energy in to electrical energy	1

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8.	The phenomenon of electrical resonance is exhibited by an electrical circuit if it contains (A) resistor and a diode (B) resistor and a capacitor (C) inductor and a capacitor (D) resistor and an inductor	
	(C) inductor and a capacitor	**1**
9.	Which of the following rays has lowest wavelength? (A) Radio waves (B) Micro waves (C) $X-$ rays (D) Gamma rays	
	(D) Gamma rays	**1**
10.	For the refraction through prism, as angle of incidence increases, the angle deviation: (A) first decreases then increases (B) first increase then decreases (C) increases continuously (D) decreases continuously	
	(A) first decreases then increases	**1**
11.	Which of the following phenomenon confirms the transverse nature of light waves? (A) Diffraction of light (B) Polarization of light (C) Interference of light (D) Dispersion of light	
	(B) Polarization of light	**1**
12.	In interaction of radiation with matter, radiation behaves as if it is made up of particles called (A) electrons (B) protons (C) photons (D) neutrons	
	(C) photons	**1**
13.	In Geiger -Marsden scattering experiment, the trajectory traced by an alpha particle depends on (A) number of collisions (B) number of scattered alpha particles (C) kinetic energy of alpha particles (D) impact parameter of the collision	
	(D) impact parameter of the collision	**1**
14.	The energy generation in stars is mainly due to (A) fusion of light nuclei (B) fusion of heavy nuclei (C) fission of heavy nuclei (D) chemical reaction	
	(A) fusion of light nuclei	**1**
15.	The column-I is the list of materials and the column-II is the list of energy gaps (E_g) of corresponding materials. Identify the correct match. Column-I: (i) Dimond (C); (ii) Silicon (Si); (iii) Germanium (Ge) Column-II: (a) $E_g = 1.1\ eV$; (b) $E_g = 5.4\ eV$; (c) $E_g = 0.7\ eV$ (A) (i) - (a), (ii) - (b), (iii) - (c) (B) (i) - (b), (ii) - (a), (iii) - (c) (C) (i) - (c), (ii) - (a), (iii) - (b) (D) (i) - (b), (ii) - (c), (iii) - (a)	
	(B) (i) - (b), (ii) - (a), (iii) - (c)	**1**
II	**Fill in the blanks by choosing appropriate answer given in the brackets for ALL the following questions: 5 X 1 = 05** ***(laminated core, wavelength, non - polar, matter waves, polar, zero)***	
16.	Oxygen molecule is an example for _____ dielectrics.	
	non - polar	**1**
17.	The net magnetic flux through any closed surface is _____.	

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	zero	**1**
18.	The energy loss due to eddy current in a transformer is minimized by using _____.	
	laminated core	**1**
19.	In diffraction of light, the _____of light is much smaller than the dimensions of the obstacle.	
	wavelength	**1**
20.	_____ are the waves associated with material particles.	
	matter waves	**1**
	PART - B	
III.	**Answer any FIVE of the following questions: 5 X 2 = 10**	
21.	Write any two basic properties of electric charge.	
	❖ Charge is additive in nature. ❖ Charge is conserved. ❖ Charge is quantized. (Any Two)	**1** **1**
22.	How does the resistance of a conductor depend on its length and area of cross-section?	
	❖ Directly proportional to length ($R \propto l$) ❖ Inversely proportional to area of cross section ($R \propto \frac{1}{A}$)	**1** **1**
23.	When the force experienced by a moving charge in a magnetic field becomes: (i) minimum and (ii) maximum?	
	(i) $\theta = 0^0$ Or when charge is moving in the direction or opposite to the magnetic field. (ii) $\theta = 90^0$ Or when charge is moving perpendicular to the magnetic field.	**1** **1**
24.	The current in a coil of inductance $5\,mH$ changes from $2.5\,A$ to $2\,A$ in $0.01\,s$. Calculate the induced emf.	
	$Given: L = 5\ X\ 10^{-3}\ H\ \ I_1 = 2.5\ A\ \ I_2 = 2\ A\ \ dt = 0.01\ s\ \ \varepsilon = ?$ W. K.T Induced emf $\varepsilon = -L\frac{dI}{dt}$ $\varepsilon = -5\ X\ 10^{-3}\left(\frac{2-2.5}{0.01}\right) = -5\ X\ 10^{-3}(-50)$ $\boldsymbol{\varepsilon = 250\ X\ 10^{-3}\ V\ or\ 250\ mV\ or\ 0.25\ V}$	**1** **1**
25.	What is displacement current? Give its expression.	
	The current which appears in the region where electric field and hence electric flux is changing with respect to time is called displacement current. $i_D = \varepsilon_0 \frac{d\emptyset_E}{dt}\quad Or\quad i_D = \varepsilon_0 A \frac{dE}{dt}$	**1** **1**
26.	Mention the two conditions for total internal reflection of light.	
	❖ A ray of light must travel from denser to rarer medium. ❖ Angle of incidence must be greater than critical angle.	**1** **1**
27.	Name the objective used in: (a) refracting type telescope and (b) reflecting type telescope.	

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(a) Convex lens of large aperture and large focal length is used as objective in refracting type telescope. **1**

(b) Concave mirror of large aperture and large focal length is used as objective in reflecting type telescope. **1**

28. Give any two differences between p type and n type semiconductors.

	p-type Semiconductor		**n-type Semiconductor**
1.	It is formed when a trivalent impurity is added to an intrinsic semiconductor.	1.	It is formed when a pentavalent impurity is added to an intrinsic semiconductor.
2.	Holes are majority charge carriers.	2.	Free electrons are majority charge carriers.
3.	Free electrons are minority charge carriers.	3.	Holes are minority charge carriers.
4.	The electrical conductivity is mainly due to holes.	4.	The electrical conductivity is mainly due to free electrons.
5.	Conductivity is relatively less.	5.	Conductivity is more. (Any Two)

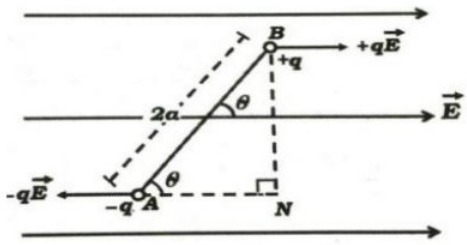
1 **1** **1**

PART-C

IV. Answer any FIVE of the following questions: 5 x 3 = 15

29. Obtain an expression for torque on an electric dipole placed in a uniform electric field.

Consider an electric dipole placed in a uniform electric field at an angle θ as shown in fig



1

W.K.T. Torque on the dipole is

τ = Force x Perpendicular distance.

$\tau = qE \times BN$..... (1)

1

From fig in triangle ABN

$\sin\theta = \frac{BN}{AB}$ $\sin\theta = \frac{BN}{2a}$ $BN = 2a\sin\theta$

Then Eqn. (1) becomes

$\tau = qE \times 2a\sin\theta$ or $\tau = 2aqE \times \sin\theta$ ..... (2)

Since $2aq = P$ the dipole moment

Then Eqn. (2) becomes

$\boldsymbol{\tau = PE\sin\theta}$

In vector form $\vec{\tau} = \vec{P} \times \vec{E}$ **..... (3)** **1**

30. Derive an expression for the effective capacitance of two capacitors connected in series.

Consider two capacitors with capacitance C_1 and C_2 connected in series as shown in fig.

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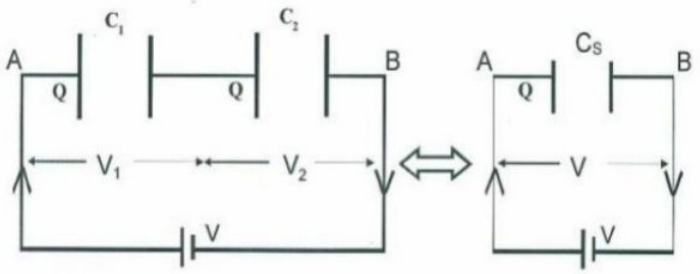
Let V_1 and V_2 are the potential differences across $C_1$and C_2 then total p.d. across the combination is



$V = V_1 + V_2$..... (1) **1**

For capacitors $C = \frac{Q}{V}$

$\Rightarrow V_1 = \frac{Q}{C_1}$ and $V_2 = \frac{Q}{C_2}$ **1**

Then Eqn. (1) becomes

$$V = \frac{Q}{C_1} + \frac{Q}{C_2}$$

Or $V = Q\left[\frac{1}{C_1} + \frac{1}{C_2}\right]$..... (2)

If C_S is equivalent capacitance of the combination then,

$V = \frac{Q}{C_S}$ ..... (3)

From Eqn. (2) and (3)

$$\frac{Q}{C_S} = Q\left[\frac{1}{C_1} + \frac{1}{C_2}\right]$$

Or $\frac{1}{C_S} = \frac{1}{C_1} + \frac{1}{C_2}$ ..... (4) **1**

31. Explain with a relevant circuit diagram, how a galvanometer is converted in to an ammeter.

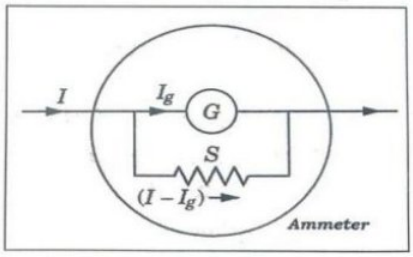
A galvanometer can be converted into an ammeter by connecting a suitable low resistance in parallel with it. **1**

Consider a galvanometer connected in parallel with low resistance S as shown in fig.

Since P.d. across S = P.d. across G

$$(I - Ig)\,S = Ig\,G.$$ **1**

$$S = \left(\frac{I_g G}{I - I_g}\right)$$ **1**



32. Write any three difference between diamagnetic and ferromagnetic materials.

Diamagnetic materials	Ferromagnetic materials
1) These are repelled by a magnet.	1) These are strongly attrected by a magnet.
2) The magnetic susceptibility is low and negative.	2) The magnetic susceptibility is high and positive.
3) They do not obey Curie's law	3) They obey Curie's law.
4) Magnetic field lines are expelled out, when a substance placed in an external magnetic field.	4) Magnetic field lines enter inside when a substance placed in an external magnetic field.
5) Relative permeability is less than one, $\mu_r < 1$	5) Relative permeability is much grater than one, $\mu_r \gg 1$ **(Any Three)**

1 **1** **1**

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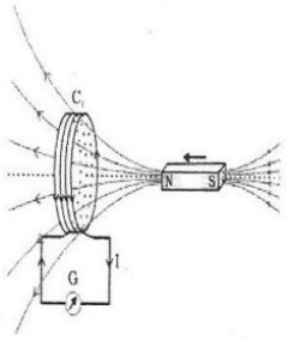
33.	Describe the coil and magnet experiment of electromagnetic induction.	
	Coil and magnet experiment: When the north pole of the magnet is moved towards or away from the coil C_1, the magnetic flux lined with the coil changes. As a result, emf is induced and current flows through the coil which causes a momentary deflection in the galvanometer G. If the magnet is kept stationary and the coil is moved, similar results are obtained. It is also observed that faster the moment of magnet, greater is the deflection. When the coil and magnet are kept stationary (no relative motion between the coil and the magnet, then no deflection is observed. Thus, an emf and hence current are induced in a coil whenever change in magnetic flux linked with it. 	**1** . **1+1**
34.	Give any three experimental observations of photoelectric effect.	
	1) The photoelectric effect is instantaneous process. (Any Three) 2) For a given photosensitive material, there exists a certain minimum cut off frequency of incident radiation, called threshold frequency below which there is no photoelectric effect. 3) For a given photosensitive material, above threshold frequency, the photoelectric current is directly proportional to the intensity of incident radiation. 4) For a given photosensitive material, above threshold frequency, kinetic energy of photoelectrons increases linearly with frequency of incident radiation. 5) For a given photosensitive material, and frequency of incident radiation, saturation current is proportional to intensity of radiation but stopping potential is independent of its intensity. (Or Graph With explanation)	**1** **1** **1**
35.	State the three Bohr's postulates of hydrogen atom.	
	1. An electron revolves around the nucleus in certain stable orbits called stationary orbits without the radiating energy. **2.** An electron revolves around the nucleus only in those orbits for which the angular momentum is integral multiple of $\frac{h}{2\pi}$ where h is Planck's constant. **3.** An atom can radiate energy only when the electron jumps from an orbit of higher energy level to an orbit of lower energy level. i.e., $h\vartheta = E_f - E_i$	**1** **1** **1**
36.	Calculate the binding energy of a nitrogen nucleus ${}^{14}_{7}N$ from the following data: (i) Mass of proton 1.00783 u, (ii) Mass of neutron 1.00867 u (iii) Rest mass of nitrogen nucleus 14.00307 u.	

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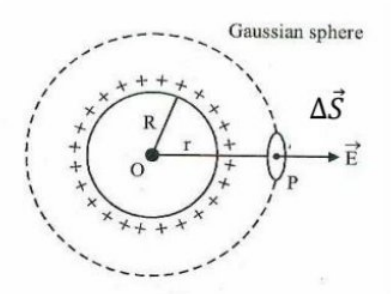
	$Given: M = 14.00307\ u\ \ Z = 7\ A = 14\ m_p = 1.00783\ u\ \ m_n = 1.00867\ u\ \Delta m = ?\ \text{BE} = ?$ Mass defect: $\Delta m = Zm_p + (A - Z)m_n - M$ $\Delta m = 7\ X1.00783 + (14 - 7)\ X\ 1.00867 - 14.00307$ $\Delta m = 0.11243\ u$ Binding energy: $BE = \Delta m\ X\ 931.5\ MeV$ $BE = 0.11243\ X\ 931.5\ MeV$ $\boldsymbol{BE = 104.72854\ MeV}$	**1** **1** **1**
	PART-D	
V	**Answer any THREE of the following questions:** **3 x 5 = 15**	
37.	State Gauss's law in electrostatics. Using the law, derive an expression for electric field at a point near the surface of a charged spherical shell.	

	Statement: The total electric flux over any closed surface is always equal to $\frac{1}{\epsilon_0}$ times the total charge enclosed over that surface.
	Consider a uniformly charged spherical shell of radius R.
	Imagine a Gaussian sphere of radius r such that the point P lies on it as shown in fig.
	If $\Delta\emptyset_E$ is the electric flux over the surface ΔS then
	$\Delta\emptyset_E = \text{E} \cdot \Delta S$ Since $\theta = 0$
	If $\emptyset_E$ is the total electric flux over the entire surface then
	$\emptyset_E = \sum \Delta\emptyset_E$
	Or $\emptyset_E = E \sum \Delta S$ ..... (1)
	Since $\sum \Delta S = 4\pi r^2$ then
	$\emptyset_E = E \cdot 4\pi r^2$ ..... (2)
	From Gauss's law $\emptyset_E = \frac{q}{\epsilon_0}$ ..... (3)
	From Eqn. (2) and (3)
	$E\ 4\pi r^2 = \frac{q}{\epsilon_0}$
	Or $\boldsymbol{E = \frac{1}{4\pi\epsilon_0}\frac{q}{r^2}}$
	In vector form
	$\boldsymbol{\vec{E} = \frac{1}{4\pi\epsilon_0}\frac{q}{r^2}\ \hat{n}}$ **..... (4)**
	 
	
		1
		1
		1
		1
		1

38.	Assuming the expression for drift velocity, derive the expression for electrical conductivity of a material $\sigma = \frac{ne^2\tau}{m}$. Where symbols have their usual meanings.	
	Consider a conductor of length l and area of cross section A connected to a battery. If V be the volume of the conductor then $V = Al$ ..... (1) If N be the number of free electrons in the conductor then $N = nV$	

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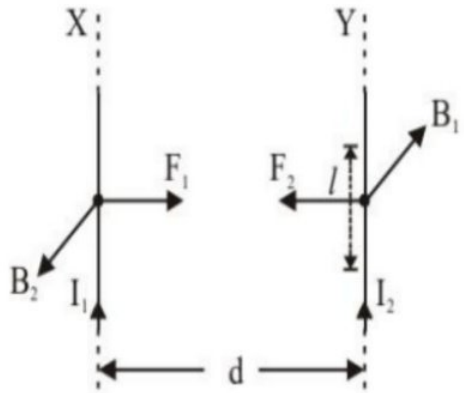
	Or $N = nAl$ ……..(2) If Q is the total charge in the conductor then $Q = Ne$ Or $Q = nAle$ ……..(3) If t is the time taken by the free electron from one end to another end then, $t = \frac{l}{v_d}$ ……. (4) If I is the current in the conductor then $I = \frac{Q}{t}$ $I = \frac{nAle}{\frac{l}{v_d}} = neAv_d$ ……. (5) Since $v_d = \frac{eE\tau}{m}$ then Eqn. (5) becomes $I = neA\left(\frac{eE\tau}{m}\right)$ Or $\frac{I}{A} = \frac{ne^2E\tau}{m}$ Since $\frac{I}{A} = J$ then $J = \left(\frac{ne^2\tau}{m}\right)E$ ……. (6) W.K.T $J = \sigma E$ ……. (7) From Eqn. (6) and (7) $\boldsymbol{\sigma = \frac{ne^2\tau}{m}}$ **……. (8)**	**1** **1** **1** **1**
39.	Obtain an expression for force per unit length between two long straight parallel conductors carrying currents and hence define 'ampere'.	
	Consider two infinitely long parallel straight conductors X and Y carrying currents I_1 and I_2 saparated by a distance d as shown in fig. Let B_1be the magnetic field on the conductor Y due to current I_1 in the conductor X then, From Ampere circuital law, $B_1 = \frac{\mu_0}{2\pi}\frac{I_1}{d}$ ……(1) Let F_2 be the magnetic force on conductor Y due to magnetic field B_1 then $F_2 = B_1I_2l \quad \because \theta = 90^0$ $\therefore F_2 = \left[\frac{\mu_0}{2\pi}\frac{I_1}{d}\right]I_2l$ ……. (2)  Similarly let B_2 be the magnetic field on the conductor X due to current I_2 in the conductor Y then, $B_2 = \frac{\mu_0}{2\pi}\frac{I_2}{d}$ …… (3) Let F_1be the magnetic force on conductor X due to magnetic field B_2 then	**1** **1**

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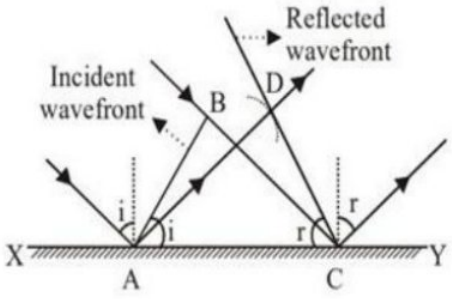
	$F_1 = B_2 I_1 l$ Or $F_1 = \left[\frac{\mu_0}{2\pi}\frac{I_2}{d}\right] I_1 l$..... (4) $\because F_1$ and F_2 are equal and opposite each other The force per unit length on each conductor is $\frac{F}{l} = \frac{\mu_0}{2\pi}\frac{I_1 I_2}{d}$ **..... (5)** **Definition of ampere:** One ampere is that steady current which, when maintained in each of the two infinitely long, straight, parallel conductors of negligible cross-section placed one metre apart in vacuum would produce a force of $2\,X\,10^{-7}$ newton per metre length on each other.	**1** **1** **1**
40.	(a) State Huygens principle for wave theory of light. (2)	
	(b) Using Huygens wave theory of light, show that the angle of incidence is equal to the angle of reflection during a plane wave is reflected by a plane surface. (3)	
	(a) According to Huygens' principle, ❖ Each point of the wavefront is the source of secondary disturbance and the wavelets emerging from these points spread out in all directions with the speed of the wave. ❖ The tangent drawn to all secondary wavelets represent the new position of wavefront at a later time.	**1** **1**
	(b) Consider a plane wave front AB incident on a plane reflecting surface XY. If the secondary wavelets from B strike the surface X Y at C in time t then $BC = vt$ ..... (1) In the same time the secondary wavelets from point A gets spread over a hemisphere of radius: $AD = vt$ ..... (2) From equations (1) and (2), BC = AD ..... (3) In ΔABC and ΔADC $\angle$ABC and $\angle$ADC = 90^0. AD = BC AC is common. $\therefore \Delta$ABC and ΔADC are congruent. Hence $\angle$BAC = $\angle$DCA Or $i = r$ ..... (4) $\therefore$ Angle of incidence is equal to angle of reflection. This is the law of reflection of light. 	**1** **1** **1**

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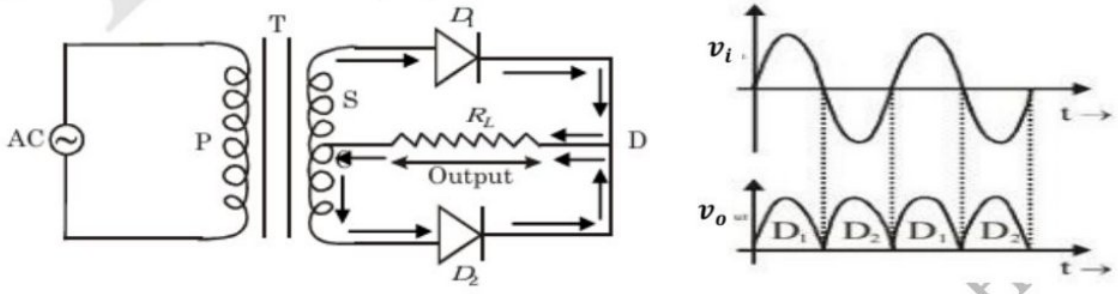
41.	(a) What is rectification? (1) (b) Using p-n junction diode explain the working of full wave rectifier with circuit diagram. (3) (c) Draw its input and output waveforms. (1)	
	Rectification: The process of conversion of alternating current (AC) in to pulsating direct current (DC) is called rectification.	**1**
	 **Working:** A full wave rectifier consists of two diodes connected across the ends of winding of a centre tapped step down transformer as shown in fig. During positive half cycle the diode D_1 becomes forward biased, whereas diode D_2 reverse biased. So, diode D_1 allows the current to flow through load resister R_L. During negative half cycle the diode D_1 becomes reverse biased, whereas diode D_2 forward biased. So, diode D_2 allows current through load resister R_L. Thus, there is current flow through R_L over the complete cycle of AC input in the same direction.	**1** **1** **1** **1+1**
VI.	**Answer any TWO of the following questions:** **2 x 5 = 10**	
42.	A point charge of $20\,\mu C$ is situated at a point O. A and B are the two points $0.05\,m$ and $0.15\,m$ away from this charge on the same side. Find the potentials at A and B. Also find the work done to move a point charge of $1.6\,X\,10^{-19}\,C$ from B to A. (Given: $\frac{1}{4\pi\varepsilon_0} = 9\,X\,10^9\,Nm^2C^{-2}$.)	
	$Given: Q = 20\,X\,10^{-6}\,C\;\; r_A = 0.05\,m\;\; r_B = 0.15\,m\;\; V_A = ?\, V_B = ?\;\; q = 1.6\,X\,10^{-19}C\;\; W = ?$ W. K. T. Electric potential at a point A due to a point charge $20\,\mu C$ is $V_A = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r_A}$ $V_A = \frac{9\,X\,10^9\,X\,20\,X\,10^{-6}}{0.05}$ $\boldsymbol{V_A = 3.6\,X\,10^6\;V}$ Electric potential at a point B due to a point charge $20\,\mu C$ is $V_B = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r_B}$ $V_B = \frac{9\,X\,10^9\,X\,20\,X\,10^{-6}}{0.15}$	**1** **1**

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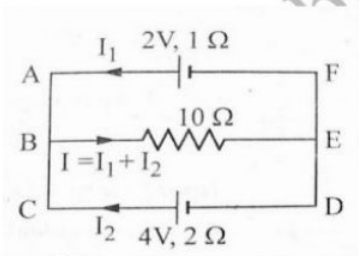
	$\boldsymbol{V_B = 1.2\ X\ 10^6\ V}$ Potential difference between A and B is $\Delta V = V_A - V_B$ $\Delta V = 3.6\ X\ 10^6 - 1.2\ X\ 10^6$ $\quad \boldsymbol{\Delta V = 2.4\ X\ 10^6\ V}$ ∴Work done in moving a charge q from B to A is $W = q\Delta V$ $\quad W = 1.6\ X\ 10^{-19}\ X\ 2.4\ X\ 10^6$ $\boldsymbol{W = 3.84\ X\ 10^{-13}\ J}$	1 1 1
43.	Find the potential difference across 10 Ω resistor in the given electrical network.  	
	From the circuit diagram, Cells are in parallel ∴ Equivalent emf is $\varepsilon_{eq} = \frac{\varepsilon_1 r_2 + \varepsilon_2 r_1}{r_1 + r_2}$ $\varepsilon_{eq} = \frac{2\ X\ 2+4\ X\ 1}{1+2} = \frac{8}{3}$ $\boldsymbol{\varepsilon_{eq} = 2.67\ V}$ $r_{eq} = \frac{r_1\ X\ r_2}{r_1 + r_2}$ $r_{eq} = \frac{1\ X\ 2}{1+2} = \frac{2}{3}$ $\boldsymbol{r_{eq} = 0.67\ \Omega}$ Current through 10 Ω resistor is $I = \frac{\varepsilon_{eq}}{R + r_{eq}}$ $I = \frac{2.67}{10+0.67}$ $\boldsymbol{I = 0.25\ A}$ P.d across 10 Ω resistor is $V = I\ R$ $V = 0.25\ X\ 10$ $\boldsymbol{V = 2.5\ V}$	1 1 1 1
	Alternate method: KVL to loop ABEFA We get $-10(I_1 + I_2) - I_1 + 2 = 0$ $11I_1 + 10I_2 = 2$ $\quad \ldots\ldots\ldots (1)\ \ X\ 5$ KVL to loop BEDCB We get $-10(I_1 + I_2) - 2I_2 + 4 = 0$ $5I_1 + 6I_2 = 2$ $\quad \ldots\ldots\ldots (2)\ \ X\ 11$ From Eqn. (1) and (2) $55I_1 + 50I_2 = 10$ $(-)\ 55I_1 + 66I_2 = 22$ $-16I_2 = -12$	
	$I_2 = \frac{4}{3}$ *or* $\boldsymbol{I_2 = 0.75\ A}$ From Eqn. (2) $5I_1 + (6\ X\ 0.75) = 2$ $I_1 = \frac{-2.5}{5}$ or $\boldsymbol{I_1 = -0.5\ A}$ $I = I_1 + I_2 = -0.5 + 0.75$ $\boldsymbol{I = 0.25\ A}$ P.d across 10 Ω resistor is $V = I\ R$ $V = 0.25\ X\ 10$ $\quad \boldsymbol{V = 2.5\ V}$	

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44.	A $20\,\Omega$ resistor, $1.5\,H$ inductor and $35\,\mu F$ capacitor are connected in series with a $220\,V, 50\,Hz$ AC supply. Calculate the impedance in the circuit. Does the current leads or lags the voltage?	
	Given: $R = 20\,\Omega$ L $= 1.5\,H$ $C = 35\,X\,10^{-6}\,F$ $v_{rms} = 220\,V$ $\vartheta = 50\,Hz$ $Z = ?$ W K T Inductive reactance $X_L = 2\pi\vartheta L = 2\,X\,3.14\,X\,50\,X\,1.5 = 471$ $\boldsymbol{X_L = 471\,\Omega}$	**1**
	Capacitive reactance $X_C = \frac{1}{2\pi\vartheta C} = \frac{1}{2\,X\,3.14\,X\,50\,X\,35\,X\,10^{-6}} = 0.00009099\,X\,10^6$ $\boldsymbol{X_C = 91\,\Omega}$	**1**
	Impedance $Z = \sqrt{R^2 + (X_L - X_C)^2}$	**1**
	$Z = \sqrt{20^2 + (471 - 91)^2} = \sqrt{20^2 + (380)^2} = 380.5$ $\mathbf{Z = 380.5\ \Omega}$	**1**
	$\because X_L > X_C$ **Current lags behind the voltage**	**1**
45.	A double convex lens of refractive index 1.56 has both radii of curvature 20 *cm*. If an object is placed at a distance of 10 *cm* from the lens. Calculate the power of a lens and also find the position of the image formed.	
	Given: $n = 1.56$ $R_1 = 20\,cm$ $R_2 = -20\,cm$ $u = -10\,cm$ $f = ?$ $P = ?$ $v = ?$ From Lens maker's formula $\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$	**1**
	$\frac{1}{f} = (1.56 - 1)\left(\frac{1}{20} + \frac{1}{20}\right)$ $\frac{1}{f} = (0.56)\left(\frac{1}{10}\right)$ $f = 17.86\,cm$ or $\boldsymbol{f = 0.1786\,m}$	**1**
	Power of the lens $P = \frac{1}{f}$ $P = \frac{1}{0.1786} = 5.6$ $\boldsymbol{P = 5.6\,D}$	**1**
	From Lens formula $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$ $\frac{1}{v} = \frac{1}{f} + \frac{1}{u} = \frac{1}{17.86} - \frac{1}{10} = -\frac{1}{22.72}$	**1**
	$\boldsymbol{v = -22.72\,cm}$	**1**

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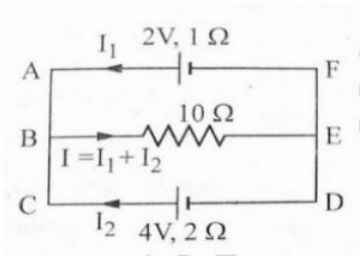
	PART-E **(For Visually Challenged Students Only)**	
43.	Two cells of emf 2 V and 4 V and internal resistances 1 Ω and 2 Ω respectively are connected in parallel so as to send the current in the same direction through an external resistance of 10 Ω. Find the potential difference across 10 Ω resistor.	
	From the circuit diagram, Cells are in parallel ∴ Equivalent emf is $\varepsilon_{eq} = \frac{\varepsilon_1 r_2 + \varepsilon_2 r_1}{r_1 + r_2}$ $\varepsilon_{eq} = \frac{2\ X\ 2+4\ X\ 1}{1+2} = \frac{8}{3}$ $\boldsymbol{\varepsilon_{eq} = 2.67\ V}$ $r_{eq} = \frac{r_1\ X\ r_2}{r_1 + r_2}$ $r_{eq} = \frac{1\ X\ 2}{1+2} = \frac{2}{3}$ $\boldsymbol{r_{eq} = 0.67\ \Omega}$ Current through 10 Ω resistor is $I = \frac{\varepsilon_{eq}}{R + r_{eq}}$ $I = \frac{2.67}{10+0.67}$ $\boldsymbol{I = 0.25\ A}$ P.d across 10 Ω resistor is $V = I\ R$ $V = 0.25\ X\ 10$ $\boldsymbol{V = 2.5\ V}$	 **Alternate method:** KVL to loop ABEFA We get $-10(I_1 + I_2) - I_1 + 2 = 0$ $11I_1 + 10I_2 = 2$ ……(1) $X\ 5$ KVL to loop BEDCB We get $-10(I_1 + I_2) - 2I_2 + 4 = 0$ $5I_1 + 6I_2 = 2$ ……(2) X 11 From Eqn. (1) and (2) $55I_1 + 50I_2 = 10$ $(-)\ 55I_1 + 66I_2 = 22$ $-16I_2 = -12$
	$I_2 = \frac{4}{3}$ *or* $\boldsymbol{I_2 = 0.75\ A}$ From Eqn. (2) $5I_1 + (6\ X\ 0.75) = 2$ $I_1 = \frac{-2.5}{5}$ or $\boldsymbol{I_1 = -0.5\ A}$ $I = I_1 + I_2 = -0.5 + 0.75$ $\boldsymbol{I = 0.25\ A}$ P.d across 10 Ω resistor is $V = I\ R$ $V = 0.25\ X\ 10$ $\boldsymbol{V = 2.5\ V}$	
	Note: Any other alternate correct method /answer should be considered	

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GOVERNMENT OF KARNATAKA
DEPUTY DIRECTOR, DEPARTMENT OF SCHOOL EDUCATION (PRE-UNIVERSITY)
CHIKODI EDUCATIONAL DISTRICT, CHIKODI
P. U. C. SECOND YEAR PREPARATORY EXAMINATION – 2024-25

Subject and subject code: PHYSICS (33)
Exam Regd. No:
Date:

Time: 3 Hour
Max.Marks: 70
No. of questions:45

General instructions:

Note: - *1) All Parts A to D are compulsory. Part – E is only for visually challenged students.*

2) For Part – A questions, first written – answer will be considered for awarding the marks.

3) Answer without relevant diagram/ figure/circuit wherever necessary will not carry any marks.

4) Direct answers to the numerical problems without detail solution will not carry any marks.

PART-A

I. Pick the correct option among the four given options for ALL of the following questions $15 \times 1 = 15$

1. SI unit of charge is

   (A) newton (B) coulomb (C) ampere (D) Vm^{-1}

2. In bringing an electron towards another electron, the electrostatic potential energy of the system
   (A) becomes zero (B) increases (C) decreases (D) remains same
3. Fuse wire is a wire of
   (A) high resistance and high melting point
   (B) low resistance and high melting point
   (C) low resistance and low melting point
   (D) high resistance and low melting point
4. A uniform electric field and a uniform magnetic field are acting along the same direction in a certain region. If an electron is projected in the region such that its velocity is pointed along the direction of fields, then the electron
   (A) will turn towards right of direction of motion
   (B) speed will decrease
   (C) speed will increase
   (D) will turn towards left of direction of motion.
5. The direction of magnetic field line of a bar magnet is
   (A) from south pole to north pole
   (B) from north pole to south pole
   (C) across the bar magnet
   (D) from south pole to north pole inside the magnet and from north pole to south pole outside the magnet
6. Self-inductance of a straight conductor is

   (A) zero (B) very large (C) infinity (D) very small

7. Two different loops are concentric and lie in the same plane. The current in the outer loop is clockwise and increasing with time. The induced current in the inner loop then, is
   (A) clockwise (B)zero
   (C) counter clockwise (D)in a direction that depends on the ratio of the loop radii

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8. In a pure resistive circuit

(A) voltage leads the current by $\frac{\pi}{2}$

(B) voltage lags behind the current by $\frac{\pi}{2}$

(C) voltage is in phase with current

(D) voltage leads the current by π

9. The electric and magnetic fields in an electromagnetic wave are

(A) in opposite phase and perpendicular to each other

(B) in opposite phase and parallel to each other

(C) in phase and perpendicular to each other

(D) in phase and parallel to each other

10. Snell's law fails

(A) when light travel from denser to rarer (B) for oblique incidence

(C) when light travel from rarer to denser (D) for normal incidence

11. Four independent waves are expressed as

(i) $y_1 = a_1 \sin \omega t$, (ii) $y_2 = a_2 \sin 2\omega t$, (iii) $y_3 = a_3 \cos 3\omega t$ and (iv) $y_4 = a_4 \sin(\omega t + \pi/3)$

The interference is possible between

(A) (i) and (ii) (B) (iii) and (iv)

(C) (i) and (iv) (D) Not possible at all

12. The graph of velocity of photon versus its frequency in vacuum will be a

(A) straight line parallel to frequency axis

(B) straight line parallel to velocity axis

(C) straight line passing through origin and making an angle of 45° with frequency axis

(D) hyperbola

13. Nuclear model is required to explain

(A) Bohr's frequency condition (B) Thomson's model

(C) Rydberg's constant (D) Rutherford's experiment

14. The binding energy of hydrogen nucleus is

(A) zero (B) 10.2 eV (C) 13.6 eV (D) more than 13.6 eV

15. Number of p-n junctions in a semiconductor diode is

(A) one (B) two (C) no junction at all (D) three

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II. Fill in the blanks by choosing appropriate answer given in the bracket for ALL the following questions. $5 \times 1 = 05$

(plane, spherical, directly, zero, polar, inversely)

16. Polar dielectric consists of _____ molecules.
17. The net magnetic flux through any closed surface is _____.
18. Inductive reactance varies _____ with frequency of ac.
19. A wavefront originated from a point source at infinite distance is _____ wave front.
20. de-Broglie wavelength of a particle varies _____ with its linear momentum.

PART-B

III. Answer ANY FIVE of the following questions $5 \times 2 = 10$

21. State and explain Coulomb's law in electrostatics.
22. Mention the expression for resistance of a wire in terms of resistivity and explain the terms.
23. A long solenoid has 200 turns per cm and carries a current of 2.5 A. Calculate the magnetic field at its centre.
24. State Lenz's law. Give its significance.
25. What is displacement current? Write the expression for it.
26. Draw the ray diagram of image formation in simple microscope when image is at near point.
27. Give the two conditions for total internal reflection to occur.
28. Name two types of extrinsic semiconductors.

PART-C

IV. Answer ANY FIVE of the following questions $5 \times 3 = 15$

29. Write any three properties of electric field lines.
30. Mention any three factors on which the capacitance of a parallel plate capacitor depends.
31. With circuit diagram explain how do you convert galvanometer into voltmeter.
32. Write any three differences between diamagnetic and ferromagnetic substances.
33. Derive the expression for motional emf in a conducting rod moving in uniform magnetic field.
34. Define the terms; i) Threshold frequency (ii) work function and (iii) Stopping potential with reference to photo electric effect.
35. State the three postulates of Bohr's theory of hydrogen atom.
36. Show that 1atomic mass unit (u) $= 1.66 \times 10^{-27}$ kg.

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PART-D

V. Answer any THREE of the following questions $3 \times 5 = 15$

37. Using Gauss's law, derive the expression for electric field due to an infinitely long straight uniformly charged wire.

38. Two cells of different emfs and different internal resistances are connected in parallel. Derive an expression for equivalent emf and equivalent internal resistance of the combination.

39. a) Deduce the force between two parallel current carrying conductors. (4)

    b) Define one ampere. (1)

40. a) Derive the expression for resultant amplitude when two coherent waves undergo interference. (3)

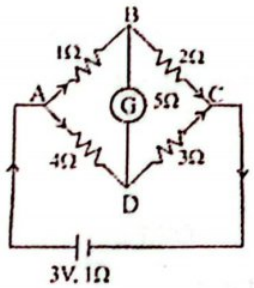
    b) Write conditions for constructive and destructive interference in terms of phase difference. (2)

41. What is rectifier? Describe with a circuit diagram, the working of a semiconductor diode as a half wave rectifier. Draw input and output waveforms.

VI. Answer any TWO of the following questions. $2 \times 5 = 10$

42. A cube of side $\sqrt{3}\ m$ has a charge $\frac{1}{16}\ nC$ at each of its vertices. Determine the potential and electric field due to this charge-array at the centre of the cube.

43. In the circuit given below, calculate current through the galvanometer.



44. An LCR circuit contains resistance of 100 Ω and supply of 200 V at 300 $rads^{-1}$. If only capacitance is taken out from the circuit and the rest of the circuit is joined, current lags behind the voltage by 60°. If on the other hand, only inductor is taken out, the current leads by 60° with applied voltage. Find the current flowing in the circuit.

45. Find the angle of minimum deviation produced by an equilateral prism of refractive index 1.55.

PART – E (For Visually Challenged Students only)

43. In a Wheatstone bridge, AB = 1Ω, BC = 2Ω, CD = 3Ω and DA = 4Ω are connected in cyclic order. A galvanometer of 5Ω is connected between B and D. In between points A and C, cell of emf 3V and internal resistance of 1 Ω is connected. Find the current through the galvanometer.

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II PUC PREPARATORY EXAMINATION - 2025

PHYSICS (33)

Time 3-00 Hours **Max Marks 70**

General Instructions :

1. *All parts A to D are compulsory.*
2. *For part -A questions, first written answer will be considered for awarding marks.*
3. *Answers without relevant diagram/ figure/ circuit wherever necessary will not carry any marks.*
4. *Direct answers to numerical problems without relevant formula and detailed solutions will not carry any marks.*

PART-A

I. Pick the correct option among the four given options for all of the following questions. **15x1=15**

1. The equivalent unit of NC^{-1} (SI unit of electric field) is
   a) Vm b) Vm^2 c) Vm^{-1} d) Vm^{-2}
2. The distance between the two protons r is decreases then the electric potential energy of the system of the two protons becomes ($r > 0$)
   a) decreases b) increases c) remains same d) none of these
3. Kirchhoff's loop rule is based on the law of conservation of
   a) Energy b) mass c) charge d) current
4. The following Statements are related to magnetic force act on moving charge in magnetic field
   Statement I - The Magnet field interacts with a moving charge and not with a stationary charge
   Statement II - A moving charge produces the magnetic field
   a) Both statements are correct and II is correct explanation of I
   b) Both statements are correct and II is not correct explanation of I
   c) statement I is correct II is wrong
   d) Both statements are wrong
5. The magnetic dipole moment is a
   a) Scalar quantity b) Vector quantity
   c) Dimensionless quantity d) Unitless quantity
6. Galvanometer is connected to a coil do not show any deflection when
   a) the north pole of the magnet is moved towards the coil
   b) the South Pole of the magnet is moved away from the coil
   c) the coil is moved towards the stationery magnet
   d) the magnet is placed at the center of the coil
7. The energy stored in the self induction coil of inductance L and current I flow through it is
   a) $\frac{1}{2}LI$ b) $\frac{1}{2}LI^2$ c) $\frac{1}{2}L^2I$ d) $\frac{1}{2}L^2I^2$
8. The column I is the list of opposition of AC in AC circuits and the column II is list of dependance of frequency of AC. Identify the correct matching.

Column I	Column II
i) resistance	A) It depends inversely with a frequency of AC
ii) capacitive reactance	B) It depends directly with frequency of AC
iii) inductive reactance	C) It is independent of frequency of AC

   a) i – A, ii- B , iii -C b) i-C, ii –B, iii – A
   c) i- C, ii –A , iii- B d) i- B, ii- A, iii-C

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9.The decreasing the order in wavelength in this group of electromagnetic waves is
a) Microwave, infrared rays, ultraviolet rays, gamma rays
b) infrared rays, microwave, ultraviolet rays, gamma rays.
c) Gama rays, infrared rays, microwave, ultraviolet rays.
d) infrared rays, Gamma Rays, microwaves, ultraviolet rays.

10. A coin is in bottom of tank filled with water appears to be raised upwards it is due to
a) reflection of light b) total internal reflection of light
c) normal shift d) lateral shift

11. The transverse nature of light is exhibited by
a) interference of light b) refraction of light
c) refraction of light d) polarization of light

12. The momentum associated with a photon is given by
a) $p=\frac{h\nu}{c}$ b) $p=\frac{h}{c\nu}$ c) $p=\frac{hc}{\nu}$ d) $p=\frac{\nu}{hc}$

13. The minimum energy is required to free the electron from the ground state of hydrogen atom to infinity distance
a) -13.6eV b) +13.6eV c) -3.6eV d) +3.6eV

14. The source of energy emitted from the interior of the stars is
a) nuclear fission b) nuclear fusion c) by chain reaction d) none of these

15. The barrier potential or junction potential of a P-N junction depends on
i) type of a semiconductor material
ii) amount of doping
iii) temperature
Which one of the following is correct
a) (i) and (ii) only b) (ii) only c) (ii) and (iii) only d) (i) (ii) and (iii)

II. Fill in the blanks by choosing appropriate answer given in the bracket for all the following questions. 5x1=5

(frequency , principal focus, Electric potential energy, directly, wavefront)

16. The work done in charge against the electrostatic repulsive force and it gets stored as.....
17. The magnetisation of magnetic material is.....Proportional to the magnetic intensity.
18. When parallel beam of light is incident on a convex lens then image is formed at.....
19..... Is defined as the Surface or locas of points(particles) having constant phase.
20. Photo electric current is independent of ..... incident radiation

PART-B

III. Answer any five of the following questions. 5x2=10

21. State and explain the coulomb's law in electrostatics.
22. Write any two limitations of Ohm's Law
23. What is the magnetic dipole moment of current loop when current flow through it is 1. 5A and area is 0.08m².
24. What is self induction? define the SI unit of self inductance of coil.
25. Mention any two different sources of energy losses in transformer.
26. What is displacement current ? Give the expression for it.
27. Write the conditions of total internal reflection of light.
28. Name the majority and minority charge carriers in p-type semiconductors.

PART-C

IV. Answer any five of the following questions. 5x3=15

29. Mention any three properties of electric field lines.

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30. Obtain the expression for equivalent capacitance of series combination of two capacitors.
31. Explain how you convert galvanometer into voltmeter.
32. Write any three differences between paramagnetic and Diamagnetic materials.
33. Derive the expression for motional EMF when a rod move in uniform magnetic field.
34. Give any three experimental results (observations) of Photoelectric effect.
35. State Bohr's postulates of hydrogen atom.
36. Compute the energy equivalent of 1 atomic mass unit (1u) in joule and MeV.
    $1u = 1.6605\times10^{-27}kg$, $e=1.602\times10^{-19}C$ and $c = 3x10x\ ms^{-1}$

PART-D

V. Answer any three of the following questions. **3x5=15**

37. Derive the Expression for electric field at a point on the equatorial line of an electric dipole.
38. Two cells of different EMF's and different internal resistances are connected in series. Derive the expression for effective EMF and effective internal resistance of this combination.
39. Arrive Expression for magnetic field at a point on the axis of a circular current loop.
40. a) Define the terms interference of light, constructive interference, destructive interference of light
    b) Write the conditions for constructive and destructive interference in terms of path difference.
41. What is a rectification? Explain the working of a full wave rectifier using a neat circuit diagram, draw its input and output waveforms.

VI. Answer any two of the following questions. **2x5=10**

42. Two point Charges $5x10^{-8}C$ and $-3\times10^{-8}C$ are located 0.16m apart. At what points on the line joining the two charges is the electric potential zero.
43. The number density of free electrons in a copper conductor is estimated at $8.5\times10^{28}m^{-3}$. How long does an electron take to drift from one end of a wire 3.0m long to its other end? The area of cross section of the wire is $2.0\times10^{-6}\ m^2$ and it is carrying a current of 3.0A.
44. A source of alternating EMF of 220V- 50Hz is connected in series with a resistance of 200Ω an inductor of 100mH and a capacitance of 30μF. Does the current lead or lag the voltage and by what angle.
45. The radii of curvature of two surfaces of a convex lens is 0.2m and 0.22m. Find the focal length of the lens if refractive index of the material of lens is 1.5. Also find the change in focal length, if it is immersed in water of refractive index 1. 33.

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MD

II PUC PREPARATORY EXAMINATION, JANUARY - 2025

II

Time : 3:15 Hours | PHYSICS - 33 | Max. Marks : 70

General Instructions:

1. All parts A to D are compulsory. Part-E is only for visually challenged students.
2. For Part – A questions, first written-answer will be considered for awarding marks.
3. Answers without relevant diagram / figure / circuit wherever necessary will not carry any marks.
4. Direct answers to numerical problems without relevant formula and detailed solutions will not carry any marks.

PART-A

I. Pick the correct option among the four given options for all the following questions:

15×1=15

1. The SI unit of electric flux is

   a) Coulomb b) Farad c) NC^{-1} d) $NC^{-1}m^2$

2. The electric field (E) and electric potential (V) inside a charged spherical shell is

   a) $E\neq0; V\neq0$ b) $E=0; V\neq0$ c) $E\neq0; V=0$ d) $E=0; V=0$

3. Mobility of free electrons in a conductor is

   a) directly proportional to electron density

   b) directly proportional to relaxation time

   c) inversely proportional to electron density

   d) inversely proportional to relaxation time

4. A strong magnetic field is applied on a stationary electron. Then the electron

   a) moves in the direction of the field

   b) moves opposite direction of the field

   c) remains stationary

   d) spinning

5. The magnetic potential energy of a dipole placed in an uniform magnetic field is given by

   a) $U= -mB\sin\theta$ b) $U= -mB\cos\theta$ c) $U= mB\cos\theta$ d) $U= mB\sin\theta$

6. A bar magnet is allowed to fall vertically through a rubber ring placed in a horizontal plane. The magnet falls with a net acceleration.

   a) =g b) zero c) <g d) >g

7. The energy stored in an inductor is given by

   a) $\frac{1}{2}LI$ b) LI^2 c) $\frac{1}{2}LI^2$ d) $\frac{1}{2}L^2I$

8. Transformers works on the principle of

   a) Self-inductance b) Mutual inductance c) Rectification d) Resonance

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9. Electromagnetic radiation used to sterilize milk is

a) X-rays b) UV rays c) Radio waves d) γ-rays

10. In refraction, light rays bent on passing from first medium to second medium because, in the second medium

a) frequency is different b) speed is different

c) amplitude is smaller d) elasticity is different

11. Which of the following statements are correct with reference to single slit diffraction pattern?

i) Fringes are of unequal width ii) Fringes are of equal width

iii) Light energy is conserved iv) Intensities of all bright fringes are equal

a) i and iii b) i and iv c) ii and iv d) ii and iii

12. The maximum kinetic energy of emitted photoelectrons depends on

a) intensity of incident radiation b) frequency of incident radiation

c) speed of incident radiation d) number of photos in the incident radiation

13. The impact parameter is minimum in alpha scattering experiment for the scattering angle of

a) 0° b) 90° c) 120° d) 180°

14. The energy equivalent to a substance of mass 1g is

a) 18×10^{13}J b) 18×10^{6}J c) 9×10^{13}J d) 9×10^{6}J

15. A positive hole in a semiconductor is

a) absence of free electrons b) an artificially created particle

c) an anti-particle of electron d) a vacancy created when an electron leaves a covalent bond

II. Fill in the blanks by choosing appropriate answer given in the brackets for all the following questions.:

(Zero, Field emission, Polarization, 90°, photo emission, 1,) **5×1=5**

16. The angle between electric field lines and equipotential surface is _____.

17. The net magnetic flux through any closed surface is _____.

18. The power factor of an AC circuit consists of pure resistor is _____.

19. Restricting the light vibrations to a particular plane is _____ phenomenon.

20. Emission of electrons from a metal surface by applying strong electric field is _____.

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PART-B

III. Answer any FIVE of the following questions: **5×2=10**

21. State and explain Gauss law.
22. Mention the limitation of Ohm's law.
23. A solenoid of 1000 turns per unit length produces a magnetic field of 2.5 mT at the midpoint on its axis, then find the magnitude of current flowing through the solenoid.
24. Write the expression for motional emf and explain the terms.
25. Give any two applications of X-rays.
26. Mention the laws of reflection of light.
27. Write any two applications of Total Internal Reflection.
28. Mention any two difference between P-type and n-type semiconductor.

PART-C

IV. Answer any FIVE of the following questions: **5×3=15**

29. Mention the basic properties of electric charge.
30. Distinguish between polar and non-polar dielectrics.
31. State Ampere's circuital law. Using it derive an expression for magnetic field strength due to straight current carrying conductor.
32. Write any three properties of diamagnetic materials.
33. Explain the coil-coil experiment to demonstrate the phenomenon of electromagnetic induction.
34. Give any three experimental observations of photoelectric effect.
35. Outline the de-Broglie explanation of Bohr's quantization rule.
36. Calculate the binding energy and binding energy per nucleon of an oxygen nucleus $\left({}_{8}O^{16}\right)$ using the following data (MeV)

    Mass of proton=1.007825u

    Mass of neutron=1.008665 u

    Mass of Oxygen nucleus = 15.995 u

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PART-D

V. Answer any THREE of the following questions: **3×5=15**

37. Derive an expression for the electric field at a point on the equatorial plane of an electric dipole.
38. Arrive at the balanced condition for Wheatstone bridge using Kirchhoff's laws.
39. Derive an expression for the magnetic field at a point on the axis of circular current loop.
40. a) What is interference of light?

    b) Write the path difference conditions for constructive and destructive interference.

    c) Mention an expression for resultant intensity at a point due to superposition of two waves from a coherent source.
41. What is Rectifier? Explain the working of a full wave rectifier with a neat circuit diagram. Draw its input-output waveforms.

VI. Answer any TWO of the following questions. **2×5=10**

42. In a parallel plate capacitor with air between the plates, each plate has an area of 6×10^{-3} m^2 and the distance between the plates is 3mm. Calculate the capacitance of the capacitor. If the space between the plates completely filled with a dielectric medium of dielectric constant K=6, what will be the new capacitance?
43. A silver wire has resistance of 2.1Ω at 27.5°C and resistance increases by 25% at 100°C. Determine the temperature co-efficient of resistivity of silver.
44. A sinusoidal voltage of 210V, 50Hz is applied to a series LCR circuit in which R=3Ω, L=25.48mH and C=796μF. Find a) The impedance of the circuit. B) The phase difference between the voltage and current; and c) The power factor.
45. At what angle should a ray of light be incident on the face of prism of refracting angle 60° so that it just suffers total internal reflection at the other face? The Refractive Index of material of prism is 1.524.

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DAKSHINA KANNADA DISTRICT
PREPARATORY EXAMINATIONS, JANUARY-2025
II PUC - PHYSICS (33)

Time: 3 hours. **Max Marks: 70** **No of questions: 45**

General Instructions:

1. ***All parts A to D are compulsory. Part-E is only for visually challenged students.***
2. ***For Part – A questions, first written-answer will be considered for awarding marks.***
3. ***Answers without relevant diagram / figure / circuit wherever necessary will not carry any marks.***
4. ***Direct answers to numerical problems without relevant formula and detailed solutions will not carry any marks.***

PART – A

I. Pick the correct option among the four given options for ALL of the following questions: **15 × 1 = 15**

1. Select the wrong statement

(A) Electric field lines never intersect
(B) Electric field lines never enter a conductor
(C) Electric field lines always form a closed loop
(D) Electric field lines will be crowded in the region of stronger field.

2. Two charges q_1 and q_2 are separated by a distance r. Potential energy between them is

(A) directly proportional to r
(B) directly proportional to r^2.
(C) inversely proportional to r
(D) inversely proportional to r^2.

3. When a polar dielectric is placed in a uniform electric field,

(A) net electric dipole moment of the material becomes zero.
(B) material acquires a net electric dipole moment.
(C) electric dipole moment of each molecules becomes zero.
(D) dielectric loses all its charge.

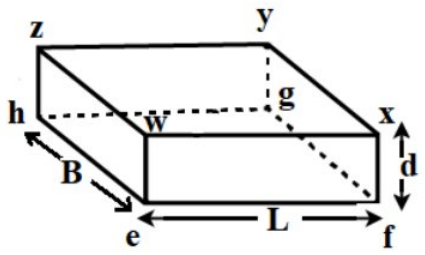
4. A rectangular solid metal piece of copper has its dimensions as shown in the diagram. If ρ is the resistivity of copper, electrical resistance between the faces efgh and wxyz is given by

(A) $R = \frac{\rho d}{LB}$

(B) $R = \frac{\rho L}{dB}$

(C) $R = \frac{\rho B}{Ld}$

(D) $R = \frac{\rho LB}{d}$



5. A circular coil of radius R is carrying current. The magnetic field is maximum

(A) on the rim of the coil
(B) at the center of the coil
(C) at a distance R from the center along the axis of the coil
(D) at a distance $\frac{R}{\sqrt{2}}$ from the center along the axis of the coil

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6. **Net magnetic flux through a closed surface is**

(A) infinity (B) $\frac{1}{\varepsilon_o}q$ (C) zero (D) $\mu_o q$

7. **Below are the two statements related to electromagnetic induction.**
Statement I : When the north pole of a magnet is moved towards a metal ring, induced current flows in the ring in such a way that, it tends to attract the north pole.
Statement II : The polarity of induced emf is such that it tends to produce a current which opposes the change in magnetic flux.
(A) Both the statements I and II are correct and II is the correct explanation for I.
(B) Both the statements I and II are correct and II is not the correct explanation for I.
(C) Statement I is wrong but the statement II is correct.
(D) Statement I is correct but the statement II is wrong.

8. **Transformer is a device used to**
(A) convert AC to DC (B) convert mechanical energy to electrical energy
(C) step up or step down the amplitude of AC (D) convert Light energy to electrical energy

9. **Match the following table by choosing the appropriate electromagnetic radiation with its property.**

Electromagnetic radiation		**Property**	
(i)	UV rays	(a)	Can penetrate through skin and blood
(ii)	X-rays	(b)	Can produce heat when absorbed by a substance
(iii)	IR Rays	(c)	Can produce vitamin D in our skin

(A) (i) – (a) , (ii) – (b), (iii) – (c) (B) (i) – (b) , (ii) – (c), (iii) – (a)
(C) (i) – (b) , (ii) – (a), (iii) – (c) (D) (i) – (c) , (ii) – (a), (iii) – (b)

10. **Total internal reflection can occur when**
(A) the ray travels from denser to rarer medium
(B) the ray is incident at an angle less than the critical angle
(C) the ray travels parallel to the interface of the two media.
(D) The ray is incident normally on the two surfaces.

11. **In which of the following cases the emergent/reflected light is a spherical wavefront?**
(A) Plane wavefront incident on a plane mirror.
(B) Plane wavefront incident on a glass slab.
(C) Plane wavefront incident on a convex lens.
(D) A plane wavefront incident on one face of a prism

12. **Which of the following quantity will not change the de Broglie wavelength of a moving particle?**
(A) charge of the particle (B) mass of the particle
(C) speed of the particle (D) momentum of the particle

13. **Nuclear atom model was proposed by**
(A) J J Thomson (B) Rutherford (C) Neil Bohr (D) Heinrich Hertz

14. **Radius of a nucleus of mass number A is** $R = R_o A^{\frac{1}{x}}$ where R_o is a constant. Value of x is
(A) 1 (B) 2 (C) 3 (D) 4

15. **Majority charge carriers in a p-type semiconductors is**
(A) electrons (B) holes (C) protons (D) neutrons

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II. **Fill in the blanks by choosing appropriate answer given in the bracket for ALL of the following questions:** **5 × 1 = 5**

(diffraction, zero, negative, electrical, positively, interference)

16. When electrons are removed from a body, the body gets …… charged.

17. AC generator converts mechanical energy to …… energy.

18. In a purely resistive AC circuit, phase difference between current and voltage is …….

19. As per sign conventions, when an object is kept at a distance 2f (f→focal length) from a convex lens, magnification is ……

20. When a compact disc is observed against sun light, it appears colored. This is due to ……

PART – B

III. **Answer any FIVE of the following questions:** **5 × 2 = 10**

21. State and explain Ohm's Law.

22. Name the shape of the path traced by a positively charged particle when it moves (i) perpendicular to the magnetic field and (ii) parallel to the magnetic field.

23. Define Magnetisation. Write its SI unit.

24. Mention two factors on which self inductance of a coil depends.

25. Write the mathematical equation representing the Ampere-Maxwell law and explain the terms.

26. Two polaroid sheets are kept with their planes parallel and pass axis making an angle of 45°. If a beam of unpolarized light of intensity I_o is incident on the first polaroid, what is the intensity of beam of light emerging from the second polaroid (in terms of I_o)?

27. Write any two Bohr's postulates.

28. Write one difference between Intrinsic and extrinsic semiconductor.

PART – C

IV. **Answer any FIVE of the following questions:** **5 × 3 = 15**

29. Write any three properties of electric charges.

30. Give three results of electrostatics of conductors.

31. Mention the three ways of increasing the current sensitivity of a moving coil galvanometer.

32. Distinguish diamagnetic and paramagnetic substances (any three).

33. Derive an expression for the motional emf induced in a metal rod moving perpendicular to a uniform magnetic field.

34. With a neat ray diagram obtain the relation between focal length and radius of curvature of a curved mirror.

35. (a) What is interference of light? **(1)**

(b) Write the conditions in terms of path difference between two coherent sources producing constructive and destructive interference. **(2)**

36. Mass defect of chlorine $\left({}^{35}_{17}C\ell\right)$ nucleus is 0.31092 u. Calculate binding energy and binding energy per nucleon of chlorine nucleus.

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PART – D

V. Answer any THREE of the following questions: **3 × 5 = 15**

37. What is a dipole? Define dipole moment. Derive an expression for the electric field at a point on the equatorial plane of a dipole.

38. (a) What is emf of a cell? **(1)**
(b) Obtain an expression for the effective emf and internal resistance of two cells connected in series. **(4)**

39. Derive an expression for the force between two long straight parallel conductors carrying currents and hence define one ampere.

40. Derive the expression for refractive index of the material of the prism in terms of angle of minimum deviation and angle of the prism.

41. What is a rectifier? With a neat circuit diagram, input and output waveforms, explain the working of a half wave rectifier.

VI. Answer any TWO of the following questions: **2 × 5 = 10**

42. An 800 pF capacitor is charged by a 100 V battery. How much energy is stored by the capacitor? The capacitor is disconnected from the battery and connected in parallel to another 800 pF capacitor. What is the electrostatic energy of the system?

43. A copper wire has 3×10^{22} free electrons in 0.021 m length. The drift velocity of electrons is found to be 2×10^{-5} ms^{-1}. How many electrons would pass through a given cross-section of the wire in one second?

44. A resistance of 10 Ω is connected in series with an inductor of inductance 0.5 H. These two are connected to 200 V, 50 Hz a.c. source. Calculate the capacitance that should be put in series with the combination to obtain the maximum current. Also, find the current through the circuit.

45. The work function of caesium metal is 2.14 eV. When light of frequency 6×10^{14} Hz is incident on the metal surface, photoemission of electrons occurs.
Find a) Energy of incident photon b) Maximum kinetic energy of photoelectrons.

PART – E

(FOR VISUALLY CHALLENGED STUDENTS ONLY)

04. A wire of resistance R is cut into 4 equal parts so that length of each piece becomes one quarter of the length of the original wire. Resistance of each piece is
(A) R/4 (B) R/2 (C) 2R (D) R

* * * * * * *

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DAKSHINA KANNADA DISTRICT
PREPARATORY EXAMINATIONS, JANUARY-2025
II PUC - PHYSICS (33)
Answers

(1) C	(2)C	(3)B	(4)A	(5)B
(6) C	(7) C	(8) C	(9)D	(10)A
(11) C	(12)A*	(13)B	(14)C	(15)B

*Two particles of same mass but different density will have same de Broglie wavelength.

(16) positively
(17) electrical
(18) zero
(19) negative
(20) diffraction

21. Statement-**1 mark** : Up to V=IR : **1 Mark**

22. (i) Circle : **1 mark** : (ii) straight line-**1 mark**

23. Definition : **1 mark** : Any SI unit-**1 mark**

24. Number of turns, permeability of the medium, area of cross section, length of the coil.
Any two – each one mark : **1+1= 2 Marks**

25. Equation- **1 mark** Explanation of terms: **1 mark**

26. **Two polaroid sheets are kept with their planes parallel and pass axis making an angle of 45°. If a beam of unpolarized light of intensity I_o is incident on the first polaroid, what is the intensity of beam of light emerging from the second polaroid (in terms of I_o)?**
When unpolarized light is incident on a polarizer, intensity of light coming out of it is half of incident.

Hence intensity of light coming out of first polaroid is $\frac{I_o}{2}$ **: 1 Mark**

Intensity of light emerging out of second polaroid sheet is $= \frac{I_o}{2} \cos^2 45 = \frac{I_o}{2} \times \frac{1}{2} = \frac{I_o}{4}$: **1 Mark**

27. Any two Bohr's postulates (each one mark) : **1+1 = 2 Marks**

28. For each explanation (difference) of Intrinsic and extrinsic: **1+1 Mark = 2 Marks**

29. Each property: **1 mark:** Total **= 3 Marks**

30. Each result: **1 mark**: Total **= 3 Marks**
Excess charges always reside on the outer surface of a charged conductor.
Electric field inside a charged conductor is zero.
Electric potential is same at all points inside a charged conductor.
Electric field lines are always normal to the surface of a conductor.

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31. Three ways (each one mark) **: 1+1+1 = 3 Marks**
Increasing number of turns
Increasing area of the coil
Using a strong magnetic field in the region of coil
Decreasing the torsional couple of suspension system

32. Three differences (each one mark) **1 +1+1 = 3 marks**

33. Diagram, Explanation **: 1 Mark**

$\varepsilon = -\frac{d\varphi}{dt} = -\frac{d}{dt}(B\ell x)$: **1 mark**

Up to $\varepsilon = B\ell v$ **: 1 mark**

Or Any alternate method

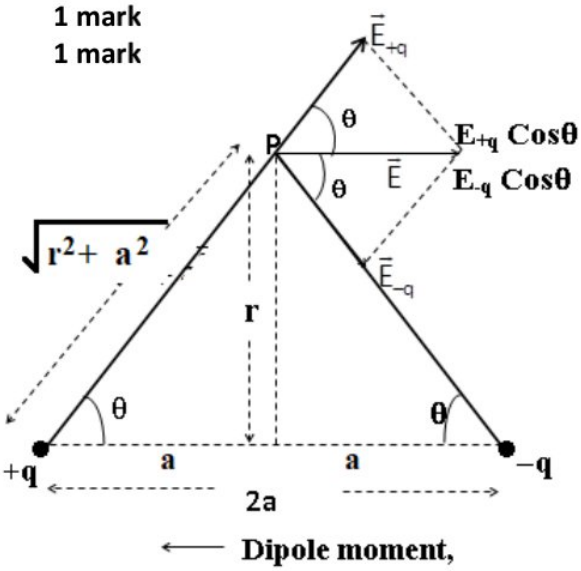
34. Ray Diagram, explanation**: 1 mark**
Derivation**: 2 marks**

35. (a) Interference definition: **1 mark**
(b) Path difference for constructive interference = $n\lambda$: **1 mark**
Path difference for destructive interference = $= (2n+1)\frac{\lambda}{2}$ or $\left(n+\frac{1}{2}\right)\lambda$: **1 mark**

36. Mass defect of chlorine $\left({}^{35}_{17}C\ell\right)$ nucleus is 0.31092 u. Calculate binding energy and binding energy per nucleon of chlorine nucleus.

Energy obtained from 1u mass is 931.5 MeV : **1 mark**
Hence energy obtained from 0.31092u mass is
$BE = 0.31902 \times 931.5 = 289.62 MeV$: **1 mark**
Binding energy per nucleon = $\frac{BE}{A} = \frac{289.62}{35} = 8.275 MeV$: **1 mark**

37. A pair of equal and opposite point charges separated by a small distance is called an electric dipole. : **1 Mark**
Product of the magnitude of one of the charges and the distance of separation between the charges. : **1 mark**
Diagram : **1 mark**



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Consider an electric dipole of dipole moment $\vec{p}$.
P be a point at a distance r from its center along the equatorial line.

Electric field at P due to $+q$ is, $E_{+q} = \frac{1}{4\pi\varepsilon_0}\frac{q}{(r^2+a^2)}$ along AP

Electric field at P due to -q is, E_{-q} $\frac{1}{4\pi\varepsilon_0}\frac{q}{(r^2+a^2)}$ along PB. **: 1 mark**

The components of electric field normal to the dipole axis cancel away.
The components along the dipole axis add up.
Net electric field at P is, $\vec{E} = -(E_{+q} + E_{-q})\, cos\,\theta\, \hat{p}$

$$\vec{E} = -\left(\frac{1}{4\pi\varepsilon_0}\frac{q}{(r^2+a^2)} + \frac{1}{4\pi\varepsilon_0}\frac{q}{(r^2+a^2)}\right)\frac{a}{\sqrt{r^2+a^2}}\hat{p}$$

$$\vec{E} = -\frac{1}{4\pi\varepsilon_0}\frac{2aq}{(r^2+a^2)\sqrt{r^2+a^2}}\hat{p}$$

$$\vec{E} = -\frac{1}{4\pi\varepsilon_0}\frac{p}{(r^2+a^2)^{3/2}}\hat{p}$$

If $a \ll r$

$$\vec{E} = -\frac{1}{4\pi\varepsilon_0}\left[\frac{P}{r^3}\right]\hat{p}$$ **: 1 mark**

38. **(a)** Potential difference across the terminals of a cell when it in open circuit is called emf of a cell. **: 1 mark**

(b)

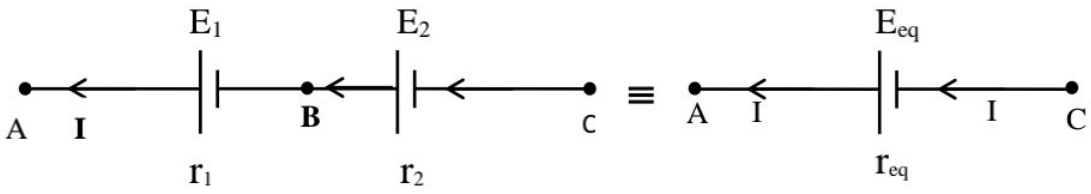

Diagram: 1 mark

Two cells having emfs E_1, E_2 and internal resistances r_1, r_2 respectively are connected in series. I is the current through the combination. V_1 and V_2 be the terminal potential differences across the cells respectively.

$V_1 = E_1 - Ir_1$.....(1)

$V_2 = E_2 - Ir_2$ .....(2)

($\because$ terminal p.d $V = E - Ir$) .....**1 mark**

If V is the p.d across the combination then, $V = V_1 + V_2$. From (1) and (2)

$V = (E_1 - Ir_1) + (E_2 - Ir_2)$

$V = E_1 + E_2 - I(r_1 + r_2)$ .....(3)

If the combination is replaced by a single cell of emf E_{eq} and internal resistance r_{eq}, then

$V = E_{eq} - Ir_{eq}$ .....(4)

Comparing (3) and (4),

$E_{eq} = E_1 + E_2$ .....**1 Mark**

and and $r_{eq} = r_1 + r_2$ ..... **1 mark**

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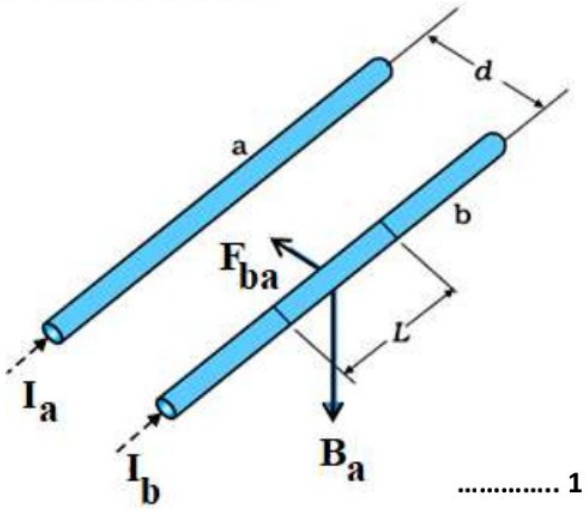
39. a and b are infinitely long parallel conductors.
I_a is current through a. I_b is current through b. I_a and I_b are flowing in the same direction.
d is be the distance between two conductors.



..... **1 mark**

Magnetic field B_a produced by current I_a at
any point on the conductor b is $B_a = \frac{\mu_0}{4\pi}\frac{2I_a}{d}$ ..... **1 mark**
The magnetic force exerted by the conductor a on the conductor b is
$\vec{F}_{ba} = I_b(\vec{L} \times \vec{B}_a)$

$$F_{ba} = I_b L B_a \sin\theta = I_b L B_a \ (\text{since } \theta = 90^\circ)$$
$$F_{ba} = I_b L\left(\frac{\mu_0}{4\pi}\frac{2I_a}{d}\right)$$
$$\therefore F_{ba} = \frac{\mu_0}{4\pi}\frac{2I_a I_b}{d}L$$

.....**1 Mark**

F_{ba} is directed towards a

Similarly. magnetic force exerted
by the conductor b on the
conductor a is
$F_{ab} = \frac{\mu_0}{4\pi}\frac{2I_a I_b}{d}L$

F_{ab} is directed towards b

Force per unit length is given by $f = \frac{F}{L} = \frac{\mu_0}{4\pi}\frac{2I_a I_b}{d} = \frac{\mu_0 I_a I_b}{2\pi d}$ .....**1 Mark**

Definition of 1A:
If $I_a = I_b = 1\text{A}$, $d = 1\text{ m}$, then $f = 2 \times 10^{-7}\text{ N/m}$
One ampere is the value of that steady current through each of the two infinitely long parallel wires of negligible area of cross section and separated by a distance of one meter in air producing a force $2 \times 10^{-7}\text{ N/m}$ between them. .....**1 Mark**

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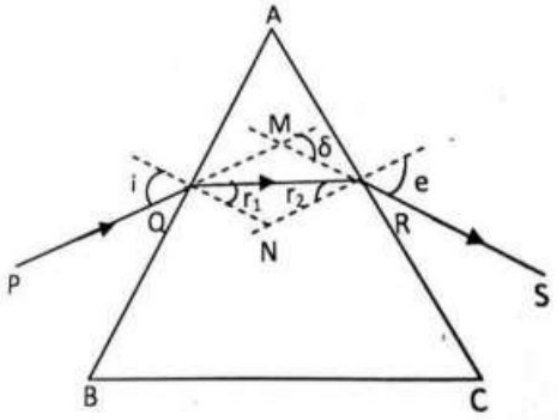
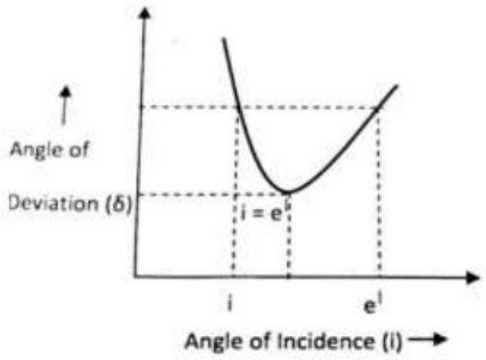
40. ABC is the principal section of the prism.
A is the angle of prism, ' i ' is the angle of incidence.
' r_1 ' is the angle of refraction at the first face AB
' r_2 ' is the angle of incidence at the second face. 'e' is and the angle of emergence.
The angle between the emergent ray (RS) and the direction of incident ray (PQ) is called the angle of deviation (δ).



.....1 Mark

From the quadrilateral AQNR,
$\angle \mathrm{A} + \angle \mathrm{QNR} = 180°$.....(1)
From the triangle QNR,
$\mathrm{r_1} + \mathrm{r_2} + \angle \mathrm{QNR} = 180°$.....(2)
From equations (1) and (2),
$\mathrm{A} = \mathrm{r_1} + \mathrm{r_2}$.....(3) **.....1 Mark**

The total deviation δ is the sum of the deviation at the two faces.
$(\mathrm{i} - \mathrm{r_1}) + (\mathrm{e} - \mathrm{r_2}) = \delta \Rightarrow (i + e) - (r_1 + r_2) = \delta$
Using equation (3), $\mathrm{i} + \mathrm{e} - \mathrm{A} = \delta$.....(4) **.....1 Mark**



.....1 Mark

From the graph, When $\delta = D_m$, $\mathrm{i} = \mathrm{e}$ and $\mathrm{r_1} = \mathrm{r_2} = \mathrm{r}$
Equation (3) becomes $2\mathrm{r} = \mathrm{A} \Rightarrow \mathrm{r} = \frac{\mathrm{A}}{2}$
Equation (4) become, $2\mathrm{i} - \mathrm{A} = \mathrm{D_m} \quad \Rightarrow \mathrm{i} = \frac{\mathrm{A}+\mathrm{D_m}}{2}$ .....(5)
The refractive index of the prism is , $\mathrm{n_{21}} = \frac{\mathrm{n_2}}{\mathrm{n_1}} = \frac{\sin \mathrm{i}}{\sin \mathrm{r}}$ .....(6)

From equations (5) and (6) $\mathrm{n_{21}} = \frac{\sin\left(\frac{\mathrm{A}+\mathrm{D_m}}{2}\right)}{\sin\left(\frac{\mathrm{A}}{2}\right)}$ **.....1 Mark**

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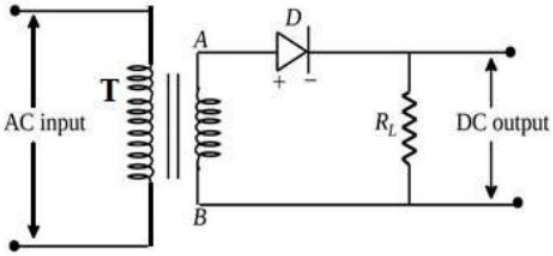
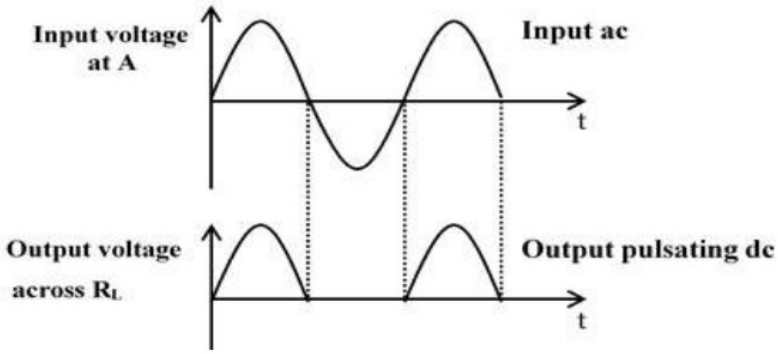
41.



T-transformer, D-Diode, R_L - Load Resistor .....2 marks

During + ve half cycle of A.C. input, A is positive with respect to B . The diode is forward biased and hence it conducts. Output appears across R_L.
During the - ve half cycle of the A.C. input, A is negative with respect to B . The diode D is reverse biased and hence it does not conduct. No output voltage appears across R_L.
The diode conducts only during positive half cycles of ac input and hence it acts a s half wave rectifier. The input waveform and output waveforms are shown below. **.....2 marks**



.....1 Mark

42. An 800 pF capacitor is charged by a 100 V battery. How much energy is stored by the capacitor? The capacitor is disconnected from the battery and connected across another uncharged 800 pF capacitor. What is the electrostatic energy of the system?

Energy stored, $U_1 = \frac{1}{2}C_1V^2 = \frac{1}{2}x800x10^{-12}x100x100 = 4x10^{-6}J$

Charge stored in the first capacitor, $Q_1=C_1V = 800x10^{-12}x100 = 8x10^{-8}C$**.....1 Mark**

Energy stored in the second capacitor, $U_2=0$
Charge stored in the second capacitor, $Q_2= 0$ **.....1 Mark**
After connecting the two capacitors in parallel, common potential difference,

$$V_c = \frac{\text{total charge}}{\text{total capacitance}} = \frac{Q_1+Q_2}{C_1+C_2} = \frac{8x10^{-8}+0}{(800+800)x10^{-12}} = 0.5x10^2 V$$ **.....1 Mark**

Energy stored in the system, $U_2 = \frac{1}{2}C_pV_c^2 = \frac{1}{2}(C_1+C_2)V_c^2$ **.....1 Mark**

$$U_2 = \frac{1}{2}(800+800)x10^{-12}x(0.5x10^2)^2 = 2x10^{-6}J$$ **.....1 Mark**

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43. A copper wire has 3×10^{22} free electrons in 0.021 m length. The drift velocity of electrons is found to be 2×10^{-5} ms^{-1}. How many electrons would pass through a given cross-section of the wire in one second?

A be the rea of cross section of wire and ℓ be its length.

Free electron density-number of free electrons per unit volume, $n=\frac{N}{V}=\frac{N}{A\ell}$

$n=\frac{3x10^{22}}{Ax0.021}m^{-3}$ .....1 Mark

$I=neAv_d \quad \Rightarrow \frac{Q}{t}=neAv_d$ .....1 Mark

$\Rightarrow \frac{n^{|}e}{t}=neAv_d$ ($n^{|}\rightarrow$number of electrons passing a cross sectional area) .....1 Mark

$\Rightarrow \frac{n^{|}e}{1}=\frac{3x10^{22}}{Ax0.021}eAx2x10^{-5}$ .....1 Mark

$\Rightarrow n^{|}=285.7x10^{17}$ electrons pass the cross sectional area in one second. .....1 Mark

44. A resistance of 10 Ω is connected in series with an inductor of inductance 0.5 H. These two are connected to 200 V, 50 Hz a.c. source. Calculate the capacitance that should be put in series with the combination to obtain the maximum current. Also, find the current through the circuit.

Maximum current flows at resonance frequency.

$\nu_o=\frac{1}{2\pi\sqrt{LC}} \quad \Rightarrow \quad \nu_o^{\,2}=\frac{1}{4\pi^2LC}$ .....1 Mark

$\Rightarrow \quad C=\frac{1}{4\pi^2L\nu_o^{\,2}}$ .....1 Mark

$\Rightarrow C=\frac{1}{4x3.14x3.14x0.5x50x50}=20.28x10^{-6}F$ .....1 Mark

Current at resonance, $I=\frac{V}{Z}=\frac{V}{R}$ .....1 Mark

$I=\frac{200}{10}=20A$ .....1 Mark

45. The work function of caesium metal is 2.14 eV. when light of frequency 6×10^{14} Hz is incident on the metal surface, photoemission of electrons occurs.

Find a) Energy of incident photon (in eV)

b) Maximum kinetic energy of photoelectrons. (in eV)

Energy of incident photon = $h\nu=6.6x10^{-34}x6x10^{14}=39.6x10^{-20}J$ .....1 Mark

$\Rightarrow$ Incident Energy $=\frac{39.6x10^{-20}}{1.6x10^{-19}}=2.475eV$ .....1 Mark

$h\nu=\varphi_o+KE_{max}$ .....1 Mark

$\Rightarrow 2.475 = 2.14 + KE_{max}$ .....1 Mark

$\Rightarrow KE_{max} = 2.475 - 2.14 = 0.335Ev$ .....1 Mark

PART – E

(FOR VISUALLY CHALLENGED STUDENTS ONLY)

04. (A)

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TUMAKURU DISTRICT P.U. COLLEGES PRINCIPALS' ASSOCIATION (R.)

SECOND PUC PREPARATORY EXAMINATION JANUARY -**2025**

Time: **3-00 hours** | **PHYSICS (33)** | Max Marks : **70**

No.of pages: **04** | Total No.of Ques: **45**

General Instructions: 1] All Parts (A to D) are compulsory.
2] For Part-A questions, first written answer will be considered for awarding marks.
3]Answers without relevant diagram/ figure/ circuit wherever necessary will not carry any marks.
4] Direct answers to numerical problems without relevant formula and detailed solutions will not carry any marks.

PART-A

I **Pick the correct option among the four given options for ALL of the following questions.** **15x1=15**

1) **At the center of an electric dipole , the total electric field due to the dipole is _**

a] Same as the elecrtic field due to individual charge

b] twice the electric field due to individual charge

c]half of the electric field due to individual charge

d] None of the above

2) **For a single positive charge q, the equipotential surfaces are**

a] coaxial cylinders with q at the center and field radially outward

b] coaxial cylinders with q at the center and field radially inward

c] concentric spheres with q at the center and field radially outward

d] concentric spheres with q at the center and field radially inward

3) **Identify the WRONG statement (related to Ohm's law) from the following**

a] The equation V = IR is true only for the devices which obey Ohm's law

b] The equation V= IR is true for all conducting devices whether they obey Ohm's law or not

c] The value of resistance R is independent of voltage V for the devices which obey Ohm's law.

d] The plot of I versus V is linear for the devices which obey Ohm's law

4) **Below are the two statements related to galvanometer**

Statement-I : For measuring currents using galvanometer, a small resistance (called shunt resistance) is connected in parallel with the galvanometer.

Statement II : Galvanometer is a very sensitive device and shunt resistance is used to bypass most of the current.

a] Statement I is correct but Statement II is wrong

b] Statement I wrong but statement II is correct.

c] Both the statements I and II are correct and II is the correct explanation of I

d] Both the statements I and II are correct but II is not the correct explanation for I.

P.T.O.

11 PRIME 5G

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5) **The correct relationship between magnetic permeability μ and magnetic susceptibility x is**

a] $\mu = \mu_0 / (1 - x)$ b] $\mu = \mu_0 (1 - x)$

c] $\mu = \mu_0 / (1 + x)$ d] $\mu = \mu_0 (1 + x)$

6) **The physical quantities are listed in Column 1 and the SI units are listed in Column 2. Identify the correct match.**

Column 1	Column 2
(i) Magnetic Flux	(a) henry
(ii) EMF	(b) weber
(iii) Mutual Inductance	(c) volt

a] i-b, ii-c, iii-a b] i-c, ii-b, iii-a c]i-c, ii-a, iii-b d] i-b, ii-a, iii-c

7) **In a transformer, the energy loss due to resistance of the windings of primary and secondary coils can be reduced by using**

a] laminated core b] ferromagnetic core

c] thicker wires for coils d]overlapped coils

8) **The electromagnetic waves that are used to kill germs in water purifiers are _**

a]Radio waves b] Microwaves

c] Infrared waves d] Ultraviolet rays

9) **The image formed by the objective of a compound microscope is ___**

a] real, inverted and diminished b] real, inverted and magnified

c] virtual, inverted and diminished d] virtual , inverted and magnified

10) **When a plane wavefront is passed through a convex lens, the shape of the refracted wavefront is _**

a]plane b] spherical c] cylindrical d] none of the above

11) **If an unpolarised light is passed through a polaroid sheet, the intensity of light coming out of the polaroid is**

a]same as the incident intensity b] two times the incident intensity

c] half of the incident intensity d] zero

12) **In the experiment of photoelectric effect, the photoelectric current depends on**

a] the intensity of incident light

b] the potential difference between the electrodes

c] nature of the emitter material d] all the above

13) **For an electron revolving around the nucleus.**

a] kinetic energy and potential energy are positive, total energy is negative.

b] kinetic energy is positive , potential energy and total energy are negative.

c] potential energy is negative , kinetic energy and total energy are positive.

d] kinetic energy and potential energy are negative, total energy is positive

14) **The radioactive decay in which a helium nucleus is emitted is called**

a] alpha decay b] gamma decay

c]negative beta decay d] positive beta decay

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15) **In an unbiased p-n-junction, holes diffuse from the p-region to n-region because**
a]free electrons in the n-region attract them
b] they move across the junction due to potential difference
c] hole concentration in p-region is more as compared to n- region
d] none of the above

II **Fill in the blanks by choosing appropriate answer given in the brackets for All the following questions.** **5x1=5**
((current , maximum, zero, mass, minimum, refraction)

16) When a bar magnet of dipole moment $\vec{m}$ is placed in a uniform magnetic field $\vec{B}$, the net force on the dipole is _____
17) The self-inductance of a coil is a measure of the inertia of the coil against the change of _____through it.
18) The power dissipated at resonance in series LCR circuit is _____
19) The bottom of a tank filled with water appears to be raised due to the phenomenon of light called _____
20) The de Brogli wavelength of a particle is inversely proportional to its _____

PART-B

III **Answer any FIVE of the following questions .** **5x2=10**
21) State and explain Gauss's law in electrostatics.
22) What is meant by dielectric strength? Mention its SI unit.
23) State Kirchhoff's junction rule. Mention the principle on which the junction rule is based.
24) A long straight wire carries a current of 35A. What is the magnitude of magnetic field at point 20cm from the wire?
25) State Faraday's law of electromagnetic induction.
Mention the law which gives the polarity of induced emf.
26) Define displacement current. Write the expression for displacement current.
27) What is ionization energy of an electron? Give its value for a hydrogen atom.
28) What is an intrinsic semiconductor? Which type of extrinsic semiconductor is obtained when an intrinsic semiconductor is doped with pentavalent impurity?

PART-C

IV **Answer any FIVE of the following questions .** **5x3=15**
29) Write any three properties of electric field lines.
30) Obtain the expression for potential energy of a system of two charges in absence of an external field.
31) Obtain an expression for the frequency of revolution of a charged particle moving in a uniform magnetic field.
32) List any three differences between diamagnetic and ferromagnetic materials.
33) A pair of adjacent coils has a mutual inductance of 1.5H. If the current in one coil changes from 0 to 20 A in 0.5s, estimate the induced emf.

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34) Write the Cartesian sign convention for mirrors.

35) Explain briefly the Hallwach's experimental observations on photoelectric effect.

36) Define (a) isotopes (b) isotones and (c) isobars

PART-D

V Answer any THREE of the following questions . 3x5=15

37) Define capacitance of a capacitor. Obtain the expression for capacitance of a parallel plate capacitor with air between the plates.

38) Derive an expression for the current through an external resistor when connected to a cell. Write the expression for the maximum current that can be drawn from the cell.

39) Obtain the expression for magnetic field at a point on the axis of a circular current loop.

40) (a) What is interference of light? 1

(b) Derive the expression for resultant amplitude when two coherent waves superpose to cause interference. 3

(c) Write the condition for constructive interference in terms of phase difference. 1

41) What is a rectifier? Describe with circuit diagram, the working of a semiconductor diode as a half-wave rectifier. Draw input and output waveforms.

VI Answer any TWO of the following questions . 2x5=10

42) A conducting sphere of radius 10cm has an unknown charge. (a) If the electric field at a point P 20 cm away from the center of the sphere is 1.5×10^3 N/C and directed radially inward, what is the net charge on the sphere? If a negative test charge of magnitude 1.5×10^{-9} C is placed at the point P, What is the magnitude and nature of the force experienced by the test charge?

43) The number density of free electrons in a copper conductor is estimated as $8.5 \times 10^{28} m^{-3}$. How long does an electron take to drift from one end of a wire 3.0m long to its other end? The area of cross section of the wire is $2.0 \times 10^{-6} m^2$ and it is carrying a current of 3.0A.

44) A sinusoidal voltage of peak value 283V and frequency 50Hz is applied to a series LCR circuit in which R= 3Ω , L=25.48mH, and C=796μF. Find (a) the impedance of the circuit (b) the phase difference between the voltage across the source and the current.

45) Double-convex lenses are to be manufactured from a glass of refractive index 1.6, with both faces of the same radius of curvature. What is the radius of curvature required if the focal length is to be 20cm? Also find the focal length of the lens when it is immersed in water of refractive index 1.33.

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