Delhi Public School, Howrah

PERIODIC TEST – II (2025-2026)

Class-XII

Care must be taken not to write anything on the question paper. All the questions must be attempted in the correct sequence.

SUBJECT: PHYSICS (CODE- 042)

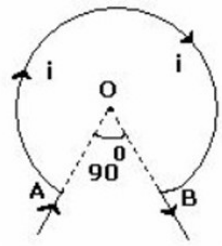
Time :- 3 Hours **F.M.-70**

General Instructions:

(1) There are 33 questions in all. All questions are compulsory.
(2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
(3) All the sections are compulsory.
(4) Section A contains sixteen questions, twelve MCQ and four assertion reasoning based of 1 mark each, Section B contains five questions of two marks each, Section C contains seven questions of three marks each, Section D contains two case study-based questions of four marks each and Section E contains three long answer questions of five marks each.
(5) There is no overall choice. However, an internal choice has been provided in two questions in Section B, one question in Section C and all three questions in Section E. You have to attempt only one of the choices in such questions.
(6) Use of calculators is not allowed.
(7) You may use the following values of physical constants where ever necessary.
i. $c = 3 \times 10^8$ m/s
ii. m_e = 9.1 x10-31 kg
iii. $e = 1.6 \times 10^{-19}$ C
iv. $\mu_0 = 4\pi \times 10^{-7}$ TmA^{-1}
v. h = 6.63 x10^{-34} Js
vi. $\varepsilon_0 = 8.854 \times 10^{-12}\ C^2N^{-1}m^{-2}$
vii. Avogadro's number = 6.023 X 10^{23} per gram mole

Q.NO.	SECTION - A	MARKS
1.	Gauss's law states that	1
	A. the total electric flux coming out of an open surface equals the net charge enclosed within the volume divided by ϵ_0.	
	B. the total electric flux coming out of any surface equals the charge enclosed within the volume divided by ϵ_0.	
	C. the total electric flux coming out of a closed surface in vacuum equals the net charge enclosed within the volume divided by ϵ_0.	
	D. the total electric flux coming out of a closed surface equals the net charge enclosed within the volume.	
2.	An electric field can deflect	1
	A. α-particle B. β rays C. γ rays D. Neutrons	
3.	The capacitance of a parallel plate capacitor is 5. When a glass slab of thickness equal to the separation between the plates is introduced between the plates, the potential difference reduces to 1/8 of the original value.	1
	The dielectric constant of glass is	
	A. 8 B. 5 C. 1.6 D. 40	

4. Consider the figure given below. The magnetic field at the centre of the circular coil of radius 1 cm and carrying current of 4 A is 1



A. $\frac{8\pi}{3}$ x 10^{-5} T B. $\frac{8\pi}{3}$ x 10^{-4} T C. 2π x 10^{-5} T D. 2π x 10^{-4} T

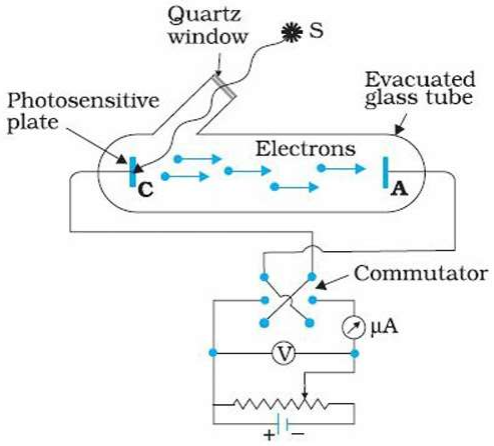
5. A proton enters a magnetic field of strength B (Tesla) with speed v, parallel to the direction of magnetic lines of force. The force on the proton is 1

A. evB/2 B. Infinite C. zero D. evB

6. Meter Bridge is used to 1

A. determine unknown emf e.
B. determine unknown voltage v.
C. determine unknown power P.
D. determine unknown resistance R.

7. Stopping potential in the experimental set up shown in the given figure is 1



A. positive potential V_0 given to the plate A for which the photocurrent stops or becomes zero.
B. positive potential V_0 given to the plate A for which the photocurrent stops increasing.
C. negative potential V_0 given to the plate A for which the photocurrent stops or becomes zero.
D. positive potential V_0 given to the plate A for which the photocurrent saturates.

8. A beam of light consisting of two wavelengths, 650 nm and 520 nm, is used to obtain interference fringes in a Young's double-slit experiment. 1

Find the ratio of fringe widths in the two cases provided the geometry of set up in two cases is same.

A. 1.47 B. 1.25 C. 1.37 D. 1.27

9. The instantaneous magnetic flux linked with a coil is given by $\emptyset = 5t^3 - 100t + 300$ Wb. 1

The EMF induced in the coil at time t = 2 second is

A. 140V B. 300V C. - 40V D. 40V

10. The ground state energy of hydrogen atom is –13.6 eV. What are the kinetic and potential energies of the electron in this state? 1

A. 13.6 eV, –27.2 eV
B. 14.6 eV, –27.2 eV
C. 14.6 eV, –29.2 eV
D. 13.1 eV, –29.2 eV

11. An aeroplane having a wingspan of 35m flies due north with the speed of 90 m/s. Given B = 4 x 10^{-5} T. The potential difference between the tips of the wings will be 1

A. 0.126 V B. 0.013 V C. 1.26 V D. 12.6 V

12. Which of the following transitions in a hydrogen emits the photon of the highest frequency? 1

A. n = 1 to n = 2
B. n = 6 to n = 2
C. n = 2 to n = 6
D. n = 2 to n = 1

For question numbers 13 to 16, two statements are given- one labeled as Assertion (A) and the other labeled as Reason (R). Select the correct answer to these questions from the codes A, B, C and D as given below.

A. Both A and R are true and R is the correct explanation of the A
B. Both A and R are true but R is NOT the correct explanation of A
C. A is true but R is false
D. Both A and R is false

13. **Assertion(A):** Two light sources emitting waves having zero or constant phase difference are known as coherent sources. 1

Reason(R): Two light sources emitting waves of similar wavelengths are coherent.

14. **Assertion (A):** Nuclear fusion requires extremely high temperatures to occur. 1

Reason (R): High temperatures provide the necessary kinetic energy to overcome the electrostatic repulsion between positively charged nuclei.

15. **Assertion(A):** The de-Broglie wavelength of electrons remains constant regardless of their accelerating voltage. 1

Reason(R): The de-Broglie wavelength is given by λ=h/c where c is the speed of light in vacuum.

16. **Assertion(A):** Images produced via total internal reflection are much brighter than those from lenses or mirrors. 1

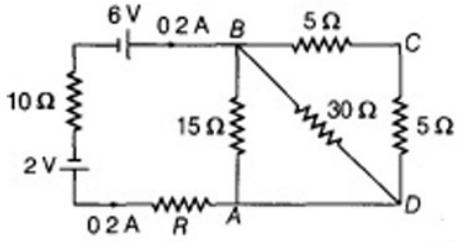
Reason(R): In total internal reflection, there's negligible loss of light intensity.

SECTION - B

17. A. Two uniformly large parallel thin plates having charge densities and are kept in the X Z- plane at a distance d apart. Sketch an equipotential surface due to electric field between the plates. 1+1
B. If a particle of mass m and charge q remains stationary between the plates. What is the magnitude and direction of this field?

18. A. Calculate the value of the resistance R in the circuit shown in the figure given below, so that the current in the circuit is 0.2A. 1+1

B. What would be the potential difference between points A and B?



19. A. Draw a diagram representing the behaviors of magnetic field lines for a (i) diamagnetic & (ii) paramagnetic substance. 1+1

B. Compare the values of magnetic susceptibilities for the above two materials.

20. (A) Two conducting wires X and Y of same diameter but different materials are joined in series across a battery. If the number density of electrons in X is twice than that in Y, then find the ratio of drift velocity of electrons in the two wires. 2

OR

20. (B) The number density of free electrons in a copper conductor is 8.5×10^{28} m^{-3}. How long does an electron take to drift from one end of a wire 3.0 m 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 3.0 A. 2

21. (A) Two identical loops, one of copper and the other of aluminium are rotated with the same angular speed in the same magnetic field. Compare – 1+1

(i) the induced emf and

(ii) the current produced in the two coils. Justify your answer.

OR

21. (B) Consider two concentric circular coils, one of radius r_1 and the other of radius $r_2 (r_1 < r_2)$ placed coaxially with centres coinciding with each other. Obtain the expression for the mutual inductance of the arrangement. 2

SECTION - C

22. A. Define magnetic dipole moment of a magnet and write its mathematical form. 1+1+1

B. What is its unit by taking into consideration the torque acting on it, when placed in magnetic field. Is it a vector or a scalar?

C. A short bar magnet placed with its axis at 30° with a uniform external magnetic field of 0.25 T experiences a torque of magnitude equal to 4.5×10^{-2} Nm. What is the magnitude of magnetic moment of the magnet?

23. A. State Gauss's law of magnetism. 1+1+1

B. From the above law find the magnetic flux linked with the sphere enclosing a current carrying solenoid.

C. Compare the magnetic field lines due to a current carrying solenoid and a bar magnet with a suitable diagram.

24. A. Calculate the radius of the first orbit of hydrogen atom. 2+1

B. Show that the velocity of electron in the first orbit is 1/137 times the velocity of light.

25. A. Draw the reflected wave front for a plane wave front incident on a plane reflecting surface. 1+2

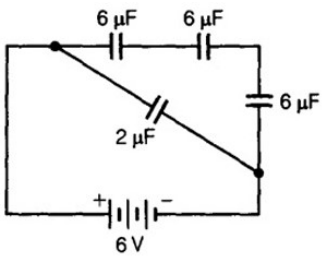
B. Verify the laws of reflection using Huygen's principle.

26. A. Write the relation between the radius and mass number of the nucleus. 1+1+1

B. Show that the density of the nucleus is independent of its mass number.

C. Two nuclei have mass numbers in the ratio 1: 8. What is the ratio of their nuclear radii?

27. (A) Four capacitors of values 6 µF, 6 µF, 6 µF and 2 µF are connected to a 6 V battery as shown in the figure. 1+2



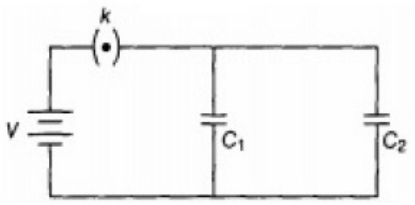
Determine –

I. The equivalent capacitance of the network.

II. The charge on each capacitor.

OR

27. (B) Two parallel plate capacitors of capacitances C_1 and C_2 such that $C_1 = 2C_2$ are connected across a battery of V volt as shown in the figure. Initially, the key (k) is kept closed to fully charge the capacitors. The key is now thrown open and a dielectric slab of dielectric constant K is inserted in the two capacitors to completely fill the gap between the plates. Find the ratio of 1+2



I. the net capacitance and

II. the energies stored in the combination before and after the introduction of the dielectric slab.

28. An electric dipole is placed in a uniform electric field E with its dipole moment p parallel to the field. Then find – 1.5+1.5

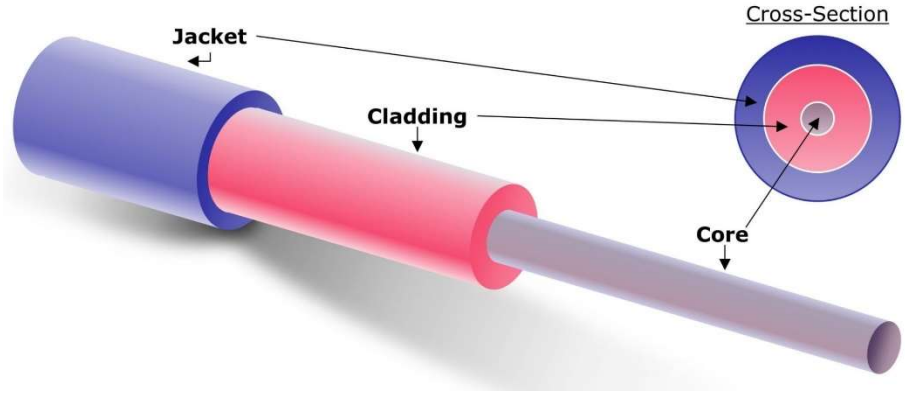
A. The work done in turning the dipole till its dipole moment points in the direction opposite to E.

B. The orientation of the dipole for which the torque acting on it becomes maximum.

SECTION – D

29. **Read the following passage and answer the questions based on that.**

Imagine a world where light carries your voice, your health data, and even secret quantum keys, all at the speed of innovation. That's the magic of optical fibres —thin strands of glass or plastic that use the principle of total internal reflection to transmit light signals over vast distances with remarkable clarity. From our phones to hospital wards, these tiny threads play colossal roles.



Such an optical fibre consists of a core with refractive index $n_1 = 1.5$ and cladding with refractive index $n_2 = 1.45$. A light ray enters the fibre from air at an angle θ with the fibre axis and undergoes multiple total internal reflections. The numerical aperture is calculated by the formula NA = $\sqrt{n_1^2 - n_2^2}$ .Assume the fibre is straight and losses are negligible.

i. The critical angle at the core–cladding interface is 1

A. 43° B. 75° C. 61° D. 42°

ii. How does the refractive index vary with radial distance from the axis? 1

A. Increases B. Decreases C. Remains constant D. Oscillates

iii. The numerical aperture (NA) of the fibre is 1

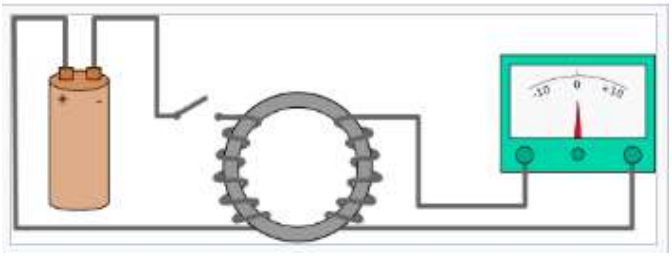
A. 0.39 B. 0.50 C. 0.55 D. 0.29

iv. If $n_1$increases while n_2 is constant, the numerical aperture (NA) will 1

A. Increase B. Decrease C. Remain same D. First increase then decrease

30. **Read the following passage and answer the questions based on that.**

Faraday's notebook on August 29, 1831 describes an experimental demonstration of induction. He wrapped two coils of wire around opposite sides of an iron ring, forming a primitive toroidal transformer. When he connected one coil to a battery, he observed a brief deflection in a galvanometer attached to the second coil. He concluded that a changing current in the first coil created a changing magnetic field in the ring, which in turn induced a current in the second coil. He described this as a "wave of electricity" propagated through the iron. Michael Faraday demonstrated that a changing magnetic field could indeed induce an electric current in a circuit. Lenz's law, formulated by Emil Lenz in 1834, describes "flux through the circuit", and gives the direction of the induced emf and current resulting from electromagnetic induction.



i. State Faraday's law of electromagnetic induction with mathematical equation explaining all the parameters. 2

ii. State Lenz's law. 1

iii. Do the phenomena of electromagnetic induction follow conservation of energy? Justify your answer. 1

SECTION - E

31. (A) (i) Define angle of deviation in a prism. 1+3+1

(ii) Obtain the relation $A+\delta = i+e$ for a prism where A is the angle of prism, δ is the angle of deviation, i is the angle of incidence and e is the angle of emergence.

(iii) Write the condition for minimum deviation.

OR

31. (B) (i) Equi-convex lenses are to be manufactured from a glass of refractive index 1.55, with both faces of the same radius of curvature. What is the radius of curvature required if the focal length is to be 10cm? 2+3

(ii) A compound microscope consists of an objective lens of focal length 0.82 cm and an eyepiece lens of focal length 2.9 cm. An object is placed 0.91 cm from the objective lens. The image is formed at the near point (25 cm) from the eye.

(a) Calculate the angular magnification of the microscope.

(b) Draw the ray diagram of compound microscope in normal adjustment.

32. (A) (i) State the working principle of a moving coil galvanometer with a properly labelled diagram. 2+2+1

(ii) If a galvanometer of resistance 49.5Ω has range of 0.05A, what will be the value of resistance needed to convert it into an ammeter of range 0-5A?

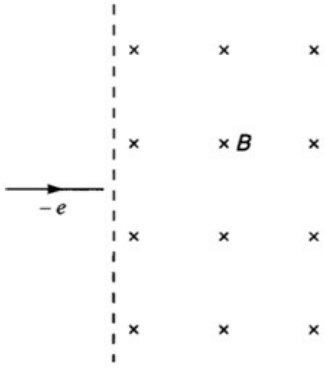
(iii) How should the above two resistors be connected to convert the galvanometer into an ammeter?

OR

32. (B) (i) Derive an expression for the magnetic force per unit length between two parallel, thin current - carrying wires. 2+1+2

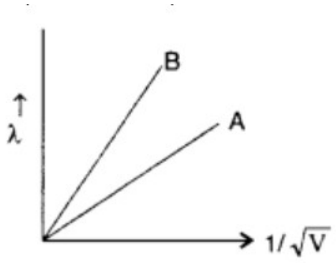
(ii) Define one ampere.

(iii) An electron moving horizontally with a velocity of 4 x 10^4 m/sec enters a region of uniform magnetic field of 10^{-5} T acting vertically upward as shown in the figure given below. Draw its trajectory and find out the time it takes to come out of the region of magnetic field.



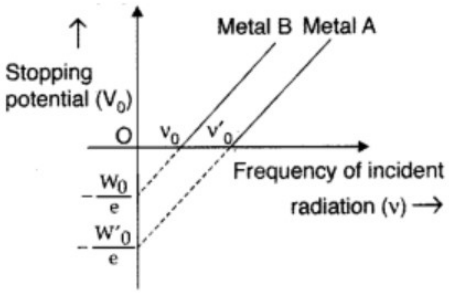
33. (A) (i) An electron and alpha particle have the same de-Broglie wavelength associated with them. How are their kinetic energies related to each other? 3+2

(ii) Two lines, A and B, in the plot given below show the variation of de-Broglie wavelength, λ versus $1/\sqrt{V}$, where V is the accelerating potential difference for two particles carrying the same charge. Which one of the two represents a particle of smaller mass?



OR

33. (B) (i) The graph given below shows the variation of stopping potential with frequency of incident radiation for two photosensitive metals A and B. Which one of the two has higher value of work-function? Justify your answer. 1+1+3



(ii) An electron is revolving around the nucleus with a constant speed of 2.2 × 10^8 m/s. Find the de-Broglie wavelength associated with it.

(iii) Write Einstein's photoelectric equation. State the three salient features observed in photoelectric effect, which can be explained on the basis of the above equation.