



Delhi Public School, Howrah

PERIODIC TEST- I (2024-2025)

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

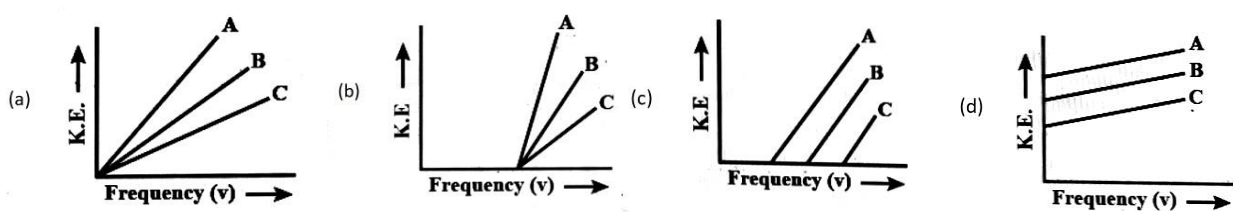
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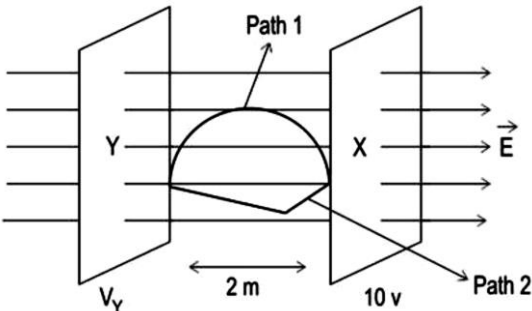
General Instructions:

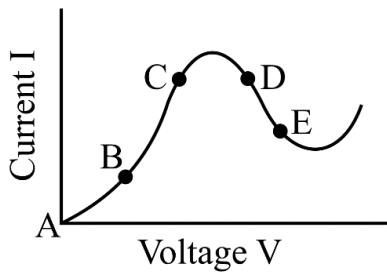
- (1) There are 33 questions in all. All questions are compulsory.
- (2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
- (3) All the sections are compulsory.
- (4) Section A contains sixteen questions, twelve MCQ and four Assertion Reasoning based of 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 one question in Section B, one question in Section C, one question in each CBQ in Section D 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. $m_e = 9.1 \times 10^{-31}$ kg
 - iii. $e = 1.6 \times 10^{-19}$ C
 - iv. $\mu_0 = 4\pi \times 10^{-7}$ TmA⁻¹
 - v. $h = 6.63 \times 10^{-34}$ Js
 - vi. $\epsilon_0 = 8.854 \times 10^{-12}$ C²N⁻¹m⁻²
 - vii. Avogadro's number = 6.023×10^{23} per gram mole

SECTION - A

1.	<p>In the figure, if net force on Q is zero then value of $\frac{q}{Q}$ is:</p> <p>(a) $\sqrt{2}$ (b) $2\sqrt{2}$ (c) $\frac{1}{2\sqrt{2}}$ (d) $\frac{1}{\sqrt{2}}$</p>	1
2.	<p>An electric dipole when placed in a uniform electric field E will have minimum potential energy, when the angle made by dipole moment with the electric field E is</p> <p>(a) π (b) $3\pi/2$ (c) zero (d) $\pi/2$</p>	1
3.	<p>A parallel plate capacitor is first charged and then a dielectric slab is introduced between the plates. The quantity that remains unchanged is</p> <p>(a) charge (b) energy (c) potential (d) capacitance</p>	1
4.	<p>A metallic plate exposed to white light emits electrons. For which of the following colours of light, the stopping potential will be minimum?</p> <p>(a) Blue (b) Yellow (c) Red (d) Violet</p>	1

5.	A parallel plate capacitor with air between the plates has a capacitance C . If the distance between the plates is doubled and the space between the plates is filled with a dielectric of dielectric constant 6, then the capacitance will become (a) $3C$ (b) $C/3$ (c) $12C$ (d) $C/6$	1
6.	Photoelectric emission is observed for three different metals A, B and C. The kinetic energy of the fastest photoelectrons versus frequency ' ν ' is plotted for each metal. Which of the following graphs shows the phenomenon correctly? 	1
7.	An astronomical telescope of ten-fold angular magnification has a length of 44 cm. The focal length of the objective is (a) 44 cm (b) 440 cm (c) 4 cm (d) 40 cm	1
8.	Yellow light is refracted through a prism producing minimum deviation. If i_1 and i_2 denote the angle of incidence and angle of emergence for the prism, then (a) $i_1 = i_2$ (b) $i_1 > i_2$ (c) $i_1 < i_2$ (d) $i_1 + i_2 = 90$	1
9.	A car battery of emf 12 V and internal resistance 5×10^{-2} ohm, receives a current of 60 A, from external source, then terminal potential difference of battery is (a) 12 V (b) 9 V (c) 15 V (d) 20 V	1
10.	The algebraic sum of all currents meeting at a point in an electrical circuit is (a) zero (b) infinite (c) positive (d) negative	1
11.	An optician prescribes spectacles to a patient with a combination of a convex lens of focal length 25 cm and a concave lens of focal length 40 cm. The power of the spectacles is (a) -6.5 D (b) -1.5 D (c) 1.5 D (d) 6.5 D	1
12.	In Young's double slit experiment, when two light waves form third minimum, they have (a) Phase difference of 3π (b) Path difference of 3λ (c) Phase difference of $5\pi/2$ (d) Path difference of $5\lambda/2$	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 are false	
13.	Assertion (A): Propagation of light through an optical fibre is due to total internal reflection taking place at the core-clade interface. Reason (R): Refractive index of the material of the core of the optical fibre is greater than that of cladding.	1
14.	Assertion (A): An electron has a higher potential energy when it is at a location associated with a negative value of potential and has a lower potential energy when at a location associated with a positive potential. Reason(R): Electrons move from a region of higher potential to a region of lower potential.	1
15.	Assertion (A): When tiny circular obstacle is placed in the path of light from some distance, a bright spot is seen at the centre of the shadow of the obstacle. Reason (R): Destructive interference occurs at the centre of the shadow.	1

16.	<p>Assertion (A): Kinetic energy of photo electrons emitted by a photosensitive surface depends upon the intensity of incident photon.</p> <p>Reason (R): The ejection of electrons from metallic surface is possible with frequency of incident photon below the threshold frequency.</p>	1
Section-B		
17.	Derive the expression of torque acting on an electric dipole placed in a uniform electric field. Draw the corresponding diagram with proper label.	2
18.	<p>In Young's experiment, the width of the fringes obtained with light of wavelength 6000 \AA is 2.0 mm. Calculate the fringe width if the entire apparatus is immersed in a liquid medium of refractive index 1.33.</p> <p style="text-align: center;">Or</p> <p>In Young's double slit experiment, the slits are 0.2mm apart and the screen is 1.5m away. It is observed that the distance between the central bright fringe and fourth dark fringe is 1.8 cm. Find the wavelength of light used.</p>	2
19.	Two copper wires, P and Q of the same area of cross-section are joined in parallel. The combination of wires is connected across a battery of potential difference V. If the length of the wires, P and Q are in the ratio 1:2, find the ratio of drift velocities of electrons in wires P and Q.	2
20.	A ray of monochromatic light passes through an equilateral glass prism in such a way that the angle of incidence is equal to the angle of emergence and each of these angles is $\frac{3}{4}$ times the angle of the prism. Determine the angle of deviation and the refractive index of the glass prism.	1+1
21.	<p>λ_α and λ_p are the wavelengths associated with a moving alpha particle and a proton respectively. Obtain the relation between velocities of the two particles for which,</p> <p>(a) $\lambda_\alpha > \lambda_p$</p> <p>(b) $\lambda_\alpha = \lambda_p$</p>	1+1
Section-C		
22.	<p>X and Y are two equipotential surfaces separated by a distance of 2 m in a uniform electric field of 10 V/m as shown below. Surface X has a potential of 10 V.</p>  <p>(a) Calculate the potential of surface Y.</p> <p>(b) What is the work done in moving a +2 C charge from surface Y to surface X along path 1? How will this work change when the charge is moved along Path 2? Give a reason for your answer.</p>	1+2
23.	<p>(a) A heating element is marked 210 V, 630 W. What is the value of the current drawn by the element when connected to a 210 V DC source?</p> <p>(b) Two electric bulbs P and Q have their resistances in the ratio of 1: 2. They are connected in series across a battery. Find the ratio of the power dissipation in these bulbs. Calculate the same if they are connected in parallel.</p>	1+2
24.	Obtain the formula for the electric field intensity due to a long thin wire of uniform linear charge density using Gauss's law.	3
25.	<p>(a) Two materials Si and Cu are cooled from 300 K to 60 K. What will be the effect on their resistivity?</p> <p>(b) Graph of current vs. voltage for a material GaAs is depicted below.</p>	1+2



- (i) Identify negative resistance region.
 (ii) Identify the region of graph where Ohm's law is obeyed.

26. (a) A tank is filled with water to a height of 12.5 cm. The apparent depth of a needle lying at the bottom of the tank is measured by a microscope to be 9.4 cm. What is the refractive index of water? If water is replaced by a liquid of refractive index 1.63 up to the same height, by what distance would the microscope have to be moved to focus on the needle again?
 (b) Suppose that the lower half of a concave mirror's reflecting surface is covered with an opaque (non-reflective) material. What effect will this have on the image of an object placed in front of the mirror?

2+1

27. How is the spacing between fringes in a double slit experiment affected if:
 (a) the slits separation is increased,
 (b) the colour of light used is changed from red to blue,
 (c) the whole apparatus is submerged in a oil of refractive index 1.2?
 Justify your answer in each case.

**1+1
+1**

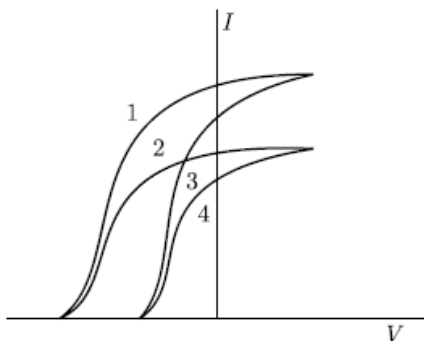
28. (a) Define the term "cut off frequency" in photoelectric emission.
 (b) The threshold frequency of a metal is f_0 . When the light of frequency $2f_0$ is incident on the metal plate, the maximum velocity of photoelectrons is v_1 . When the frequency of the incident radiation is increased to $5f_0$, the maximum velocity of photoelectrons is v_2 . Find the ratio $v_1 : v_2$.

3

Or

The graph given below shows the variation of photoelectric current (I) with the applied voltage (V) for two different materials and for two different intensities of the incident radiations.

3



- Identify and explain using Einstein's photoelectric equation for the pair of curves that correspond to
 (i) different materials but same intensity of incident radiation,
 (ii) different intensities but same materials.

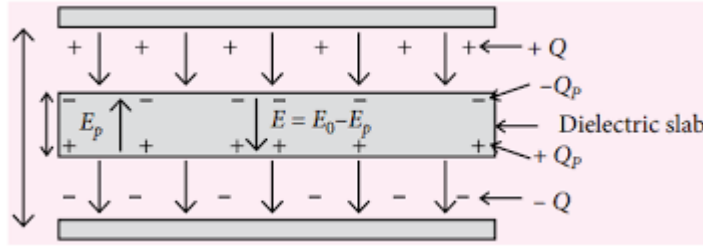
Section-D

Case Study Based Questions

Read the following paragraph and answer the questions that follow.

29. A dielectric slab is a substance which does not allow the flow of charges through it but permits them to exert electrostatic forces on one another.
 When a dielectric slab is placed between the plates, the field E_0 polarises the dielectric. This induces charge $-Q_p$ on the upper surface and $+Q_p$ on the lower surface of the dielectric. These induced charges set up a field E_p inside the dielectric in the opposite direction of E_0 as shown.

4

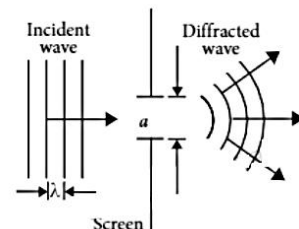


- (i) In a parallel plate capacitor, the capacitance increases from $4\mu\text{F}$ to $80\mu\text{F}$, on introducing a dielectric medium between the plates. What is the dielectric constant of the medium?
- 10
 - 20
 - 50
 - 100
- (ii) A parallel plate capacitor with air between the plates has a capacitance of 8 pF . The separation between the plates is now reduced half and the space between them is filled with a medium of dielectric constant 5. Calculate the value of capacitance of the capacitor in second case.
- 8 pF
 - 10 pF
 - 80 pF
 - 100 pF
- (iii) A dielectric introduced between the plates of a parallel plate condenser
- decreases the electric field between the plates
 - increases the charge stored in the condenser
 - decreases the capacity of the condenser
 - increases the capacity of the condenser
- (iv) A parallel plate capacitor of capacitance 1 pF has separation between the plates is d . When the distance of separation becomes $2d$ and wax of dielectric constant x is inserted in it the capacitance becomes 2 pF . What is the value of x ?
- 2
 - 4
 - 6
 - 8

Or

- (v) A parallel plate capacitor having area A and separated by distance d is filled by copper plate of thickness b . The new capacity is
- $\frac{\epsilon_0 A}{d + \frac{b}{2}}$
 - $\frac{\epsilon_0 A}{2d}$
 - $\frac{\epsilon_0 A}{d - b}$
 - $\frac{2\epsilon_0 A}{d + \frac{b}{2}}$

30. The phenomenon of bending of light around the sharp corners and the spreading of light within the geometrical shadow of the opaque obstacles is called diffraction of light. The light thus deviates from its linear path. The deviation becomes much more pronounced, when the dimensions of the aperture or the obstacle are compared to the wavelength of light.

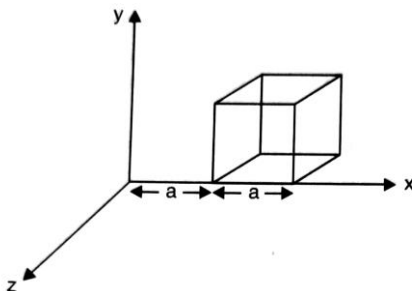


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- (i) Light seems to propagate in rectilinear path because
- Its spread is very large
 - Its wavelength is very small
 - Reflected from the upper surface of atmosphere
 - It is not absorbed by atmosphere
- (ii) In diffraction from a single slit the angular width of the central maxima does not depend on
- Wavelength of light used
 - Width of the slit
 - Distance of slits from the screen
 - Ratio of wavelength and slit width
- (iii) For a diffraction from a single slit, the intensity of the central point is
- Infinite
 - Finite and same magnitude as the surrounding maxima
 - Finite but much larger than the surrounding maxima
 - Finite and substantially smaller than the surrounding maxima
- (iv) In a single slit diffraction experiment, the width of the slit is made double its original width. Then, the central maxima on the diffraction pattern will become
- Narrower and fainter
 - Narrower and brighter
 - broader and fainter
 - broader and brighter
- Or
- (v) In a single diffraction pattern observed on a screen placed at D metre distance from the slit of width d metre, the ratio of the width of the central maxima to the width of other secondary maxima is
- 2:1
 - 1:2
 - 1:1
 - 3:1

Section-E

31. (a) Derive the expression of electric field intensity due to an electric dipole at a point on the perpendicular bisector of the dipole.
 (b) A cube with each side 'a' is kept in an electric field given by $\mathbf{E} = Cx \mathbf{i}$, (as is shown in the figure)



Where C is a positive dimensional constant. Find out –
 (i) the electric flux through the cube, and
 (ii) the net charge inside the cube

2+3

Or

- (a) Compare the electric fields due to a monopole (single charge) and a dipole. Draw the corresponding graphs of electric field with distance from for both of the cases
- (b) Show that the potential energy of a dipole making angle θ with the direction of the field is given by $u(\theta) = -\vec{p} \cdot \vec{E}$. Hence, find out the amount of work done in rotating it from the position of unstable equilibrium to the stable equilibrium.

2+3

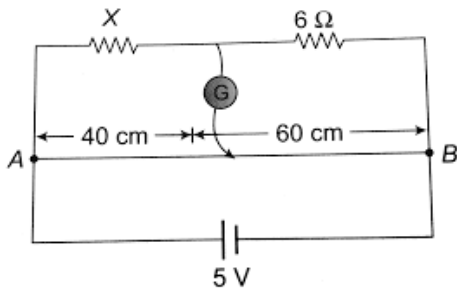
32. (a) Define the term drift velocity.
- (b) On the basis of electron drift, derive an expression for resistivity of a conductor in terms of number density of free electrons and relaxation time.
- (c) How will you explain increase in resistivity of a metal with increase of temperature in terms of electronic movement within it?
- (c) Why alloys like constantan and manganin are used for making standard resistors?

1+2
+1+
1

Or

- (a) State Kirchoff's laws of current electricity.
- (b) Use Kirchoff's laws to derive the condition for the balanced condition in a Wheatstone bridge in terms of four resistances of its arms.
- (c) Observe the circuit diagram of a meter bridge which is balanced as shown in figure below. Find the unknown resistance X.

1+2
+2



33. (a) Draw a neat labelled ray diagram of an astronomical telescope in normal adjustment.
- (b) An astronomical telescope may be a refracting type or a reflecting type. Which one will you prefer to use for observation of heavenly objects? Why?
- (c) The total magnification produced by a compound microscope is 20. The magnification produced by the eyepiece is 5. The microscope is focused on a certain object. The distance between the objective and eyepiece is observed to be 14 cm. If least distance of distinct vision is 20 cm. Calculate the focal length of the objective and the eyepiece?

1+2
+2

Or

- (a) Draw a ray diagram for the formation of image of a point object by a thin double convex lens having radii of curvature R_1 and R_2 . Hence derive lens maker's formula.
- (b) A converging lens of refractive index 1.5 has a power of 10 D. When it is completely immersed in a liquid, it behaves as a diverging lens of focal length 50 cm. Find the refractive index of the liquid.

3+2