



B.K. BIRLA CENTRE FOR EDUCATION

SARALA BIRLA GROUP OF SCHOOLS
A CBSE DAY-CUM-BOYS' RESIDENTIAL SCHOOL



TERM-1 EXAMINATION (2026-27)

PHYSICS (042) SET-1

Class: XII

Date: 31.08.26

Admission no:

Time: 3hrs

Max Marks: 70

Roll no:

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. $c = 3 \times 10^8 \text{ m/s}$ ii. $m_e = 9.1 \times 10^{-31} \text{ kg}$ iii. $e = 1.6 \times 10^{-19} \text{ C}$ iv. $\mu_0 = 4\pi \times 10^{-7} \text{ TmA}^{-1}$
v. $h = 6.63 \times 10^{-34} \text{ Js}$ vi. $\epsilon_0 = 8.854 \times 10^{-12} \text{ C}^2\text{N}^{-1}\text{m}^{-2}$ vii. Avogadro's number = 6.023×10^{23} per gram mole

SECTION-A

(16 Q X 1 M= 16 M)

1. The unit of electric field is:
(a) C/m (b) V/m (c) J/C (d) Both a and b
2. The potential at a point due to a point charge is inversely proportional to:
(a) Distance (b) Square of distance (c) Charge (d) Capacitance
3. Ohm's law is valid only when:
(a) Temperature remains constant (b) Current is zero
(c) Resistance is infinite (d) Voltage is zero
4. Magnetic field due to a long straight current-carrying wire is:
(a) Zero (b) Radial (c) Uniform (d) Circular

5. Two concentric and coplanar circular loops P and Q have their radii in the ratio 2:3. Loop Q carries a current 9 A in the anticlockwise direction. For the magnetic field to be zero at the common centre, loop P must carry
 - (a) 3A in clockwise direction
 - (b) 9A in clockwise direction
 - (c) 6A in anti-clockwise direction
 - (d) 6A in the clockwise direction.
6. Magnetic field lines are always:
 - (a) Open curves
 - (b) Closed curves
 - (c) Straight lines
 - (d) Intersecting at poles
7. Lenz's law is a consequence of:
 - (a) Conservation of energy
 - (b) Conservation of charge
 - (c) Newton's third law
 - (d) Coulomb's law
8. The average value of AC over one complete cycle is:
 - (a) Maximum
 - (b) Zero
 - (c) RMS value
 - (d) Peak value
9. In a pure inductive AC circuit, the current:
 - (a) Leads the voltage by 90°
 - (b) Lags the voltage by 90°
 - (c) Is in phase with the voltage
 - (d) Lags the voltage by 180°
10. Electromagnetic waves are:
 - (a) Longitudinal
 - (b) Transverse
 - (c) Both
 - (d) Neither
11. What happens to the frequency and the wavelength when light passes from a rarer to a denser medium?
 - (a) Wavelength remains unchanged but frequency changes
 - (b) They are independent
 - (c) Wavelength and frequency changes
 - (d) Wavelength changes but the frequency remain unchanged
12. The speed of the yellow light in a certain liquid is 2.4×10^8 m/s. Find the refractive index of the liquid.
 - (a) 6.25
 - (b) 5.73
 - (c) 1.25
 - (d) 9.73

For Questions 13 to 16, two statements are given –one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the options as given below.

- (a) If both Assertion and Reason are true and Reason is correct explanation of Assertion.
- (b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
- (c) If Assertion is true but Reason is false.
- (d) If Reason is true but Assertion is false.

13. **Assertion:** Electric lines of force never cross each other.
Reason: At any point, electric field has a unique direction.
14. **Assertion (A):** A galvanometer can be converted into an ammeter by connecting a low resistance (shunt) in parallel.
Reason (R): A high resistance in series increases the range properly.
15. **Assertion:** Induced current opposes the cause producing it.
Reason: This is in accordance with Lenz's law.

16. **Assertion:** The power in an ac circuit is minimum if the circuit has only a resistor.

Reason: Power of a circuit is independent of the phase angle.

SECTION-B

(5Q X 2 M= 10 M)

17. What will the force between two small spheres that have $2 \times 10^{-7} \text{ C}$ and $3 \times 10^{-7} \text{ C}$ be, if they are suspended in the air and have 30 cm of distance between them? 2
18. Draw equipotential surfaces for (i) an electric dipole and (ii) two identical positive charges placed near each other. 2
19. Derive the equation of the balanced state in a Wheatstone bridge using Kirchhoff's laws. 2
20. Electromagnetic waves with wavelength
- (i) λ_1 is suitable for radar systems used in aircraft navigation.
 - (ii) λ_2 is used to kill germs in water purifiers.
 - (iii) λ_3 is used to improve visibility in runways during fog and mist conditions.
- Identify and name the part of the electromagnetic spectrum to which these radiations belong. Also arrange these wavelengths in ascending order of their magnitude. 2
21. Draw the graph showing intensity distribution of fringes with phase angle due to diffraction through a single slit. What is the width of the central maximum in comparison to that of a secondary maximum?

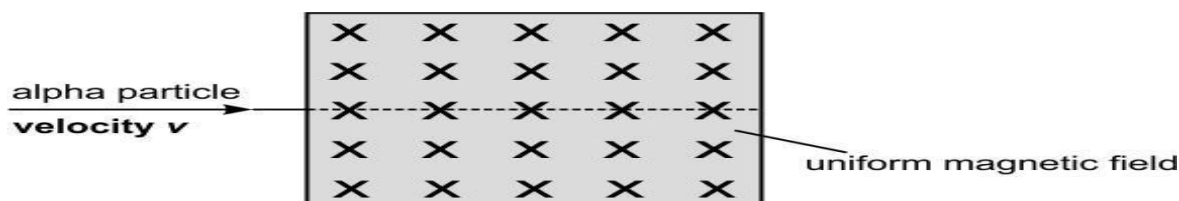
OR

Write two points of difference between an interference pattern and a diffraction pattern.

SECTION-C

(7Q X 3 M= 21 M)

22. Derive the expression for electric field due to a point charge. 3
23. An alpha particle is moving with a velocity v . It enters a magnetic field (B) as shown below. The magnetic field is perpendicular and into the plane of paper. 3



A uniform electric field is applied in the same region as the magnetic field so that the alpha particle passes un-deviated through the combined fields.

- (a) What should be the direction of the electric field?
- (b) Without any change in the electric and magnetic field, the alpha particle is replaced by the following particles:
- (i) proton moving with a velocity v
 - (ii) electron moving with a velocity $v/2$

Will there be any change a deviation in the path of the particles? Give a reason for your answer.

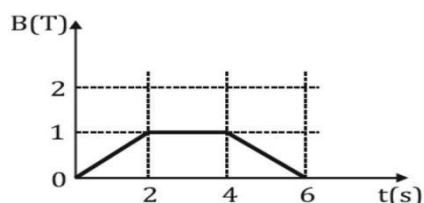
Or

Two long straight parallel conductors carrying currents I_1 and I_2 are separated by a distance d . If the currents are flowing in the same direction, show how the magnetic field produced by one

exerts an attractive force on the other. Obtain the expression for this force and hence define 1 ampere. 3

24. Find the stable and unstable potential energies for $m = 0.32 \text{ J T}^{-1}$ and $B = 0.15 \text{ T}$. 3

25. The magnetic field through a circular loop of wire, 12cm in radius and 8.5Ω resistance, changes with time as shown in the figure. The magnetic field is perpendicular to the plane of the loop. Calculate the current induced in the loop and plot a graph showing induced current as a function of time. 3

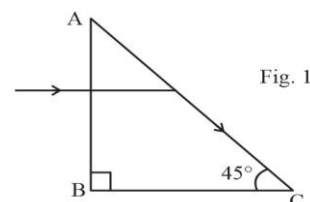


26. Identify the part of the electromagnetic spectrum which: 3

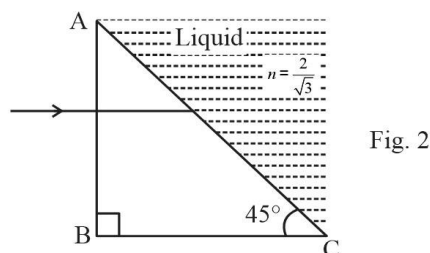
(a) is used in radar system, (b) is used for sterilisation, (c) is used for studying crystal structure. Write any one method of the production and detection of each of the above radiations.

(b) A light ray entering a right-angled prism undergoes refraction at the face AC as shown in Fig. 1.

27. What is the refractive index of the material of the prism in Fig. 1?



(a) If the side AC of the above prism is now surrounded by a liquid of refractive index $2/\sqrt{3}$ shown in Fig. 2, determine if the light ray continues to graze along the interface AC or undergoes total internal reflection or undergoes refraction into the liquid.



(b) Draw the ray diagram to represent the path followed by the incident ray with the corresponding angle values. (Given, $\sin^{-1}(\frac{\sqrt{2}}{\sqrt{3}}) = 54.6^\circ$)

28. 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. Distance between two slits is 2mm and screen is placed at distance 1.2 m from the plane of slits. Find the distance of the third bright fringe on the screen from the central maximum for wavelength 650 nm.

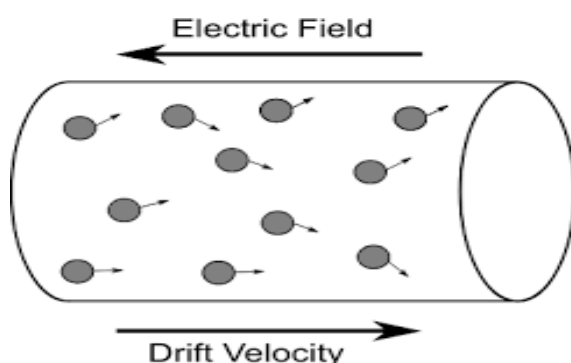
SECTION-D (Case Study Based Questions)

(2 Q X 4 M= 8 M)

29. Drift velocity is the average velocity of electrons in a conductor material due to an electric

field. In a conducting material, it is also proportional to the magnitude of an external electric field.

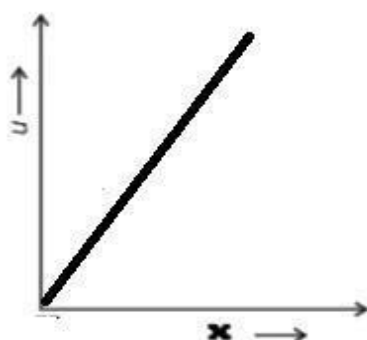
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- (i) The drift velocity of electrons in a conductor is 0.8 mm/s. The potential difference across a conducting wire is doubled keeping other factors constant. What is the value of new drift velocity? 1
 (a) 0.4mm/s (b) 0.64 mm/s (c) 1.6 mm/s (d) 0.2 mm/s
- (ii) How would be the current density of a conductor get affected when the potential difference is tripled keeping other factors constant. 1
 (a) Doubled (b) halved (c) no change (d) tripled
- (iii) Two conducting wires of the same material, radii in the ratio 1:2 and lengths in the ratio 2:3 are connected in series to a battery of emf 5V. What is the ratio of the drift velocities of electrons in the two wires? 1
 (a) 4:1 (b) 1:3 (c) 2:3 (d) 4:3
- (iv) A current of 3.2 A, flows through a conducting wire of number density 10^{28} m^{-3} and cross sectional area 10^{-6} m^2 . The drift velocity of electrons in the wire is 1
 (a) 4 mm/s (b) 2 mm/s (c) 1mm/s (d) 0.5 mm/s

Or

(iv) The following is the graph between a drift velocity of electrons in a conductor and a physical quantity X. Identify the quantity.



- (a) Current (b) Area of cross section (c) number density (d) length of conductor

30. Case Study: Read the following paragraph and answer the questions.

A number of optical devices and instruments have been designed and developed such as periscope, binoculars, microscopes and telescopes utilising the reflecting and refracting

properties of mirrors, lenses and prisms. Most of them are in common use. Our knowledge about the formation of images by the mirrors and lenses is the basic requirement for understanding the working of these devices. Compound microscope and telescope are designed by using two coaxial convex lenses of different focal lengths, one of the lenses is objective lens and the other one is eye lens. Eye lens acts as simple microscope and there are two cases of image formation in both. Telescope is of two type refracting type and reflecting type in reflecting type objective lens is replaced by concave mirror.

- (a) What is the role of objective lens in a compound microscope and telescope? 1
- (b) What do you understand by tube length of telescope? 1
- (c) Write two advantages of using reflecting telescope. 1
- (d) Draw the ray diagram of image formation by reflecting type telescope. 1

OR

- (d) Draw the ray diagram of image formation by refracting type telescope. 1

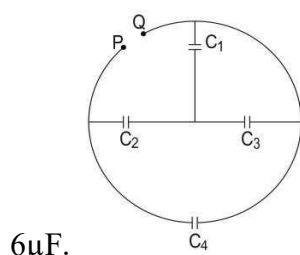
SECTION-E

(3 Q X 5 M= 15 M)

31. Derive the expression for potential due to a uniformly charged spherical shell (i) outside the surface of the shell, (ii) at the surface of the shell, (iii) inside the shell. Draw the potential, distance graph. 5

Or

- (a) Find the effective capacitance between points P and Q, if each capacitor has a capacitance of



- (b) Find the ratio of charges on capacitors C_1 and C_4 , if the potential difference between points P and Q is 10 V.

32.

- (a) Draw graphs showing the variations of inductive reactance and capacitive reactance with frequency of applied ac source. 5
- (b) Draw the phasor diagram for a series LRC circuit connected to an AC source.
- (c) When an alternating voltage of 220V is applied across a device X, current of 0.25A flows which lags behind the applied voltage in phase by $\pi/2$ radian. If the same voltage is applied across another device Y, the same current flows but now it is in phase with the applied voltage.
 - (i) Name the devices X and Y.
 - (ii) Calculate the current flowing in the circuit when the same voltage is applied across the series combination of X and Y.

Or

- (a) A series LCR circuit is connected to an ac source. Using the phasor diagram, derive the expression for the impedance of the circuit.

- (b) Plot a graph to show the variation of current with frequency of the ac source, explaining the nature of its variation for two different resistances R_1 and R_2 ($R_1 < R_2$) at resonance.

33. (a) Draw a schematic diagram of refraction at spherical surface and using it find the relation between object distance, image distance and refractive indices in terms of radius of curvature.
(b) Double-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 20 cm?

OR

- (a) A beam of light converges at a point P. Now a lens is placed in the path of the convergent beam 12 cm from P. At what point does the beam converge if the lens is a convex lens of focal length 20 cm.
(b) A small telescope has an objective lens of focal length 144 cm and an eyepiece of focal length 6.0 cm. What is the magnifying power of the telescope? What is the separation between the objective and the eyepiece?

-----ALL THE BEST-----