B.K. BIRLA CENTRE FOR EDUCATION

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

PREBOARD-III EXAMINATION (2025-26)

PHYSICS (042) (SET-II)

Class: XII **Time: 3hrs**
Date: 15.01.26 **Max Marks: 70**
Admission no: **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. $c = 3 \times 10^8$ 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. $\varepsilon_0 = 8.854 \times 10^{-12}$ $C^2N^{-1}m^{-2}$ vii. Avogadro's number = 6.023×10^{23} per gram mole

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SECTION-A (16 Q X 1 M= 16 M)

1. An α- particle accelerated through V volt is projected towards a nucleus. Its distance of closest approach is r. If a proton accelerated through the same potential is projected towards the same nucleus, the distance of closest approach of proton will be
   (a) r (b) 2r (c) r/2 (d) r/4
2. The ratio of the longest wavelength of the Lyman series to the longest wavelength of the Balmer series of the hydrogen spectrum is
   (a) 9:31 (b) 7:29 (c) 5:27 (d) 3:23
3. A photo electric surface is illuminated successively by monochromatic light of wavelength λ and λ/2 . If the maximum kinetic energy of the emitted photoelectrons in the second case is 3 times that in the first case, the work function of the surface of the material is;
   (a) hc/3λ (b) hc/2λ (c) hc/λ (d) 2hc/λ
4. Two point charges +4q and +q are kept at a distance of 30 cm from each other. At which point between them, the field intensity will be equal to zero?
   (a) 15cm away from the +4q charge (b) 20cm away from the +4q charge
   (c) 7.5cm away from the +q charge (d) 5cm away from the +q charge

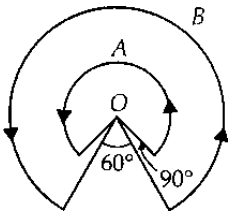
5. The electric potential in a certain region of space is given by $V=-8x^2+4x$, where V is in volt and x is in metre. In this region, the equipotential surfaces are

   (a) planes parallel to y-z plane (b) planes parallel to x-axis

   (c) concentric circles centered at the origin (d)concentric cylinders with axes parallel to y-axis

6. A wire A, bent in the shape of an arc of a circle, carrying a current of 2A and having radius 2cm and another wire B, also bent in the shape of an arc of a circle, carrying current of 3A and having radius of 4cm, are placed as shown in figure. The ratio of magnetic fields due to the wires A and B at the common centre 'O' is:

   (a) 4 : 6 (b) 6 : 4 (c) 6 : 5 (d) 2 : 5



7. An iron rod of volume $10^{-3}\ m^3$ and relative permeability 1000 is placed as core in a solenoid with10 turns /cm. If a current of 0.5A is passed through the solenoid, then the magnetic moment of the rod will be approximately

   (a) $5 \times 10^2\ Am^2$ (b) $0.5 \times 10^2\ Am^2$ (c) $500 \times 10^2\ Am^2$ (d) $50 \times 10^2\ Am^2$

8. A long solenoid of diameter 0.1m has 2×10^4 turns per metre. At the centre of the solenoid, a coil of 100 turns and radius 0.01m is placed with its axis coinciding with the solenoid axis. The current in the solenoid reduces at a constant rate to 0A from 4A in 0.05s. If the resistance of the coil is $10\ \pi^2\ \Omega$, the total charge flowing through the coil during the time is

   (a) $320\mu C$ (b) $16\mu C$ (c) $32\mu C$ (d) $160\mu C$

9. A magnet is moved towards a coil (i) quickly (ii) slowly, then the induced e.m.f. is

   (a) larger in case (i) (b) smaller in case (i)

   (c) equal to both the cases (d) larger or smaller depending upon the radius of the coil

10. The condition under which a microwave oven heats up a food item containing water molecules most efficiently, is

    (a) The frequency of the microwaves must match the resonant frequency of the water molecules.

    (b) The frequency of the microwaves has no relation with natural frequency of water molecules.

    (c) Microwaves are heat waves, so always produce heating.

    (d) Infrared waves produce heating in a microwave oven.

11. Two point charges placed at a certain distance r in air exert a force F on each other. Then the distance r′ at which these charges will exert the same force in a medium of dielectric constant k is given by;

    (a)r (b) r/k (c) $(\sqrt{r})\ /\ k$ (d) $r/(\sqrt{k})$

12. In a circuit L, C & R are connected in series with an alternating voltage source of frequency f. The current leads the voltage by 45°. The value of C is:

    (a) $1/\pi f(2\pi f_L - R)$ (b) $1/2\pi f(2\pi f_L - R)$ (c) $1/\pi f(2\pi f_L + R)$ (d) $1/2\pi f(2\pi f_L + R)$

For questions 13 to 16, two statements are given-one labelled Assertion (A) and the other labelled 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 A

(b) Both A and R are true and R is NOT the correct explanation of A

(c) A is true but R is false

(d) A is false and R is also false

13. Assertion: Within some range of electric field pure semiconductors obey Ohm's law.
Reason: At higher electric field, current doesn't vary linearly with potential difference.

14. Assertion: A lens of short focal length can be used as magnifying glass.
Reason: The angular magnification produced in relaxed eye viewing is one less than the maximum angular magnification produced by magnifying glass.

15. Assertion: As work function of a material increases by some mechanism, it requires greater energy to excite the electrons from its surface.
Reason: A plot of stopping potential (Vs) versus frequency (ν) for different materials, has greater slope for metals with greater work functions.

16. Assertion: The space-charge region on either side of the junction together is known as depletion region.
Reason: During the formation of p-n junction due to the concentration gradient across p and n-sides of the junction, holes diffuse from n-side to p-side and electrons diffuse from p-side to n-side.

SECTION-B (5 Q X 2 M= 10 M)

17. In a YDSE setup, the fringe pattern is seen on a screen placed at distance D. The slits are separated by a distance d and are illuminated by light of wavelength λ. Find the least distance from the central maximum where the intensity falls to half of the maximum intensity.

OR

A prism is set for minimum deviation for a light of wavelength λ_1. The angle of minimum deviation δ_m in this case is equal to the angle of prism. When the prism is set for minimum deviation for light of another wavelength λ_2, the angle of minimum deviation is 30^o. The refractive index of the prism for λ_1 is $\sqrt{3}$. Find the refractive index of the prism for light of wavelength λ_2.

2

18. Draw the transversal nature of electromagnetic waves showing components of its electric field and magnetic field components. 2

19. Show how magnetic field lines behave in the presence of paramagnetic and diamagnetic substances using diagrams. What is the best way to describe this unique feature? 2

20. An electron and a photon both have wavelength of 1nm. What is the ratio of energy of photon to kinetic energy of electron? 2

21. Stat any two characteristic features in photoelectric effect which cannot be explained on the basis of wave theory of light. 2

SECTION-C (7 Q X 3 M= 21 M)

22. Derive an expression for the force per unit length between two infinitely long parallel current carrying conductors. Hence define SI unit of electric current. 3

23. (a) State Bohr's postulate that gives the quantisation condition for stable orbits in hydrogen atom. Justify it using de Broglie's hypothesis.

(b) The electron in hydrogen atom is initially in the third excited state. What is the maximum

number of spectral lines which can be emitted when it finally moves to the ground state? 3

24. Explain, with the help of circuit diagram, the working of a full wave rectifier. Write relation of its output frequency with input frequency. 3
25. Two charges -3q and q are placed fixed on the x-axis separated by distance,'d'. Where a third charge 2q should be placed such that it will not experience any force? 3
26. A metallic rod of 'L' length is rotated with angular frequency of 'ω' with one end hinged at the centre and the other end at the circumference of a circular metallic ring of radius L, about an axis passing through the centre and perpendicular to the plane of the ring. A constant and uniform magnetic field B parallel to the axis is present everywhere. Deduce the expression for the emf between the centre and the metallic ring. 3
27. (i) Monochromatic light of frequency 6.0×10^{14} Hz is produced by a laser. The power emitted is 2.0×10^{-3} W. Estimate the number of photons emitted per second on an average by the source.
(ii) Draw a plot showing the variation of photoelectric current versus the intensity of incident radiation on a given photosensitive surface.

OR

The Kinetic Energy (K.E.), of a beam of electrons, accelerated through a potential V, equals the energy of a photon of wavelength 5460 nm. Find the de Broglie wavelength associated with this beam of electrons.

28. Draw a graph showing the variation of binding energy per nucleon with mass number for different nuclei. State with reason why light nuclei usually undergo nuclear fusion. What characteristic property of nuclear force explains the constancy of binding energy per nucleon in the range of mass number A lying between 30 and 170?

SECTION-D (2 Q X 4 M= 8 M)

29. Case Study :

Read the following paragraph and answer the questions.

A compound microscope is an optical instrument used for observing highly magnified images of tiny objects. Magnifying power of a compound microscope is defined as the ratio of the angle subtended at the eye by the final image to the angle subtended at the eye by the object, when both the final image and the object are situated at the least distance of distinct vision from the eye. It is given as $m = m_e m_o$ where m_e is the magnification produced by the eye lens and m_o is the magnification produced by the objective lens.

Consider a compound microscope that consists of an objective lens of focal length 2.0 cm and an eyepiece of focal length 6.25 cm separated by a distance of 15 cm.

(i) The object distance for eye-piece, so that final image is formed at the least distance of distinct vision, will be

(a)3.45 cm (b) 5 cm (c) 1.29 cm (d) 2.59 cm

(ii) How far from the objective should an object be placed to obtain final image at the least distance of distinct vision?

(a) 4.5 cm (b) 2.5 cm (c) 1.5 cm (d) 3.0 cm

(iii) What is the magnifying power of microscope in this case?

(a) 20 (b) 30 (c) 40 (d) 50

(iv) The intermediate image formed by the objective of a compound microscope is

(a) real, inverted and magnified (b) real, erect and magnified

(b) virtual,erect and magnified (d) virtual, inverted and magnified

OR

(iv)The magnifying power of compound microscope increases with

(a) the focal length of objective lens is increased and that of eye lens is decreased

(b) the focal length of objective lens is decreased and that of eye lens is increased

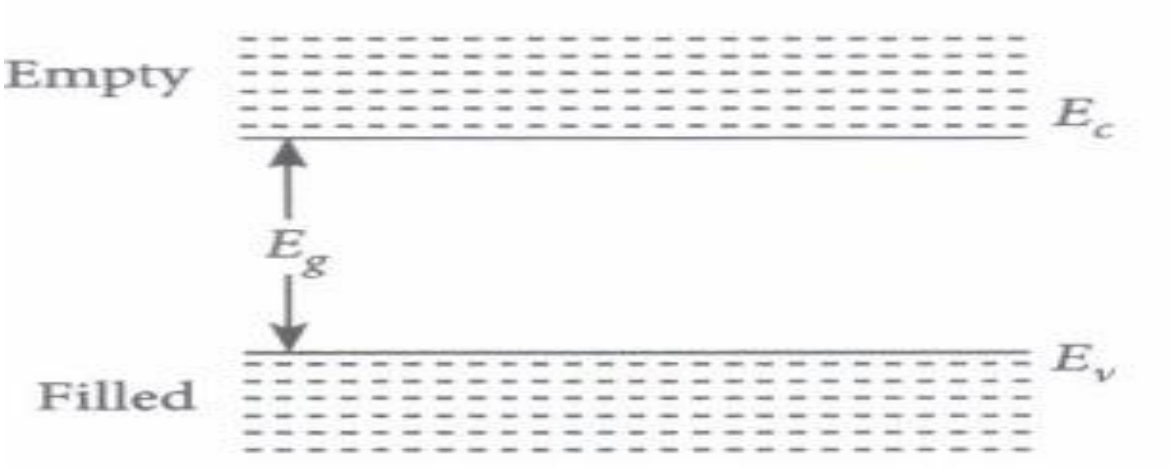
(c)the focal length of both objective lens and of eye lens is increased

(d) the focal length of both objective lens and of eye lens is decreased

30. Case study: Light emitting diode.

Read the following paragraph and answer the questions:

From Bohr's atomic model, we know that the electrons have well defined energy levels in an isolated atom. But due to interatomic interactions in a crystal, the electrons of the outer shells are forced to have energies different from those in isolated atoms. Each energy level splits into a number of energy levels forming a continuous band. The gap between top of valence band and bottom of the conduction band in which no allowed energy levels for electrons can exist is called energy gap.



(i) What is the energy band gap in insulators? 1

(ii) Explain the effect of biasing on energy band gap of semiconductor. 1

(iii) Carbon, silicon and germanium have four valence electrons each. At room temperature, explain the order of conducting nature of these element. 2

OR

(iii) Draw V-I characteristic of a p-n junction diode in

(a) forward bias and (b) reverse bias

SECTION-E (3 Q X 5 M= 15 M)

31. (a) State Huygens principle.

(b) A plane wave front is incident obliquely from denser to a rarer medium. Draw suitable Huygens construction for the same and hence deduce the Snell's law of refraction

(c) Also show using the above that the frequency of the wave does not change with change in the medium

OR

(a) Draw a labeled diagram of compound microscope when final image is formed at least distance of distinct vision.

(b) A compound microscope consists of an objective lens of focal length 2.0 cm and an eyepiece of focal length 6.25 cm separated by a distance of 15 cm. How far from the objective should an object be placed in order to obtain the final image at:

(i) The least distance of distinct vision (25 cm)?

(ii) Infinity? What is the magnifying power of the microscope in each case?

32. (a) A camera usually operates at 1.5 V and this potential difference is not sufficient to emit light energy using flash. For this purpose, the flash circuit of the camera has a capacitor that is charged to 300 V-330 V using various electrical components. If the voltage generated across the plates of the capacitor is 300 V and the capacitance of the parallel plate capacitor used is 100 μF, then find the energy released when the trigger button on the camera is pressed. 5

(b) How much charge does the 100 μF capacitor charged to 300 V hold?

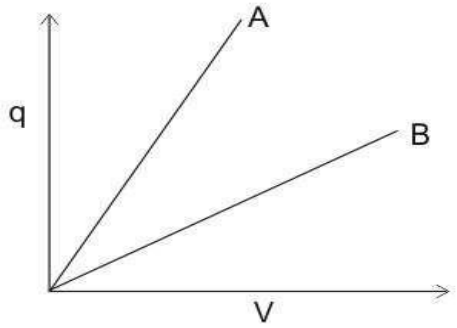
(c) If the distance between the parallel plate capacitor of capacitance 100 μF is increased two times, then calculate the capacitance of the capacitor. (d)

The graph below shows the variation of charge 'q' with potential difference 'V' for a parallel plate capacitor 'C' for scenarios P and Q.

Scenario P - the space between the capacitor 'C' is filled with air.

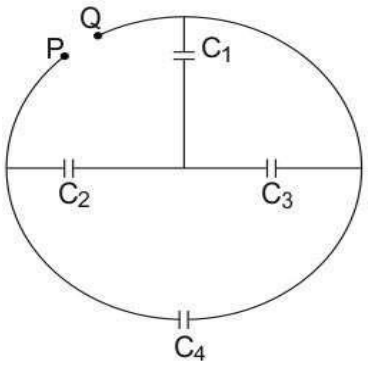
Scenario Q - the space between the capacitor 'C' is filled with a substance of dielectric constant K.

Which of the two lines A or B corresponds to scenario Q? Give a reason for your answer.



OR

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



6μF.

(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.

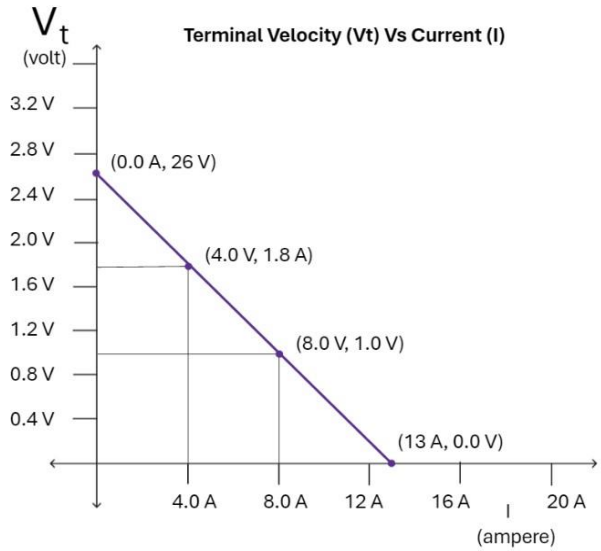
33. (a) Explain why the resistivity of metals increase with temperature while that of semiconductors decrease with temperature

(b) Two cells are connected in parallel. The emf's and internal resistances of the two cells are given as $(\varepsilon_1, r_1) = (3.0\,V, 0.1\Omega)$ and $(\varepsilon_2, r_2) = (2.0\,V, 0.2\,\Omega)$. Calculate the effective internal resistance and effective emf of the battery.

(c) A graph of the potential difference across a cell is plotted as a function of the current drawn from it. Answer the following:

(i) Determine the emf of the cell.

(ii) Determine the internal resistance of the Cell.



OR

(a) Write two limitations of ohm's law. Plot their I-V characteristics.

(b) A heating element connected across a battery of 100 V having an internal resistance of 1 Ω draws an initial current of 10 A at room temperature 20.0 °C which settles after a few seconds to a steady value. What is the power consumed by battery itself after the steady temperature of 320.0 °C is attained? Temperature coefficient of resistance averaged over the temperature range involved is 3.70×10^{-4} °C^{-1}. 5

ALL THE BEST