B2E Learning

Regd. Office **:** Narayan Chamber, 501-F, Gopalpura Bypass Rd, Surya Nagar, Jaipur, Rajasthan 302018

Sample Paper 3

Class- XII Exam - 2022-23

PHYSICS

Time : 3 Hours **Maximum Marks : 70**

General Instructions :

(1) There are 35 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. All the sections are compulsory.

(3) Section A contains eighteen MCQ of 1 mark each, Section B contains seven questions of two marks each, Section C contains five questions of three marks each, section D contains three long questions of five marks each and Section E contains two case study based questions of 4 marks each.

(4) There is no overall choice. However, an internal choice has been provided in section B, C, D and E. You have to attempt only one of the choices in such questions.

(5) Use of calculators is not allowed.

SECTION-A

Q1. A polaroid is used to **(1)**

(a) reduce intensity of light (b) produce polarised light

(c) increase intensity of light (d) produce unpolarised light

Q2. A strong argument for the particle nature of cathode rays is that they **(1)**

(a) cast shadow (b) produce fluorescence

(c) travel through vacuum (d) get deflected in magnetic field

Q3. A radioactive substance emits **(1)**

(a) α-rays (b) β-rays

(c) γ-rays (d) all of these

Q4. The torque acting on electric dipole of dipole moment $\vec{P}$ placed in electric field of intensity $\vec{E}$ is **(1)**

(a) $\vec{P} \times \vec{E}$ (b) $\vec{P} \cdot \vec{E}$

(c) pE (d) $\vec{P} / \vec{E}$

Q5. A 10 μF capacitor is charged to a potential difference 50 V and it is then connected to another uncharged capacitor in parallel. If common potential difference becomes 20 V, then capacitance of the second capacitor is **(1)**

(a) 10μ F (b) 15μ F

(c) 20μ F (d) 30μ F

Q6. If a bar magnet of length 10 cm and pole strength 40 A-m is placed at an angle of 30° in a uniform magnetic field of intensity 2×10^{-4} T, then torque acting on it is **(1)**

(a) 8×10^{-4} N-m (b) 6×10^{-4} N-m
(c) 4×10^{-4} N-m (d) 2×10^{-4} N-m

Q7. In a circuit with a coil of resistance 2Ω, the magnetic flux changes from 2 Wb to 10 Wb in 0.2 s. The charge that flows in the coil during this time is **(1)**

(a) 5 C (b) 4 C
(c) 1 C (d) 0.8 C

Q8. Reactance of a capacitor of capacitance C for an alternating current of frequency $\frac{400}{\pi}$ Hz is 25Ω. The value of C is **(1)**

(a) 25μ F (b) 50μ F
(c) 75μ F (d) 100μ F

Q9. In an oscillating LC-circuit, effective inductance is 200μ H. If frequency of oscillation is 1200 kHz, then capacitance of capacitor in the circuit is **(1)**

(a) 11 pF (b) 22 pF
(c) 44 pF (d) 88 pF

Q10. The magnifying power of a magnifying glass of power 12 dioptre is **(1)**

(a) 4 (b) 1200
(c) 3 (d) 25

DIRECTION : (Q11-Q14) Fill in the blanks with appropriate answer.

Q11. ..... spectrum is also called molecular spectrum. **(1)**

Q12. According to classical theory, the path of an electron in Rutherford's atom is ..... . **(1)**

Q13. If the current gain in common-emitter is 100, then the emitter current in a transistor for a base current of 5 mA, is ..... mA. **(1)**

Q14. The pressure exerted by an electromagnetic wave of intensity I on a non-ref ecting surface is (where c= Velocity of light) ..... . **(1)**

DIRECTION : (Q15-Q18) Answer the following:

Q15. The force $\vec{F}$ experienced by a particle of charge q moving with velocity $\vec{v}$ in a magnetic field $\vec{B}$ is given by $\vec{F} = q(\vec{v} \times \vec{B})$. Which pair of vectors is always at right angles to each other? **(1)**

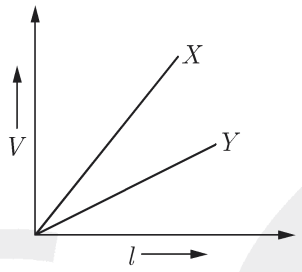
Q16. What is the relationship between amplitudes of electric and magnetic fields in free space? **(1)**

Q17. Find the ratio of De-Broglie wavelengths associated with electrons accelerated through 25V and 36 V . **(1)**

Q18. Why is it said that nuclear forces are saturated forces? **(1)**

SECTION B

Q19. The variation of potential deference V with length in case of two potentiometers X and Y is as shown in the given diagram. Which one of these two, you prefer for comparing e.m.f's of two cells and why? **(2)**



Q20. Draw a sketch of a plane electromagnetic wave propagating along the Z-direction. Depict clearly the directions of electric and magnetic fields varying sinusoidally with Z. **(2)**

Q21. What is (1) momentum and (2) energy of photon of wavelength 0.01Å? **(2)**

Q22. When a capacitor is connected in series LR circuit, the alternating current flowing in the circuit increases. Explain why? **(2)**

Q23. A short bar magnet placed with its axis at $30°$ to a uniform magnetic field of $0.2\,T$ experiences a torque of $0.060\ \text{Nm}$.

1. Calculate magnetic moment of the magnet
2. Find out what orientation of the magnet corresponds to its stable equilibrium in the magnetic field. **(2)**

Q24. Deduce ohm's law using the concept of drift velocity **(2)**

OR

Derive an expression for the internal resistance of a cell in terms of e.m.f and terminal potential difference of a cell. **(2)**

Q25. Prove that the radius of the nth Bohr orbit of an atom is directly proportional to n^2, where n is principal quantum number. **(2)**

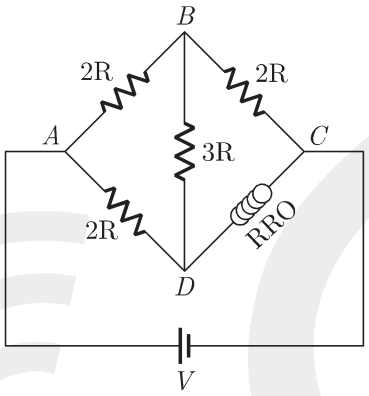
OR

Draw a graph showing the variation of binding energy per nucleon with mass number. Hence, from the graph, explain why elements having mass number A between 30 and 170 have almost same binding energy. **(2)**

SECTION C

Q26. (i) Use Kirchhoff's rules to obtain the balance condition in a Wheatstone bridge.

(ii) Calculate the value of R in the balance condition of the Wheatstone bridge, if the carbon resistor connected across the arm CD has the colour sequence red, red and orange, as is shown in the figure. **(3)**



Q27. A long straight wire AB carries a current of $4\ \text{A}$. A proton P travels at $4 \times 10^6\ \text{m/s}$ parallel to the wire $0.2\ \text{m}$ from it and in a direction opposite to the current. Calculate the force which the magnetic field of current exerts on the proton. Also specify the direction of the force. **(3)**

Q28. For a single slit of width "a", the f rst minimum of the interference pattern of a monochromatic light of wavelength λ occurs at an angle of λ/a. At the same angle of λ/a, we get a maximum for two narrow slits separated by a distance "a" Explain. **(3)**

Q29. (i) Depict the equipotential surfaces for a system of two identical positive point charges placed a distance d apart.

(ii) Deduce the expression for the potential energy of a system of two point charges q_1 and q_2 brought from inf nity to the points with positions r_1 and r_2 respectively in presence of external electric field E. **(3)**

OR

A slab of material of dielectric constant K has the same area as that of the plates of a parallel plate capacitor but has the thickness $2d/3$, where d is the separation between the plates. Find out the expression for its capacitance when the slab is inserted between the plates of the capacitor.

Q30. Obtain the relation between the decay constant and half life of a radioactive sample.The half life of a certain radioactive material against α- decay is 100 days. After how much time, will the undecayed fraction of the material be 6.25%? **(3)**

SECTION D

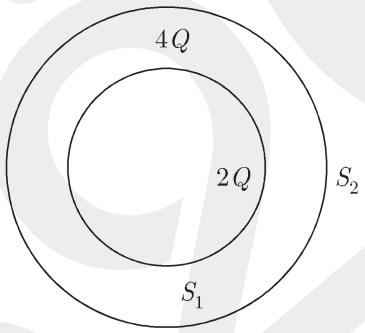
Q31. (i) A point charge causes an electric flux of $-1 \times 10^3 \text{N} \cdot \text{m}^2\text{C}^{-1}$ to pass through a spherical Gaussian surface of 10 cm radius centered on the charge.

(a) How much flux will pass through the surface, if the radius of the Gaussian surface is doubled?
(b) Find the value of the point charge.

(ii) Two point charges $q_A = 3\mu C$ and $q_B = -3\mu C$ are located 20 cm apart in vacuum. What is the electric field and its direction at the mid-point O of the line AB joining the two charges? **(5)**

OR

1. Deduce the expression for the torque acting on a dipole of dipole moment $\vec{p}$ in the presence of a uniform electric field $\vec{E}$.
2. Consider two hollow concentric spheres, S_1 and S_2, enclosing charges 2Q and 4Q respectively as shown in the figure.
   (a) Find out the ratio of the electric f ux through them.
   (b) How will the electric flux through the sphere S_1 change if a medium of dielectric constant 'ε_r' is introduced in the space inside S_1 in place of air? Deduce the necessary expression. **(5)**



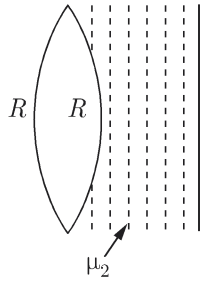
Q32. (i) Describe a simple experiment (or activity) to show that the polarity of emf induced in a coil is always such that it tends to produce a current which opposes the change of magnetic flux that produces it.

(ii) The current flowing through an inductor of self inductance L is continuously increasing. Plot a graph showing the variation of
(a) Magnetic flux versus the current
(b) Induced emf versus dI/dt
(c) Magnetic potential energy stored versus the current. **(5)**

OR

A series L-C-R circuit is connected to an AC source having voltage $V = V_m \sin \omega t$. Derive the expression for the instantenous current I and its phase relationship to the applied voltage.
Obtain the condition for resonance to occur.
Define 'power factor'. State the conditions under which it is maximum and minimum **(5)**

Q33. A biconvex lens with its two faces of equal radius of curvature R is made of a transparent medium of refractive index μ_1. It is kept in contact with a medium of refractive index μ_2 as shown in the figure.



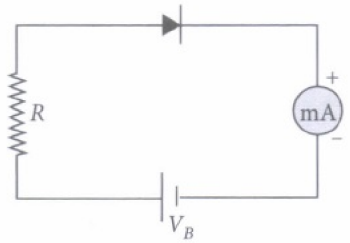
1. Find the equivalent focal length of the combination.
2. Obtain the condition when this combination acts as a diverging lens.
3. Draw the ray diagram for the case $\mu_1 > (\mu_2 + 1)/2$, when the object is kept far away from the lens. Point out the nature of the image formed by the system. **(5)**

OR

1. Using Huygen's construction of secondary wavelets explain how a diffraction pattern is obtained on a screen due to a narrow slit on which a monochromatic beam of light is incident normally.
2. Show that the angular width of the first diffraction fringe is half that of the central fringe.
3. Explain why the maxima at $\theta = \left(n + \frac{1}{2}\right)\frac{\lambda}{a}$ become weaker and weaker with increasing n. **(5)**

SECTION E

Q34. A silicon p-n junction diode is connected to a resistor R and a battery of voltage V_B through milliammeter (mA) as shown in figure. The knee voltage for this junction diode is $V_N^- = 0.7$ V. The p-n junction diode requires a minimum current of 1 mA to attain a value higher than the knee point on the J- V characteristics of this junction diode. Assuming that the voltage V across the junction is independent of the current above the knee point. A p-n junction is the basic building block of many semiconductor devices like diodes. Important process occurring during the formation of a p-n junction are diffusion and drift. In an n-type semiconductor concentration of electrons is more as compared to holes. In a p-type semiconductor concentration of holes is more as compared to electrons. (4)



(i) If $V_B = 5$ V, the maximum value of R so that the voltage V is above the knee point voltage is

(a) 40 Ω (b) 4.3 Ω

(c) 5.0 Ω (d) 5.7 Ω

(ii) If $V_B = 5$ V, the value of R in order to establish a current to 6 mA in the circuit is

(a) 833 Ω (b) 717 Ω

(c) 950 Ω (d) 733 Ω

(iii) If $V_B = 6$ V, the power dissipated in the resistor R, when a current of 6 mA flows in the circuit is

(a) 30.2 mW (b) 30.8 mW

(c) 31.2 mW (d) 31.8 mW

(iv) When the diode is reverse biased with a voltage of 6 V and $V_{bi} = 0.63$ V. Calculate the total potential.

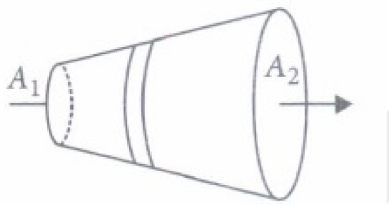
(a) 9.27 V (b) 6.63 V

(c) 5.27 V (d) 0.63 V

Q35. The flow of charge in a particular direction constitutes the electric current. Current is measured in Ampere. Quantitatively, electric current in a conductor across an area held perpendicular to the direction of flow of charge is defined as the amount of charge is flowing across that area per unit time.

Current density at a point in a conductor is the ratio of the current at that point in the conductor to the area of cross section of the conductor of that point.

The given figure shows a steady current flows in a metallic conductor of non uniform cross section. Current density depends inversely on area, so, here $J_1 > J_2$, as $A_1 < A_2$.



(i) What is the current flowing through a conductor, if one million electrons are crossing in' one millisecond through a cross-section of it ?

(a) 2.5×10^{-10} A (b) 1.6×10^{-10} A

(c) 7.5×10^{-9} A (d) 8.2×10^{-11} A

(ii) SI unit of electric current is

(a) Cs (b) Ns^{-2}

(c) Cs^{-1} (d) $C^{-1}s^{-1}$

(iii) A steady current flows in a metallic conductor of non-uniform cross-section. Which of these quantities is constant along the conductor?

(a) Electric field (b) Drift velocity

(c) Current (d) Current density

(iv) A constant current I is flowing along the length of a conductor of variable cross-section as shown in the figure. The quantity which does not depend upon the area of cross-section is

(a) electron density (b) current density

(c) drift velocity (d) electric field