Class XII Session 2024-25

PHYSICS FULL SYLLABUS MOCK TEST – 01

Maximum Marks: 70 **Time allowed: 3 hours**

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. All the sections are compulsory.
3. **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.**
4. 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.
5. Use of calculators is not allowed.
6. 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. $m_p = 1.7 \times 10^{-27}$ kg

iv. $e = 1.6 \times 10^{-19}$ C

v. $\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1}

vi. $h = 6.63 \times 10^{-34}$ J s

vii. $\varepsilon_0 = 8.854 \times 10^{-12}$ C^2 N^{-1} m^{-2}

viii. Avogadro's number = 6.023×10^{23} per gram mole

SECTION – A

[16 × 1]

Q1. A uniform electric field pointing in positive X-direction exists in a region. Let A be the origin, B be the point on the X-axis at x = +1 cm and C be the point on the Y-axis at y = +1 cm. Then the potential at points A, B and C satisfy.

(A) $V_A < V_B$ (B) $V_A > V_B$ (C) $V_A < V_C$ (D) $V_A > V_C$

Q2. A conducting wire connects two charged conducting spheres such that they attain equilibrium with respect to each other. The distance of separation between the two spheres is very large as compared to either of their radii. The ratio of the magnitudes of the electric fields at the surfaces of the two spheres is

(A) $\frac{r_1}{r_2}$ (B) $\frac{r_2}{r_1}$ (C) $\frac{r_2^2}{r_1^2}$ (D) $\frac{r_1^2}{r_2^2}$

Q3. A long straight wire of circular cross section of radius 'a' carry a steady current I. The current is uniformly distributed across its cross section. The ratio of magnitudes of the magnetic field at a point a/2 above the surface of wire to that of a point a/2 below its surface is

(A) 4:1 (B) 1:1 (C) 4:3 (D) 3:4

Q4. The diffraction effect can be observed in

(A) sound waves only (C) ultrasonic waves only

(B) light waves only (D) sound waves as well as light waves

Q5. A capacitor consists of two parallel plates, with an area of cross-section of 0.001 m^2 separated by a distance of 0.0001 m. If the voltage across the plates varies at the rate of 10^8 V/s, then the value of displacement current through the capacitor is

(A) 8.85×10^{-3} A (B) 8.85×10^{-4} A

(C) 7.85×10^{-3} A (D) 9.85×10^{-3} A

Q6. In a series LCR circuit, the voltage across the resistance, capacitance and inductance is 10 V each. If the capacitance is short circuited the voltage across the inductance will be

(A) 10 V (B) $10\sqrt{2}$ V (C) $10 / \sqrt{2}$ V (D) 20 V

Q7. Correct match of column I with column II is

C-I (waves)	C-II (Production)
(1) Infra-red	P. Rapid vibration of electrons in aerials
(2) Radio	Q. Electrons in atoms emit light when they move from higher to lower energy level.
(3) Light	R. Klystron valve
(4) Microwave	S. Vibration of atoms and molecules

(A) 1-P, 2-R, 3-S, 4-Q (B) 1-S, 2-P, 3-Q, 4-R

(C) 1-Q, 2-P, 3-S, 4-R (D) 1-S, 2-R, 3-P, 4-Q

28. The distance of closest approach of an alpha particle is d when it moves with a speed V towards a nucleus. Another alpha particle is projected with higher energy such that the new distance of the closest approach is d/2. What is the speed of projection of the alpha particle in this case?

(A) V/2 (B) $\sqrt{2}$ V (C) 2 V (D) 4 V

Q9. A point object is placed at the centre of a glass sphere of radius 6 cm and refractive index 1.5. The distance of virtual image from the surface of the sphere is

(A) 2 cm (B) 4 cm (C) 6 cm (D) 12 cm

10. Colours observed on a CD (Compact Disk) is due to

(A) Reflection (B) Diffraction (C) Dispersion (D) Absorption

Q11. The number of electrons made available for conduction by dopant atoms depends strongly upon

(A) doping level (B) increase in ambient temperature

(C) energy gap (D) options (a) and (b) both

Q12. If copper wire is stretched to make its radius decrease by 0.1%, then the percentage change in its resistance is approximately

(A)-0.4% (B)+0.8% (C) +0.4% (D) +0.2%

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 the 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 both Assertion and Reason are false.

Q13. **Assertion (A):** On increasing the current sensitivity of a galvanometer by increasing the number of turns may not necessarily increase its voltage sensitivity.

Reason(R): The resistance of the coil of the galvanometer increases on increasing the number of turns.

Q14. **Assertion (A):** In a hydrogen atom there is only one electron but its emission spectrum shows many lines.

Reason (R): In a given sample of hydrogen there are many atoms each containing one electron; hence many electrons in different atoms may be in different orbits so many transitions from higher to lower orbits are possible.

Q15. **Assertion (A):** Nuclei having mass number about 60 are least stable.

Reason (R): When two or more light nuclei are combined into a heavier nucleus then the binding energy per nucleon will decrease.

Q16. **Assertion (A):** de Broglie's wavelength of a freely falling body keeps decreasing with time.

Reason (R): The momentum of the freely falling body increases with time.

SECTION – B

[05 × 2]

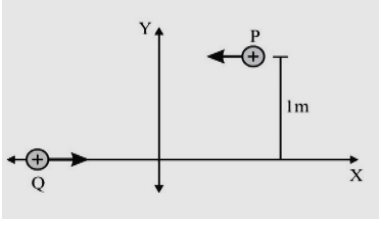
17. A platinum surface having work function 5.63 eV is illuminated by a monochromatic source of 1.6×10^{15} Hz. What will be the minimum wavelength associated with the ejected electron.

Q18. (I) In Young's double-slit experiment using monochromatic light of wavelength λ, the intensities of two sources is I. What is the intensity of light at a point where path difference between wave front is λ/4?

OR

(II) A beam of light consisting of two wavelengths, 4000 Å and 6000 Å, is used to obtain interference fringes in a Young's double-slit experiment. What is the least distance from the central maximum where the dark fringe is obtained?

Q19. P and Q are two identical charged particles each of mass 4×10^{-26} kg and charge 4.8×10^{-19} C, each moving with the same speed of 2.4×10^5 m/s as shown in the figure. The two particles are equidistant (0.5 m) from the vertical Y -axis. At some instant, a magnetic field B is switched on so that the two particles undergo head-on collision.



Find -

(I) the direction of the magnetic field and

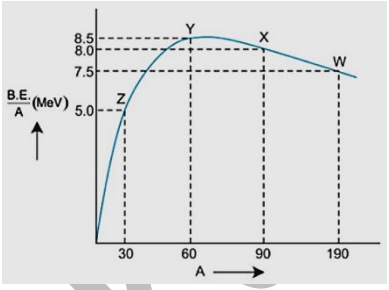
(II) the magnitude of the magnetic field applied in the region.

Q20. Binding energy per nucleon vs mass number curve for nuclei is shown in the figure. W, X, Y and Z are four nuclei indicated on the curve. Identify which of the following nuclei is most likely to undergo

(i) Nuclear Fission

(ii) Nuclear Fusion.

Justify your answer.

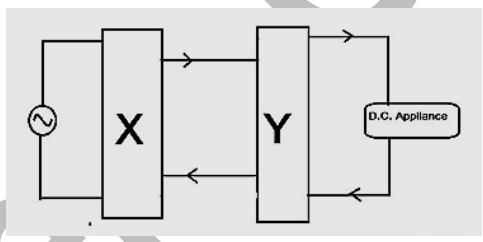


Q21. What should be the radius 'r' of nearest possible orbits of satellite of mass 'm' revolving around the planet of mass 'M' as per Bohr Postulates in terms of m, M, G, h where G is Gravitational constant and h is plank's constant.

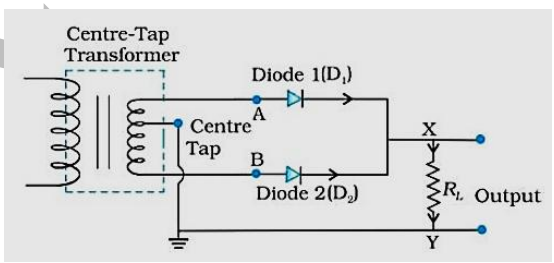
SECTION – C

[07 × 3]

Q22. (I) Identify the circuit elements X and Y as shown in the given block diagram and draw the output waveforms of X and Y.



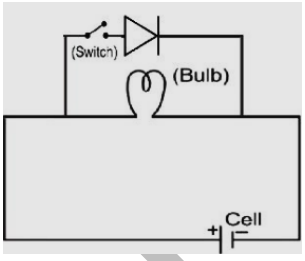
(II) If the centre tapping is shifted towards Diode D1 as shown in the diagram, draw the output waveform of the given circuit.



Q23. Find the expression for the capacitance of a parallel plate capacitor of plate area A and plate separation d when (I) a dielectric slab of thickness t and (II) a metallic slab of thickness t, where (t < d) are introduced one by one between the plates of the capacitor. In which case would the capacitance be more and why?

Q24. (I) Draw a ray diagram for the formation of image by a Cassegrain telescope.

(II)Why these types of telescopes are preferred over refracting type telescopes. (Write 2 points)



25. (I) Draw the energy band diagram for P-type semiconductor at (i) T = 0K and (ii) room temperature. (II)In the given diagram considering an ideal diode, in which condition will the bulb glow

(a) when the switch is open

(b) when the switch is closed; Justify your answer.

Q26. A boy is holding a smooth, hollow and non-conducting pipe vertically with charged spherical ball of mass 10 g carrying a charge of +10 mC inside it which is free to move along the axis of the pipe. The boy is moving the pipe from East to West direction in the presence of magnetic field of 2T. With what minimum velocity, should the boy move the pipe such that the ball does not move along the axis. Also determine the direction of the magnetic field.

Q27. A light ray entering a right-angled prism undergoes refraction at the face AC as shown in Fig. 1.

(I) What is the refractive index of the material of the prism in Fig. 1?

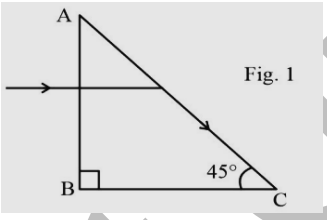


Fig. 1

(II)(a) If the side AC of the above prism is now surrounded by a liquid of refractive index $\frac{2}{\sqrt{3}}$ as 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.

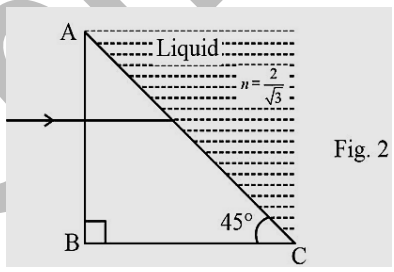


Fig. 2

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

Q28. (I) State Gauss's theorem in electrostatics. Using this theorem, derive an expression for the electric field due to an infinitely long straight wire of linear charge density λ.

OR

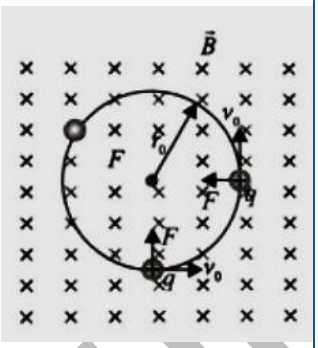
(II) (a) Define electric flux and write its SI unit.

(b) Use Gauss's law to obtain the expression for the electric field due to a uniformly charged infinite plane sheet of charge.

SECTION – D

[02 × 4]

29. **Case Study Based Question: Motion of Charge in Magnetic Field**



Motion of Charge in Magnetic Field An electron with speed $v_0 << c$ moves in a circle of radius r_o in a uniform magnetic field. This electron is able to traverse a circular path as the magnetic force acting on the electron is perpendicular to both v_o and $\vec{B}$ as shown in the figure. This force continuously deflects the particle sideways without changing its speed and the particle will move along a circle perpendicular to the field. The time required for one revolution of the electron is T_0

(i) If the speed of the electron is now doubled to $2v_0$. The radius of the circle will change to

(A) $4r_0$ (B) $2\ r_o$ (C) R_0 (D) $r_0/\ 2$

(ii) If $v = 2v_0$ then the time required for one revolution of the electron (T) will change to

(A) $4\ T_0$ (B) $2\ T_0$ (C) T_0 (D) $T_0\ /\ 2$

(iii) A charged particles is projected in a magnetic field. The acceleration of the particle is found to be. Find the value of x.

(A) 4 ms^{-2} (B) -4 ms^{-2} (C) -2 ms^{-2} (D) 2 ms^{-2}

(iv) If the given electron has a velocity not perpendicular to B, then trajectory of the electron is

(A) straight line (B) circular (C) helical (D) zig-zag

OR

If this electron of charge (e) is moving parallel to uniform magnetic field with constant velocity v, the force acting on the electron is

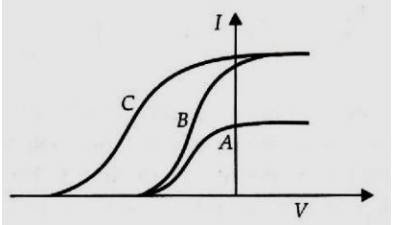
(A) Bev (B) Be/v (C) B/ev (D) Zero

Q30. **Case Study Based Question: Photoelectric effect**

It is the phenomenon of emission of electrons from a metallic surface when light of a suitable frequency is incident on it. The emitted electrons are called photoelectrons.

Nearly all metals exhibit this effect with ultraviolet light but alkali metals like lithium, sodium, potassium, cesium etc. show this effect even with visible light. It is an instantaneous process i.e. photoelectrons are emitted as soon as the light is incident on the metal surface. The number of photoelectrons emitted per second is directly proportional to the intensity of the incident radiation. The maximum kinetic energy of the photoelectrons emitted from a given metal surface is independent of the intensity of the incident light and depends only on the frequency of the incident light. For a given metal surface there is a certain minimum value of the frequency of the incident light below which emission of photoelectrons does not occur.

(I) In a photoelectric experiment plate current is plotted against anode potential.



(A) A and B will have same intensities while B and C will have different frequencies

(B) B and C will have different intensities while A and B will have different frequencies

(C) A and B will have different intensities while B and C will have equal frequencies

(D) B and C will have equal intensities while A and B will have same frequencies.

(II) Photoelectrons are emitted when a zinc plate is

(A) Heated (B) hammered

(C) Irradiated by ultraviolet light (D) subjected to a high pressure

(III) The threshold frequency for photoelectric effect on sodium corresponds to a wavelength of 500 nm. Its work function is about

(A) 4×10^{-19} J (B) 1 J (C) 2×10^{-19} J (D) 3×10^{-19} J

(IV) The maximum kinetic energy of photoelectrons emitted from a surface when photons of energy 6 eV fall on it is 4 eV. The stopping potential is

(A) 2 V (B) 4 V (C) 6 V (D) 10 V

OR

The minimum energy required to remove an electron from a substance is called its

(A) work function (B) kinetic energy

(C) stopping potential (D) potential energy

SECTION – D

[03 ×5]

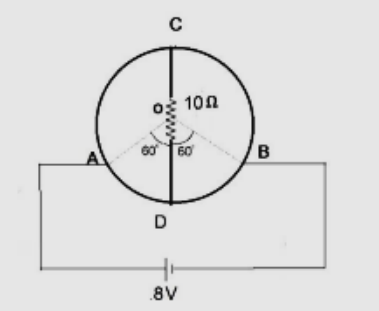
Q31. (I) a) Write two limitations of ohm's law. Plot their I-V characteristics.

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}.

OR

(II) a) Using Kirchhoff's laws obtain the equation of the balanced state in Wheatstone bridge.

b) A wire of uniform cross-section and resistance of 12 ohm is bent in the shape of circle as shown in the figure. A resistance of 10 ohms is connected to diametrically opposite ends C and D. A battery of emf 8V is connected between A and B. Determine the current flowing through arm AD.



Q32. (I) Explain briefly, with the help of a labelled diagram, the basic principle of the working of an a.c. generator. In an a.c. generator, coil of N turns and area A is rotated at an angular velocity ω in a uniform magnetic field B. Derive an expression for the instantaneous value of the emf induced in coil. What is the source of energy generation in this device?

OR

(II) a) With the help of a diagram, explain the principle of a device which changes a low ac voltage into a high voltage. Deduce the expression for the ratio of secondary voltage to the primary voltage in terms of the ratio of the number of turns of primary and secondary winding. For an ideal transformer, obtain the ratio of primary and secondary currents in terms of the ratio of the voltages in the secondary and primary coils.

b) Write any two sources of the energy losses which occur in actual transformers.

c) A step-up transformer converts a low input voltage into a high output voltage. Does it violate law of conservation of energy? Explain

Q33. (I) a) A giant refracting telescope at an observatory has an objective lens of focal length 15 m. If an eyepiece of focal length 1.0 cm is used, what is angular magnification of the telescope in normal adjustment?

b) If this telescope is used to view the moon, what is the diameter of the image of the moon formed by the objective lens? The diameter of the moon is 3.48×10^6 m, and the radius of lunar orbit is 3.8×10^8 m.

OR

(II) 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

a) the least distance of distinct vision (25 cm) and

b) infinity? What is the magnifying power of the microscope in each case?