Class XII Session 2024-25

PHYSICS FULL SYLLABUS MOCK TEST – 09

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]

1. The formation of depletion region in a p-n junction diode is due to

a) movement of dopant atoms b) drift of electrons only

c) diffusion of both electrons and holes d) drift of holes only

2. Inversion temperature of a thermocouple is the temperature of the hot junction at which the emf is:

a) minimum b) Low c) maximum d) zero

3. The graph drawn with object distance along abscissa & image as ordinate for a convex lens is

a) straight b) circle c) rectangular hyperbola d) parabola

4. The μ_0 is also known as :

a) magnetic dipole b) Absolute Permittivity

c) Magnetic dipole moment d) Magnetic flux

5. Submarine cables act as

a) spherical capacitor

b) cylindrical capacitor with inner cylinder earthed

c) parallel plate capacitor

d) cylindrical capacitor with outer cylinder earthed

6. The magnetic moment of a current (l) carrying circular coil of radius (r) and number of turns (n) varies as

a) $\frac{1}{r^2}$ b) r c) $\frac{1}{r}$ d) r^2

7. A conducting circular loop is placed in a uniform magnetic field, B = 0.025 T with its plane perpendicular to the loop. The radius of the loop is made to shrink at a constant rate of 1 mm s^{-1}. The induced emf when the radius is 2 cm, is

a) 2μV b) πμV c) 2 πμV d) $\frac{\pi}{2}\mu V$

8. A paramagnetic sample shows a net magnetisation of 8 Am^{-1} when placed in an external magnetic field of 0.6T at a temperature of 4K. When the same sample is placed in an external magnetic field of 0.2 T at a temperature of 16K, the magnetisation will be

a) 6 Am^{-1} b) 2/3 Am^{-1} c) 2.4 Am^{1} d) 32/3 Am^{-1}

9. Consider a ray of light incident from air onto a slab of glass (refractive index n) of width d, at an angle θ. The phase difference between the ray reflected by the top surface of the glass and the bottom surface is

a) $\frac{4\pi d}{\lambda}\left(1-\frac{1}{n^2}sin^2\theta\right)^{1/2}$ b) $\frac{4\pi d}{\lambda}\left(1-\frac{1}{n^2}sin^2\theta\right)^{1/2}+2\pi$

b) $\frac{4\pi d}{\lambda}\left(1-\frac{1}{n^2}sin^2\theta\right)^{1/2}+\frac{\pi}{2}$ d) $\frac{4\pi d}{\lambda}\left(1-\frac{1}{n^2}sin^2\theta\right)^{1/2}+\pi$

10. Select the correct statements. Coulomb's law correctly describes the electric force that:

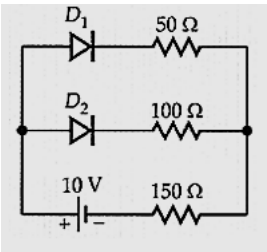
i. binds the electrons of an atom to its nucleus.

ii. binds the protons and neutrons in the nucleus of an atom.

iii. binds atoms together to form molecules.

a) (i), (ii), and (iii) b) (i) and (iii) c) (ii) and (iii) d) (i) and (ii)

11. Assume that each diode shown in the figure has a forward bias resistance of 50 Ω and an infinite reverse bias resistance. The current through the 150 Ω resistance is



a) 0.04 A

b) zero

c) 0.05 A

d) 0.66 A

12. The radius of curvature of the curved surface of a plano-convex lens is 20 cm. If the refractive index of the material of the lens be 1.5, it will

a) act as a concave lens irrespective of side on which the object lies

b) act as a convex lens only for the objects that lie on its curved side

c) act as a concave lens for the objects that lie on its curved side

d) act as a convex lens irrespective of the side on which the object lies

13. **Assertion (A):** de-Broglie wavelength is significant for microscopic particles
Reason (R): de-Broglie wavelength is inversely proportional to the mass of a particle when velocity is kept constant.
a) Both A and R are true and R is the correct explanation of 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) A is false but R is true.

14. **Assertion:** An applied electric field polarises a polar dielectric.
Reason: The molecules of a polar dielectric possess a permanent dipole moment, but in the absence of electric field, these dipoles are randomly oriented and when electric field is applied these dipoles align along the direction of electric field.
a) Both A and R are true and R is the correct explanation of 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) A is false but R is true.

15. **Assertion:** Light from two coherent sources is reaching the screen. If the path difference at a point on the screen for yellow light is $\frac{3\lambda}{2}$, then the fringe at that point will be coloured.
Reason: (R) Two coherent source always have constant phase relationship.
a) Both A and R are true and R is the correct explanation of 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) A is false but R is true.

16. **Assertion (A):** At resonance, the inductive reactance is equal and opposite to the capacitive reactance.
Reason (R): In series LCR-circuit, the inductive reactance is equal and opposite to the capacitive reactance.
a) Both A and R are true and R is the correct explanation of 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) A is false but R is true.

SECTION – B

[05 × 2]

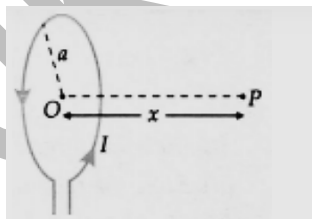
17. Given: Wavelength of light in mercury is 5.5×10^{-5}.
i. Calculate its frequency and period.
ii. What is the wavelength of the light in the glass, if the refractive index of glass is 1.5?

18. A ball of superconducting material is dipped in liquid nitrogen and placed near a bar magnet.
i. In which direction will it move?
ii. What will be the direction of its magnetic moment?

19. Why do semiconductors obey Ohm's law for only low fields?

20. i. Define the terms: **impact parameter** and distance of **closest approach** for an α-particle in the Geiger Marsden scattering experiment.
ii. What will be the value of the impact parameter for scattering angle (I)$\theta = 0^o$ and (II) $\theta = 180^o$?

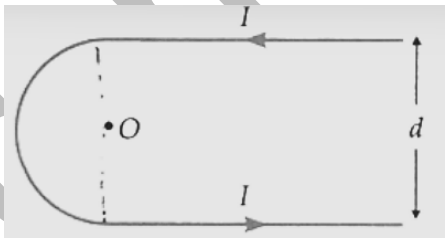
21. A student records the following data for the magnitudes (B) of the magnetic field at axial points at different distances x from the centre of a circular coil of radius a carrying a current I. Verify (for any two) that these observations are in good agreement with the expected theoretical variation of B with x.



x →	x = 0	x - a	x = 2 a	x = 3a
y→	B_0	$0.25\sqrt{2}B_0$	$0.039\sqrt{5}B_0$	$0.010\sqrt{10}B_0$

OR

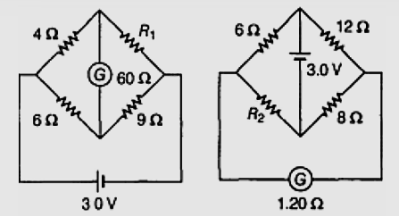
In the given figure, the curved portion is a semi-circle and the straight wires are long. Find the magnetic field at point O.

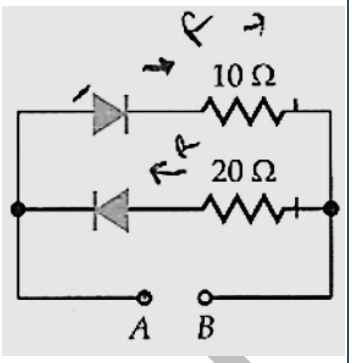


SECTION – C

[07 × 3]

22. Define the current sensitivity of a galvanometer. Write its SI unit. Figure shows two circuits each having a galvanometer and a battery of 3 V. When the galvanometer in each arrangement do not show any deflection, obtain the ratio R_1 / R_2 .





23. A battery of V may be connected across points A and B, as shown in the figure. Find the current drawn from the battery if the positive terminal is connected to
i. the point A and
ii. the point B Assume that the resistance of each diode is zero in forward bias and infinity in reverse bias.

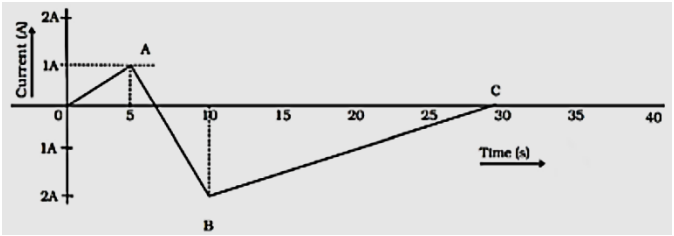
24. Consider a thin target (10^{-2} m square, 10^{-3} m thickness) of sodium, which produces a photocurrent of 10μ A when a light of intensity 100W/m^2 ($\lambda = 660$nm) falls on it. Find the probability that a photoelectron is produced when a photon strikes a sodium atom. [Take density of Na = 0.97 kg/m^3].

25. The neutron separation energy is defined as the energy required to remove a neutron from the nucleus. Obtain the neutron separation energies of the nuclei $^{41}_{20}Ca$ and $^{27}_{13}Al$ from the following data:
$m(^{40}_{20}Ca) = 39.962591$ u
$m(^{41}_{20}Ca) = 40.962278$ u
$m(^{26}_{13}Al) = 25.986895$ u
$m(^{27}_{13}Al) = 26.981541$ u

26. Using Bohr's postulates, obtain the expression for the total energy of the electron in the stationary states of the hydrogen atom. Hence draw the energy level diagram showing how the line spectra corresponding to Balmer series occur due to transition between energy levels.

27. A parallel beam of light of wavelength 600 nm is incident normally on a slit of width 0.2 mm. If the resulting diffraction pattern is observed on a screen 1 m away, find the distance of
a. first minimum, and b. second maximum, from the central maximum.

28. A (current vs time) graph of the current passing through a solenoid is shown in Figure. For which time is the back electromotive force (u) a maximum. If the back emf at t = 3s is e, find the back emf at t = 7 s, 15s, and 40s. OA, AB, and BC are straight line segments.



OR

How is the mutual inductance of a pair of coils affected when:
i. separation between the coils is increased?
ii. the number of turns of each coil is increased?

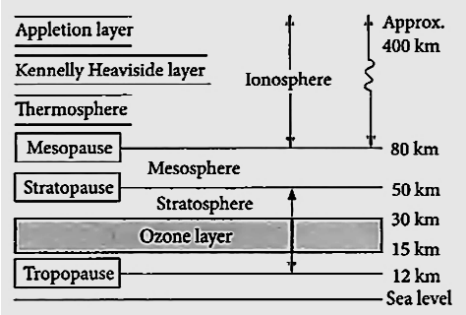
iii. A thin iron sheet is placed between the two coils, other factors remaining the same?

SECTION – D

[02 × 4]

29. **Case Study Based Question:**

Radio waves are produced by the accelerated motion of charges in conducting wires. Microwaves are produced by special vacuum tubes. Infrared waves are produced by hot bodies and molecules also known as heat waves. UV rays are produced by special lamps and very hot bodies like Sun.



(a) Solar radiation is
i. transverse electromagnetic wave
ii. longitudinal electromagnetic waves
iii. both longitudinal and transverse electromagnetic waves
iv. none of these

a) Option (i) b) Option (iv) c) Option (iii) d) Option (ii)

(b) What is the cause of greenhouse effect?

a) Ultraviolet rays b) X-rays c) Infrared rays d) Radiowaves

(c) Biological importance of ozone layer is

a) it stops ultraviolet rays b) none of these.

c) it reflects radiowaves d) It layer reduces greenhouse effect

OR

Earth's atmosphere is richest in

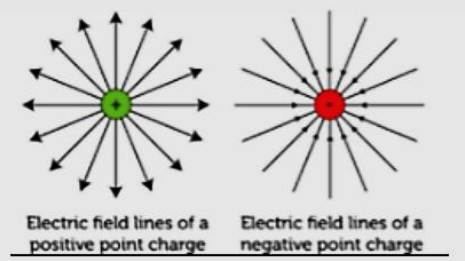
a) ultraviolet b) infrared c) X-rays d) microwaves

(d) Ozone is found in

a) troposphere b) mesosphere c) ionosphere d) stratosphere

30. **Case Study Based Question:**

A charge is a property associated with the matter due to which it experiences and produces an electric and magnetic field. Charges are scalar in nature and they add up like real numbers. Also, the total charge of an isolated system is always conserved. When the objects rub against each other charges acquired by them must be equal and opposite.



(a) The cause of charging is:

a) the actual transfer of atoms b) the actual transfer of protons

c) the actual transfer of electrons d) the actual transfer of neutrons

(b) Pick the correct statement.

i. The glass rod gives protons to silk when they are rubbed against each other.

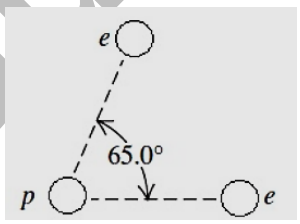
ii. The glass rod gives electrons to silk when they are rubbed against each other.

iii. The glass rod gains protons from silk when they are rubbed against each other.

iv. The glass rod gains electrons when they are rubbed against each other.

a) Option (i) b) Option (iv) c) Option (iii) d) Option (ii)

(c) If two electrons are each 1.5×10^{-10} m from a proton, as shown in Figure, magnitude of the net electric force they will exert on the proton is



a) 1.97×10^{-8} N

b) 3.83×10^{-8} N

c) 4.63×10^{-8} N

d) 2.73×10^{-8} N

(d) A charge is a property associated with the matter due to which it produces and experiences:

a) electric effects only b) magnetic effects only

c) both electric and magnetic effects d) non magnetic effects only

OR

The cause of quantization of electric charges is:

a) transfer of an integral number of electrons b) transfer of an integral number of neutrons

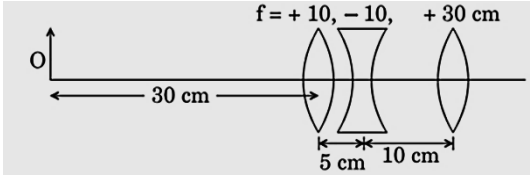
c) transfer of an integral number of protons d) transfer of an integral number of Atom

SECTION – E

[03 ×5]

31. a. Using the ray diagram for a system of two lenses of focal lengths f1 and f2 in contact with each other, show that the two lens system can be regarded as equivalent to a single lens of focal length f, where $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$. Also write the relation for the equivalent power of the lens combination.

b. Determine the position of the image formed by the lens combination given in the figure.



OR

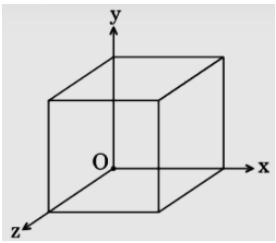
What is interference of light? Write two essential conditions for sustained interference pattern to be produced on the screen. Draw a graph showing the variation of intensity versus the position on the screen in Young's experiment when (a) both the slits are opened and (b) one of the slit is closed. What is the effect on the interference pattern in Young's double-slit experiment when:

i. Screen is moved closer to the plane of slits?

ii. Separation between two slits is increased. Explain.

32. a. Two-point charges q_1 and q_2 are kept r distance apart in a uniform external electric field $\vec{E}$. Find the amount of work done in assembling this system of charges.

b. A cube of side 20 cm is kept in a region as shown in the figure. An electric field $\vec{E}$ exists in the region such that the potential at a point is given by $V = 10x + 5$, where V is in volt and x is in m.



Find the i. electric field $\vec{E}$, and ii. total electric flux through the cube.

OR

a. Derive the expression for the electric potential due to an electric dipole at a point on its axial line.

b. Depict the equipotential surfaces due to an electric dipole.

33. An ac voltage $V = V_m \sin \omega t$ is applied to a series LCR circuit. Obtain an expression for the current in the circuit and the phase angle between the current and voltage. What is resonance frequency?

OR

A resistor of 400 Ω, an inductor of $\frac{5}{\pi}$ H and a capacitor of $\frac{50}{\pi}$ μF are connected in series across a source of alternating voltage of 140 sin 100 πt V. Find the voltage (rms) across the resistor, the inductor and the capacitor. Is the algebraic sum of these voltages more than the source voltage? If yes, resolve the paradox. (Given, $\sqrt{2} = 1.414$).