Class XII Session 2024-25

PHYSICS FULL SYLLABUS MOCK TEST – 07

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

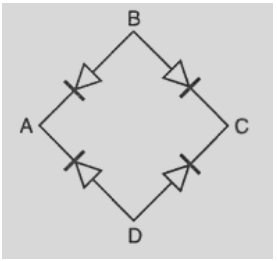
vii. $\varepsilon_0 = 8.854 \times 10^{-12}$ C^2 N^{-1} m^{-2}

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

SECTION – A

[16 × 1]

1. A bridge rectifier is shown in the figure. Alternating input is given across A and C.



If the output is taken across BD, then it is:

a) full wave rectified b) zero

c) half wave rectified d) same as input

2. If P and Q are two batteries connected in series with anode of one connected to anode of the other, producing voltages E_1 and $E_2 > E_1$ respectively. The e.m.f of the pair is

a) E_1 b) E_2 c) $E_2 - E_1$ d) $E_2 + E_1$

3. An object approaches a convergent lens from the left of the lens with a uniform speed 5 m/s and stops at the focus. The image

a) moves away from the lens with a uniform acceleration

b) moves away from the lens with a uniform speed 5 m/s

c) moves towards the lens with a non-uniform acceleration

d) moves away from the lens with a nonuniform acceleration

4. A bar magnet is cut into two equal halves parallel to its magnetic axis. The physical quantity that remains unchanged is:

a) moment of inertia b) pole strength

c) magnetic moment d) magnitude of magnetisation

5. A capacitor is charged by a battery. Between the plates, during process of charging:

a) only conduction current exists.

b) only displacement current exists.

c) both displacement current and conduction current exist.

d) no current exists.

6. A vertical straight conductor carries a current vertically upwards. A point P lies to the east of it at a small distance and another point Q lies to the west in the same direction. The magnetic field at P is:

a) greater or less than at Q, depending upon the strength of the current

b) greater than at Q

c) less than at Q

d) same as at Q

7. Given magnetic field B, area A and length l of a solenoid. The magnetic energy per unit volume is

a) $\frac{1}{2\,\mu_0}\,B^2A$ b) $\frac{3}{2\,\mu_0}\,B^2Al$ c) $\frac{1}{2\,\mu_0}\,B^3Al$ d) $\frac{B^2}{2\,\mu_0}$

8. The ratio of magnetic fields due to a small bar magnet in the end on position to the broad side on position is

a) 1 : 1 b) 1: 4 c) 2 : 1 d) 1 : 2

9. Which of the following phenomenon cannot take place with longitudinal waves (e.g., sound waves)?

a) polarisation b) diffraction c) reflection d) interference

10. When a negatively charged, conductor is connected to earth

a) Electrons flow from the earth to the conductor

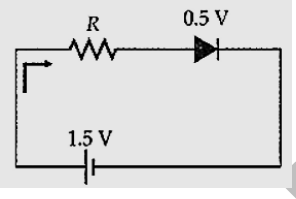
b) Protons flow from the conductor to the earth

c) No charge flow occurs

d) Electrons flow from the conductor to the earth

11. The diode used in the circuit shown in the figure has a constant voltage drop at 0.5 V at all

currents and a maximum power rating of 100 milliwatts. What should be the value of the resistor R, connected in series with diode for obtaining maximum current?



a) 20 Ω b) 6.76 Ω

c) 5 Ω d) 5.6 Ω

12. The layered lens is made of two kinds of glass. A point source of light is placed on its principal axis. If the reflections from the boundaries between layers are ignored, the lens will form

a) no image at all b) two images c) infinite images d) only one image

13. **Assertion (A):** The de Broglie wavelength of a molecule varies inversely as the square root of temperature.
Reason (R): The root mean square velocity of the molecule depends on the temperature
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:** Two concentric charged inner and outer shell are given. The potential difference between the shells depends on charge of inner shell.
Reason: Potential due to charge of outer shell remains same at every point inside the sphere.
a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
c) Assertion is correct statement but reason is wrong statement.
d) Assertion is wrong statement but reason is correct statement.

15. **Assertion:** Skiers use air glasses.
Reason: (R) Light reflected by snow is partially polarised.
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):** Transformers are used only in alternating current sources, not in direct current.
Reason (R): Only a.c. can be stepped up or down by means of transformers
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. Use the formula $\lambda_m T = 0.29$ cm K to obtain the characteristic temperature ranges for different parts of the electromagnetic spectrum. What do the numbers that you obtain tell you?

18. Two magnetic poles, one of which is 10 times as strong as the other, exert on each other a force equal to 9.604 mN, when placed 10 cm apart in air. Find the strength of the two poles

19. Two crystals C_1 and C_2, made of pure silicon, are doped with arsenic and aluminium respectively.

a. Identify the extrinsic semiconductors so formed.

b. Why is doping of intrinsic semiconductors necessary?

20. The ground state energy of hydrogen atom is -13.6 eV. If an electron makes a transition from an energy level -1.51 eV to - 3.4 eV, then calculate the wavelength of the spectral line emitted and name the series of hydrogen spectrum to which it belongs.

21. A beam of protons with a velocity 4×10^5 m/s enters a uniform magnetic field of 0.3 T at an angle 60° to the magnetic field. Find the radius of the helical path taken by the proton beam. Also find the pitch of the helix mp = 1.67×10^{-27} k

OR

What will be the path of a charged particle moving in a region of crossed (or transverse) uniform electrostatic and magnetic fields with initial velocity zero?

SECTION – C

[07 × 3]

22. Two cells of emf 2E and E and internal resistances 2r and r respectively, are connected in parallel. Obtain the expressions for the equivalent emf and the internal resistance of the combination.

23. Draw the circuit diagram of a full wave rectifier. Explain its working principle. Show the input waveforms given to the diodes D_1 and D_2 and the corresponding output waveforms obtained at the load connected to the circuit.

24. A beam of monochromatic radiation is incident on a photosensitive surface. Answer the following questions giving reasons. i. Do the emitted photoelectrons have the same kinetic energy?

ii. Does the kinetic energy of the emitted electrons depend on the intensity of incident radiation?

iii. On what factors does the number of emitted photoelectrons depend?

25. Deuteron is a bound state of a neutron and a proton with a binding energy B = 2.2 MeV. A γ-ray of energy E is aimed at a deuteron nucleus to try to break it into a (neutron + proton) such that the n and p move in the direction of the incident γ-ray. If E = B, show that this cannot happen. Hence calculate how much bigger than B must E be for such a process to happen.

26. Using Bohr's total postulates, derive the expression for the total energy of the electron in the stationary states of hydrogen atom.

27. In single slit diffraction, explain why the maxima at $\theta = \left(n + \frac{1}{2}\right)\left(\frac{\lambda}{a}\right)$ becomes weaker and weaker as n increases. State two important differences between interference and diffraction pattern.

28. i. Define mutual inductance.

ii. A pair of adjacent coils has a mutual inductance of 1.5 H. If the current in one coil changes from 0 to 20 A in 0.5 s, what is the change of flux linkage with the other coil?

OR

A small flat search coil of area 5 cm^2 with 140 closely wound turns is placed between the poles of a powerful magnet producing magnetic field 0.09 T and then quickly removed out of the field region. Calculate

a. change of magnetic flux through the coil, and

b. emf induced in the coil.

SECTION – D

[02 × 4]

29**. Case Study Based Question:**

Electrons oscillating in a circuit give rise to radiowaves. A transmitting antenna radiates most effectively the radiowaves of wavelength equal to the size of the antenna. The infrared waves incident on a substance set into oscillation all its electrons, atoms and molecules. This increases the internal energy and hence the temperature of the substance.

(a) If v_g, v_X and v_m are the speeds of gamma rays, X-rays and microwaves respectively in vacuum, then

a) $v_g > v_X > v_m$ *b)* $v_g < v_X < v_m$ *c)* $v_g > v_X > v_m$ d) $v_g = v_X = v_m$

(b) Which of the following will deflect in electric field?

a) ultraviolet rays b) γ -rays c) X-rays d) cathode rays

(c) γ-rays are detected by

a) point contact diodes b) ionization chamber

c) thermopiles d) photocells

OR

We consider the radiation emitted by the human body. Which one of the following statements is true?

i. The radiation emitted is in the infrared region.

ii. The radiation is emitted only during the day.

iii. The radiation is emitted during the summers and absorbed during the winters.

iv. The radiation emitted lies in the ultraviolet region and hence it is not visible.

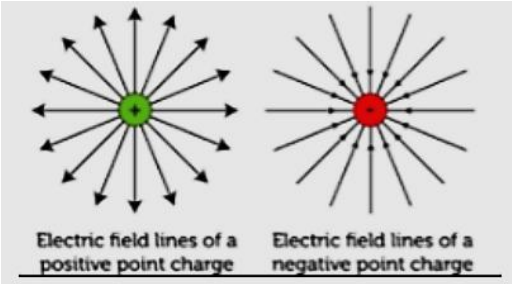
a) Option (iv) b) Option (ii) c) Option (iii) d) Option (i)

(d) The frequency of electromagnetic wave, which best suited to observe a particle of radius 3×10^{-4} cm is the order of

a) 1014 Hz b) 10^{12} Hz c) 10^{13} Hz d) 10^{15} Hz

Q30. **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.

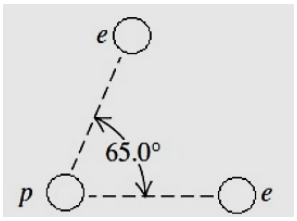
ii. The glass rod gives electrons to silk when they are rubbed against each other.

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

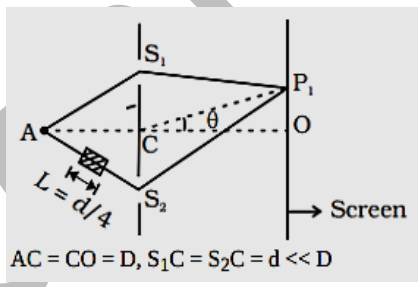
[03 ×5]

31. i. A coin is placed inside a denser medium. Why does it appear to be raised? Obtain an expression for the height through which the object appears to be raised in terms of refractive index of the medium and real depth.

ii. A compound microscope consists of an objective lens of focal length 2 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 the least distance of distinct vision (25 cm)? Calculate the magnifying power of the microscope.

OR

A small transparent slab containing material of $\mu = 1.5$ is placed along AS_2 (Figure). What will be the distance from O of the principal maxima and of the first minima on either side of the principal maxima obtained in the absence of the glass slab?



32. i. Define the capacitance of a capacitor. Obtain the expression for the capacitance of a parallel plate capacitor in vacuum in terms of plate area A and separation d between the plates.

ii. A slab of material of dielectric constant k has the same area as the plates of a parallel plate $\frac{3d}{4}$ capacitor but has a thickness -. Find the ratio of the capacitance with dielectric inside it to its capacitance without the dielectric.

OR

a. Explain why, for any charge configuration, the equipotential surface through a point is normal to the electric field at that point. Draw a sketch of equipotential surfaces due to a single charge (-q), depicting the electric field lines due to the charge.

b. Obtain an expression for the work done to dissociate the system of three charges placed at the vertices of an equilateral triangle of side **a** as shown alongside.

33. a. State the condition for resonance to occur in series LCR a.c. circuit and derive an expression for resonant frequency.

b. Draw a plot showing the variation of the peak current (i_m) with frequency of the a.c, source used. Define the quality factor Q of the circuit.

OR

With the help of a diagram, explain the principle of a device which changes a low voltage into a high voltage but does not violate the law of conservation of energy. Give any one reason why the device may not be 100% efficient.