MODEL EXAMINATION 2022-23

SUBJECT: PHYSICS **MAX. MARKS : 70**
CLASS : XII **DURATION: 3 HRS**

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

Questions 1 to 18 carry 1 mark each.

1. A positively charged particle is released from rest in a uniform electric field. The electric potential energy of the charge
(a) remains a constant because the electric field is uniform.
(b) increases because the charge moves along the electric field.
(c) decreases because the charge moves along the electric field.
(d) decreases because the charge moves opposite to the electric field.

2. The electromagnetic radiations used for water purification and eye surgery is:
(a) Infrared (b) Microwave (c) X-rays (d) None of these

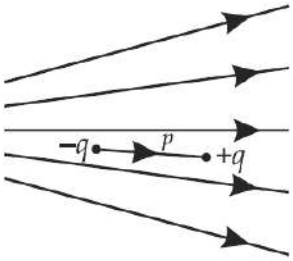
3. When a body is charged by conduction, its mass U
(a) remains same. (b) increases. (c) decreases. (d) increase or decrease.

4. Time period of a charged particle undergoing a circular motion in a uniform magnetic field is independent of
(a) speed of the particle (b) mass of the particle
(c) charge of the particle (d) magnetic field

5. Angular width of central maxima of a single slit diffraction pattern is independent of:
(a) slit width (b) frequency of the light used
(c) wavelength of the light used (d) distance between slit and screen

6. In a Young's double slit experiment, the source is white light. One of the holes is covered by a red filter and another by a blue filter. In this case
(a) there shall be alternate interference patterns of red and blue.
(b) there shall be an interference pattern for red distinct from that for blue.
(c) there shall be no interference fringes.
(d) there shall be an interference pattern for red mixing with one for blue.

7. Figure here shows electric field lines in which an electric dipole p is placed as shown. Which of the following statements is correct?



(a) The dipole will not experience any force.
(b) The dipole will experience a force towards right.
(c) The dipole will experience a force towards left.
(d) The dipole will experience a force upwards.

8. A paramagnetic sample shows a net magnetization of 8 Am^{-1} when placed in an external magnetic field of 0.6 T at a temperature of 4 K. When the same sample is placed in an external magnetic field of 0.2 T at a temperature of 16 K, the magnetisation will be
(a) 32/3 Am^{-1} (b) 2/3 Am^{-1} (c) 6 Am^{-1} (d) 2.4 Am^{-1}

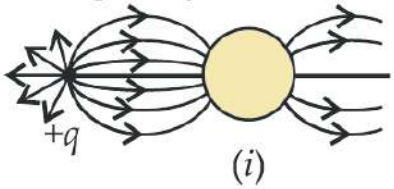
9. A negatively charged object X is repelled by another charged object Y. However an object Z is attracted to object Y. Which of the following is the most possibility for the object Z?
(a) positively charged only (b) negatively charged only
(c) neutral or positively charged (d) neutral or negatively charged

10. The output of a step-down transformer is measured to be 24 V when connected to a 12 W light bulb. The value of the peak current is 1
(a) $\frac{1}{\sqrt{2}A}$ (b) $\sqrt{2}A$ (c) 2A (d) $2\sqrt{2}$ A

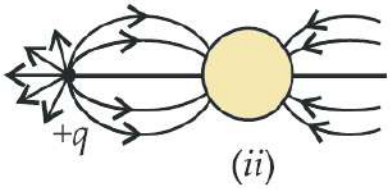
11. A charged particle oscillates about its mean equilibrium position with a frequency of 10^9 Hz. The electromagnetic waves produced.
(a) will have frequency of 10^9 Hz. (b) will have frequency of 2 x 10^9 Hz.
(c) will have a wavelength of 0.2 m. (d) fall in the region of micro-waves.

12. When a voltage measuring device is connected to AC mains, the metre shows the steady input voltage of 220 V. This means:
(a) Input voltage cannot be AC voltage, but a DC voltage.
(b) Maximum input voltage is 220 V.
(c) The metre reads not V but V_2 and is calibrated to read $\sqrt{V^2}$.
(d) The pointer of the meter is stuck by some mechanical defect.

13. A point positive charge is brought near an isolated conducting sphere in given figure. The electric field is best given by



(*i*)



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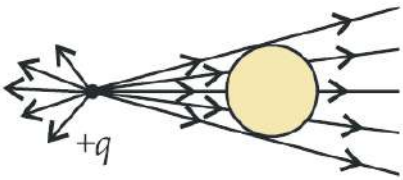

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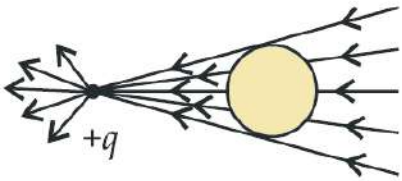


(*iv*)

(a) Fig. (i) (b) Fig. (ii) (c) Fig. (iii) (d) Fig. (iv)

14. The relationship between angle of incidence i, prism of angle A and angle of minimum deviation for a triangular prism is:

(a) $A + \delta_m = i$ (b) $A + \delta_m = 2i$ (c) $A + \delta/2$ (d) $2A + \delta_m = i$

15. A +q charge is placed in the centre of a cubical box. The total flux coming out of a wall has a value of:

(a) $\frac{q}{6\varepsilon_o}$ (b) $\frac{q}{\varepsilon_o}$ (c) $\frac{6q}{\varepsilon_o}$ (d) $\frac{q}{3\varepsilon_o}$

ASSERTION-REASON BASED QUESTIONS

In the following questions, a statement of assertion (A) is followed by a statement of Reason (R). Choose the correct answer out of the following choices.

(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): In the phenomenon of mutual induction, self induction of each of the coil persists.
Reason (R): Self-induction arises when strength of current in one coil changes. In mutual induction, current is changing in both the individual coils.

17. Assertion (A): Ferromagnetic substances become paramagnetic beyond Curie temperature.
Reason (R): Domains are destroyed at high temperature.

18. Assertion (A): The current in a.c. circuit is said to be wattless if average power consumed in the circuit is zero. It is the component $I_{rms} \sin \phi$ of the a.c.
Reason (R): In an inductive (L) or capacitive (C) circuit as $\phi = \pi/2$ so power factor = 0 and so the current is wattless.

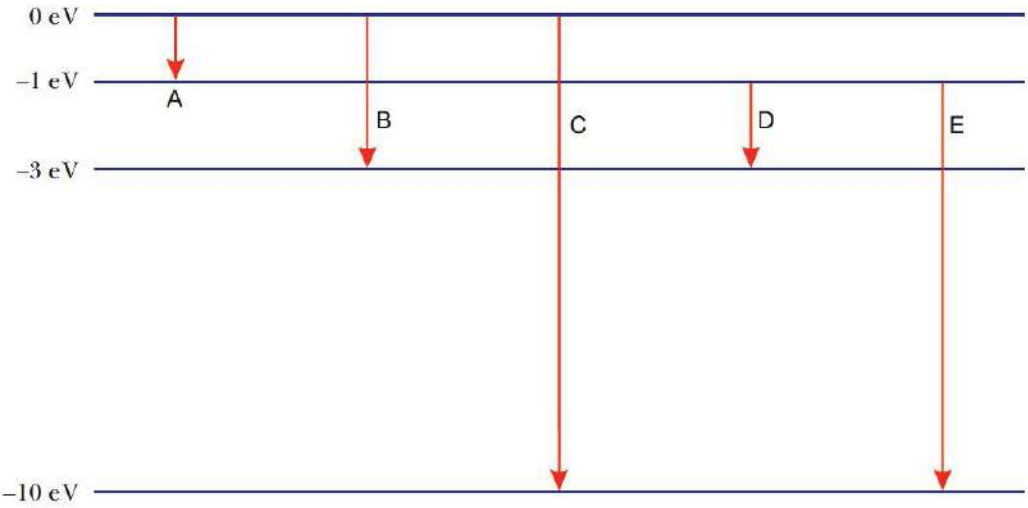
SECTION – B

Questions 19 to 25 carry 2 marks each.

19. Show that the radius of the orbit in hydrogen atom varies as n^2, where n is the principal quantum number of the atom.

OR

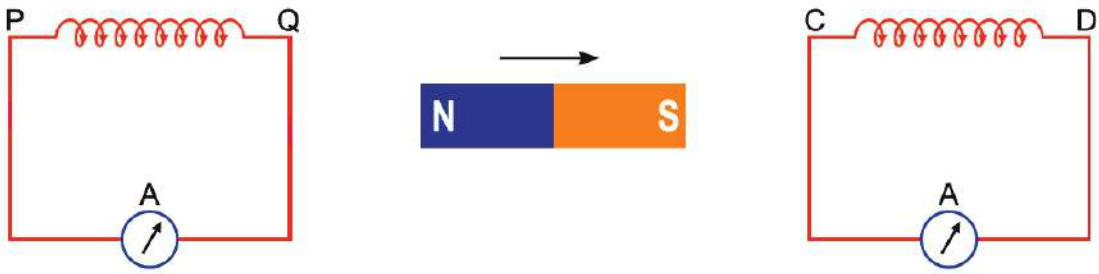
The energy levels of an atom are given below in the diagram.



Which of the transitions belong to Lyman and Balmer series? Calculate the ratio of the shortest wavelengths of the Lyman and the Balmer series of the spectra.

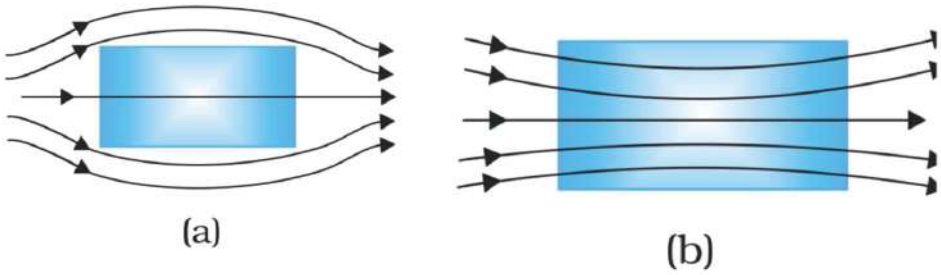
20. Write Einstein's photoelectric equation and point out any two characteristic properties of photons on which this equation is based.

21. A bar magnet is moved in the direction indicated by the arrow between two coils PQ and CD. Predict the directions of induced current in each coil.



OR

A uniform magnetic field gets modified as shown in figure when two specimens A and B are placed in it.



(i)Identify the specimen A and B.
(ii) How is the magnetic susceptibility of specimen A different from that of specimen B?

22. (i) What are the necessary conditions for total internal reflection to occur?
(ii) Draw a labelled diagram of an optical fibre and show how light propagates through the optical fibre using this phenomenon.

23. Draw the ray diagram of an astronomical telescope showing image formation in the normal adjustment position. Write the expression for its magnifying power.

24. (a) There are uniform electric and magnetic fields in a region pointing along X-axis. An a-particle is projected along Y-axis with a velocity v. What will be the shape of the trajectory?
(b) An electron is accelerated through a potential difference V. Write the expression for its final speed, if it was initially at rest.

25. Draw the intensity pattern for single slit diffraction and double slit interference. Hence, state two differences between interference and diffraction patterns.

SECTION – C

Questions 26 to 30 carry 3 marks each.

26. Define the terms (i) 'cut-off voltage' and (ii) 'threshold frequency' in relation to the phenomenon of photoelectric effect.
Using Einstein's photoelectric equation show how the cut-off voltage and threshold frequency for a given photosensitive material can be determined with the help of a suitable plot/graph.

27. How are electromagnetic waves produce? What is the source of energy of these waves? Write mathematical expressions for electric and magnetic fields of an electromagnetic wave propagating along the z-axis. Write any two important properties of electromagnetic waves.

28. A charge is distributed uniformly over a ring of radius '*a*'. Obtain an expression for the electric field intensity at a point on the axis of the ring. Hence, show that for points at large distances from the ring, it behaves like a point charge.

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 surface due to electric dipole.

29. An a.c. source generating a voltage $\varepsilon = \varepsilon_0 \sin \omega t$ is connected to a capacitor of capacitance C. Find the expression for the current I flowing through it. Plot a graph of ε and I versus ωt to show that the current is ahead of the voltage by $\pi/2$.

OR

An ac voltage $V = V_0 \sin \omega t$ is applied across a pure inductor of inductance L. Find an expression for the current i, flowing in the circuit and show mathematically that the current flowing through it lags behind the applied voltage by a phase angle of $\frac{\pi}{2}$. Also draw graphs of V and i versus ωt for the circuit.

30. (a) Three photo diodes D_1, D_2 and D_3 are made of semiconductors having band gaps of 2.5 eV, 2 eV and 3 eV respectively. Which of them will not be able to detect light of wavelength 600 nm?

(b) Why photodiodes are required to operate in reverse bias? Explain.

SECTION – D

Questions 31 to 33 carry 5 marks each.

31. (a) Define a wave front.

(b) Draw the diagram to show the shape of plane wave front as they pass through (i) a thin prism and (ii) a thin convex lens. State the nature of refracted wave front.

(c) Verify Snell's law of refraction using Huygens's principle.

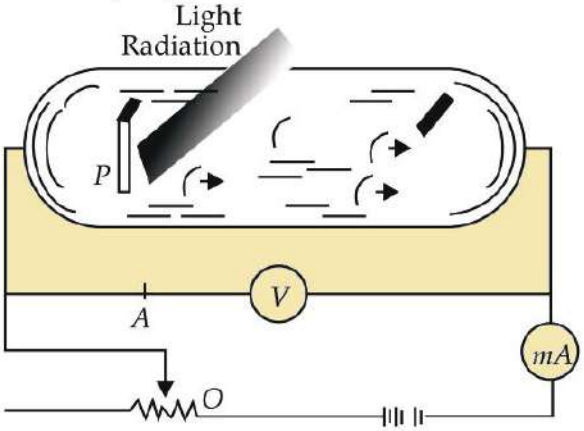
OR

(a) State two main considerations taken into account while choosing the objective of astronomical telescope.

(b) Draw a ray diagram of reflecting type telescope. State its magnifying power.

(c) State the advantages of reflecting type telescope over the refracting type.

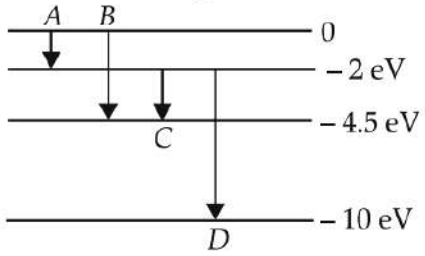
32. (a) Consider a beam of electron (each electron with energy E_0) incident on a metal surface kept in an evacuated chamber What may happen?



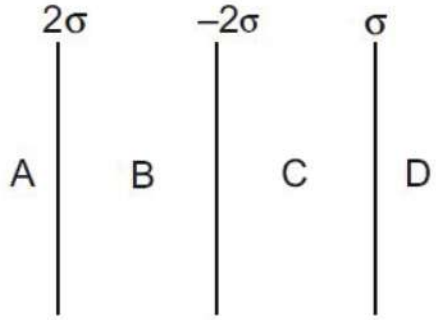
(b) What should be the wavelength of a photon required to remove a proton from a nucleus which is bound to the nucleus with 1 MeV energy?
(c) Define intensity of radiation on the basis of photon nature of light. Write its SI unit.

OR

(a) State Bohr's postulate to define stable orbits in hydrogen atom. How does de Broglie's hypothesis explain the stability of these orbits?
(b) A hydrogen atom initially in the ground state absorbs a photon which excites it to the n = 4 level. Estimate the frequency of the photon.
(c) The energy levels of a hypothetical atom are given below. Which of the shown transitions will result in the emission of photon of wavelength 275 nm?



33. (a) State Gauss's law in electrostatics. Using this law derive an expression for the electric field due to a uniformly charged infinite plane sheet.
(b) In the figure there are three infinite long thin sheets having surface charge density $+2\sigma$, -2σ and $+\sigma$ respectively. Give the magnitude and direction of electric field at a point to the left of sheet of charge density $+2\sigma$ and to the right of sheet of charge density $+\sigma$.



OR

(a) Define an ideal electric dipole. Give an example.
(b) Derive an expression for the torque experienced by an electric dipole in a uniform electric field. What is net force acting on this dipole.
(c) An electric dipole of length 2 cm is placed with its axis making an angle of 60^0 with respect to uniform electric field of 10^5 N/C.
If it experiences a torque of $8\sqrt{3}$ Nm, calculate the (i) magnitude of charge on the dipole, and (ii) its potential energy.

SECTION – E(Case Study Based Questions)

Questions 34 to 35 carry 4 marks each.

34. Case-Study 1:

Read the following paragraph and answer the questions

The relation between self-inductance and mutual inductance of two coils is $M = \sqrt{L_1 L_2}$. However, the above equation assumes zero flux leakage and 100% magnetic coupling between the two coils. In reality there is always some loss due to leakage and position, so the magnetic coupling between the two coils can never reach or exceed 100%. The fraction of magnetic flux produced by the current in one coil that links with the other coil is called the coefficient of coupling between the two coils. It is denoted by (k). k = 1, when the flux produced by one coil, completely links with the other coil and is called magnetically tightly coupled. k = 0, when the

flux produced by one coil, does not link at all with the other coil and thus the coils are said to be magnetically isolated.

(i) Under which condition the relation between self-inductance and mutual inductance of two coils M = $\sqrt{L_1 L_2}$ is valid?

(ii) What is coefficient of coupling?

(iii) When two coils are said to be magnetically isolated?

OR

When two coils are said to be magnetically tightly coupled?

35. Case-Study 2:

Read the following paragraph and answer the questions.

Capacitors Colour Code Read the following passage and answer the question that follows:

Capacitor Colour Code: Capacitor values as written on small capacitors are sometimes misleading. Letters like p (pico) or n (nano) are used in place of the decimal point to identify its position and the value of the capacitor. For example, a capacitor labelled as n33 = 0.33nE 8n2 = 8.2nF, 22n = 47nF and so on. Sometimes, capacitors are marked with the capital letter K to signify a value of Kilo pico-Farads. As for example, a capacitor with the markings of 100K would be 1000 x 100 pF = 100 KpF = 100 nF. Sometimes, a three letter code consists of the two value digits and a multiplier. For example, the digits 471 = 47 x 10 = 470 pF, 332 = 33 x 100 = 3300 pF. To reduce these confusions an International colour coding scheme was developed almost same as that of resistance colour code.

Band	Digit 1	Digit 2	Multiplier
Colour			
Black	0	0	x 1
Brown	1	1	x 10
Red	2	2	x 100
Orange	3	3	x 1,000
Yellow	4	4	x 10,000
Green	5	5	x 1,00,000
Blue	6	6	x 10,00,000
Violet	7	7	x 1,00,00,000
Grey	8	8	x 0.01
White	9	9	x 0.1

(i) What will be the colour code of a 27 nF capacitor?

(ii) What is the value of the capacitor bearing a colour code: brown, green, brown?

(iii) Two capacitors marked as 221 and 220, respectively are joined in parallel. What is the total capacitance value?

OR

68k is written on a capacitor. What is its value?