PRE-BOARD EXAMINATION – 2023

Std. 12 | **PHYSICS** | **Time : 3 hrs.**

11-12-2023 | **Max. Marks : 70**

General Instructions:

i) *There are 33 questions in all. All questions are compulsory.*

ii) *This question paper has five sections: Section A, Section B, Section C, Section D and Section E.*

iii) *All the sections are compulsory.*

iv) ***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.*

v) *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.*

vi) *Use of calculators is not allowed.*

vii) *You may use the following values of physical constants where ever necessary*

a) $c = 3 \times 10^8$ m/s b) $m_e = 9.1 \times 10^{-31}$ kg

c) $e = 1.6 \times 10^{-19}$ C d) $\mu_0 = 4\pi \times 10^{-7}$ TmA^{-1}

e) $h = 6.63 \times 10^{-34}$ Js f) $\varepsilon_0 = 8.854 \times 10^{-12}$ $C^2N^{-1}m^{-2}$

g) Avogadro's number = 6.023 X $10^{2^{23}}$per gram mole.

SECTION – A

1. The electric field in a region is given by $(5\hat{\imath} + 4\hat{\jmath} + 5\hat{k})$units, the electric flux through the surface Area of 20 units lying perpendicular the Y-Z plane will be:

(A) 100 units (B) 80 units

(C) 180 units (D) 20 units

2. The value of electric field inside a conducting sphere having radius R and charge Q will be:

(A) $\frac{KQ}{R}$ (B) $\frac{KQ}{R^2}$ (C) Zero (D) $\frac{KQ^2}{R}$

3. When radiation of given frequency is incident upon different metals, the maximum kinetic energy of electrons emitted;

(A) Decreases with increase of work function

(B) Increase with increase of work function

(C) Remains same with increase of work function

(D) Does not depend on work function

4. The orbital radius of first excited level of hydrogen atom is;

(A) $4r_o$ (B) $\frac{r_o}{2}$ (C) $2r_o$ (D) $8r_o$

5 The current sensitivity of a moving coil galvanometer is 5div/mA and its voltage sensitivity is 20div/V. The resistance of the galvanometer is:

(A) 40Ω (B) 25Ω (C) 250Ω (D) 500Ω

6. Two magnetic materials A and B have relative magnetic permeability of 0.96 and 500. Identify the magnetic materials A and B.

7. When a proton is released from rest in a room, it starts with an acceleration a_o towards west. When it is projected towards north with a speed of v_o, it moves with an initial acceleration $3a_o$ towards west. The electric and magnetic field in the room are;-

(A) $\frac{ma_o}{e}$ east, $\frac{3ma_o}{ev_o}$ vertically upwards (B) $\frac{ma_o}{e}$east, $\frac{3ma_o}{ev_o}$ vertically downwards

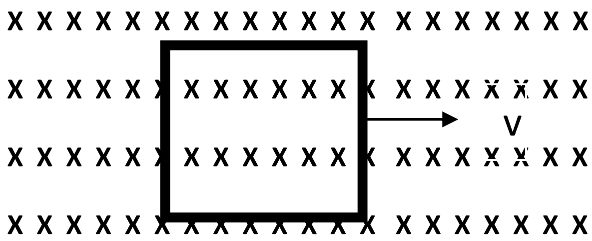
(C) $\frac{ma_o}{e}$ west, $\frac{3ma_o}{ev_o}$ vertically upwards (D) $\frac{ma_o}{e}$west, $\frac{3ma_o}{ev_o}$ vertically downwards

8. S.I unit of magnetic pole strength is;
(A) A/m (B) A-m (C) V/m (D) ampere-m^{-2}

9. If the angular speed of the armature and the number of turns of the coil in an a.c generator are doubled. Then the amplitude of the induced e.m.f will become;
(A) two times (B) ½ times (C) four times (D) same

10. The phase difference between electric field and magnetic filed in electromagnetic waves is:
(A) 0 (B) $\frac{\pi}{4}$ (C) $\frac{\pi}{2}$ (D) π

11. A conducting square loop of side 'l' and resistance 'R' moves in its plane with a uniform velocity 'v' in a region of uniform magnetic field 'B' as shown in the figure. The current induced in the loop is;



(A) $\frac{Blv}{R}$, clockwise (B) $\frac{Blv}{R}$, anticlockwise
(C) $\frac{2Blv}{R}$, anticlockwise (D) zero

12. The average binding energy per nucleon is maximum for the nucleus;
(A) ${}^{4}_{2}He$ (B) ${}^{56}_{26}Fe$ (C) ${}^{12}_{6}C$ (D) ${}^{238}_{92}U$

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 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.

13. Assertion (A): Photo electric effect demonstrates the wave nature of light.
Reason (R): The number of electrons emitted from a photo sensitive surface is directly proportional to the frequency of incident of radiation.

14. Assertion (A): When a pn junction diode is not biased, there is no motion of charge carriers.
Reason (R): In a pn junction diode with open ends the electric field is varying.

15. Assertion (A): An applied electric field will polarize the molecules in a polar dielectric.
Reason (R): In polar dielectric each molecule has permanent electric dipole moments.

16. Assertion (A): The minimum distance between an object and its real image formed by a convex lens is 2f.
Reason (R): The minimum distance between an object and its real image is minimum when its magnification is 2.

SECTION - B

17. Draw a neat diagram of a pn junction diode and explain how potential barrier is formed. (2)

18. Using photon picture of light, show how Einstein's photoelectric equation can be established. (2)

19. A ray of light passes through an equilateral prism such that i =e and e is ¾ times the angle of prism. Calculate refractive of material of prism. (2)

20. A cell of emf 'E' and internal resistance 'r' is connected across a variable resistor 'R'. Plot a graph showing variation of voltage 'V' of the cell versus the current 'I'. Using the plot, show how the emf of the cell and its internal resistance can be determined. (2)

21. Calculate the distance of an object of height 'h' from a concave mirror of radius of curvature 20 cm, so as to obtain a real image of magnification 2. Find the location of image also. (2)

(OR)

Draw a neat ray diagram of a compound microscope. Write its magnifying power. (2)

SECTION – C

22. The total energy of an electron in the first excited state of the hydrogen atom is about –3.4 eV.
   (i) What is the kinetic energy of the electron in this state?
   (ii) What is the potential energy of the electron in this state?
   (iii) Which of the answers above would change if the choice of the zero of potential energy is changed? (3)

23. Draw the circuit diagram of a meter bridge used to determine the unknown resistance 'X' of a given wire. Hence derive the expression for 'X' in terms of known resistance 'S' included in the resistance box. (3)

24. State Ampere's circuital law. Use this law to find magnetic field intensity due to an infinitely long straight current carrying wire. How are these magnetic field lines different from the electric field lines? (3)

25. State Gauss's theorem. Using it, derive an expression for electric field intensity at a point due to an infinite plane charge sheet. Write important characteristics of this electric filed intensity. (3)

26. Using Bohr's postulates, derive the expression for the total energy of the electron revolving in n^{th} orbit of hydrogen atom. Find the wave length of Hα. Given the value of Rydber constant $R=1.1 \times 10^7 m^{-1}$ (3)

27. Name the electromagnetic waves in the wavelength range of 10nm to 10 $\times 10^{-3}$ nm. How are these wave produced? Write two of its uses. (3)

28. (i) Define mutual inductance of a pair of coils.
   (ii) A pair of adjacent coils has a mutual inductance of 1.5H. If the current in one coil changes from 0 to 20A in 0.5 s, what is change of flux linkage with other coil (3)

(OR)

   (i) What do you mean by self induction? Why is it called so?
   (iii) Define one henry of self inductance.
   (ii) A current passing through a coil changing at the rate of 0.5A/s induces a back emf of 2V. Find the self inductance of the coil. (3)

SECTION – D

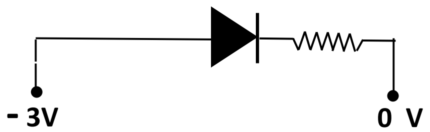
29. An intrinsic semiconductor is nothing but a semiconducting crystal in its pure form without any impurity present in it. A doped semiconductor is known as an extrinsic semiconductor. P-type extrinsic semiconductor is formed by adding a suitable trivalent element in a suitable proportion with tetravalent germanium or silicon crystal. Similarly, an N-type extrinsic semiconductor is

formed by adding a suitable pentavalant element with germanium or silicon. A p-n junction diode a semiconducting device formed by bringing intimate contact between a thin layer of p type and n type extrinsic semiconductors. This diode will be operated by applying a potential difference across the P section and N section. A diode is said to be forward biased when the potential applied to p-section is greater than potential applied to n-section and potential applied to p- section is less than n-section then the diode is said to be reverse biased. The diode is highly conductive during forward bias and non conductive during reverse bias. The I-V graph is a non linear obtained during forward or reverse bias of a diode. (1x4=4)

29.1 When germanium is doped with indium, thus the extrinsic semiconductor formed will be;
(A) n- type extrinsic semiconductor (B) n or p- type extrinsic semiconductor
(C) intrinsic semiconductor (D) p- type extrinsic semiconductor

29.2 Name two important processes that occur during the formation of a pn junction.

29.3 A p-n junction diode is applied with the potential as shown in figure.
The diode;
(A) is reverse biased
(B) is forward biased
(C) is non conductive
(D) is reverse biased & non conductive



29.4 The resistance of an ideal p-n junction diode during its reverse bias is;
(A) Zero (B) Infinity (C) 1.2 Ω (D) 6Ω

(OR)

The resistance of an ideal p-n junction diode during its forward bias is;
(A) 6Ω (B) Infinity (C) 1.2 Ω (D) Zero

30. The British physicist Thomas Young experimentally observed sustained interference pattern for monochromatic sodium light on a screen by using his famous double slit experimental arrangement. The two slits S_1 and S_2 being illuminated by light from a single slit behaves as two coherent sources of light. Light coming out of these slits superimpose and form alternate bright and dark fringes on the screen. The distance between two constructive bright fringes is called fringe width. (1x4=4)

30.1 What do you mean by coherent sources?
30.2 What do you mean by interference of light?
30.3 Two slits in this experiment are placed symmetrically with respect to the primary source. What is the initial phase difference between the waves liberated from the slits?
30.4 What will happen to fringe width if the whole apparatus is immersed in a liquid of refractive index 'μ'?

(OR)

Two waves of amplitudes A_1 and A_2 are superimposed on with a phase of 'Φ' at a point on the screen. Write the expression for resultant amplitude.

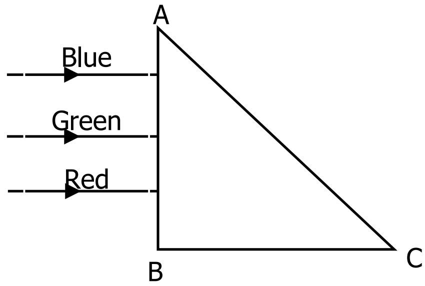
SECTION – E

31. (i) In Youngs' double slit experiment, write the condition for (a) constructive interference and (b) destructive interference at a point on the screen. Draw a graph showing the variation of intensity in the interference pattern against position 'x' on the screen.
(ii) Compare the interference pattern observed in Young's double slit experiment with single slit diffraction, point out three distinguishing features.

(OR)

(i) Sketch a graph to show the variation of the angle of deviation as a function of angle of incidence for light passing through a prism. Derive an expression for refractive index of the prism in terms of angle of minimum deviation and angle of prism.

(ii) A composite light consisting three colours incident on the surface of an isosceles right angled prism as shown in the figure. Given that refractive indices of glass for different colours μ_{Blue} =1.47, μ_{yellow} =1.44 and μ_{red} =1.39. Trace the path the light emerging through the surface AC.



32. (i) An a.c source of voltage $V=V_o \sin \omega t$ is connected to a series combination of L, C and R. Use the phasor diagram to obtain expressions for impedance of the circuit and phase difference between voltage and current. Find the condition when current will be in phase with voltage. What is circuit in this condition called?

(ii) In a series LR circuit X_L =R and power factor of the circuit is P_1, When capacitor with capacitance C such that $X_L = X_C$ is put in series. The power factors become P_2. Calculate $\frac{P_1}{P_2}$. (3+2)

(OR)

(i) Write the function of a transformer. State its principle of working with the help of a neat diagram. Mention various energy losses in this device.

(ii) The primary coil of an ideal step up transformer hass 100 turns and transformation ratio is 100. The input voltage and power respectively are 220V and 1100W. Calculate:

(a) Number of turns in secondary (b) current in primary (c) voltage across secondary (d) current in secondary (e) power in secondary. (2½+2½)

33. Find the expression for the energy stored in the capacitor. Also find the energy lost when the charged capacitor is disconnected from the source and connected in parallel with the uncharged capacitor. Where does this loss of energy appear? (2+2+1)

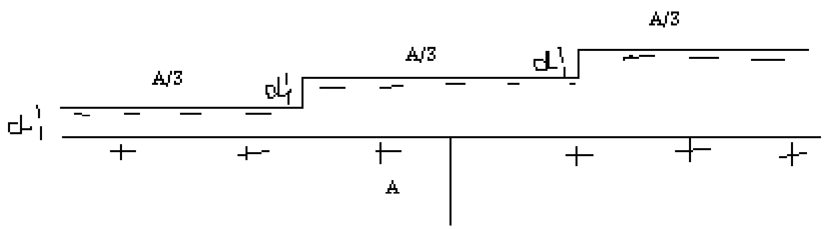
(OR)

(i) An electric dipole is held in a uniform electric field.

(a) Using suitable diagram, show that it does not undergo any translatory motion.

(b) Define torque. Give its SI unit. Derive an expression for the torque acting on this dipole.

(ii) A capacitor is made of a flat plate of area A and second plate having a stair like structure as shown in figure below. If width of each stair is A/3 and height is d. Find the capacitance of the arrangement. (3+2)



-x-x-x-x-x-x-x-