PRE-BOARD EXAMINATION 2 (2019-20)
PHYSICS (THEORY-042)
CLASS – XII

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

General Instructions:

1. *All questions are compulsory. There are 37 questions in all.*
2. *This question paper has four sections: Section A, Section B, Section C and Section D.*
3. *Section A contains twenty questions of one mark each, Section B contains seven questions of two marks each, Section C contains seven questions of three marks each, and Section D contains three questions of five marks each.*
4. *There is no overall choice. However, internal choices have been provided in two questions of one mark each, two questions of two marks, one question of three marks and three questions of five marks weightage. You have to attempt only one of the choices in such questions.*
5. *You may use the following values of physical constants where ever necessary.*

$c = 3 \times 10^{8}$ m/s

$h = 6.63 \times 10^{-34}$ Js

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

$\mu_0 = 4\pi \times 10^{-7}$ TmA^{-1}

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

$\frac{1}{4\pi\varepsilon_0} = 9 \times 10^{9}$ N m^2 C^{-2}

$m_e = 9.1 \times 10^{-31}$ kg

mass of neutron = 1.675×10^{-27} kg

mass of proton = 1.673×10^{-27} kg

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

Boltzmann constant = 1.38×10^{-23} JK^{-1}

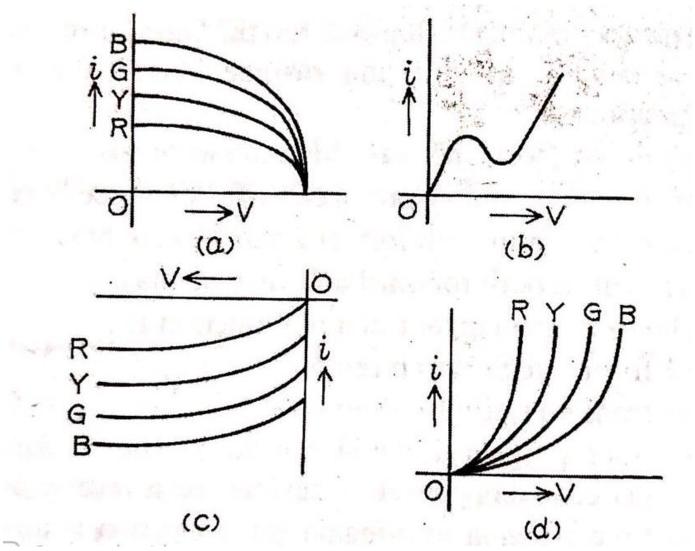
SECTION-A

Directions (Q1-Q10) Select the most appropriate option from those given below each question.

1. n-type semiconductors is formed: **1**
(a) when a germanium crystal is doped with an impurity containing 3 valance electrons
(b) when a germanium crystal is doped with an impurity containing 5 valance electrons
(c) from pure germanium
(d) from pure silicon.

2. The wavelength of a photon needed to remove a proton from a nucleus which is bound to the nucleus with 1 MeV energy is nearly **1**
(a) 1.2 nm (b) 1.2×10^{-3} nm (c) 1.2×10^{-6} nm (d) 1.2×10^{1} nm

3. The *I-V* characteristics of an LED is: **1**



4. The average binding energy per nucleon of most nuclei is of the order of: **1**

(a) 10^{-12} eV (b) 10^{-12} MeV (c) 10^{-12} BeV (d) 10^{-12} J

5. An electron and positron are formed by a photon of energy 2.6 MeV. The total kinetic energy of both these particles will be (approximately): **1**

(a) 2.6 MeV (b) 1.6 MeV (c) 1.0 MeV (d) 3.6MeV

6. The simple Bohr model cannot be directly applied to calculate the energy levels of an atom with many electrons. This is because **1**

(a) of the electrons not being subject to a central force.

(b) of the electrons colliding with each other

(c) of screening effects

(d) the force between the nucleus and an electron will no longer be given by Coulomb's law.

7. The force responsible for γ- particle scattering is: **1**

(a) gravitational force (b) nuclear force

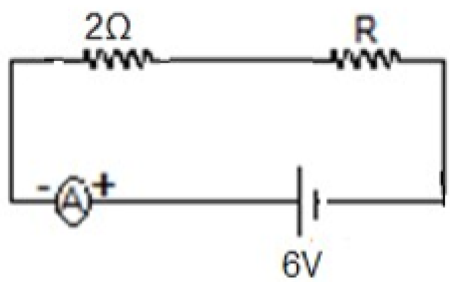
(c) coulombian force (d) magnetic force

8. The ionisation potential of hydrogen atom in the lowest orbit of electron is -13.6 eV. Its electron-energy in the n = 2 state is : **1**

(a) 3.4 eV (b) -6.8 eV (c) -13.6 eV (d) -27.2 eV

9. If the ammeter in the given circuit shown in the diagram reads 2A, the resistance R is : **1**

(a) 1Ω (b) 2Ω (c) 3Ω (d) 4Ω



10. Time period of a charged particle undergoing a circular motion in a uniform magnetic field is independent of : **1**

(a) speed of the particle (b) mass of the particle

(c) charge of the particle (d) magnetic field

Directions (Q11 –Q15) Fill in the blanks with appropriate answer.

11. If the angular speed of the armature of a dynamo is doubled then the amplitude of the induced e.m.f will become_______. **1**

OR

An equilateral prism is made up of material of refractive index . The angle of minimum deviation of light passing through the prism is_________.

12. A free floating magnetic needle at North pole is __________to the surface of earth. **1**

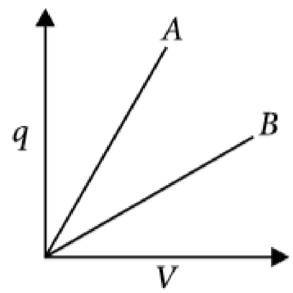
13. The magnetic field due to a solenoid is given by __________ **1**

14. The force is __________ when the currents in the conductors are in the same direction. **1**

15. Dip is __________ at the equator and 90^0 at the magnetic poles. **1**

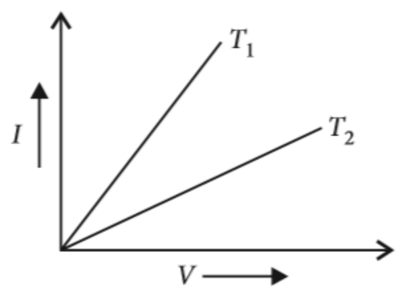
Directions (Q16 –Q20) Answer the following:-

16. The given graph shows variation of charge '*q*' versus potential difference '*V*' for two capacitors C_1 and C_2. Both the capacitors have same plate separation but plate area of C_2 is greater than that of C_1. Which line (A or B) corresponds to C_1 and why? **1**



17. What is the characteristic property of a diamagnetic material? **1**

18. *I-V* graph for a metallic wire at two different temperatures, T_1 and T_2 is as shown in the figure. Which of the two temperatures is lower and why? **1**



19. Why electric field lines are perpendicular at a point on an equipotential surface of a conductor? **1**

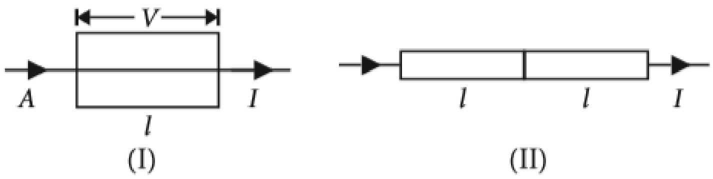
20. A capacitor has been charged by a dc source. What are the magnitude of conduction and displacement current, when it is fully charged? **1**

OR

Arrange the following electromagnetic waves in order of increasing frequency: γ-rays, Microwaves, Infrared rays and Ultraviolet rays.

SECTION-B

21. A metal rod of square cross-sectional area *A* having length *l* has current *I* flowing through it when a potential difference of *V* volt is applied across its ends (figure I). Now the rod is cut parallel to its length into two identical pieces and joined as shown in figure II. What potential difference must be maintained across the length of *2l* so that the current in the rod is still *I* ?



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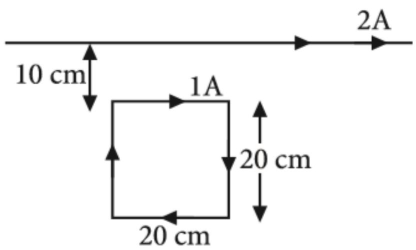
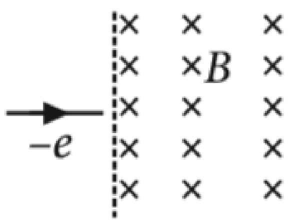
22. A square loop of side 20 cm carrying current of 1 A is kept near an infinite long straight wire carrying a current of 2 A in the same plane as shown in the figure. **2**



Calculate the magnitude and direction of the net force exerted on the loop due to the current carrying conductor.

23. An electron moving horizontally with a velocity of 4×10^4 m/s enters a region of uniform magnetic field of 10^{-5} T acting vertically upward as shown in the figure. **2**



Draw its trajectory and find out the time it takes to come out of the region of magnetic field.

24. If χ stands for the magnetic susceptibility of a given material, identify the class of material for which **2**

(i) $-1 \leq \chi < 0$

(ii) $0 < \chi < \varepsilon$ (ε stands for a small positive number)

25. How are X-rays produced? Write their two important uses. **2**

26. (a) Write the conditions under which light sources can be said to be coherent. **2**

(b) Why is it necessary to have coherent sources in order to produce an interference pattern?

OR

A parallel beam of light of 500 nm falls on a narrow slit and the resulting diffraction pattern is observed on a screen 1 m away. It is observed that the first minimum is at a distance of 2.5mm from the centre of the screen. Calculate the width of the slit.

27. The electron in a given Bohr orbit has a total energy of –1.5 eV. Calculate its **2**

(i) kinetic energy.

(ii) potential energy.

(iii) wavelength of radiation emitted, when this electron makes a transition to the ground state.

[Given: Energy in the ground state = –13.6 eV and Rybderg's constant = 1.09×10^{7} m^{-1}]

OR

Calculate the de-Broglie wavelength of the electron orbiting in the n = 2 state of hydrogen atom.

SECTION-C

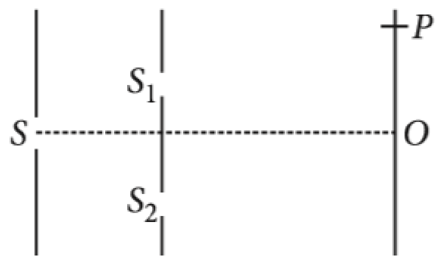
28. (a) Find the relation between drift velocity and relaxation time of charge carriers in a conductor. **3**

(b) A conductor of length L is connected to a d.c. source of e.m.f. V. If the length of the conductor is tripled by stretching it, keeping V constant. Explain how drift velocity would be affected.

29. (a) How is the focal length of a spherical mirror affected when the wavelength of the light used is increased? **3**

(b) A convex lens has 20 cm focal length in air. What is its focal length in water? (Refractive index of air-water = 1.33, refractive index of air-glass = 1.5).

30. In a modified set-up of Young's double slit experiment, it is given that $SS_2 - SS_1 = \frac{\lambda}{4}$, i.e. the source '$S$' is not equidistant from the slits S_1 and S_2. **3**



(a) Obtain the conditions for constructive and destructive interference at any point P on the screen in terms of the path difference, $\delta = S_2P - S_1P$.

(b) Does the observed central bright fringe lie above or below 'O'? Give reason to support your answer.

31. State the necessary conditions for producing total internal reflection of light. Draw ray diagrams to show how specially designed prisms make use of total internal reflection to obtain inverted image of the object by deviating rays (i) through 90° and (ii) through 180°. **3**

32. In a plot of photoelectric current versus anode potential, how does **3**

(i) the saturation current vary with anode potential for incident radiations of different frequencies but same intensity.

(ii) the stopping potential vary for incident radiations of different intensities but same frequency.

(iii) photoelectric current vary for different intensities but same frequency of incident radiations. Justify your answer in each case.

OR

Define the term "cut off frequency" in photoelectric emission. The threshold frequency of a metal is *f*. When the light of frequency *2f* is incident on the metal plate, the maximum velocity of photo-electron is v_1. When the frequency of the incident radiation is increased to *5f*, the maximum velocity of photoelectrons is v_2. Find the ratio $v_1 : v_2$.

33. (i) Describe the working principle of a solar cell. Mention three basic processes involved in the generation of emf. **3**

(ii) Why are *Si* and *GaAs* preferred materials for solar cells?

34. In a parallel plate capacitor with air between the plates, each plate has an area of 6×10^{-3} m^2 and the separation between the plates is 3 mm. **3**

(i) Calculate the capacitance of the capacitor.

(ii) If this capacitor is connected to 100V supply, what would be the charge on each plate?

(iii) How would charge on the plates be affected, if a 3 mm thick mica sheet of $K = 6$ is inserted between the plates while the voltage supply remains connected?

SECTION- D

35. (a) Define the term 'mutual inductance'. Deduce the expression for the mutual inductance of two long coaxial solenoids having different radii and different number of turns. **5**

(b) A coil is mechanically rotated with constant angular speed ω in a uniform magnetic field which is perpendicular to the axis of rotation of the coil. The plane of the coil is initially held perpendicular to the field. Plot a graph showing variation of

(i) magnetic flux f and

(ii) the induced emf in the coil as a function of ωt.

OR

What are eddy currents? How are they produced? Describe briefly three main useful applications of eddy currents.

36. (i) Draw a labelled diagram of a step-down transformer. State the principle of its working. **5**

(ii) Express the turn ratio in terms of voltages.

(i) Find the ratio of primary and secondary currents in terms of turn ratio in an ideal transformer.

(ii) How much current is drawn by the primary of a transformer connected to 220 V supply when it delivers power to a 110 V – 550 W refrigerator?

OR

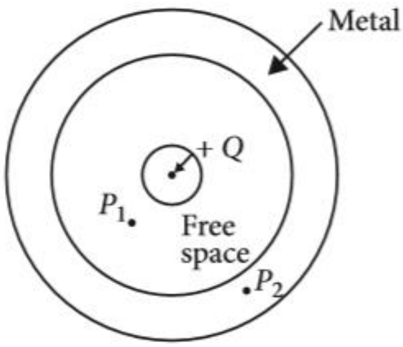
(i) With the help of a labelled diagram, describe briefly the underlying principle and working of a step up transformer.

(ii) Write any two sources of energy loss in a transformer.

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

37. (i) Define electric flux. Write its S.I. unit. **5**

(ii) A small metal sphere carrying charge $+Q$ is located at the centre of a spherical cavity inside a large uncharged metallic spherical shell as shown in the figure. Use Gauss's law to find the expressions for the electric field at points P_1 and P_2.



(iii) Draw the pattern of electric field lines in this arrangement.

OR

(a) Using Gauss's law, derive an expression for the electric field intensity at any point outside a uniformly charged thin spherical shell of radius R and charge density σ C/m^2. Draw the field lines when the charge density of the sphere is (i) positive, (ii) negative.

(b) A uniformly charged conducting sphere of 2.5 m in diameter has a surface charge density of 100 $\mu C/m^2$. Calculate the

(i) charge on the sphere.

(ii) total electric flux passing through the sphere.