Pre-Board Examination 1- 2019-2020

Sub: Physics

Class: XII Marks: 70

Date: Time: 3 hrs.

General Instructions:

1. This paper consists of 8 printed pages and 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 20 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, an internal choice has been provided in one question of two marks, one question of three marks and all the three questions of five marks weightage.
5. You have to attempt only one of the choices in such questions.
6. You may use the following values of physical constants wherever necessary.
   - $c = 3 \times 10^{8}$ m/s
   - $h = 6.63 \times 10^{-34}$ Js
   - $e = 1.6 \times 10^{-19}$ C
   - $\mu_o = 4\pi \times 10\text{-}7$ T m A $^{-1}$
   - $\boldsymbol{\varepsilon}_0 = 8.854 \times 10\text{-}12$ C2N^{-1} m^{-2}
   - $1/ 4\pi\varepsilon_0 = 9 \times 109$ N m^{2} C $^{-2}$
   - Mass of electron = 9.1×10^{-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:

1 What is the value of the angle between the vectors $\vec{p}$ and $\vec{E}$ for which the potential energy of an electric dipole of dipole moment $\vec{p}$, kept in an external electric field $\vec{E}$, has maximum value? 1

2 Name the colours corresponding to the digits 4 and 7 in the colour code scheme for carbon resistors. 1

3 State which of the two, the capacitor or an inductor, tends to become a SHORT when the frequency of the applied alternating voltage has a very high value. 1

4 Derive the relation between radius of curvature and focal length of a concave mirror. 1

5 What is the longest wavelength corresponding to Lyman series? 1

6 A ray of light incident at an angle θ on a refracting face of a prism emerges from the other face normally. If the angle of the prism is 5° and the prism is made of a material of refractive index 1.5, the angle of incidence is 1

(a) 7.5°.

(b) 5°.

(c) 15°.

(d) 2.5°.

7 The optical density of turpentine is higher than that of water while its mass density is lower. Fig 9.2. Shows a layer of turpentine floating over water in a container. For which one of the four rays incident on turpentine in Fig 9.2, the path shown is correct? 1

(a) 1

(b) 2

(c) 3

(d) 4

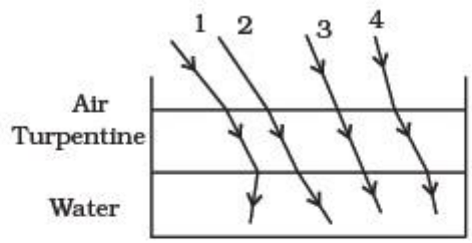


Fig. 9.2

8 1. In a cyclotron, a charged particle 1
(a) Undergoes acceleration all the time.
(b) Speeds up between the dees because of the magnetic field.
(c) Speeds up in a dee.
(d) Slows down within a dee and speeds up between dees.

9 In a permanent magnet at room temperature 1
(a) Magnetic moment of each molecule is zero.
(b) The individual molecules have non-zero magnetic moment which are all perfectly aligned.
(c) Domains are partially aligned.

10 A loop, made of straight edges has six corners at A(0,0,0), B(L,O,0) ,C(L,L,0), D(0,L,0) E(0,L,L) and 0,0,L). A magnetic field ˆ ˆ B = Bo (i + k) T is present in the region. The flux passing through the loop ABCDEFA (in that order) is 1
(a) Bo L^2 Wb.
(b) 2 Bo L^2 Wb.
(c) $\sqrt{2}$ Bo L^2 Wb.
(d) 4 Bo L^2 Wb

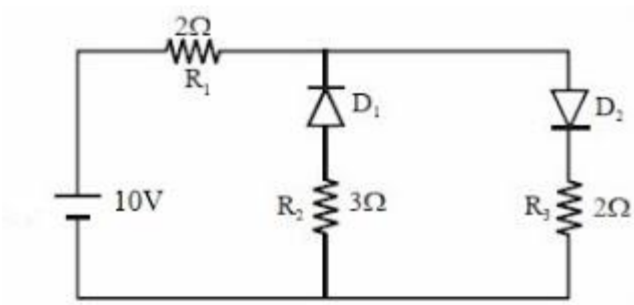
11 If the rms current in a 50 Hz ac circuit is 5 A, the value of the current 1/300 seconds after its value becomes zero is 1
(a) $5\sqrt{2}$ A
(b) $5\sqrt{(3/2)}$ A
(c) 5/6 A
(d) $5/\sqrt{2}$ A

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

13 A long solenoid has 1000 turns per metre and carries a current of 1 A. It has a soft iron core of μ_r = 1000. The core is heated beyond the Curie temperature, Tc
.

(a) The H field in the solenoid is (nearly) unchanged but the B field decreases drastically.
(b) The H and B fields in the solenoid are nearly unchanged.
(c) The magnetization in the core reverses direction.
(d) The magnetization in the core diminishes by a factor of about 10^8. 1

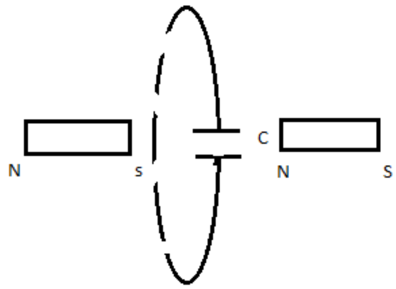
14 The given circuit has two ideal diodes connected as shown in the figure below. 1



The current flowing through the resistance R_1 will be
(1) 1.43 A
(2) 3.13 A
(3) 2.5 A
(4) 10.0 A

15 The work function of Platinum is twice that of the work function of Calcium. If the minimum photon energy required to emit photoelectrons from the surface of Platinum is E, then that for the surface of Calcium would be 1
a)2E
b)3E/2
c)E/2
d)Cannot be determined

16 Two bar magnets are moved towards a metallic loop quickly which is connected across a capacitor C. what is the polarity of the capacitor. 1



State whether true or false:

17 Resolving power of a microscope depends on the focal length of the objective. 1

18 Metals have very low temperature coefficient of resistance at room temperature. 1

19 Equipotential surfaces are equidistant in a uniform field. 1

20 Magnetic Core of the earth causes magnetism of the earth 1

SECTION B:

21 A 400 cm potentiometer wire has a resistance of 100 Ω which is connected to a battery of 4 V and a resistance of 10 ohm in series. A voltmeter reads V volt across the balance point of 240 cm of the potentiometer wire. Find the voltage V. 2

22 Name the phenomenon which proves transverse wave nature of light. Give two uses of the device which works based on this phenomenon. 1+1

OR

Name the phenomenon which is responsible for bending of light around sharp corners of an obstacle. Under what conditions does this phenomenon take place? Give one application of this phenomenon in everyday life. ½ +1+ ½

23 The equivalent wavelength of a moving electron has the same value as that of a photon having an energy of 6×10^{-17} J. Calculate the momentum of the electron. 2

24 The short wavelength limit for the Lyman series of the hydrogen spectrum is 913.4 Å. Calculate the short wavelength limit for Balmer series of hydrogen spectrum. 2

25 Draw the energy band diagram for an n type and a p-type semiconductor. 2

26 Eight identical spherical drops, each carrying a charge 1 nC are at a potential of 900 V each. All these drops combine together to form a single large drop. Calculate the potential of this large drop. (Assume no wastage of any kind and take the capacitance of a sphere of radius r as proportional to r). 2

27 In the circuit to determine the galvanometer constant, the current flowing in the galvanometer G when the key K2 is kept open is I. On closing the key K2, the current in the galvanometer becomes I /n, where n is an integer. Obtain an expression for resistance Rg of the galvanometer in terms of high resistance R, shunt resistance S and n. To what form does this expression reduce when the value of R is very large as compared to S? 2

Section C:

28 The magnitude F of the force between two straight parallel current carrying conductors kept at a distance d apart in air is given by F = μ_0 2Π $I1I2/$ d Where I1 and I2 are the currents flowing through the two wires Use this expression, and the sign convention that the Force of attraction is assigned a negative sign and Force of repulsion is assigned a positive sign. 1+1+1
Draw graphs showing dependence of F on (i) $I1I2$ when d is kept constant (ii) d when the product $I1I2$ is maintained at a constant positive value. (iii) d when the product $I1I2$ is maintained at a constant negative value.

OR

Draw graphs to show the variation of intensity of magnetization with magnetic intensity for high positive, low positive and high negative susceptibility. 1+1+1

29 Find the value of the phase lag/lead between the current and voltage in the given series LCR circuit consisting of 2μF capacitor, 3 m H inductor and a 40 ohm resistor in series with a 220 V 50 Hz AC supply. Without making any other change, find the value of the additional capacitor, such that when 'suitably joined' to the capacitor (C= 2μF) that would make the power factor of this circuit unity. 1 ½ +1 ½

30 A point object O is kept at a distance of 30 cm from a convex lens of power +4D towards its left. It is observed that when a convex mirror is kept on the right side at a distance of 50 cm from the convex lens, the image of the object O formed by the lens-mirror combination coincides with the object itself. Calculate the focal length of the convex mirror. 3

31 Define radio activity. State the laws of radio activity. Derive the equation for number of radioactive nuclei left un-decayed after a time t. define half-life. Derive an equation for the same. 3

32 What are the two processes that help in the formation of the junction? What are the variable and steady states of a diode? Define junction potential? 1 + 1 +1

33 The data given below gives the photon energy (in eV) for a number of waves whose wavelength values (in nm) are also given. 1+1+1

WAVELENGTH (nm)	PHOTON ENERGY (e V)
200	6.216
400	3.108
600	2.072
800	1.556
1000	1.243
1200	1.036

(Without doing any calculation/taking any reading), explain how one can use this data to draw an appropriate graph to infer

(i) Photon energy corresponding to a wavelength of 100 nm. (ii) The wavelength value (in nm) corresponding to a photon energy of 1 eV. (iii) Velocity of light assuming that the value of Plank's constant is known.

34 Give reasons for the following: 1 +1 +1

(i) The Zener diode is fabricated by heavily doping both the p and n sides of the junction

(ii) (ii) A photodiode, when used as a detector of optical signals is operated under reverse bias.

(iii) (iii) The band gap of the semiconductor used for fabrication of visible LED's must at least be 1.8 eV.

SECTION D:

35 a) State the theorem which relates total charge enclosed within a closed surface S and the electric flux passing through it. Prove it for a single point charge. 2 + 3

b) An 'atom' was earlier assumed to be a sphere of radius a having a positively charged point nucleus of charge +Ze at its centre. This nucleus was believed to be surrounded by a uniform density of negative charge that made the atom neutral as a whole. Use this theorem to find the electric field of this 'atom' at a distance r (r> a. If this dipole were to be put in a uniform external electric field, obtain an expression for the torque acting on the dipole.

OR 2 +2 + 1

Show that the electric field at any point on the axial line of the electric dipole is twice that along the equatorial line of the dipole, if the distance of the point on either line are equal. (You are expected to derive both expressions first).

36 State the laws which relates to generation of induced emf in a conductor being moved in a magnetic field with the expressions. Apply these laws to obtain an expression for the induced emf when one rod of length L is free to move with an angular velocity w in a uniform, time independent and 'normal' magnetic field B. 2 +3

OR

1 +1 +2 +1

An a.c. voltage V = Vm sin ωt is applied across an inductor of inductance L.
Apply Kirchhoff's loop rule to obtain expressions for (i) the current flowing in the circuit (ii) the inductive reactance L Hence find the instantaneous power Pi supplied to the inductor. Show graphically the variation of Pi with ωt.

37 Explain, with the help of a diagram, how is the phenomenon of total internal reflection used in 1 +1 +3
(i) an optical fibre
(ii) A prism that inverts an image without changing its size.
A right angled prism made from a material of refractive index μ is kept in air.
A ray PQ is incident normally on the refracting side AB of the prism.
Find (in terms of μ) the maximum value of θ up to which this incident ray necessarily undergoes total internal reflection at the face AC of the prism.

OR 1 +1 +3

State Huygens's principle in wave-optics. How did Huygens explain the absence of the back wave? Use this principle to draw the refracted wave front for a plane wave incident from a denser to a rarer medium. Hence obtain Snell's law of refraction.