FIRST PREBOARD EXAMINATION (2019-20)

CLASS: XII

Subject: PHYSICS **Date: 08.12.2019**

Time allowed: 3Hours Maximum Marks: 70

General Instructions:

1. **All** questions are **compulsory**.
2. This question paper contains 10 printed pages.
3. There are **37** questions in all.
4. This question paper has four sections: Section A, Section B, Section C and Section D.
5. 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.
6. There is no overall choice. However, internal choices have been provided in two questions of one mark, 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.
7. You may use the following values of physical constants wherever necessary.

$$\mu_\circ = 4\pi x10^{-7}\ TmA^{-1}$$
$$1/4\pi\varepsilon_\circ = 9x10^{9} Nm^{2}C^{-2}$$
$$c=3x10^{8}\ m/s$$
$$e=1.6x10^{-19}C$$
$$\varepsilon_\circ = 8.854x10^{-12}\ C^{2}N^{-1}m^{-2}$$
$$h = 6.63\ X\ 10^{-34}\ Js$$
$$R = 1.03x10^{7}m^{-1}$$
$$\text{mass of neutron} = 1.67x\ 10^{-27}\ kg$$
$$\text{mass of electron} = 9.1x10^{-31}\ kg$$
$$\text{mass of proton} = 1.673\ x\ 10^{-27}\ kg$$

Section – A

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

1. Two charges are at distance d apart in air. Coulomb force between them is F. If a dielectric material of dielectric constant K is placed between them, the coulomb force now becomes 1
   (a) F/K (b) FK
   (c) F/K^2 (d) K^2F

2. If a unit positive charge is taken from one point to another over an equipotential surface, then 1
   (a) work is done on the charge. (b) work is done by the charge.
   (c) work done is constant. (d) no work is done.

   OR

   A capacitor is charged by a battery. The battery is removed and another identical uncharged capacitor is connected in parallel. The total electrostatic energy of resulting system 1
   (a) decreases by a factor of 2 (b) remains the same
   (c) increases by a factor of 2 (d) increases by a factor of 4

3. A 100W, 200V bulb is being operated at 160V, the power dissipation is 1
   (a) 32 W (b) 64 W
   (c) 100 W (d) 160 W

4. The sensitivity of a moving coil galvanometer increases with the decrease in 1
   (a) number of turns (b) area of coil
   (c) magnetic field (d) torsional constant of spring

5. The mutual induction of two coils depends upon 1
   (a) medium between coils (b) separation between coils
   (c) both on (a) and (b) (d) none of (a) and (b)

   OR

   Lenz's law is essential for
   (a) Conservation of energy (b) conservation of mass 1
   (c) conservation of momentum (d) conservation of charge

6. The peak value of 220 V ac voltage is 1
   (a) 155.6V (b) 220.0V
   (c)311V (d) 440V

7. In a pure capacitive circuit, the current 1

(a) lags behind applied emf by angle $\pi/2$
(b) leads the applied emf by an angle π
(c) leads the applied emf by an angle $\pi/2$
(d) and applied emf are in same phase

8. A plane electromagnetic wave of energy U and velocity c is incident on a nonreflecting surface. Then the momentum transferred by the electromagnetic wave to the surface is 1

(a) 0 (b) $\frac{U}{c}$
(c) $\frac{2U}{c}$ (d) $\frac{U}{2c}$

9. If an electromagnetic wave of wavelength 500 km is to be produced by an oscillating charge, then frequency of oscillating charge must be 1

(a) 600Hz (b) 500 Hz
(c) 167 Hz (d) 15 Hz

10. Electrons used in an electron microscope are accelerated by a voltage of 25 kV. If the voltage is increased to 100 kV then the de-Broglie wave length associated with the electrons would 1

(a)increase by 2 times (b) decrease by 2 times
(c) decrease by 4 times (d) increase by 4 times

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

11. When red light is replaced by blue light in interference experiment, the fringe width ---------------. 1

12. The radius of inner most orbit of a hydrogen atom is 5.1×10^{-11} m. The radius of orbit in the second excited state is---------------. 1

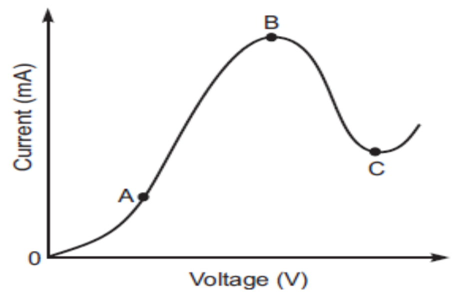
13. ------------------ are charge less (neutral) and almost massless particles that hardly interact with matter. 1

14. The width of depletion layer of a p-n junction diode ----------- when it is reverse biased. 1

15. A p-n junction device that does not draw current but supplies the same to the load is ----------------------. 1

Directions (Q16 –Q20) Answer the following

16. The graph shown in the figure represents a plot of current versus voltage for a given semiconductor. Identify the region, if any, over which the semiconductor has a negative resistance. 1



17. Does a bar magnet exert a torque on itself due to its own field? 1

18. Why does bluish colour predominate in a clear sky? 1

19. Draw the geometrical shape of the emerging wave front when a plane wave passes through a convex lens? 1

20. Under what condition does a biconvex lens of glass having a certain refractive index act as a plane glass sheet when immersed in a liquid? 1

Section -B

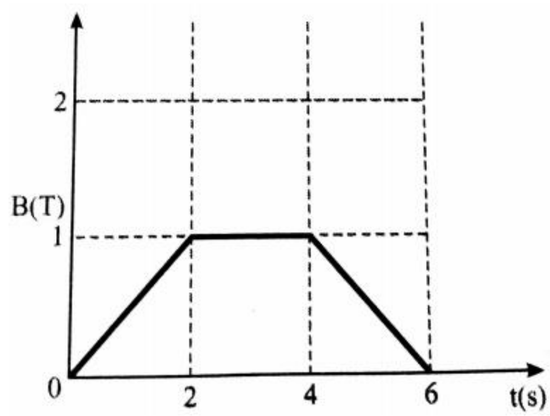
21. A thin straight infinitely long conducting wire having charge density λ is enclosed by a cylindrical surface of radius r and length l, its axis coinciding with the length of the wire. Find the expression for the electric flux through the surface of the cylinder. 2

22. A capacitor of unknown capacitance is connected across a battery of V volt. The charge stored in it is 360 μC. When potential across the capacitor is reduced by 120 volt, the charge stored in it becomes 120 μC. Calculate the potential V and the unknown capacitance C. 2

23. (a) Obtain the expression for the cyclotron frequency. 2

(b) A deuteron and a proton are accelerated by the cyclotron. Can both be accelerated with the same oscillator frequency? Give reason to justify your answer.

24. The magnetic field through a circular loop of wire 12 cm in radius and 8.5 Ω resistance, changes with time as shown in the figure. The magnetic field is perpendicular to the plane of the loop. Calculate the induced current in the loop and plot it as a function of time. 2



OR

What are eddy currents? How are they produced? How can they be minimised in transformer? 2

25. State two properties of electromagnetic waves. How can we show that electromagnetic waves carry momentum? 2

OR

(a) Which segment of electromagnetic waves has highest frequency? Give one use of these waves. 2

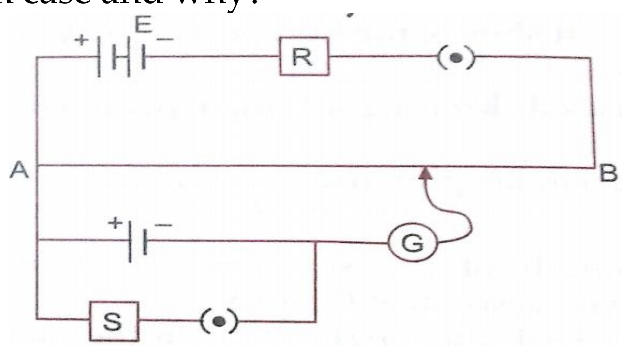
26. Unpolarised light of intensity I_0 is passed through a polaroid P_1. When this polarised beam passes through another polaroid P_2 and if the pass axis of P_2 makes angle θ with the pass axis of P_1, then write the expression for the intensity of light emerging from P_2. Draw a plot showing the variation of intensity of emerging light from P_2 when θ varies from 0 to π. 2

27. Describe with the help of a circuit diagram how a Zener diode works to obtain a constant dc voltage from the unregulated dc output of a rectifier. 2

Section –C

28. (a) Two wires one of manganin and the other of copper have equal length and equal resistance. Which one of these wires will be thicker? 3

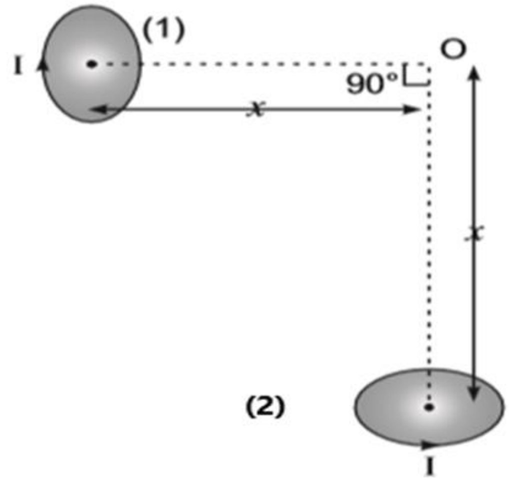
(b) Two students X and Y perform an experiment on potentiometer separately using the circuit diagram shown here. Keeping other parameters unchanged (i) X increases the value of resistance R. (ii) Y decreases the value of resistance S in the set up. How would these changes affect the position of the null point in each case and why?



29. How is a galvanometer converted in to a voltmeter and an ammeter? Draw the relevant diagram and find the resistance of the arrangement in each case. Take resistance of galvanometer as G. 3

OR

Two very small identical circular loops, (1) and (2) of radius R each, carrying equal currents I are placed vertically (with respect to the plane of the paper) with their geometrical axes perpendicular to each other as shown in the figure. Find the magnitude and direction of the net magnetic field produced at the point O. 3

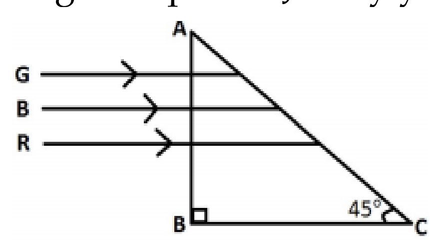


30. With the help of a circuit diagram, explain the working of a junction diode as a full wave rectifier. Draw its input and output wave forms. 3

31. (a) Define the term 'intensity of radiation' in photon picture. 3
(b) Plot a graph showing the variation of photo current versus collector potential for three different intensities $I_1 > I_2 > I_3$, two of which (I_1 and I_2) have the same frequency υ and the third has frequency $\upsilon_1 > \upsilon$.

32. (a) Using Bohr's postulates, Obtain the expression for the total energy of the electron in the stationary states of the hydrogen atom. What is the significance of total negative energy possessed by the electron? 3
(b) Draw the energy level diagram showing how the line spectra corresponding to Balmer series occur due to transition between energy levels.

33. State the conditions of total internal reflection. Refractive indices of the given prism material for Red, Blue and Green colors are respectively 1.39, 1.48 and 1.42 respectively. Trace the path of rays through the prism. Justify your answer. 3



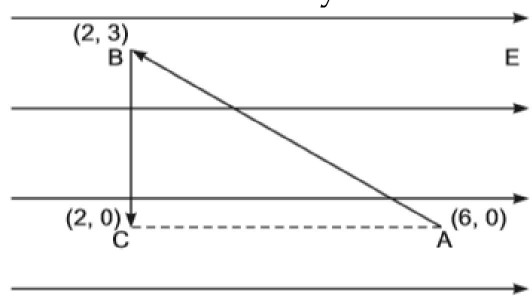
34. (a) Draw a graph showing the variation of potential energy between a pair of nucleons as a function of their separation. Indicate the regions in which the nuclear force is (i) attractive (ii) repulsive. 3
(b) The radioactive isotope D decays according to the sequence

$$D \xrightarrow{\alpha} D_1 \xrightarrow{\beta^-} D_2$$

If the mass number and atomic number of D_2 are 176 and 71 respectively, what is the (i) mass number (ii) atomic number of D?

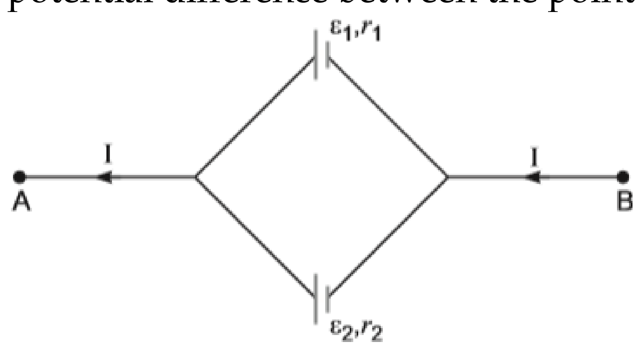
Section -D

35. (a)Derive an expression for the electric field intensity at a point on the equatorial line of an electric dipole of dipole moment $\vec{p}$ and length 2a. What is the direction of this field? 5
(b) A test charge 'q' is moved without acceleration from A to C along the path from A to B and then from B to C in electric field E as shown in the figure. (i) Calculate the potential difference between A and C. (ii) At which point (of the two) is the electric potential more and why?

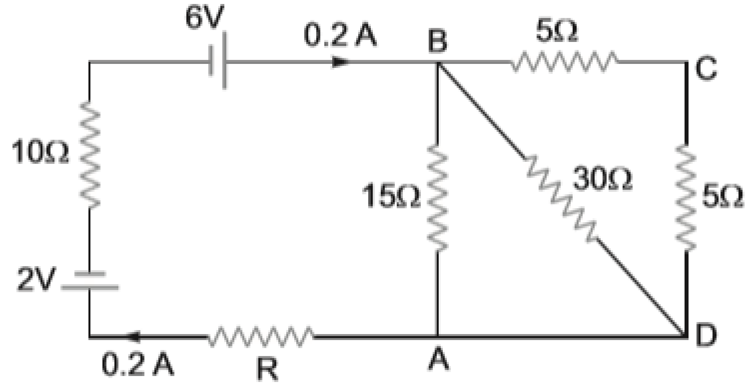


OR

(a)Two cells of emfs ε_1, ε_2 and internal resistance r_1 and r_2 respectively are connected in parallel as shown in the figure. Deduce the expressions for (i) the equivalent emf of the combination (ii) the equivalent resistance of the combination and (iii) the potential difference between the points A and B. 5



(b)Calculate the value of the resistance R in the circuit shown in the figure so that the current in the circuit is 0.2 A. What would be the potential difference between points A and B?



36. (a) Show that the time period (T) of oscillation of a freely suspended magnetic dipole of magnetic moment (m) in a uniform magnetic field(B) is given by T = $2\pi \sqrt{\frac{I}{mB}}$,where I is moment of inertia of the magnetic dipole. 5

(b) Identify the following magnetic materials:

(i) A material having susceptibility χ_m = - 0.0015

(ii) A material having susceptibility χ_m = 10^{-5}

(c) Current in a circuit falls from 5.0 A to 0.0 A in 0.1 s. If an average emf of 200 V is induced calculate the self-induction of the circuit.

OR

(a) Using phasor diagram for a series LCR circuit connected to an ac source of voltage v = $v_0 \sin \omega t$, derive the relation for the current flowing in the circuit and the phase angle between the voltage across the resistor and the net voltage in the circuit. 5

(b) Draw a plot showing the variation of the current I as a function of angular frequency 'ω' of the applied ac source for the two cases of a series combination of (i) inductance L_1, capacitance C_1 and resistance R_1 and (ii) inductance L_2, capacitance C_2 and resistance R_2 where $R_2 > R_1$.

Write the relation between L_1, C_1 and L_2, C_2 at resonance.

Which one, of the two, would be better suited for fine tuning in a receiver set? Give reason.

37. (a) Draw a labelled ray diagram to obtain the image formed by an astronomical telescope in normal adjustment position. Define its magnifying power and give the expression. 5

(b) Write two advantages of reflecting telescope over refracting telescope.

(c) A giant refracting telescope at an observatory has an objective lens of focal length 15 m. If this telescope is used to view the moon, what is the diameter of the image of the moon formed by the objective lens? The diameter of the moon is 3.8×10^6 m and radius of lunar orbit is 3.8×10^8 m.

OR

Describe diffraction of light due to a single slit with diagram. Explain formation of the pattern of fringes obtained on the screen and plot showing variation of intensity with angle θ in single slit diffraction. 5