



**SUPPLEMENTARY EXAMINATION 2019 (TARGET PAPER)**  
**PHYSICS PAPER - II**  
**(Science Groups)**

**Time Allowed: 2 Hours 40 mins.**

**Max.Marks: 68**

**SECTION 'B'**  
**(SHORT – ANSWER QUESTIONS)**

**NOTE:** Answer any TEN part questions. All Questions carry equal marks.

Q-2

- i) **Define the coefficient of linear and cubical expansions. Also prove that  $\alpha = \frac{1}{3} \beta$  OR** Determine the root mean square speed of oxygen molecule at 800K? **OR Write down two statements of Second Law of Thermodynamics & prove their equivalence. Also discuss 2<sup>nd</sup> Law in terms of Entropy.**
- ii) **Differentiate between Terminal Potential Difference and the E.M.F of a battery. Derive the relevant expression. OR** A resistor is made by using a 50m Nichrome wire of diameter 0.8mm at 0<sup>o</sup> C. Calculate its resistance at 50<sup>o</sup> C? **OR Define Resistivity? Discuss the effect of temperature on the resistance of the conductor. OR Derive the expression for the equivalent capacitance when three capacitors are connected in series or in parallel. OR** You are given three resistors each of 2 ohms. How would you arrange these to obtain to equivalent resistance of:  
(a) 1.33 ohms (b) 3 ohms (c) 6 ohms? Verify the results mathematically.
- iii) **In an Hydrogen atom an electron experience a transition from a state whose excitation energy is 13.06 eV to another state whose binding energy is 3.4 eV. What are the Quantum numbers? Also give the name of the spectral lines. OR Determine the Shortest and Longest wavelength of photons emitted for the lines of Balmer OR Paschen series. Also determine energies at these wavelengths. ( $R_{\infty} = 1.097 \times 10^7 \text{ m}^{-1}$ ) OR Differentiate between inertial and non-inertial frames of reference. Write the postulates of Einstein's special theory of relativity? OR** A steel bar is 10m in length at -2.5<sup>o</sup> C. What will be the change in its length when it is at 25<sup>o</sup> C? ( $\beta = 3.3 \times 10^{-8} \text{ K}^{-1}$ )
- iv) **Calculate the relativistic speed and momentum at which the mass of a particle is equal to double of its rest mass? OR** What minimum energy in electron volt is required in an X-ray tube in order to produce X-ray with a wavelength of  $0.1 \times 10^{-10} \text{ m}$ ? ( $h = 6.63 \times 10^{-34} \text{ J.s}$ ) **OR Sodium surface is shinned with the light of wavelength  $3 \times 10^{-7} \text{ m}$ . Find the kinetic energy of the emitted photoelectrons and the cutoff wavelength of sodium. Work function of sodium is 2.46 eV. OR** The range of visible light is 4000 Å to 7000 Å. Will photoelectrons be emitted from the copper surface for which work function is 4.4 eV, when it is illuminated by the visible light? Give mathematical proof of your answer. ( $c = 3 \times 10^8 \text{ m/s}$ ,  $h = 6.63 \times 10^{-34} \text{ J.s}$ )
- v) **Find the Q-value of the reaction when  ${}^{239}_{94}\text{Pu}$  makes an alpha decay.**  
$${}^{239}_{94}\text{Pu} \longrightarrow \alpha - \text{particle} + {}^{235}_{92}\text{U} + Q$$
  
(Mass of  ${}^{235}_{92}\text{U} = 235.0439u$ , Mass of  ${}^4_2\text{He} = 4.0026u$ , Mass of  ${}^{239}_{94}\text{U} = 239.0522u$ )  
**OR Give the Construction and working of a Transformer and derive relevant mathematical expression. OR** Sodium ( ${}^{23}_{11}\text{Na}$ ) has an atomic mass of 22.989u. Find the total binding energy of the sodium nucleus and also estimate the binding energy per nucleon? **OR What is meant by LASER? Differentiate between spontaneous and stimulated emission of radiations. OR** What is Radioactive decay? Discuss  $\alpha$ ,  $\beta$  and  $\gamma$  decay with examples. **OR If the no. of atoms per gram of  ${}^{226}_{88}\text{Ra}$  is  $2.666 \times 10^{21}$  and it decays with a half life of 1622 years; Find the decay constant and activity of sample. OR** How much energy will be obtained if a neutron of mass  $1.67 \times 10^{-27} \text{ kg}$  is entirely converted into energy? Give your answer in both Joules and electron volts. ( $c = 3 \times 10^8 \text{ m/s}$ )
- vi) State the following Laws? (ANY FOUR)
- |                      |                           |                            |
|----------------------|---------------------------|----------------------------|
| a) Biot-Savart's Law | b) Ampere's Circuital Law | c) Wein's Displacement law |
| e) Lenz's Law        | f) Stephan's Law          | g) Rayleigh-Jean's Law     |
- OR Define the following briefly:**  
a) Pair Production b) Uncertainty Principle c) Compton's Effect d) Annihilation of Matter
- vii) **What is Motional EMF? Also derive its mathematical expression. OR Derive the expression for force acting on a current-carrying conductor, placed in a uniform magnetic field.**

**OR** Prove mathematically that the radius of circular path for a charge moving in the uniform magnetic field

is  $r = \frac{mv}{qB \sin \theta}$  **OR** Prove that  $1 \frac{\text{volt}}{\text{meter}} = 1 \frac{\text{Newton}}{\text{Coulomb}}$ , Name the physical quantity.

**OR** Define Electric Flux? Under what conditions flux will be zero, maximum and minimum?

**OR** Find the wavelength of 2.0g light ball moving with a velocity:

- a) 1.0 mm per century                      b) 1.0 m/s

- viii) Show that the average translational K.E. of the gas molecules is directly proportional to the absolute temperature? **OR** A Carnot engine whose low temperature reservoir is at 200K has an efficiency of 50%. It is desired to increase this to 75%. By how many degrees must the temperature of low reservoir be decreased if the temperature of higher temperature reservoir remains constant. **OR** Is it possible to cool a room by keeping the door of a refrigerator open? Explain.  
**OR** A heat engine performing 400 J of work in each cycle has an efficiency of 25%. How much heat is absorbed and rejected in each cycle. **OR** Calculate the speed of electromagnetic wave in free space.
- ix) What is semi-conductor diode? Describe the working of PN Junction for forward biasing or How it is used for Half wave rectification. **OR** How are p-type and n-type substances made? Explain with the help of diagram.  
**OR** An aeroplane flying in a region where the vertical component of the earth's magnetic field is  $3.2 \times 10^{-4}$  Tesla if the wing span of the aeroplane is 50 meters and its velocity is 360 km/hr, find the induced E.M.F. between the tips of the wings of the aeroplane. **OR** Calculate the binding energy of the Hydrogen atom?
- x) A galvanometer having a internal resistance of 60 ohms gives the full scale deflection for a current of 5 mA. What is the value shunt resistance required to convert it into an Ammeter of 10A range? **OR** How can the galvanometer can be converted into Voltmeter? Derive the relevant expression. **OR** Two point charges of  $+2 \times 10^{-7}$  and  $-5 \times 10^{-7}$  coulomb are placed at a distance of 50cm from each other. Find the point on the line joining the charges at which the electric field is zero? **OR** A positively charged thin sheet attracts a negatively charged sphere having a charge of  $-5 \times 10^{-6}$  C with 1.695 N force. Find the surface charge density.
- xi) Two point charges of  $+2 \times 10^{-4}$  and  $-2 \times 10^{-4}$  coulomb are placed at a distance of 40cm from each other. A charge of  $+5 \times 10^{-5}$  coulomb is placed midway between them. What is the magnitude and direction of force on it. **OR** A small sphere of weight  $5 \times 10^{-3}$  N is suspended by a silk thread 50mm long which is attached to a point on a large charged insulating plane. When a charge of  $6 \times 10^{-8}$  C is placed on the ball the thread makes an angle of  $30^\circ$  with the vertical. What is the charge density on the plane.
- xii) Find the current required to produce the magnetic field of induction  $B = 2.512 \times 10^{-3}$  Web/m<sup>2</sup> in a 50 cm long solenoid having 4000 turns of a wire. **OR** State Ohm's law? Derive the expression of the conductor in terms of its dimensions. **OR** Why gases have two molar specific heats and discuss why  $C_p$  is greater than  $C_v$ ? **OR** A rectangular block of iron has the dimensions of 1.2cm x 1.2cm and 15cm. (i) What is the resistance of the opposing square ends? (ii) What is the resistance between two of the rectangular faces?
- xiii) How many excess electrons must be placed on each of the two small spheres placed 3.0 cm apart if the force of repulsion between the spheres is  $10^{-19}$  N? **OR** Derive the expression for the parallel or series combination of three resistors? **OR** If the electron beam in the T.V picture tube is accelerated by 20 kV. What will be the de Broglie's wavelength of an electron? **OR** A capacitor of 100 pF is charged to a potential difference of 50 volts. Its plates are then connected in parallel to another capacitor and it is found that the potential difference between the plates falls to 35 volts. What is the capacitance of the second capacitor?
- xiv) State Coulomb's Law and give its mathematical relation for force between the charges when placed:  
i. In a free space    ii. In a medium of relative permittivity ( $\epsilon$ ) **OR**  
A water heater that will deliver 1 kg of water per minute is required. The water is supplied at  $20^\circ$  C and an output temperature of  $80^\circ$  C is desired. What should be the resistance of the heating element in the water if the line voltage is 220V. **OR** A pair of adjacent coils has a mutual inductance of 850 mH. If the current in the primary coil changes from 0 to 20A in 0.1 sec; what is the change in the magnetic flux in the secondary coil of 800 turns? **OR** An electron exists within a region of  $10^{-10}$  m. Find its momentum uncertainty and the approximate Kinetic Energy.
- xv) Differentiate between Magneto and AC Generator. What is meant by frequency of Alternating current? **OR** How fast will a proton of mass  $1.67 \times 10^{-27}$  kg be moving if it is to follow a circular path of radius 4cm in a uniform magnetic field of 0.7 Tesla entering perpendicularly? ( $e = 1.6 \times 10^{-19}$  C) **OR** A straight metal rod 100cm long can slide with negligible friction on a parallel conducting rails. It moves at right angle to the uniform magnetic field of 0.72 Tesla. The rails are joined to a battery of E.M.F 6 volt and a fixed series resistance of 2 $\Omega$ . Find the force required to hold the rod in position. **OR** Define Wheatstone bridge. Also prove that for a balanced Wheatstone Bridge  $\frac{R_1}{R_2} = \frac{R_3}{R_4}$

## SECTION 'C'

### (DETAILED-ANSWER QUESTIONS)

(Marks: 28)

**NOTE:** Attempt any **TWO** questions from this Section. Draw Neat and Labelled diagrams where necessary.

- Q-4 a) **Define Isothermal and Adiabatic process. Using the first law of thermodynamics, for an ideal gas show that  $C_p - C_v = R$ .**  
**OR**  
**Derive the pressure gas equation for an ideal gas on the basis of Kinetic molecular theory of gases.**
- b) Explain J.J Thomson's experiment to determine the charge to mass ( $\frac{e}{m}$ ) ratio of electron. Also derive the relevant expressions? How is the radius of the circular path calculated from it.  
**OR**  
**State Ampere's Law and derive an expression for the magnetic field "B" of the long solenoid.**
- Q-5 a) **What is A.C. Generator? Explain its working and derive the expression for maximum E.M.F. produced by A.C. Generator?**  
**OR**  
**State Gauss's law and apply it to find electric intensity at a point close to infinitely large sheet, having uniform positive charge distribution.**
- b) **What is Compton effect? Explain why is it not observable with the visible light? Derive the relation for the Compton's shift.** **OR** What is photoelectric effect? Explain its important results with the help of graph. Also derive Einstein's photo-electric equation.
- Q-6 a) **Give the construction and working of Geiger Counter** **OR** Wilson Cloud chamber? **Also draw the Diagram.**  
**OR**  
**State Faraday's laws of electromagnetic induction. Explain the phenomenon of Mutual or Self induction and also derive the expression of coefficient of Mutual or Self Inductance. Also give its unit.**
- b) **What is Radioactivity? Explain the Law of Radioactivity with an exponential curve and also discuss the relation between Half life and Decay constant?**  
**OR**  
State the postulates of Bohr's atomic theory. Using Bohr's atomic theory derive an expression for the Total energy and radius of the nth orbit of H-atom.

----- **BEST OF LUCK** -----

Marked with '**RED BOLD**' are the '**MOST IMPORTANT**' Questions.

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