



COMPREHENSIVE EXAMINATION 2019

XII – 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) Explain the principle of construction and working of bimetallic strip **OR** Determine the root mean square speed of Oxygen molecule at 800K. ($k = 1.38 \times 10^{-23} JK^{-1}$) **OR** Derive Boyle's or Charles' law on the basis of K.M.T starting from the pressure gas equation? **OR** Write down two statements of Second Law of Thermodynamics & prove their equivalence? Also discuss 2nd law in terms of Entropy? **OR** State the fundamental assumptions of Kinetic theory of gases? **OR** Find the change in volume of Copper Sphere of 0.6 m diameter when it is heated from 30° C to 100° C. [$\alpha = 19 \times 10^{-6} / ^\circ C$]
- ii) Differentiate between Terminal Potential Difference and the E.M.F of a battery. Derive the relevant expression. **OR** A 50 ohms resistor is required from a copper wire 0.2mm in diameter. What is length of the wire needed? [$\rho = 1.6 \times 10^{-8} \Omega m$] **OR** What are the factors on which resistance of a conductor depends? Define resistivity and temperature coefficient of resistance. **OR** Derive the expression for the equivalent capacitance when 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** Lyman series? Also determine energies at these wavelengths. ($R_\infty = 1.097 \times 10^7 m^{-1}$) **OR** A steel bar is 10m in length at -2.5° C. What will be the change in its length when it is at 25° C? ($\beta = 3.3 \times 10^{-8} K^{-1}$)
- 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 $0.1 \times 10^{-10} m$? ($h = 6.63 \times 10^{-34} J.s$) **OR** Sodium surface is shinned with the light of wavelength $3 \times 10^{-7} m$. 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. ($c = 3 \times 10^8 m/s$, $h = 6.63 \times 10^{-34} J.s$)
- v) Find the Binding energy of ${}_{52}^{126}Te$ in MeV if the mass of proton = 1.0078 a.m.u, mass of neutron = 1.0086 amu and $m_{Te} = 125.9033$ a.m.u **OR** Sodium (${}_{11}^{23}Na$) 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** Do α , β and γ -rays come from the same element. Why do we find all three in many radioactive elements? **OR** What is Radioactive decay? Discuss α , β and γ decay with examples. **OR** If the no. of atoms per gram of ${}_{88}^{226}Ra$ is 2.666×10^{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 $1.67 \times 10^{-27} kg$ is entirely converted into energy? Give your answer in both Joules and electron volts. ($c = 3 \times 10^8 m/s$) **OR** Given $m_0c^2 = 0.511 MeV$. Find the total energy 'E' and the kinetic energy 'K' of an electron moving with the speed $v=0.85c$.
- 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 |
| e) Capacitance of a capacitor | f) Electric intensity | g) Black body radiations | |
- vii) Derive an expression for the force on a conductor carrying current, placed in a uniform magnetic field. **OR** Derive the expression for torque on a current-carrying rectangular coil in a uniform magnetic field when its face makes an angle α with the field? **OR** Define Electric Intensity. Derive expression for the electric field intensity at a point near an isolated point charge. **OR** Show that electric potential difference (ΔV) is the dot product of electric intensity (\vec{E}) and displacement ($\Delta \vec{r}$). **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) **Define the coefficient of linear and cubical expansions. Also prove that $\alpha = \frac{1}{3} \beta$ 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** It is observed that when a mercury in a glass thermometer is put in a flame, the column of mercury first descends and then rises. Explain. **OR** A heat engine performs work at the rate of 500 kilowatt. The efficiency of the engine is 30%. Calculate the loss of heat per hour. **OR** Define linear expansion? Discuss the construction and working of bimetallic strip in a thermostat?
- ix) **What is semi-conductor diode? Describe the working of PN Junction for forward biasing or How it is used for full 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 3.2×10^{-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 whose resistance is 100 ohms, deflects full scale for a potential difference of 50 millivolts across its terminals. What shunt resistance must be connected to convert it into an ammeter of 5 Ampere range? OR** How can the galvanometer can be converted into Ammeter? Derive the relevant expression. **OR** Two point charges of $+2 \times 10^{-7}$ and -5×10^{-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 -5×10^{-6} C with 1.695 N force. Find the surface charge density. **OR** Write down construction and working of a device which is used to detect direction of current.
- xi) **State Gauss's law and apply it to find electric intensity at a point close to infinitely large sheet, having uniform positive charge distribution. OR** Two point charges of $+2 \times 10^{-4}$ and -2×10^{-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 5×10^{-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 6×10^{-8} C is placed on the ball the thread makes an angle of 30° with the vertical. What is the charge density on the plane. **OR** Two point charges of $+2 \times 10^{-7}$ and -5×10^{-7} coulombs are placed at a distance of 55cm from each other. Find a point on the line joining the charges at which the electric intensity is zero. **OR** Show that the rest mass of photon is zero? Derive the relation for the momentum of photon.
- xii) **The inner and outer diameters of the toroid are 22cm and 26cm. If a current of 5A is passed which produces 0.02 tesla flux density inside the core. Find the approximate length of the wire wound on the toroid. 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 electrons should be removed from each of the two similar spheres each of 20g so that the electrostatic repulsion is balanced by gravitational force? 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? **OR** Calculate the speed of Electromagnetic Wave?
- 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 (ϵ) **OR**
A water heater that will deliver 1 kg of water per minute is required. The water is supplied at 20° C and an output temperature of 80° 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) **Define Wheatstone bridge. Also prove that for a balanced Wheatstone Bridge $\frac{R_1}{R_2} = \frac{R_3}{R_4}$. OR** How fast will a proton of mass 1.67×10^{-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 2Ω . Find the force required to hold the rod in position. **OR** Differentiate between Magneto and AC Generator? What is meant by frequency of Alternating current?

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 Carnot Engine? Describe its construction & working and also Derive an expression an expression for its efficiency. Can the efficiency of Carnot Engine be 100%?**

OR

State and explain the First Law of Thermodynamics. On the basis of the 1st Law explain:

1. Isothermal Process
2. Isobaric Process
3. Adiabatic Process
4. Isochoric Process

OR

Derive the equation for pressure of an ideal gas on the basis of Kinetic molecular theory of gases. Also show that the absolute temperature of an ideal gas is directly proportional to the average translational Kinetic energy of molecules.

- b) **Define Capacitor. Derive the expression for the capacitance of a parallel plate capacitor when:**

- i. Air exists between the plates
- ii. Dielectric exists between the plates

OR

Differentiate between inertial and non-inertial frames of reference. Give the postulates of special theory of relativity and the results drawn from it.

OR

State Ampere's. What is Solenoid? Also derive an expression for the magnetic field of induction 'B' due to the long solenoid.

- Q-5 a) **What is A.C. Generator? Obtain an expression for e.m.f induced in an A.C Generator. How can be the A.C generator be converted into D.C generator?**

OR

Define Nuclear fission and fusion reactions. Explain Fission Chain reaction. How can the Nuclear Fission chain reaction can be controlled? Name the process which produce energy in the sun and in the nuclear reactor.

OR

Define electric potential difference between two points in an electric field. Derive the mathematical relationship between the electric potential difference and electric intensity?

- b) **What is photoelectric effect? Explain its important results with the help of graph. Also derive Einstein's photo-electric equation.**

OR

On what principle does a Transformer work?

Give the working of a transformer with the help of a labelled diagram. Derive the relations between:

- i. EMF and number of turns.
- ii. EMF and current

OR

State the postulates of Bohr's atomic theory. Using Bohr's atomic theory derive an expression for the Radius / Energy of nth orbit of the Hydrogen atom.

- Q-6 a) **Give the construction and working of Wilson Cloud chamber**

OR

Geiger Counter? 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.

OR Derive an expression for the Absolute Electric Potential.

- 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

Define metastable state and population inversion of the Lasing material. Differentiate between Principle of production of laser and light from an incandescent bulb? Describe the construction and working of the Ruby laser?

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

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

✚ **PEC REGISTERED ENGINEER - BE (NED UET) -**

MS (APPLIED MATHEMATICS) [NED UET]

✚ **CAREER COUNSELOR / ADMISSIONS EXPERT -**

CEO / FOUNDER (EDUCATIONIST HUB)

✚ **FACEBOOK: WWW.FACEBOOK.COM/SADIO.SALEEM32**

✚ **MOBILE / WHATSAPP: +92322-238705-6**

✚ **LINKEDIN: WWW.LINKEDIN.COM/IN/SADIO-SALEEM-01a0867b**