FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION-2022 FOR RECRUITMENT TO POSTS IN BS-17 UNDER THE FEDERAL GOVERNMENT
PHYSICS, PAPER-II

Roll Number

TIME ALLOWED: THREE HOURS	**PART-I (MCQS) MAXIMUM MARKS = 20**
PART-I(MCQS): MAXIMUM 30 MINUTES	**PART-II MAXIMUM MARKS = 80**

NOTE: (i) **Part-II** is to be attempted on the separate **Answer Book.**
(ii) Attempt **ONLY FOUR** questions from **PART-II**. **ALL** questions carry **EQUAL** marks.
(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.
(iv) Write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.
(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.
(vi) Extra attempt of any question or any part of the question will not be considered.
(vii) **Use of Calculator is allowed.**

PART – II

Q. 2. **(a)** An electric dipole, comprising a positive charge q and a negative charge $-q$, is placed on the *x*-axis. Each charge is at the same distance from the origin. The total separation between the charges is $2a$.Calculate the electric field E due to these charges along the *y*-axis at the point P, which is at a distance *y* from the origin. Assume $y \gg a$ ($\varepsilon_o = 8.85\times10^{-12}\ C^2N^{-1}m^{-2}$). (10)

(b) Write down a mathematical expression to evaluate electric field E at a distance r from the source charge Q in vector form. Sketch the graph of E as a function of r. (6)

(c) Define electric field and a dipole. (4) **(20)**

Q. 3. **(a)** Discuss photoelectric effect and establish Einstein's equation for the photoelectric effect. (10)

(b) Describe the inadequacy of the wave theory of light to explain the effect. (6)

(c) A photon of energy 12 eV falls on a certain metal plate whose work function is 4.15 eV. Find the stopping potential. The mass and charge of electron are $9.11\times10^{-31}kg$ and $1.6\times10^{-18}C$ respectively and the value of Planck's constant is $6.64\times10^{-34}\ J\times$ s. (4) **(20)**

Q. 4. **(a)** Discuss intrinsic and extrinsic semiconductors. (10)

(b) Describe the properties of diamagnetic, paramagnetic and ferromagnetic materials. (6)

(c) Briefly discuss the Landé g factor. (4) **(20)**

Q. 5. **(a)** Four charged particles of charge q, $2q$, $3q$ and $4p$ are at the corners of a square of side 'a' arranged in counter clockwise direction. Determine **(i)** the electric field at the location of charge q and **(ii)** the total electric force exerted on q. (8)

(b) A parallel plate capacitor has a plate separation of 1 *mm*. Calculate the surface area of each plate of the capacitor to obtain a capacitance of 1F. Is it possible to produce such a capacitor in the lab? Comment. ($\varepsilon_o = 8.85\times10^{-12}\ C^2N^{-1}m^{-2}$). (6)

(c) Define (6) **(20)**
(i) Capacitance **(ii)** The unit of capacitance **(iii)** Surface charge density

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Q. 6. **(a)** Set up the Schrodinger wave equation for a particle of mass m confined in a one-dimensional box which has perfectly rigid walls at $x = 0$ and $x = L$. Solve the differential equation to find the expressions for energy and the eigen wave functions of the particle. (10)

(b) Sketch the graphs for the first three eigen wave functions ψ_1, ψ_2 and ψ_3. (5)

(c) Plot the graphs for the probability densities corresponding to ψ_1, ψ_2 and ψ_3. (5) **(20)**

Q. 7. **(a)** Discuss the motion of a charged particle of mass m, charge q and velocity $\boldsymbol{v}$ in a magnetic field B which is directed into the plane of paper. (8)

(b) Discuss atomic description of dielectrics. (6)

(c) Let x be the separation between the parallel plates of a capacitor of capacitance C in the absence of a dielectric material. A slab of a material of dielectric constant γ and thickness $\frac{1}{3}x$ is placed between the plates. Calculate the capacitance in the presence of the dielectric material. (6) **(20)**

Q. 8. **(a)** Discuss the properties of three subatomic particles and their corresponding antiparticles. (10)

(b) Explain in detail, how γ- radiation can be detected? (5)

(c) How can we prove that an electron does not exist in the nucleus of an atom? (5) **(20)**

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