FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION-2026 FOR RECRUITMENT
TO POSTS IN BS-17 UNDER THE FEDERAL GOVERNMENT

Roll Number

PHYSICS, PAPER-II

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

NOTE: (i) First attempt **PART-I (MCQs)** on separate **OMR Answer Sheet** which shall be taken back after **30 minutes.**
(ii) Overwriting/cutting of the options/answers will not be given credit.
(iii) There is **no negative** marking. All MCQs must be attempted.

PART-I (MCQs)(COMPULSORY)

Q.1. (i) Select the best option/answer and fill in the appropriate Box ■ on the **OMR Answer Sheet.(20x1=20)**
(ii) Answers given anywhere else, other than OMR Answer Sheet, will not be considered.

1. **The angle between two vectors $\vec{A} = \hat{x} + \hat{z}$ and $\vec{B} = \hat{y} + \hat{z}$ is:**
   (A) 0° (B) 20° (C) 30° (D) 60°
2. **The curl of a gradient of a scalar field T, $\nabla \times (\nabla T)$, is zero. This statement is:**
   (A) Always true (B) Depends on the value of T
   (C) In contradiction to the fundamental theorem of Gradient
   (D) In contradiction to the fundamental theorem of Curl
3. **The electric field of a sphere falls off like $1/r^2$; the electric field of an infinite line falls off like $1/r$; and the electric field of an infinite plane falls off as:**
   (A) $1/r^3$ (B) $1/r^2$ (C) $1/r$ (D) None of these
4. **The dimension of $(\vec{p} \cdot \vec{\nabla})\vec{E}$ represents which of the following physical quantity?**
   (A) Dipole moment (B) Force (C) Magnetic field (D) None of these
5. **When the continuity equation is such that $\vec{\nabla} \cdot \vec{J} = 0$; which of the following statements is true?**
   (A) Steady current flows (B) Charge is not piling up (C) $\frac{\partial \rho}{\partial t} = 0$ as well (D) All of these
6. **The correction term used by Maxwell to the Ampere's law $J_d = \epsilon_0 \frac{\partial E}{\partial t}$ called the displacement current is a misleading term and has nothing to do with the:**
   (A) Current (B) Charge (C) Electric field (D) Magnetic field
7. **What is meant by specific surface?**
   (A) Surface area per unit volume (B) Surface area per unit weight
   (C) Surface weight per unit area (D) None of these
8. **Quartz crystal, normally used in quartz clocks etc. is chemically:**
   (A) Silicon dioxide (B) Germanium dioxide
   (C) A mixture of germanium oxide and silicon dioxide (D) Sodium silicate
9. **Bohr's Atomic Model is based upon:**
   (A) Einstein's relativistic theory (B) Classical theory (C) Planks quantum theory (D) Both (B) & (C)
10. **With increasing quantum number n, the energy difference between adjacent levels in atoms is:**
    (A) Decreases (B) Increases (C) Remain constant (D) Zero
11. **The relationship between energy of a photon of light and its frequency is given by:**
    (A) De-Broglie dual nature of matter (B) Bohr's model
    (C) Planck's Quantum theory (D) Rutherford's atomic model
12. **Rutherford's Model of atom failed because:**
    (A) The atom did not have a nucleus and electrons
    (B) It did not account for the attraction between protons and neutrons
    (C) It did not account for the stability of the atom (D) There is no space between the nucleus and the electron
13. **The spectral lines of Lyman series are emitted when electron jumps from higher orbit to:**
    (A) 1st orbit (B) 2nd orbit (C) 3rd orbit (D) 4th orbit
14. **The factor that indicates attenuation taking place per centimeter is known as the:**
    (A) Mass attenuation coefficient (B) Linear attenuation coefficient (C) Decay rate (D) Atomic number
15. **If φ_m and φ_n are two wavefunctions, such that $\int_{-\infty}^{\infty} \varphi_m^* \varphi_n = 1$, then φ_m and φ_n must be:**
    (A) Orthogonal (B) Perpendicular (C) Normalized (D) Orthonormal
16. **In the case of infinite square-well potential, if width of the well is halved, the energy of the ground state will:** (A) Be halved (B) Remain the same (C) Become doubled (D) Become four times
17. **Beta minus (β^-) decay involves:**
    (A) Proton → neutron + positron + neutrino (B) Neutron → proton + electron + antineutrino
    (C) Proton → neutron + electron + neutrino (D) Neutron → proton + positron + neutrino
18. **The strong nuclear force acts between:**
    (A) Protons only (B) Neutrons only (C) Protons and neutrons (D) Electrons and protons

19. **The binding energy of a nucleus is:**
(A) Energy required to remove a nucleon (B) Energy released when the nucleus is formed from nucleons
(C) Both (A) & (B) (D) Energy of the electrons

20. **Which of the following is not a naturally occurring radioactive element?**
(A) Uranium (B) Plutonium (C) Thorium (D) Radium

PART-II

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.**

Q. 2. **(a)** State and explain Gauss' law in dielectrics. Also give its significance. **(5)**
(b) Derive a mathematical expression for an electric field at a point lying outside of a uniformly charged spherical shell. **(5)**
(c) A spherical shell has a total charge $q = 4\mu C$ and radius $0.3\ m$. Calculate the electric field at a distance of $.5\ m$ from the center of the shell. **(10)** **(20)**

Q. 3. **(a)** What is meant by induced emf? Why is it called induced? **(10)**
(b) Derive an expression for induced emf in a coil with N turns due to changing magnetic flux. **(5)**
(c) Magnetic flux through a 20 turn coil changes from 0.5 to 0.1 Wb in 0.2 s. How much emf would be induced in the coil? **(5)** **(20)**

Q. 4. **(a)** Discuss the time-independent Schrodinger wave equation. Why is it called time independent? **(5)**
(b) Solve the time-independent Schrodinger wave equation for a particle in a one-dimensional potential well of width of L. **(5)**
(c) Find the ground-state energy of electron in a 1-D potential well with L = 1 nm. Mass of electron = m = 9.11×10^{-31} kg. **(10)** **(20)**

Q. 5. **(a)** What is meant by Bravais lattice? **(5)**
(b) Calculate the volume of the base-centered cubic structure of side length $0.4\ nm$. The volume needs to be in $Å^3$. **(5)**
(c) Clearly elaborate the difference between base-centered and face-centered cubic lattices. Also discuss types of base-centered cubic cell. **(10)** **(20)**

Q. 6. **(a)** Define Fermi sphere. Is this an energy state? Explain. **(10)**
(b) Deduce the Fermi-Dirac distribution function **(5)**

$$f(E,T) = \frac{1}{e^{(E-E_F)/K_BT} + 1}$$

for Fermi energy level $(E = E_F)$
(c) Calculate the Fermi energy for Cu in eV with number density (n) of $8.49 \times 10^{28}\ atoms/_{m^3}$ **(5)** **(20)**

$$\left[E_F = \frac{h^2}{2m}\left(\frac{3n}{8\pi}\right)^{2/3}, m = 9.11 \times 10^{-31} Kg, h = 6.62 \times 10^{-34} J.s\right]$$

Q. 7. **(a)** Explain on scientific grounds the difference between alpha, beta and gamma decay. **(5)**
(b) Write the decay equation for the alpha decay of U_{92}^{38}. **(5)**
(c) The charge number and mass number of two nuclei A & B are the same. But their binding energies are such that $(B.E)_A > (B.E)_B$. Which nucleus will have more mass and why? **(10)** **(20)**

Q. 8. **(a)** Explain nuclear fission with the help of one practical application. **(5)**

(b) What are elementary and composite particles? Give two examples from each family of elementary particles. **(5)**

(c) What is controlled fusion? Why is it hard to achieve on earth? **(10)** **(20)**

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