FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION FOR RECRUITMENT TO POSTS IN BPS-17 UNDER THE FEDERAL GOVERNMENT, 2009

S.No.	
R.No.	

PHYSICS, PAPER-II

TIME ALLOWED:	**(PART-I) 30 MINUTES**	**MAXIMUM MARKS:20**
	(PART-II) 2 HOURS & 30 MINUTES	**MAXIMUM MARKS:80**

NOTE: (i) First attempt **PART-I (MCQ)** on separate **Answer Sheet** which shall be taken back after **30 minutes.**
(ii) Overwriting/cutting of the options/answers will not be given credit.
(iii) Use of Scientific Calculator is allowed.

PART – I (MCQ) (COMPULSORY)

Q.1. Select the best option/answer and fill in the appropriate box on the Answer Sheet. (20)

(i) The impedance of RLC series resonance circuit at resonant frequency is:
(a) Greater than R (b) Equal to R (c) Zero (d) None of these

(ii) An electron has a velocity of 10km/s normal to a magnetic field of 0.1 T flux density. If the radius of the path is 569nm then the frequency is:
(a) 2.79 GHz (b) 3.1 MHz (c) 2.8 KHz (d) None of these

(iii) If a current of 10 A flows through an electric heater for an hour and converts 8.64 MJ of electrical energy into heat energy. Then the potential difference across the heater is:
(a) 864 V (b) 240 V (c) 100 V (d) None of these

(iv) An alpha particle is accelerated to a velocity *v* in a particle accelerator by a potential difference of 1200 V. Which of the following potential differences would be needed to double the velocity of the alpha particle?
(a) 2400 V (b) 3600 V (c) 4800 V (d) None of these

(v) Two thin parallel wires carry currents along the same direction. The force experienced by one due to the other is:
(a) Parallel to the lines (b) perpendicular to the lines and attractive
(c) perpendicular to the lines and repulsive (d) None of these

(vi) If 300 mA current is passing through an electric bulb, then the number of electrons passing through in one minute will be:
(a) 1.12×10^{20} (b) 1.6×10^{19} (c) 6.02×10^{18} (d) None of these

(vii) An electric iron of resistance 20 Ω takes a current of 5.0 A. The thermal energy developed in 30s is:
(a) 15 kJ (b) 100 J (c) 10 J (d) None of these

(viii) An ideal gas has a volume of exactly 1 liter at 1.00 atm and –20°C. To how many atmospheres pressure must it be subjected to be compressed to 0.500 liter at 40°C?
(a) 5.2 atm (b) 2.47 atm (c) 1.5 atm (d) None of these

(ix) In Bohr's model the lowest orbit corresponds to:
(a) Maximum energy (b) Minimum energy (c) Zero energy (d) None of these

(x) The diffusion of the free electrons across the unbiased p-n junction produces:
(a) Forward bias (b) Reverse bias (c) Depletion region (d) None of these

(xi) The P-N junction, on forward biasing acts like a:
(a) Capacitor (b) Inductor (c) Insulator (d) None of these

(xii) The impedance at the resonant frequency of a series RLC circuits with L = 15 mH, C=0.015 F, and R = 80 Ω:
(a) 0 KΩ (b) 30 Ω (c) 80 Ω (d) None of these

(xiii) Weber is a unit of:
(a) Magnetic field intensity (b) Magnetic Flux
(c) Magnetic Flux Density (d) None of these

(xiv) The magnetic flux through an element of area **A** in a uniform magnetic field **B** is expressed as:
(a) AB (b) **B. A** (c) **A x B** (d) None of these

(xv) In an electric circuit, currents flowing towards a node having four branches are 2A, -3A and 4A, then the current in the fourth branch is:
(a) 2A (b) -3 A (c) 4 A (d) None of these

(xvi) With the passage of time, the rate of decay of a radioactive element will:
(a) Increase exponentially (b) Decrease linearly
(c) Becomes zero in two half-life time (d) None of these

(xvii) The place where controlled fission chain reaction is carried is?
(a) A black hole (b) A star (c) A reactor (d) None of these

(xviii) In 19th century, Faraday and Maxwell worked on the unification of two forces named as:
(a) Gravitational and Weak forces (b) Electric and magnetic forces
(c) Weak and Strong forces (d) None of these

(xix) Electromagnetic wave theory of light was proposed by:
(a) Newton (b) Michelson (c) Maxwell (d) None of these

(xx) The concept of field theory was put forward by:
(a) Franklin (b) Kepler (c) Orsted (d) None of these

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)** Extra attempt of any question or any part of the attempted question will not be considered. **(iv)** Use of Scientific calculator is allowed.

Q.2. (a) State and prove Gauss law. Compare it with Coulomb's law for calculating electric field. **(4+4+2)**

(b) Determine the **E** field caused by a spherical cloud of electrons with a volume charge density $\rho = \rho_0$ for $0 \le R \le b$ (both ρ_0 and b are positive) and $\rho = 0$ for R > b. Sketch the charge distribution and electric field for this charge. **(6+4)**

Q.3. (a) Explain Maxwell's equations. Write the fundamental relations for electrostatic and magnetostatic models. How these were modified to Maxwell's equations? What is the main contribution of Maxwell in this regard? **(4+2+4+2)**

(b) Derive Maxwell's two divergence equations from its two curl equations and the equation of continuity. **(4+4)**

Q.4. (a) What are P-type and N-type semiconductors? Draw ampere-volt characteristic of a PN junction. Why there is sudden increase in the small reverse saturation current at the breakdown voltage? Write the uses of zener diode. **(4+2+4+2)**

(b) What are transistors? Draw the three common transistor circuits. Explain the function of transistor in the saturation mode. **(2+2+4)**

Q.5. What is Compton Effect? Derive an expression for Compton shift. How it depends upon the scattering angle? What do you mean by Red Shift? **(2+8+6+4)**

Q.6. (a) Describe Schrodinger's wave equation. Normalize $\Psi = \mathbf{A}e^{-\alpha x}$, where A and α are real constants, A has units of $(\text{length})^{-1/2}$ and α with units of $(\text{length})^{-2}$. **(6+4)**

(b) What is the probability of finding the particle described by this wave function between x = 0.99 and x = 1.01 units? Also find the possible solution for E andV.

[Given the integration from -∞ to +∞ $\int_e^{-2x} dx = \sqrt{(\pi/2)}$] **(4+6)**

Q.7. (a) Explain Radioactive decay. Find an expression for decay rate. Relate half life to the disintegration constant. What are the units for the measurement of radioactivity? **(4+6+2+2)**

(b) A 2.71g sample of radioactive KCI is decaying at a constant rate of 440 Bq into the isotope ^{40}K, which constitutes 1.17% of the normal potassium. Calculate the half-life of this nuclide. **(6)**

Q.8. Write short notes on **ANY TWO** of the followings: **(10,10)**
(i) Poynting theorem and Poynting vectors
(ii) Elementary particles and their properties
(iii) Unification of forces.

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