FEDERAL PUBLIC SERVICE COMMISSION

COMPETITIVE EXAMINATION FOR RECRUITMENT TO POSTS IN BS-17 UNDER THE FEDERAL GOVERNMENT, 2011

Roll Number

PHYSICS, PAPER-I

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

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

(PART-I MCQs) (COMPULSORY)

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

(i) The angular momentum of a particle moving under the influence of a central force is:
(a) Infinite (b) Negative (c) Zero (d) Constant

(ii) Transverse component of the central force acting on a particle to keep it moving along a circular path is:
(a) mv^2r (b) mv^2/r (c) Zero (d) Constant

(iii) Law of Inertia can be defined in:
(a) Accelerated system (b) Non accelerated system (c) Both (a) and (b) (d) None of these

(iv) The K.E of the particle executing a uniform circular motion:
(a) Increases (b) Decreases (c) Remains same (d) None to these

(v) What type of force acts on a raindrop to reduce its speed?
(a) Gravitational Force (b) Force of Friction (c) Electromagnetic Force (d) Drag Force

(vi) The branch of heat relating to the measurement of temperature of a body is called:
(a) Thermometry (b) Photometery (c) Ellipsometery (d) Calorimetry

(vii) Which type of ideal gas will have the largest value for $C_p - C_{vi}$?
(a) Monoatomic (b) Diatomic (c) Polyatomic (d) The value will be the same for all

(viii) What would be the most likely value for C_T, the molar heat capacity at constant temperature?
(a) Zero (b) Zero $< C_T < C_V$ (c) $C_V < C_T < C_P$ (d) C_T = infinite

(ix) For which of the following process the entropy change Zero?
(a) Isoberic (b) Isothermal (c) Adiabatic (d) Constant volume

(x) The zeroth law of thermodynamics helps to define the term:
(a) Temperature (b) Pressure (c) Volume (d) Density

(xi) The law of conservation of mass in fluid dynamics can be expressed as:
(a) Av = constant (b) ρAv = constant (c) $P+1/2\rho^V+\rho gy$ = constant (d) None of these

(xii) The SI units of viscosity is:
(a) N-S/m^2 (b) Dynes-S/cm^2 (c) N-S/m (d) Dynes-S/cm

(xiii) The equation of continuity requires that the total mass within certain volume must remain constant:
(a) If there are sources as well as sinks (b) If there are no sources & sinks
(c) If there are sources only (d) If there are sinks only

(xiv) If the length of the "L" and the total force acting on it is 'F' then surface tension given is:
(a) F x L (b) F . L (c) F / L (d) L / F

(xv) If the particle of liquid which pass through a certain point do not follow the same path, as that followed by the particles that passed the same point previously the liquid is said to have:
(a) Steady flow (b) Non steady flow (c) Turbulent flow (d) None of these

(xvi) The potential energy of a simple harmonic oscillator is
(a) -Kx (b) $-Kx^2$ (c) $1/2\ Kx^2$ (d) $-1/2\ Kx^2$

(xvii) Types of the mechanical waves are:
(a) Longitudinal & sound waves (b) Sound & radio waves
(c) Longitudinal & transverse waves (d) Transverse & x-rays

(xviii) The refracted ray bends towards the normal when it enters from:
(a) Rare to denser medium (b) Denser to rare medium
(c) Air to vacuum (d) None of these

(xix) On a reflection from a fixed end, a transverse wave undergoes a phase change of:
(a) 90° (b) 180° (c) 270° (d) 360°

(xx) Resolving power of a diffraction gratting can be written as:
(a) $\lambda/\Delta\lambda$ (b) $\Delta\theta /\Delta\lambda$ (c) $\Delta\lambda/ \lambda$ (d) $\Delta\lambda/ \Delta\theta$

PART-II

NOTE:**(i)** **PART-II** is to be attempted on 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.**

Q.2. (a) Why do the unit vectors **i**. **j**. and **k** have no units? Are the unit vectors in the cylindrical and spherical coordinate system constant vectors? Explain **(3,3,4)**

(b) Elaborate the hybrid nature of the operator $\boldsymbol{\overline{V}}$. Write the expansion of $\boldsymbol{\overline{V}} \cdot \boldsymbol{\overline{V}}$ **V,** where **V** is a vector quantity. **(5,5)**

Q.3. (a) Can an object be increasing in speed as its acceleration decreases? If so, give an example; if not explain why. **(3,3,4)**

(b) State Kepler's Law of planetary motion. An Earth satellite, in circular orbit at an altitude *h* of 230 km above the Earth's surface, has a period *T* of 89 min. What mass of the Earth follows from these data? **(4,6)**

Q.4. (a) State the relativistic effect on mass, length and time. Describe the Einstein's postulates of relativity. **(3,3,3,3)**

(b) What is the total energy ***E*** of a 2.53-**MeV** electron? (When an energy is used as an adjective, it refers to the kinetic energy of the particle; here ***K*** = 2.53 **MeV**.) **(8)**

Q.5. (a) State Bernoulli's Theorem. A spherical, helium-filled balloon has a radius ***R*** of 12.0 m. The balloon, support cables and basket have a mass *m* of 196 kg. What maximum load ***M*** can the balloon carry? Take density of helium = 0.160 kg/m^3 and *density of air* = 1.25 kg/m^3 **(4,6)**

(b) Briefly describe the concept of surface tension? How can you evaluate the surface tension of a liquid experimentally? **(4,6)**

Q.6. (a) Differentiate between the phase velocity and the group velocity. Sound waves can be used to measure the speed at which blood flows in artries and veins. Explain how? **(4,6)**

(b) Use Maxwell's equations to derive the electromagnetic wave equation. **(10)**

Q.7. (a) Why does the boiling temperature of a liquid increase with pressure? A bubble of 5.0 mol of helium is submerged at a certain depth in liquid water when the water undergoes a temperature increase VT of 20°C at constant pressure. As a result the bubble expands. How much heat ***Q*** is added to the helium during the expansion and temperature increase? **(3,7)**

(b) Two blocks of copper, the mass m of each being 850 g, are put into thermal contact in an insulated box. The initial temperatures of the two blocks are 325 K and 285 K and the constant heat c of capacity of copper is 0.386 J/g.K. What is the final equilibrium temperature T of the two blocks? **(10)**

Q.8. Write notes on **ANY TWO** of the following: **(10,10)**
(a) Michelson-Morely experiment
(b) Travelling waves and standing waves
(c) Gyroscope

****

FEDERAL PUBLIC SERVICE COMMISSION

COMPETITIVE EXAMINATION FOR RECRUITMENT TO POSTS IN BS-17 UNDER THE FEDERAL GOVERNMENT, 2011

Roll Number

PHYSICS, PAPER-II

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

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

(PART-I MCQs) (COMPULSORY)

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

(i) The Lorentz force is the sum of:
(a) Gravitational and centripetal force (b) Electric and magnetic force
(c) Magnetic and nuclear force (d) Electric and nuclear force

(ii) The area under the hysteresis loop is proportional to:
(a) Magnetic energy density (b) Thermal energy per unit volume
(c) Electrical energy per unit volume (d) Mechenical energy per unit volume

(iii) The frequency of A.C is measured using:
(a) Multimeter (b) Avometer (c) Tachometer (d) Speedometer

(iv) $\Delta.E=\rho/\epsilon_0$ is called:
(a) Gauss's law (b) Faraday's law (c) Ampere 's law (d) Boit and savart law

(v) For computation of the rate at which the dipole radiates energy, the interaction of the normal component of _____ is done over sphere of radius R.
(a) Electric field (b) Pointing vector (c) Addition vector (d) Radiation

(vi) Semiconductor material have _____ bonds:
(a) Ionic (b) Covalent (c) Mutual (d) Metallic

(vii) The depletion region of a p-n junction is formed:
(a) During the manufacturing process (b) When forward bias is applied to it
(c) Under reverse bias (d) When its temperature is reduced

(viii) The current amplification factor alpha dc is given by:
(a) I_C/I_E (b) I_C/I_B (c) I_B/I_E (d) I_B/I_C

(ix) In amplitude modulation:
(a) Carrier frequency is changed (b) Carrier amplitude is changed
(c) Three sidebands are produced (d) Fidelity is improved

(x) Demodulation:
(a) is performed at the transmitting station (b) removes side bands
(c) rectifies modulation signal (d) is opposite of modulation

(xi) Which of the following X-rays lines will have the greatest frequency in a given element?
(a) K_α (b) K_β (c) L_α (d) It depends on the element

(xii) Which of these statements is a consequence of plank's derivation of the radiation law?
(a) Atomic oscillator can emit and absorb energy at discrete values only
(b) Atomic oscillator can emit and absorb energy at discrete frequencies only
(c) Both (a) and (b) (d) Neither (a) nor (b)

(xiii) The Zeeman effect without the spin of the electron is called ____ Zeeman effect.
(a) Anomalous (b) Normal (c) Paschen (d) None of these

(xiv) Zero point energy of harmonic oscillator is:
(a) $\hbar w$ (b) $\hbar w/2$ (c) Zero (d) $\hbar w^2$

(xv) According to Pauli Exclusion principle for two identical fermions, the total ____ is antisymmetric:
(a) Matrix (b) Wave function (c) Operator (d) Tensor

(xvi) The decay rate of a radioactive source is measured in units of:
(a) Curies (b) Roentgens (c) Rads (d) Rems

(xvii) Why are the fission fragments usually radioactive?
(a) They come originally from radioactive ^{235}U (b) They have a large neutron excess
(c) They have a large binding energy per nucleon (d) They are moving at high speed

(xviii) In a nuclear reactor, the function of the moderator is:
(a) to absorb neutrons (b) to keep the reactor from going critical
(c) to slow down the neutrons (d) to absorb heat from the core

(xix) What is the main difficulty associated with the fusion process as a source of electrical power?
(a) The scarcity of fuel (b) The coulomb barrier
(c) The radioactivity of the products (d) The danger of an explosion.

(xx) Binding energy of a deuteron is
(a) 2.22 Mev (b) 2.80 Mev (c) 2.3 Mev (d) None of these

PART-II

NOTE:(i) **PART-II** is to be attempted on 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.

Q.2. (a) How can an LRC series circuit made to find the dielectric constant of a medium? **(10)**

(b) A 1.5-mH inductor in an ***LC*** circuit stores a maximum energy of 17 ***uj***. What is the peak current ***I***? **(10)**

Q.3. (a) Obtain Faraday's law of electromagnetic induction. Emphasize the role of the Lenz's law. **(7, 3)**

(b) A solenoid has length ***L*** = 1.23 m and inner diameter ***d*** = 3.55 cm. It has five layers of windings of 850 turns each and carries a current $\mathbf{i_o}$ = 5.57 A. What is ***B*** at its center? **(10)**

Q.4. (a) Discuss and explain the common-base static characteristics. **(10)**

(b) Where did Rayleigh and Jeans go wrong? How did Planck radiation formula account for the discrepancy in the black body radiations **(3,7)**

Q.5. (a) Is the Compton effect more supportive of the photon theory of light than the photoelectric effect? Explain your answer. **(4,6)**

(b) A bullet of mass 41 g travels at 960 m/s. What wavelength can we associate with it? Why does the wave nature of the bullet not reveal itself through diffraction effects? **(6,4)**

Q.6. (a) How does the Rutherford orbital motion violate the classical physics? **(10)**

(b) Discuss the modification suggested in the Bohr's atomic model to account for the nuclear motion and the hydrogenic atoms. **(10)**

Q.7. (a) In what basic ways do the so-called strong force and the electrostatic force differ? Explain your answer. **(10)**

(b) Analysis of Potassium and Argon atoms in a moon rock sample by a mass spectrometer shows that the ratio of the number of (stable) ^{40}Ar atoms present to the number of (radioactive) ^{40}K atoms is 10.3. Assume that all the Argon atoms were produced by the decay of Potassium atoms, with a half-life of 1.25 X 10^9 y. How old is the rock? **(10)**

Q.8. Write notes on **ANY TWO** of the following: **(10 + 10 = 20)**
(a) Schrödinger's wave equation (b) Nuclear Fission and fusion
c) Semiconductors and applications

****