

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:	(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 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) Photometry (c) Ellipsometry (d) Calorimetry
- (vii) Which type of ideal gas will have the largest value for $C_p - C_v$?
(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) $0 < C_T < C_V$ (c) $C_V < C_T < C_P$ (d) $C_T = \text{infinite}$
- (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) $Av = \text{constant}$ (b) $\rho Av = \text{constant}$ (c) $P + 1/2\rho^V + \rho gy = \text{constant}$ (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) $F \times L$ (b) $F \cdot L$ (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) $-1/2 Kx^2$

PHYSICS, PAPER-I

(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 grating 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 $\bar{\nabla}$. Write the expansion of $\bar{\nabla} \cdot \bar{V}$ $\bar{V}$, where $\bar{V}$ 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 arteries 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 ΔT 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 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)
- The Lorentz force is the sum of:
 - Gravitational and centripetal force
 - Electric and magnetic force
 - Magnetic and nuclear force
 - Electric and nuclear force
 - The area under the hysteresis loop is proportional to:
 - Magnetic energy density
 - Thermal energy per unit volume
 - Electrical energy per unit volume
 - Mechanical energy per unit volume
 - The frequency of A.C is measured using:
 - Multimeter
 - Avometer
 - Tachometer
 - Speedometer
 - $\Delta E = \rho / \epsilon_0$ is called:
 - Gauss's law
 - Faraday's law
 - Ampere's law
 - Boit and savart law
 - 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.
 - Electric field
 - Pointing vector
 - Addition vector
 - Radiation
 - Semiconductor material have _____ bonds:
 - Ionic
 - Covalent
 - Mutual
 - Metallic
 - The depletion region of a p-n junction is formed:
 - During the manufacturing process
 - When forward bias is applied to it
 - Under reverse bias
 - When its temperature is reduced
 - The current amplification factor alpha dc is given by:
 - I_C / I_E
 - I_C / I_B
 - I_B / I_E
 - I_B / I_C
 - In amplitude modulation:
 - Carrier frequency is changed
 - Carrier amplitude is changed
 - Three sidebands are produced
 - Fidelity is improved
 - Demodulation:
 - is performed at the transmitting station
 - removes side bands
 - rectifies modulation signal
 - is opposite of modulation
 - Which of the following -rays lines will have the greatest frequency in a given element?
 - K_α
 - K_β
 - L_α
 - It depends on the element
 - Which of these statements is a consequence of plank's derivation of the radiation law?
 - Atomic oscillator can emit and absorb energy at discrete values only
 - Atomic oscillator can emit and absorb energy at discrete frequencies only
 - Both (a) and (b)
 - Neither (a) nor (b)
 - The Zeeman effect without the spin of the electron is called _____ Zeeman effect.
 - Anomalous
 - Normal
 - Paschen
 - None of these
 - Zero point energy of harmonic oscillator is:
 - $\hbar w$
 - $\hbar w / 2$
 - Zero
 - $\hbar w^2$

PHYSICS, PAPER-II

- (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 **i₀** = 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 1.25×10^9 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
