

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) $N\text{-S/m}^2$ (b) Dynes-S/cm^2 (c) $N\text{-S/m}$ (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 $\bar{\nabla} \cdot \bar{\nabla} \mathbf{V}$, where \mathbf{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/m³ and density of air = 1.25 kg/m³ (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
