



FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION FOR
RECRUITMENT TO POSTS IN BPS-17 UNDER
THE FEDERAL GOVERNMENT, 2010
PHYSICS, PAPER-I

Roll Number

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) If $A = 6i - 8j$, then $4A$ has the magnitude:
 (a) 40 (b) 10 (c) 20 (d) None of these
- (ii) Let $A = 2i + 6j - 3k$ and $B = 4i + 2j + k$ then $A \cdot B$ equals:
 (a) $8i + 12j - 3k$ (b) 17 (c) 23 (d) None of these
- (iii) If ∇ is an operator, then $\nabla \cdot \mathbf{V}$ means:
 (a) Gradient of a Scalar field (b) Curl of a vector field
 (c) Divergence of a Vector field (d) None of these
- (iv) The volume of a parallelepiped bounded by Vectors A, B and C can be obtained from the expression:
 (a) $(A \times B) \cdot C$ (b) $(A \cdot B) \times C$ (c) $(A \times B) \times C$ (d) None of these
- (v) A force acting on a particle is conservative if:
 (a) It obeys Newton's third law (b) It obeys Newton's second law
 (c) It works equals the change in Kinetic energy (d) None of these
- (vi) A torque applied to a rigid object always tends to produce:
 (a) A rotational acceleration (b) A linear acceleration
 (c) Precision (d) None of these
- (vii) When the velocity of a body is constant, its acceleration is:
 (a) Maximum (b) Zero (c) Infinity (d) None of these
- (viii) In the absence of external torque the total angular momentum is:
 (a) Constant (b) Zero (c) infinity (d) None of these
- (ix) The rate of change of Momentum of the particle is:
 (a) Energy (b) Force (c) Impulse (d) None of these
- (x) Constructive and destructive superposition of waves is observed in:
 (a) Polarisation (b) Interference (c) Diffraction (d) None of these
- (xi) The intensity of a wave is proportional to the square of:
 (a) Amplitude (b) Time (c) Intensity (d) None of these
- (xii) The colours in soap bubbles, oil slick etc. in a thin film is due to:
 (a) Diffraction (b) Polarisation (c) Interference (d) None of these
- (xiii) For higher resolution, in a diffraction grating, one needs to have:
 (a) Large number of ruling (b) Small number of ruling
 (c) No rulings at all (d) None of these
- (xiv) To produce interference, the sources must be:
 (a) Intense (b) Incoherent (c) Coherent (d) None of these
- (xv) Interference fringes are of:
 (a) Unequal width (b) Equal width (c) Variable width (d) None of these
- (xvi) A Carnot Cycle is:
 (a) a rectangle on a P-V graph (b) bounded by two isotherms and two adiabatics
 (c) any four sided process on a P-V graph (d) None of these
- (xvii) In an Adiabatic process:
 (a) The temperature of the system remains constant
 (b) The temperature of the system must change
 (c) The internal energy of the system remains constant
 (d) None of these

PHYSICS, PAPER-I

- (xviii) A Carnot Cycle heat engine operates between 227°C and 127° C. Its efficiency is:
(a) 44% (b) 20% (c) 79% (d) None of these
- (xix) Metals pipe carrying water some times bursts in winter because:
(a) Water expands (b) Ice expands when melts
(c) Metal contracts more than water (d) None of these
- (xx) A Fahrenheit thermometer and Celsius thermometer shows the same reading at:
(a) 200° (b) -40° (c) 100° (d) None of these

PART – II

NOTE:	<p>(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.</p>
--------------	---

- Q.2.** (a) Define a Scalar field, obtain an expression for the Gradient of a Scalar field. Why the gradient of a Scalar field is Vector? (11)
(b) Given $\Phi(x,y,z)=x^2yz^3$, find grad Φ at (1,2,1). (05)
(c) For what values of 'a', the vector $A=2i+aj+k$ and $B=4i-2j-2k$ are perpendicular. (04)
- Q.3.** (a) Distinguish between Linear and Angular Momentum. Explain the law of Conservation of Angular Momentum. Prove that the Angular momentum is constant in the absence of external torque. (14)
(b) The angular momentum J of a particle is given as $J=8t^4 i - 2t^2 j + 12t^3 k$,
Find the torque τ at $t = 1$ (06)
- Q.4.** (a) Discuss in detail the relativity of mass, time and length. (05)
(b) What is time dilation? Explain with example. (11)
(c) When we say that a clock in moving frame runs slower than a clock in a stationary frame. What does it mean? (04)
- Q.5.** (a) Differentiate between Streamline and turbulent motion of a liquid. (03)
(b) What is "Coefficient of viscosity"? Explain in detail the Stoke's law applicable in determining the coefficient of viscosity of a Viscous liquid experimentally. (14)
(c) Why do automanufacturers recommend using different viscosities of Engine oil in cold and hot climate. (03)
- Q.6.** (a) What is Polarization of light? Explain Polarization by reflection and obtain Brewster Law. Also explain the idea of double refraction. (13)
(b) We wish to use a Quartz sheet ($n=1.54$) in air as polarizer. Find the polarizing angle and angle of refraction. (05)
(c) Why can't we polarize sound waves? (02)
- Q.7.** (a) Define Internal energy. State and explain First and Third laws of thermodynamics. (14)
(b) What is a heat engine? Determine the efficiency of the engine if it takes 10,000 J of heat and delivers 2000 J of work per cycle. (06)
- Q.8.** Write notes on **ANY TWO:** (20)
(a) Centre of Mass
(b) Diffraction Grating and Resolving Power
(c) Production of low Temperature.



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) A Watt – sec is a unit of:
 (a) Force (b) Energy (c) Power (d) None of these
- (ii) The direction of any magnetic induction effect is such as to oppose the cause of the effect. This is:
 (a) Coulumb's Law (b) Ampere's Law (c) Lenz's Law (d) None of these
- (iii) A magnetic field cannot:
 (a) accelerate a charge (b) Exert a force on a charge
 (c) change the kinetic energy of a charge (d) None of these
- (iv) The inverse of resistivity is called Conductivity. Its unit is:
 (a) Ohm⁻¹ (b) ohm-metre (c) (ohm-meter)⁻¹ (d) None of these
- (v) An LRC Circuit has $R=4\Omega$, $X_C=3$ and $X_L=6$, the impedance of the circuit is:
 (a) 5Ω (b) 7Ω (c) 13Ω (d) None of these
- (vi) A "step-down" transformer is used to:
 (a) increase the power (b) decrease the voltage (c) Increase the voltage (d) None of these
- (vii) Electrical potential is the potential energy per unit:
 (a) Charge (b) Voltage (c) Force (d) None of these
- (viii) The force on a charge moving with the velocity in a magnetic field B is given by:
 (a) $F = (q/v \times B)$ (b) $F = (qv \times B)$ (c) $F = (qv + B)$ (d) None of these
- (ix) A changing current "i" in any circuit induces an emf "e" in that circuit, which is equal to:
 (a) $e = di/dt$ (b) $E = i d\Phi/dt$ (c) $e = -L di/dt$ (d) None of these
- (x) Inductive reactance of an inductor is:
 (a) $X_L = \omega^2 L$ (b) $X_L = \omega/L$ (c) $e = -L di/dt$ (d) None of these
- (xi) The resonant frequency of an LC-Circuit is:
 (a) $f = 2\pi LC$ (b) $f = 1 / 2\pi\sqrt{LC}$ (c) $f = 1/2LC$ (d) None of these
- (xii) The deliberate addition of an impurity element in a semi-conductor is called:
 (a) doping (b) annealing (c) mixing (d) None of these
- (xiii) The conversion of AC into DC is called:
 (a) amplification (b) rectification (c) modulation (d) None of these
- (xiv) The Laser light is:
 (a) monochromatic (b) coloured (c) chromatic (d) None of these
- (xv) The Laser light may be obtained from:
 (a) quartz crystal (b) NaCl crystal (c) ruby crystal (d) None of these
- (xvi) The emission of photoelectrons in photoelectric effect is dependent on:
 (a) threshold frequency (b) intensity of light (c) Nature of metal (d) None of these
- (xvii) Which one of the following is NOT needed in Nuclear Fission reactor:
 (a) fuel (b) accelerator (c) moderator (d) None of these
- (xviii) The half life of a radioactive isotope is 140 days. How many days would it take to loose 3/4 of its initial activities:
 (a) 105 days (b) 280 days (c) 35 days (d) None of these
- (xix) Most of the energy produced in Sun is due to:
 (a) Nuclear fusion (b) Chemical reaction (c) Nuclear Fission (d) None of these
- (xx) A U-235 nucleus will split when it captures:
 (a) an α -particle (b) e.m. radiation (c) neutron (d) None of these

NOTE:	<p>(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.</p>
--------------	---

- Q.2.** (a) State and prove Gauss's Law in electrostatics and express the law in differential forms. **(14)**
(b) Find the electric intensity at a point outside a volume distribution of charge confined into a spherical region of radius R. **(06)**
- Q.3.** (a) State and explain Ampere's Law. Derive an expression for the value of 'B' inside a solenoid. **(14)**
(b) A thin 10 cms long solenoid has a total of 400 turns of wire and carries a current of 0.20 amp. Calculate the field inside near the centre. $\left(\text{Given } \mu_0 = 12.57 \times 10^{-7} \text{ T - m/A} \right)$ **(06)**
- Q.4.** (a) How a Semi Conductor diode is used as a half wave and full wave rectifier? **(08)**
(b) What are the transistors? Give Construction and Symbol of PNP and NPN transistor. **(07)**
(c) The resistivity of a metal increases with increase in temperature while that of a semi conductor decreases. Explain. **(05)**
- Q.5.** (a) Discuss briefly the wave nature of matter and obtain an expression of de Broglie's wavelength for matter waves. **(14)**
(b) Calculate the de Broglie's wavelength of a 0.20kg ball moving with a speed of 15 m/s. **(06)**
- Q.6.** (a) Derive Einstein's photoelectric effect on the basis of quantum theory and derive Einstein's photoelectric equations. **(14)**
(b) Calculate the work function of Na in electron-volts, given that the threshold wavelength is 6800 Å and $h = 6.625 \times 10^{-34}$ J-S **(06)**
- Q.7.** (a) Define the terms decay constant, half life and average life as applied to a radioactive substance. Find the relation between them. **(11)**
(b) The half life of Radium is 1590 years. In how many years will one gm of pure element (a) loose one centigram and (b) be reduced to one centigram. **(07)**
(c) When a nucleus emits a γ – ray photon, what happens to its atomic number and its actual mass. **(02)**
- Q.8.** Write notes on **ANY TWO** of the following: **(20)**
(a) Self and Mutual Inductance
(b) Pauli's Exclusion Principle
(c) Compton Scattering
