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.B equals:
(a) 8i+12j-3k (b) 17 (c) 23 (d) None of these

(iii) If V is an operator, then V.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 x B).C (b) (A.B)x C (c) (A x B) x 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) Polaristaion (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

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(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:	**(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) 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.

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PHYSICS, PAPER-II

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.**
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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) $(ohm\text{-}meter)^{-1}$ (d) None of these

(v) An LRC Circuit has R= 4Ω, Xc = 3 and X_L=6, the impedence of the circuit is:
(a) 5 Ω (b) 7 Ω (c) 13 Ω (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 x B) (b) F = (qv x 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 dΦ/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 = 2Π LC (b) f = 1 / 2Π√ 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

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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'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. $\left(\text{Given } \mu_o = 12.57 \times 10^{-7} \text{ T - m/A}\right)$ **(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 A° and h = 6.625 x 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

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