



**FEDERAL PUBLIC SERVICE COMMISSION**  
**COMPETITIVE EXAMINATION-2019**  
**FOR RECRUITMENT TO POSTS IN BS-17**  
**UNDER THE FEDERAL GOVERNMENT**

Roll Number

**PHYSICS, PAPER-I**

<b>TIME ALLOWED: THREE HOURS</b>	<b>PART-I (MCQS)</b>	<b>MAXIMUM MARKS = 20</b>
<b>PART-I(MCQS): MAXIMUM 30 MINUTES</b>	<b>PART-II</b>	<b>MAXIMUM MARKS = 80</b>
<b>NOTE: (i) Part-II is to be attempted on the separate Answer Book.</b>		
<b>(ii) Attempt ONLY FOUR questions from PART-II. ALL questions carry EQUAL marks.</b>		
<b>(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.</b>		
<b>(iv) Write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.</b>		
<b>(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.</b>		
<b>(vi) Extra attempt of any question or any part of the question will not be considered.</b>		
<b>(vii) Use of Calculator is allowed.</b>		

**PART – II**

- Q. 2.**
- (a) Explain the Divergence of a Vector field with its physical significance? (10)
  - (b) A rural mail carrier leaves the post office and drives 22.0 km in a northerly direction. He then drives in a direction  $60.0^\circ$  south of east for 47.0 km. What is his displacement from the post office? (5)
  - (c) Vectors  $\vec{C}$  and  $\vec{D}$  have magnitudes of 3 units and 4 units, respectively. What is the angle between the directions of  $\vec{C}$  and  $\vec{D}$  if  $\vec{C} \cdot \vec{D}$  equals (a) zero, (b) 12 units and (c) -12 units? (5) (20)
- Q. 3.**
- (a) Distinguish between Linear and Angular momentum. Explain the laws of conservation of Angular momentum. (10)
  - (b) Estimate the net force needed to accelerate (i) a 1000kg car at  $\frac{1}{2}g$ ; (ii) a 200g apple at the same rate. (5)
  - (c) A vertical force is applied to a block of mass  $m$  that lies on a floor. What happens to the magnitude of the normal force on the block from the floor as magnitude  $F$  is increased from zero if force is (a) downward and (b) upward? (5) (20)
- Q. 4.**
- (a) Describe the Michelson - Morley Experiment and show how negative results obtained from this experiment were interpreted? (10)
  - (b) Derive equation of Lorentz velocity transformations and show that speed of light is independent of the relative motion between the frames of reference. (10) (20)
- Q. 5.**
- (a) What is surface tension? How surface tension is responsible for rising of liquid in capillaries? (10)
  - (b) Water circulates throughout a house in a hot-water heating system. If the water is pumped at a speed of 0.50 m/s through a 4.0cm diameter pipe in the basement under a pressure of 3.0 atm, what will be the flow speed and pressure in a 2.6cm diameter pipe on the second floor 5.0 m above? Assume the pipes do not divide into branches. (5)
  - (c) When blood pressure is measured, why must the cuff be held at the level of the heart? (5) (20)
- Q. 6.**
- (a) What is polarization of waves? How plane polarized light can be obtained by a polarization sheet. (10)
  - (b) Two flat mirrors are perpendicular to each other. An incoming beam of light makes an angle of  $15^\circ$  with the first mirror. What angle will the outgoing beam make with the second mirror? (5)
  - (c) Since the density of air decreases with an increase in temperature, but the bulk modulus  $B$  is nearly independent of temperature. How would you expect the speed of sound waves in air to vary with temperature? (5) (20)
- Q. 7.**
- (a) State and explain Equipartition Theorem. (10)
  - (b) Define laws of thermodynamics. Explain 3<sup>rd</sup> law of thermodynamics in detail. (10) (20)
- Q. 8.** Write the short notes on any TWO of the following: (10 each) (20)
- (a) Gyrocope
  - (b) Classical Maxwell-Boltzmann Statistics
  - (c) Spin and Precession

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**PHYSICS, PAPER-II**

<b>TIME ALLOWED: THREE HOURS</b> <b>PART-I(MCQS): MAXIMUM 30 MINUTES</b>	<b>PART-I (MCQS)</b> <b>PART-II</b>	<b>MAXIMUM MARKS = 20</b> <b>MAXIMUM MARKS = 80</b>
<b>NOTE: (i) Part-II is to be attempted on the separate Answer Book.</b> <b>(ii) Attempt ONLY FOUR questions from PART-II. ALL questions carry EQUAL marks.</b> <b>(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.</b> <b>(iv) Write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.</b> <b>(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.</b> <b>(vi) Extra attempt of any question or any part of the question will not be considered.</b> <b>(vii) Use of Calculator is allowed.</b>		

**PART – II**

- Q. 2.** (a) Derive an expression for the torque and potential energy of an electric dipole in an electric field. (10)
- (b) Show that the energy density of a parallel plate capacitor with dielectric medium between them is directly proportional to the square of electric field intensity. (6)
- (c) In a microwave oven torque acting on an electric dipole is responsible for the production of heat. Comment. (4) **(20)**
- Q. 3.** (a) Discuss origin of magnetism by considering processes that creates magnetic field in an atom. (8)
- (b) What are ferromagnetic domains? How does a typical ferromagnetic material is investigated by Hysteresis loop for technological applications? (8)
- (c) How does effect of nuclear magnetism becomes important in nuclear magnetic resonance? (4) **(20)**
- Q. 4.** (a) Derive an expression for the time-independent Schrodinger wave equation in one dimension for a single particle. Define Hamiltonian operator. (10)
- (b) Discuss various quantum numbers to describe the complete behavior of an electron in an orbital. (6)
- (c) How slowly must an electron be moving for its deBroglie wave-length equal to 1mm? (4) **(20)**
- Q. 5.** (a) Discuss the behavior of particle trapped in infinitely deep well and show that the energy of particle inside the well is quantized. (10)
- (b) Explain the terms wave function, probability density and normalization condition associated with quantum mechanics. (6)
- (c) Find the expectation value of the momentum. (4) **(20)**
- Q. 6.** (a) What is an oscillator? How an LC oscillator works? Discuss Barkhaausian criteria for oscillations. (10)
- (b) What is a feedback transistor? Differentiate negative feedback and positive feedback. (6)
- (c) what are RC filters (4) **(20)**
- Q. 7.** (a) Discuss principle, construction and working of Nuclear Reactor. Define Breeder Reactor. (8)
- (b) What is nuclear fusion? Describe Proton-Proton cycles for energy release in the Sun and Stars. (8)
- (c) What is Q-Value of a nuclear reaction? (4) **(20)**
- Q. 8.** Write comprehensive notes on any TWO of the following **(10 each)** **(20)**
- (a) The Biot and Savart law (b) Cyclotron
- (c) Electromagnetic waves

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