FEDERAL PUBLIC SERVICE COMMISSION

COMPETITIVE EXAMINATION FOR RECRUITMENT TO POSTS IN BS-17 UNDER THE FEDERAL GOVERNMENT, 2013

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 **OMR 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 Calculator is allowed.**

PART-I ((MCQs) (COMPULSORY)

Q.1. (i) Select the best option/answer and fill in the appropriate Circle ● on the **OMR Answer Sheet. (20x1=20)**
(ii) Answers given anywhere, other than OMR Answer Sheet, shall not be considered.

1. The square of the orbital period of a planet is:
(a) Directly proportional to the cube of the semi-major axis of its orbit.
(b) Directly proportional to the cube of the semi-minor axis of its orbit.
(c) Inversely proportional to the cube of the semi-major axis of its orbit.
(d) Inversely proportional to the cube of the semi-minor axis of its orbit. **(e)** None of these

2. If the velocity of the particle becomes doubled then its K.E:
(a) Becomes doubled **(b)** Reduces to half **(c)** Becomes four times **(d)** None of these

3. The P.E of a simple harmonic oscillator is:
(a) $-\frac{1}{2}kx^2$ **(b)** $\frac{1}{2}kx^2$ **(c)** kx^2 **(d)** kx **(e)** None of these

4. Two car racers are 100 Km away from each other. They drive their cars at 40 Km/h and 60 Km/h respectively towards each other. After 15 minutes they will be at a distance of:
(a) 25 Km **(b)** 50 Km **(c)** 60 Km **(d)** 75 Km **(e)** None of these

5. The equation of adiabatic change is:
(a) $PV^r = K$ **(b)** $P^rV = K$ **(c)** $(PV)^r = K$ **(d)** None of these

6. By exerting a certain amount of pressure on an ice block, you:
(a) Rise its melting point **(b)** Lower its melting point
(c) Make it melting at 0^oC only **(d)** None of these

7. Mercury thermometer can be used to measure temperature upto:
(a) 250^oC **(b)** 100^oC **(c)** 360^oC **(d)** 500^oC **(e)** None of these

8. Three Vectors $\vec{A}, \vec{B}$ *and* $\vec{C}$ not in the same plane make a Parallelepiped. The volume of Parallelepiped is:
(a) $(\vec{A}\times\vec{B})\times\vec{C}$ **(b)** $(\vec{A}.\vec{B})\times\vec{C}$ **(c)** $(\vec{A}\times\vec{B}).\vec{C}$ **(d)** $(\vec{A}.\vec{B})\,\vec{C}$ **(e)** None of these

9. The moment arm $(\vec{r}=4m)$ and force $(\vec{F}=10N)$ make an angle of 30^0 about the turning point. The torque produced will be:
(a) 40 N.m **(b)** 20 N.m **(c)** 34.6 N.m **(d)** None of these

10. In total internal reflection the refracted ray makes an angle of _____ with the normal.
(a) 0^o **(b)** 90^o **(c)** 180^o **(d)** None of these

11. Solar eclipse occurs when:
(a) Earth is between sun and moon **(b)** Sun is between moon and earth
(c) Moon is between earth and sun **(d)** None of these

12. Light is dispersed into different colours when passing through a glass prism because:
(a) Refraction of light occurs in glass **(b)** Refractive index of different colours is different
(c) Glass is denser than air **(d)** None of these

13. A ball is thrown with a velocity of $8\hat{j}\,(m/Sec)$. The acceleration *(m/Sec²)*is $4\hat{i}+2\hat{j}$ $(\hat{i}\ and\ \hat{j}\ are\ unit\ vectors)$. The displacement after 5 seconds:
(a) 52m **(b)** 68m **(c)** 82m **(d)** None of these

14. The time period of a Second's pendulum is 2 Sec. The mass of the Spherical bob of Second's pendulum is 50g and is empty. If it is replaced by another solid bob of same radius but mass 100g then its time period will be:
(a) 8 Sec. **(b)** 4 Sec. **(c)** 1 Sec. **(d)** 2 Sec. **(e)** None of these

15. The equation of the displacement of a harmonic oscillator is x=3 Sinwt + 4 Coswt (m) . The amplitude of the particle will be:
(a) 1m **(b)** 5m **(c)** 7m **(d)** 12m **(e)** None of these

16. One m^3 is equivalent to:
(a) 1000 liters **(b)** 100 liters **(c)** 10 liters **(d)** None of these

17. The frequency of Second's pendulum is:
(a) 2 hertz **(b)** 1 hertz **(c)** 0.5 hertz **(d)** None of these

18. The gradient of Scalar Potential is:
(a) Scalar quantity **(b)** Vector quantity **(c)** Neither Scalar nor Vector **(d)** None of these

19. Beats are produced because of:
(a) Interfrence of sound waves **(b)** Refraction of sound waves
(c) Diffraction of sound waves **(d)** None of these

20. The sound waves are:
(a) Longitudinal **(b)** Transverse **(c)** Electromagnetic **(d)** None of these

PART-II

NOTE: **(i)** **Part-II** is to be attempted on the separate **Answer Book.**
(ii) Candidate must write **Q. No.** in the **Answer Book** in accordance with **Q. No.** in the **Q. Paper.**
(iii) Attempt **ONLY FOUR** questions from **PART-II. ALL questions carry EQUAL marks.**
(iv) Extra attempt of any question or any part of the attempted question will not be considered.
(v) **Use of Calculator is allowed.**

Q.No.2. **(a)** The Vectors $\vec{A} = 2\hat{i} + \hat{j} + 3\hat{k}$, $\vec{B} = \hat{i} - 2\hat{j} - 2\hat{k}$. Find the magnitudes of $\vec{A}$ & $\vec{B}$, $\vec{A} \cdot \vec{B}$ and Projection of $\vec{B}$ on $\vec{A}$. **(2,2,3,3)**

(b) Prove that $\vec{A} \times (\vec{B} \times \vec{C}) = \vec{B}(\vec{A} \cdot \vec{C}) - \vec{C}(\vec{A} \cdot \vec{B})$. **(6)**

(c) Are the units vectors in the cylindrical and spherical coordinate system constant vectors? Explain. **(4)**

Q.No.3. **(a)** State Kepler's laws of planetary motion and prove
(i) Law of Areas (ii) Law of periods. **(2,4,4)**

(b) Use Maxwell's equations to derive the electromagnetic wave equation. **(10)**

Q.No.4. **(a)** What is Doppler's effect? Derive expressions of frequency of sound heard by observer when:
(i) The observer moving towards a stationary source
(ii) The source is moving towards a stationary observer. **(2,6,6)**

(b) A stationary observer detects sound of frequency 250 hertz emitted from a source at rest. He detects sound of frequency 750 hertz when source is moving towards him with constant velocity. Determine velocity of sound.
(Velocity of sound = 341 m/Sec.) **(6)**

Q.No.5. **(a)** Describe the Young's double slit experiment and find the conditions of constructive and destructive interference. **(10)**

(b) The double slit arrangement is illuminated by light of wavelength 546nm, the slits are 0.12mm apart and the screen on which the interference pattern appears is 55cm away. What is angular position of first maxima? What is linear distance between 3rd and 4th maxima? **(4,6)**

Q.No.6. **(a)** Describe the Postulates of relativity. Show the relativistic effect on mass, length and time. **(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.No.7. **(a)** Derive the expressions of position and time coordinates in frame S' relative to S (Lorentz Transformation). **(12)**

(b) Derive the Bernoulli's equation of a steady flow. **(8)**

Q.No.8. Write notes on any **TWO** of the following: **(10 each)** **(20)**
(a) Travelling and Standing Waves.
(b) LASER, its production and applications.
(c) Laws of thermodynamics.

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(iii) **Use of calculator is allowed.**

PART-I ((MCQs) (COMPULSORY)

Q.1. (i) Select the best option/answer and fill in the appropriate Circle ◯ on the **OMR Answer Sheet. (20x1=20)**
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1. If whole charge is concentrated at a point then the volume charge density outside the point is:
(a) 1 **(b)** Zero **(c)** Infinity **(d)** None of these

2. Potential due to point charge is:
(a) Symmetric **(b)** Anti-symmetric **(c)** Radially symmetric
(d) Spherically symmetric **(e)** None of these

3. Pointing Vector represents:
(a) Current **(b)** Current density **(c)** Energy flux **(d)** Magnetic induction **(e)** None of these

4. Boundary conditions are used for solution of:
(a) Homogenous Eq. **(b)** Inhomogeneous Eq. **(c)** Both of these **(d)** None of these

5. The direction of the inducted e.m.f. is given by:
(a) The induced e.m.f. rule **(b)** The Cockscrew rule **(c)** Ampere's swimming rule
(d) Fleming's right-hand rule **(e)** None of these

6. How many valence electrons are in every semiconductor material?
(a) 1 **(b)** 2 **(c)** 3 **(d)** 4 **(e)** None of these

7. Minority carriers are many times activated by:
(a) Heat **(b)** Pressure **(c)** Dopants **(d)** None of these

8. If conductance increases as temperature increases, this is known as a:
(a) Positive coefficient **(b)** Negative current flow **(c)** Negative coefficient
(d) Positive resistance **(e)** None of these

9. Three different points are shown on a dc load line. The upper point represents the:
(a) Minimum current gain **(b)** Quiescent point **(c)** Saturation point
(d) Cutoff point **(e)** None of these

10. The Solid-State Detector is basically:
(a) A forward biased p n-junction **(b)** A reversed biased p n-junction **(c)** A forward biased transistor
(d) A photocell **(e)** None of these

11. The signal voltage gain of an amplifier, A_v, is defined as:
(a) $A_v = V_{in}/V_{out}$ **(b)** $A_v = I_c * R_c$ **(c)** $A_v = R_c/R_E$ **(d)** $A_v = R_c/R_L$ **(e)** None of these

12. The total number of electron around the nucleus is called:
(a) Atomic number **(b)** Mass number **(c)** Avogadro's number **(d)** Gram mole **(e)** None of these

13. Nuclei of the same element having the same Z but different values of N are called:
(a) Isotopes **(b)** Isobars **(c)** Isomers **(d)** Allotropes **(e)** None of these

14. Charge on each α-particle is equal to:
(a) The charge on proton **(b)** Twice the charge on proton **(c)** Three times the charge on proton
(d) Four times the charge on proton **(e)** None of these

15. Which of the following particles move with velocity of light:
(a) α-particle **(b)** β-particle **(c)** γ-particle **(d)** None of these

16. How many neutrons are in the nuclide ^{66}Zn?
(a) 66 **(b)** 36 **(c)** 30 **(d)** 26 **(e)** None of these

17. Which particle is considered as an ideal projectile for induced nuclear reactions:
(a) Electron **(b)** Proton **(c)** Neutron **(d)** γ-particle **(e)** None of these

18. The function of the moderator in a nuclear reactor is:
(a) To slow down the neutrons **(b)** To absorb the neutrons **(c)** To cool the reactor
(d) To control the energy released **(e)** None of these

19. Which of the following process is responsible for energy emission in Sun?
(a) Alpha decay **(b)** Beta decay **(c)** Fission **(d)** Fusion **(e)** None of these

20. The half life of a radioactive substance is 10 days. This means that:
(a) Completely disintegrates in 20 days **(b)** Completely disintegrates in 40 days
(c) 1/8 will be left after 40 days **(d)** 7/8 part disintegrates in 30 days **(e)** None of these

PART-II

NOTE: **(i)** **Part-II** is to be attempted on the separate **Answer Book.**
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(v) **Use of calculator is allowed.**

Q.No.2. **(a)** State and explain Gauss's Law in electrostatics and express it in differential form. **(10)**
(b) Find the electric intensity at a point out side a volume distribution of charge confined in a region of radius R. **(10)**

Q.No.3. **(a)** State and explain Faraday's Law of electromagnetic induction. **(10)**
(b) How Maxwell's equations are derived from fundamental relations for electrostatic and magneto static models? Explain these equations. **(10)**

Q.No.4. **(a)** Explain P-N junction as rectifier. **(6)**
(b) How a transistor is formed. Give construction and symbol of a PNP transistor? **(8)**
(c) How resistivity of semiconductors change with temperature. **(6)**

Q.No.5. **(a)** Explain Compton Effect and Photoelectric Effect. How they support photon theory of light? **(10)**
(b) Discuss De-Broglie's Hypothesis. **(10)**

Q.No.6. **(a)** Discuss Bohr's atomic model and its success. How Rutherford's orbital motion violate classical physics? **(10)**
(b) Describe Schrodinger's wave equation. **(10)**

Q.No.7. **(a)** What is Radioactive decay? Define half life and average life and relate half life to the disintegration constant. **(10)**
(b) Discuss elementary particles and their properties. **(10)**

Q.No.8. Write note on any **TWO** of the following: **(10 each)** **(20)**
(a) Pointing Theorem and Pointing Vector **(b)** Nuclear Fission and Fusion
(c) Band theory of Solids

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