FEDERAL PUBLIC SERVICE COMMISSION

COMPETITIVE EXAMINATION FOR RECRUITMENT TO POSTS IN BS-17 UNDER THE FEDERAL GOVERNMENT, 2012

Roll Number

PHYSICS, PAPER-I

TIME ALLOWED: THREE HOURS	(PART-I MCQs)	30 MINUTES	MAXIMUM MARKS: 20
	(PART-II)	2 HOURS & 30 MINUTES	MAXIMUM MARKS: 80

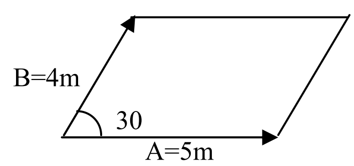
NOTE: **(i)** Candidate must write **Q. No.** in the **Answer Book** in accordance with **Q. No.** in the **Q. Paper.**
(ii) Attempt **ONLY FOUR** questions. **ALL** questions carry **EQUAL** marks.
(iii) Extra attempt of any question or any part of the attempted question will not be considered.
(iv)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

PART-II

Q. 2. (a) A vector is given by R=2i + j + 3k. Find
(i) the magnitude of 'x', 'y' and 'z' components.
(ii) the magnitude of 'R'.
(iii) the angle between 'R' and 'x', 'y' and 'z' axis. **(3,3,3)**

(b) Vectors 'A' and 'B' have equal magnitude of 5.0. If the sum of 'A' and 'B' is the vector 6j. Find the angle between 'A' and 'B'. **(6)**

(c) Find the area of the parallelogram shown with vectors 'A' and 'B'. **(5)**



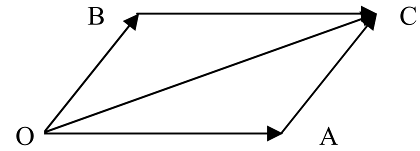
Q. 3. (a) State Hook's Law. A mass attached to an elastic spring is displaced from its equilibrium position and released. Show that its motion is simple harmonic and derive the differential equation, relation for instantaneous velocity, displacement and acceleration and plot each quantity with time for such motion. **(1,1,2,3,3)**

(b) A block of unknown mass is attached with an elastic spring having spring constant 6.5N/m and undergoes simple harmonic motion with an amplitude of 10 cm. When the block is half way between its equilibrium position and end point, its speed is 30cm/sec. Find
(i) Mass of the block (ii) Time period of the system
(iii) Maximum acceleration of the block **(2,3,3)**

(c) A mass spring system is in an elevator which moves upward with an acceleration "a". What will be the effect on measured value of spring constant compared to its value when elevator is at rest. **(2)**

Q. 4. (a) What are conservative and non-conservative forces? Give two examples of each. Prove mathematically that work done round a closed path in conservative field is zero. **(2,2,6)**

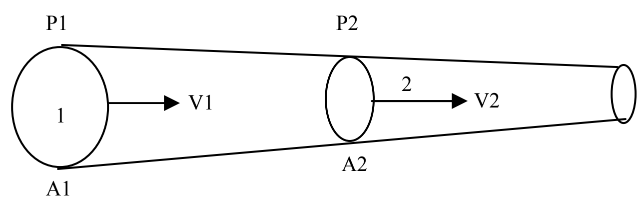
(b) A force acting on a particle moving in XY plane is given by $F=(2yi + x^2j)N$, where x and y are in meters. Particle moves from origin to a final position having coordinates x = 5.0m and y = 5.0m as shown in figure. Calculate the work done by the force F along
(i) Path OAC
(ii) Path OBC
(iii) Path OC
(iv) Is force F is conservative **(2,2,2.2)**



(c) Name various forces of nature **(2)**

Q. 5. **(a)** Differentiate between Laminar and Turbulent flow. Derive Bernoulli's equation for an incompressible and non-viscous fluid flowing through a non-uniform pipe and show that the sum of pressure, Kinetic energy per unit mass and potential energy per unit mass at one point is the same as the sum of these quantities at another point with different cross-sectional area. **(2,5,3)**

(b) A horizontal constricted pipe as shown in figure **(8)**



is called a Venturi Tube and can be used to measure the flow speed of an incompressible fluid. Derive the relation for flow speed at point (2) if pressure difference (P_1-P_2) is known.

(c) Why the speed of water in the middle of smooth flowing stream is high than its speed on the sides. **(2)**

Q. 6. **(a)** What is moment of Inertia? A rigid body of mass "M" is rotating with angular velocity 'ω'. Derive the relation for rotational kinetic energy of the body in terms of moment of inertia. **(2,8)**

(b) Prove that the moment of inertia of a uniform rod of length "L" and mass "M" about an axis passing through its centre is $I=ML^2/12$. **(8)**

(c) Differentiate the amount of energy of a bullet fired by a gun and a rifle with same linear velocity. **(2)**

Q. 7. **(a)** Differentiate between the special and general theory of relativity. Write the basic postulates of special theory of relativity. **(2,4)**

(b) An event occurs at a point (x,y,z) at time "t" in a frame of reference "S". Using Lorentz Transformation, derive the coordinate (x', y', z') and "t'" of the event observed in a frame "S'" moving relative to "S" with a constant speed "U" in positive X-direction. **(10)**

(c) Differentiate between Inertial and Non-Inertial Frames of reference. **(4)**

Q. 8. Write short notes on any TWO of the following: **(10,10)**
(a) Interference of light and Young's Double Slit experiment.
(b) LASER, its production and applications.
(c) Second Law of Thermodynamics and its applications.

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PHYSICS, PAPER-II

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PART-II

Q. 2. (a) Charge is uniformly distributed on a line with charge density λ. Calculate the electric field intensity at a point lying vertically at a distance y from the center of charge distribution. **(10)**

(b) In a uniform electric field near the surface of earth, a particle having charge of $q = -3x10^{-9}$ C is acted upon by a force $5x10^{-6}$ N. Find
(i) The magnitude of electric field.
(ii) Find the magnitude and direction of electric force on an electron placed in this field.
(iii) Find the ratio of electric force and gravitational force in this case. **(3,3,3)**

(c) What is meant by point charge? **(1)**

Q. 3. (a) State the Faraday's law of electromagnetic induction. Using this law, find the inductance due to a current carrying coil in the specific case of solenoid. **(10)**

(b) A solenoid 126cm long is formed from 1870 windings carrying a current of 4.36A. The core of the solenoid is filled with iron and the effective permeability constant is 968. Calculate the inductance of the solenoid assuming that it can be treated as ideal with a diameter of 4.45cm. **(8)**

(c) Write the importance of Faraday's law in today's prospective. **(2)**

Q. 4. (a) What is Modern Physics? Give the failure of Classical Physics in explanation of Photoelectric effect. Derive the photoelectric equation and comment how quantum physics was successful in explanation of photoelectric effect. Also plot photoelectric equation. **(3,3,5,3)**

(b) A beam of radiation with frequency $3.19x10^{15}$ hertz is incident on a metal surface and knocks out electrons from it. If the work function of the metal is 2.33 eV, find the maximum kinetic energy of the emitted electrons in electron volts. **(5)**

(c) What is the difference between ionization energy and work function? **(1)**

Q. 5. (a) Differentiate the Metals, Semiconductors and Insulators on the basis of Energy Band Theory. **(5)**

(b) What is a PN junction? How it is formed and why it is called a diode. **(8)**

(c) What is a rectifier? How we can use diode as a rectifier? Explain full-wave and half-wave rectification in detail. **(7)**

PHYSICS, PAPER-II

Q. 6. **(a)** Explain how Devison and Germer experimentally proved that a material particle like accelerated electrons can act as a wave. **(10)**

(b) Calculate the de.Broglie wavelength of an electron which is accelerated through a potential difference of 100 KV. Should we apply the relativistic correction in this calculation? **(8)**

(c) Sketch the probability of occurrence of an electron in Hydrogen atom. **(2)**

Q. 7. **(a)** What is Radioactivity? What changes occur in radioactive nucleus when α, β and γ radiation are emitted from it. How we can differentiate these rays experimentally. **(10)**

(b) Define half-life of a radio element. Describe the law of radioactive decay and plot a graph between half life and activity of a radio-nuclide. **(8)**

(c) Is proton an elementary particle; comment. **(2)**

Q. 8. **(a)** Define nuclear Fission and Fusion Reactions. What is the source of energy released in these reactions; Justify your answer with examples. Explain Fission Chain Reaction. **(10)**

(b) A $^7Li_3$ is bombarded by a proton. Two alpha particles ($^4He_2$) are produced. Find the reaction energy.
Mass of proton = 1.007825amu   Mass of $^7Li_3$ = 7.016003amu
Mass of alpha particle = 4.002603amu **(8)**

(c) In the given nuclear reaction $_{13}Al^{27} + {}_1H^1 \longrightarrow {}_zX^A + {}_2He^4$; What is X? **(2)**

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