FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION FOR
RECRUITMENT TO POSTS IN BPS-17 UNDER
THE FEDERAL GOVERNMENT, 2009
PHYSICS, PAPER-I

S.No.	
R.No.	

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 body is moving northward and the force applied is eastward, the acceleration produced is:
(a)   Northward   (b)   At 45° East of North   (c)   Eastward   (d)   None of these

(ii)   The correct form for the dimension of Power is:
(a) $[ML^2T^{-3}]$ (b) $[ML^3T^{-2}]$ (c) ML^2T^{-4} (d)   None of these

(iii)   The work done by the force $\vec{F} = 4\hat{a}_x - 3\hat{a}_y - 2\hat{a}_z$ N in giving a 1nC charge a displacement of $10\hat{a}_x + 2\hat{a}_y - 7\hat{a}_z$ m is:
(a)   10 nJ   (b)   15 nJ   (c)   20 nJ   (d)   None of these

(iv)   Three masses are placed on the x-axis; 200g at x = 0, 500g at x = 30cm, and 400g at x = 70cm. The center of mass will be at:
(a)   0.89 m   (b)   0.69 m   (c)   0.39 m   (d)   None of these

(v)   A 60 kg woman stands on a light, cubical box that is 5.0cm on each edge. The box sits on the floor. What pressure does the box exerts on the floor?
(a) 2.4×10^5 N/m^2 (b) 5×10^5 N/m^2 (c) 3×10^5 N/m^2 (d)   None of these

(vi)   SI unit of stress is same as that of:
(a)   Force   (b)   Momentum   (c)   Pressure   (d)   None of these

(vii)   What is the maximum speed at which a car can round a curve of 25m radius on a level road if the coefficient of static friction between the tires and the road is 0.80?
(a)   25 m/s   (b)   14 m/s   (c)   10 m/s   (d)   None of these

(viii)   The equation of a simple harmonic motion with amplitude 5m and time period 0.5s is:
(a) $y = 5 \sin(4\pi t)$ (b) $y = 0.5 \sin(2\pi t/5)$ (c) $y = 5 \sin(2\pi t)$ (d)   None of these

(ix)   Two particles each of mass 5.0kg are mounted 4.0m apart on a mass-less light rod which is capable of rotation about its center? The moment of inertia is:
(a)   1.25 kgm^2 (b)   20 kgm^2 (c)   40 kgm^2 (d)   None of these

(x)   The time period of mass of 1kg attached to a spring of spring constant of 100N/m is:
(a) 0.2π (b) π (c) 2π (d)   None of these

(xi)   A 14cm inner diameter water main furnishes water (through intermediate pipes) to a 1.00cm inner diameter faucet pipe. If the average speed in the faucet pipe is 3.0 cm/s, what will be the average speed it causes in the water main?
(a)   0.015 cm/s   (b)   0.15 m/s   (c)   0.5 m/s   (d)   None of these

(xii)   What is the tension T in the rope if a 10N weight is being pulled upward by it with a constant velocity of 2m/s?
(a)   12N   (b)   8N   (c)   5N   (d)   None of these

(xiii)   The ratio of linear Stress/Linear Strain is called:
(a)   Young's Modulus (b)   Bulk Modulus   (c)   Deformation   (d)   None of these

(xiv)   A body is moving with constant speed in a circle, its velocity vector:
(a)   Remains constant (b)   Changes its magnitude (c) Changes its direction
(d)   None of these

(xv)   When a constant torque is acting on a rotating system, which of the following is constant?
(a)   Angular velocity (b)   Angular acceleration (c)   Angular momentum
(d)   None of these

(xvi)   A planet has a mass four times and diameter twice that of the earth. What is the value of g on the planet?
(a)   19.6 m/s^2 (b)   9.8 m/s^2 (c)   4.9 m/s^2 (d)   None of these

(xvii) A geo-stationary satellite revolves around the earth from:
    (a) East to west   (b) West to east   (c) North to south   (d) N...

(xviii) According to Einstein, with the great increase in the speed of a body, the relativistic is:
    (a) Length remains constant   (b) Time decreases
    (c) Mass increases   (d) None of these

(xix) If graph between $1/m$ and a is a straight line, then:
    (a) $m \propto a$ (b) $m \propto 1/a$ (c) $m \propto 1/a^2$ (d) None of these

(xx) The frequency of rotation ω of a spaceship about its own axis to create gravity like earth is the square root of:
    (a) g/r (b) r^2/g (c) g/r^2 (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 gradient. Find the gradient of the magnitude of a position vector **r**. What conclusion do you derive from your result? **(4,4,2)**

(b) Sketch a function **V = -yx̂ + xŷ**. Find curl **V.** What would be its divergence? **(4,4,2)**

Q.3. (a) What is theory of relativity? Consider two inertial frames, A and B, with axes parallel and origins O,O' coinciding at $t = t' = 0$ and B moving with uniform velocity **v** along x-axis of A. Letting $\gamma = 1/\sqrt{[1-(v^2c^2)]}$, the Lorenz transformation $A \to B$ is $x' = \gamma(x - vt)$, $y' = y$, $z' = z$, $t' = \gamma(t - vx/c^2)$. From the principle of equivalence of inertial frames infer the inverse Lorenz transformation $B \to A$. **(8,4)**

(b) We can write one of Maxwell's equation of **B** in inertial frame 1 as
$$\mathbf{B}. d\mathbf{1}_1 = \mu_0 \left(\varepsilon_0\ \partial\phi_{E1}/\partial t_1 = i_1\right).$$
Write it in inertial frame 2 according to Einstein's principle of relativity. Does $\mathbf{B}_1 = \mathbf{B}_2$? **(4,4)**

Q.4. (a) State and prove Bernoulli's Theorem. **(12)**

(b) If the speed of flow past the lower surface of an airplane wing is 110 m/s. What speed of flow over the upper surface will give a pressure difference of 900 Pa between upper and lower surface? Take the density of air to be 1.3×10^{-3} g/cm^3. **(8)**

Q.5. (a) Describe waves and its types. Derive an expression for speed of wave on a stretched string by Newton's second law. **(4,8)**

(b) The equation of a transverse wave on a string is
$$Y = (2mm) \sin [(20m^{-1})x – (600s^{-1})t].$$
The tension in the string is 15N.
(i) What is the wave speed?
(ii) Find the linear density of this string in grams/meter. **(4,4)**

Q.6. (a) What is interference of waves? Describe all the necessary conditions for constructive and destructive interference. Explain one interferometer. **(2,6,4)**

(b) Two sound waves from two coherent sources with same frequency 450 Hz are traveling in the same direction at 330 m/s. What is the phase difference of the waves at a point that is 4.4m from one source and 4m from the other source. **(8)**

Q.7. (a) State and explain Second Law of Thermodynamics. Prove that Clausius and Kelvin-Plank statements of it are equivalent. **(6,6)**

(b) A Carnot engine operates between the temperatures 850 K and 300 K. The engine performs 1200 J of work each cycle, which takes 0.25 s. Calculate its efficiency and its average power. What are the rates of heat input and heat exhaust per cycle? **(8)**

Q.8. Write short notes on **ANY TWO** of the followings: **(10,10)**
    (i) Laser and its applications   (ii) Classical Maxwell-Boltzmann Statistics
    (iii) Dynamics of rigid bodies

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