



الامتحان التنافسي للمتقدمين للدراسات العليا (الدكتوراه) لقسم الفيزياء-كلية العلوم
جامعة بغداد للعام الدراسي ٢٠١٥-٢٠١٦

الاختصاص: فيزياء البلازما

اولاً: الورقة العامة ٢٠%

1- Multiple Choice Questions:

Q.1) The Coriolis force for dynamics of a particle in a rotating coordinate system is given as:

- (a) $F = -m\dot{\omega} \times r$ (b) $F = -2m\omega \times \dot{r}$
(c) $F = -m\omega \times (\omega \times r)$ (d) $F = m\ddot{r}$

Q.2) Semiconductor nano crystals are classified as :

- (a) 1D (b) 0D (c) 3D (d) 2D

Q.3) The nature of binding for a crystal with alternate and evenly spaced positive and negative ions is:

- (a) Ionic (b) metallic (c) covalent (d) Vander walls

Q.4) The characteristic impedance Z_0 of free space encountered by electromagnetic wave is the SI units of

- (a) Henry (b) Farad. Ohm (c) Ohm (d) $\frac{1}{\text{Farad} \cdot \text{Sec}}$

Q.5) What is the quantum number n of a particle of mass m confined to a one dimensional box of length L when its energy is $2h^2 / mL^2$?

- (a) 4 (b) 8 (c) 2 (d) 16

Q.6) Particles in degenerate energy levels all have the same

- (a) Energy. (b) Momentum. (c) Quantum numbers. (d) Velocity.



الامتحان التنافسي للمتقدمين للدراسات العليا (الدكتوراه) لقسم الفيزياء-كلية العلوم
جامعة بغداد للعام الدراسي ٢٠١٥-٢٠١٦

الاختصاص: فيزياء البلازما

اولاً: الورقة العامة ٢٠%

1- Multiple Choice Questions:

Q.7) The absolute value of the real number x is defined by:

(a) $|x| = \begin{cases} x, & \text{if } x < 0 \\ -x, & \text{if } x \geq 0 \end{cases}$ (b) $|x| = \begin{cases} x, & \text{if } x \geq 0 \\ -x, & \text{if } x < 0 \end{cases}$

(c) $|x| = x$ for $-\infty < x < \infty$, (d) $|x| = -x$ for $-\infty < x < \infty$.

Q.8) The result of $(e^{x_1})^{x_2}$ is given by:

(a) $e^{x_1+x_2}$, (b) e^{x_1/x_2} , (c) $e^{x_1-x_2}$, and (d) $e^{x_1x_2}$.

Q.9) The Domain (D_0) and Range (R_g) of the function $y = \sqrt{x+4}$ are given by:

(a) $D_0 : x \geq -4$, $R_g : y \geq 0$ (b) $D_0 : -\infty < x < \infty$, $R_g : y = 0$

(c) $D_0 : x = 0$, $R_g : y = -4$. (d) $D_0 : x \geq -4$, $R_g : y = 0$.

Q.10) The energy operator in quantum mechanics, $\hat{H} = -\frac{\hbar^2}{2m} \frac{\partial^2 x}{\partial x^2} + V$

(here given for one particle in one dimension) is called the

- a) Lagrangian b) Hamiltonian
c) Hermitian d) Angular momentum

Q.11) The commutator $[L^2, L_y] = :$

- a) 0 b) $i\hbar L_x$ c) $-i\hbar L_z$

Q.12) The probability of finding a particle in differential region dx is:

- a) $\psi(x,t) dx$ b) $\psi(x,t)/\psi^*(x,t) dx$ c) $\psi^*(x,t)\psi(x,t) dx$



2- Short Note Questions:

- Q.1)** An ideal pendulum, its small-angle period is measured on the moon to be 0.4 second long. What must be the length of the pendulum arm? (Hint: assume that $m_{\text{moon}} = (1/6) m_{\text{earth}}$, exactly).
- Q.2)** A disk of mass M is constrained to roll down an inclined plane without slipping. Solve the Lagrange equations for motion.
- Q.3)** By plotting the temperature dependence of electrical resistivity, show how to differentiate between metal and semiconductor.
- Q.4)** There is no perfect solid due to the defects and dislocations, name them.
- Q.5)** Evaluate $\int \frac{\cos x dx}{\sin x}$.
- Q.6)** Find $\frac{dy}{dx}$ for $y = \cosh^2 5x - \sinh^2 5x$.
- Q.7)** Prove that : $H = \hbar\omega \left({}^+a a + \frac{1}{2} \right)$, where H is the Hamiltonian of the one dimensional harmonic oscillator, ${}^+a$ is the rising operator and a is the lowering operator.
- Q.8)** Hydrogen atom in the state $\psi(\vec{r}, t) = \sqrt{\frac{3}{4}} \psi_{100}(\vec{r}) e^{-iE_1 t / \hbar} + \sqrt{\frac{1}{4}} \psi_{211}(\vec{r}) e^{-iE_2 / \hbar}$

What is the probability of measurements which give $E = E_2$?



2 Multiple Choice Question:

- Q.1) In general, the term plasma means;
(a) collection of charged particles, (b) the ionized state of matter,
(c) the fourth state of the matter, (d) an ionized gas.
- Q.2) All matter exist in plasma form above
(a) 100 Kelvin, (b) 1000 Kelvin, (c) 10000 Kelvin, (d) 100000 Kelvin.
- Q.3) Plasma charged particles (e and i) in gravitational field will drift in
(a) Same direction, (b) opposite directions,
(c) perpendicular directions, (d) random directions.
- Q.4) The magnetic mirror is a plasma confinement scheme based on the
(a) variant of μ , (b) invariant of μ , (c) variant of B , (d) invariant of B .
- Q.5) A mixed of two partially ionized gases plasma must be treated as
(a) one fluid, (b) two fluids, (c) three fluids, (d) five fluids.
- Q.6) In high frequency electron waves, the plasma approximation is
(a) not valid, (b) valid, (c) sometime not valid, (d) almost valid.
- Q.7) In any finite system, plasma oscillation will
(a) not propagate, (b) propagate, (c) be local, (d) not of them.
- Q.8) The condition for a plasma to be complex is
(a) $\Gamma < 1$, (b) $\Gamma > 1$, (c) $\Gamma \ll 1$, (d) $\Gamma \gg 1$
- Q.9) ionization of atoms, by a chain of collisions with electrons, is called
(a) stepwise ionization, (b) direct ionization,
(c) collisional ionization, (d) chain ionization.
- Q.10) The ionosphere prevents long electromagnetic waves from propagating therein if their frequencies are ----- the frequency of plasma oscillations.
(a) less than, (b) greater than, (c) equal to, (d) more greater than
- Q.11) The presence of particles in plasma can alter its
(a) ionization equilibrium, (b) thermal equilibrium,
(c) other properties, (d) not of them.
- Q.12) The breakdown electric field strength of dry air is about
(a) 2.5 V/cm, (b) 2.5 kV/cm, (c) 25 V/cm, (d) 25 kV/cm



الاختصاص: فيزياء البلازما

2 Short Note Questions

- Q.1) Does plasma a new (forth) state of matter? Why?
- Q.2) Does plasma occurs naturally in the environment when we live? Why?
- Q.3) Although electron temperature inside a fluorescent light bulb is about 20000°K it doesn't feel that hot. Explain that.
- Q.4) One can define plasma as a weakly ionized gas whose Debye radius is small compared with its size L . Explain that.
- Q.5) At the boundaries between ideal and dense plasmas, the ideality parameter, γ , can have the value 0.09, what is the number of plasma particles in Debye sphere at that boundary? Discuss your result.
- Q.6) An ion engine has a 1-T magnetic field, and hydrogen plasma is to be shot out at $E \times B$ velocity of 1000 km/sec. How much internal electric field must be present in the plasma?
- Q.7) A space capsule making a reentry into the earth's atmosphere suffers a communication blackout because plasma is generated by the shock wave in front of capsule. If the radio operates at a frequency of 300 MHz, what is the minimum plasma density during the blackout?
- Q.8) Lightning is a powerful electrical breakdown between a cloud and the Earth, between two clouds, or within one cloud. How it occurs?