University of Baghdad
College of Science
Department of Physics
Date: 13 / 8 / 2015

Qualifying Examination
for Ph.D Students
Year:2015-2016
Time: 3 Hours

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

الاختصاص: فيزياء المواد

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_o of free space encountered by electromagnetic wave has the SI units of

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

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.

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1-Multiple Choice Questions:

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

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

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

Q.8) The result of $\left(e^{x_1}\right)^{x_2}$ 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) $\psi^*(x,t)\psi(x,t)\,dx$

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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 $m_{moon} = (1/6)\, m_{earth}$, 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 : $H = \hbar w\left({}^{+}a\, a + \frac{1}{2}\right)$, 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 $E = E_2$?

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2 Multiple Choice Question:

Q.1) The distance between the adjacent nuclei or corresponding to the (maximum, minimum) potential energy is called the bond length.

Q.2) The (metallic, ionic) bond arises from electrostatic attraction between the oppositely charged ions

Q.3) The (hydrogen, covalent) bond is formed by hydrogen between two strongly electronegative atoms or groups of atoms (oxygen, nitrogen)

Q.4) Most metallic solids (crystallize, not crystalline) in the most densely packed structures such as FCC structure.

Q.5) (Crystals, glasses) are built up from an irregular three- dimensional network of polyhedral

Q.6) In a polymer chain the atoms of the backbone chain are connected by (covalent, van der waals) bonds.

Q.7) The crystalline stat of polymers differs from typical crystalline solids in that it is not associated with any (regularity, irregularity) of external form.

Q.8) Phase transformation, involve the (changes, stability) occurring between phases.

Q.9) An amorphous material such as glass or a high polymer is cooled from its (solid, molten) state, crystallization does not occur.

Q.10) Solid solution in alloy systems may be (two, one) kinds substitutional and interstitial.

Q.11) The solid eutectic consists of intimate (mixture, powder) of fine crystals arranged in the form of lamellae or rodlike or spherical particles.

Q.12) the mass transport phenomena within a solid and between solid – solid, solid-liquid and solid –gas are controlled by (diffusion, migration).

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2 Short Note Questions

Q.1) Explain the addition polymerization

Q.2) Plot

a- Variation of potential energy with interatomic distance (for two atoms)

b- Tetragonal ,Monoclinic

c- Cooling curves for solid solution alloys

Q.3) Explain the mechanism of diffusion in solids

Q.4) Explain homogenous nucleation

Q.5) The difference between continuous phase and dispersed phase

Q.6) Stats the types of composites

Q.7) Define 1-dimensional 2-dim and 3-dimensional nanocomposites

Q.8) The difference between AFM and SEM