



الامتحان التنافسي للمتقدمين للدراسات العليا (الدكتوراه) المحاولة الثانية لقسم الفيزياء-كلية العلوم / جامعة بغداد للعام الدراسي ٢٠١٥-٢٠١٦
الاختصاص:فيزياء الاغشية الرقيقة
اولاً:الورقة العامة ٢٠%

1- Multiple Choice Questions:

Q.1) 120 Pa is equal to

- (a) 1.2×10^4 atm, (b) 1.2×10^{-4} atm, (c) 1.2×10^3 atm, (d) 1.2×10^{-3} atm.

Q.2) While you are sitting on your chair, the earth is exerting you a gravitational force and you are exerting the earth -----force.

- (a) Same (b) greater (c) smaller (d) no

Q.3) Hamilton's principle is an example of a:

- a) Hamiltonian (b) Lagrange multiplier (c) stationary point (d) vibrational principle.

Q.4) The bulk superconductor is

- (a) Perfect paramagnetic (b) Perfect piezomagnetic (c) Perfect diamagnetic.

Q.5) Hall coefficient determines:

- (a) the concentration of charge carriers. (b) the concentration and type of charge carriers. (c) the magnetic field.

Q.6) The conventional unit cube of the diamond structure contains :

- (a) 4 atoms. (b) 8 molecules (c) 8 atoms

Q.7) For cross products,

- (a) the commutative and associative laws are valid
(b) the commutative and associative laws are not valid
(c) the commutative law is not valid while the associative law is valid
(d) the commutative law is valid while the associative law is not valid.

Q.8) The necessary and sufficient condition that the field \vec{F} be a conservative is that

- (a) $\text{div } \vec{F} = 0$, (b) $\text{grad } \vec{F} = 0$, (c) $\text{curl } \vec{F} = 0$, (d) $\text{div grad } \vec{F} = 0$.

Q.9) The following equation: $\oint_C M dx + N dy = \iint_R \left(\frac{\partial N}{\partial x} - \frac{\partial M}{\partial y} \right) dx dy$ is the definition of

- (a) Green's theorem in the plane (b) Stoke's theorem (c) divergence theorem of Gauss



Q.10 The expectations value of a function $f(x)$ when the wave function depends only on x is given by $\langle f(x) \rangle =$

- (a) $\int_{-\infty}^{\infty} \psi^*(x) f(x) \psi(x) dx$ (b) $\int_{-\infty}^{\infty} f(x) \psi(x) dx$
 (c) $\int_{-\infty}^{\infty} f(x) \psi^*(x) dx$ (d) $\int_{-\infty}^{\infty} \sqrt{f(x)} \psi(x) dx$

Q.11 The coupling of two angular moment, j_1 and j_2 gives the following number of substates:

- (a) $j_1 + j_2$ (b) Values from j_1 to j_2 , in integer steps.
 (c) Values from $|j_1 - j_2|$ to $|j_1 + j_2|$, in integer steps.

Q.12 A particle has a total energy that is less than that of a potential barrier. When the particle penetrates the barrier, its wave function is

- (a) A positive constant. (b) Oscillatory.
 (c) Exponentially increasing. (d) Exponentially decreasing

2- Short Note Questions

Q.1) What is the meaning of simple harmonic motion?

Q.2) What is the magnitude of the resultant sum of the following three displacement vectors?

$$\vec{D}_1 = (20, 5)\text{m}, \vec{D}_2 = (-12, -28)\text{m}, \vec{D}_3 = (-3, 7)\text{m}$$

Q.3) 1-Discuss briefly 3 ways to measure the binding energy of the excitons.

Q.4) By plotting the temperature dependence of the heat capacity, show how to differentiate between metals and dielectric materials in general.

Q.5) Convert $2\left(\cos\frac{\pi}{6} + i\sin\frac{\pi}{6}\right)$ into the rectangular form.

Q.6) Find $\vec{A} \times \vec{B}$, where $\vec{A} = 2\vec{i} - 3\vec{j} - \vec{k}$ and $\vec{B} = \vec{i} + 4\vec{j} - 2\vec{k}$.

Q.7) The wave function of a particle at given time is given by $\psi(x) = \frac{e^{ikx}}{\sqrt{x^2 + a^2}}$, where k and a are constants. Is $\psi(x)$ normalized? If not, find the normalization constant.

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 $E = E_1$?



ثانياً: الورقة الخاصة ٨٠%

Multiple Choice Questions:

Q.1) The type of atomic bonding most common in semiconductor is

- (a) Metallic (b) ionic (c) chemical (d) covalent

Q.2) Ionization within a P-N junction causes a layer on each side of the barrier called the:

- (a) Junction (b) depletion region (c) barrier voltage (d) forward voltage.

Q.3) Which material may also be considered a semiconductor element?

- (a) Carbon (b) ceramic (c) mica (d) argon

Q.4) What can a semiconductor sense?

- (a) Magnetism (b) temperature (c) pressure (d) all of them

Q.5) Elements with 1, 2, or 3 valence electrons usually make excellent:

- (a) conductors (b) semiconductors (c) insulators (d) neutral

Q.6) Minority carriers are many times activated by:

- (a) Heat (b) pressure (c) dopants (d) forward bias.

Q.7) If conductance increases as temperature increases, this is known as a:

- (a) positive coefficient
(b) negative current flow
(c) negative coefficient
(d) positive resistance



Q.8) What would be a typical magnitude for the reverse current in a general- purpose Silicon diode?

- (a) A few picampers
- (b) A few nanoampers
- (c) A few microampers
- (d) A few milliamperes

Q.9) If the drift velocity of holes under a field gradient of 100 V/m is 5 m/p, the mobility is

- (a) 0.05
- (b) 0.5
- (c) 50
- (d) 500

Q.10) when a p-n junction is unbiased, the junction electric current at equilibrium is

- (a) Zero as no charges cross the junction.
- (b) Zero as equal number of carriers cross the barrier.
- (c) Mainly due to diffusion of majority carriers.
- (d) Mainly due to diffusion of minority carriers.

Q.11) The junction capacitance of linearly graded junction varies with the applied reverse bias, V as

- (a) V^{-1}
- (b) $V^{-1/2}$
- (c) $V^{-1/3}$
- (d) $V^{1/2}$

Q.12) The leakage electric current of a p-n junction is caused by

- (a) Heat energy.
- (b) Chemical energy.
- (c) Barrier potential.
- (d) Majority carriers.



2-Short Note Questions

- Q.1) Explain briefly, what happens when the p-n junction in (a) forward biased and (b) Reverse biased .Illustrate your answer with relevant diagrams.
- Q.2) What is the meaning of:
- 1- Hall Effect.
 - 2- Mass- action law.
 - 3- The basic methods to fabricate the junction.
- Q.3) What is the conditions to get rectifying contacts when the metal have a contact with semiconductor explain this case.
- Q.4) Thermoelectric power is the one of methods to determine the type of carriers for semiconductor explain this method.
- Q.5) Explain how the Fermi level shifts when the semiconductor doped as n or p-type.
- Q.6)Speak about the absorption edge and the relation between the absorption coefficient and the photon energy.
- Q.7) What is the meaning of the d.c conductivity? Talk about the mechanisms of conductance with temperature.
- Q.8) Compare between LED and Laser diode.