MANSOURA UNIVERSITY FACULTY OF SCIENCE PHYSICS DEPARTMENT	YEAR: 4TH LEVEL SPECIALIZATION: PHYSICS PROGRAM	SECOND SEMESTER MAY, 2015 TIME: 2 HOURS

Subject: *Nuclear Physics* (فيزياء نووية - ف ٤٢١)

	ANSWER THE FOLLOWING QUESTIONS: (FULL MARK: 80)	Mark
1.a)	*Define briefly Nordheim strong rule applied in nuclear shell model for odd-odd nuclides.*	8
1.b)	*Given the ground state of $^{137}Ba_{81}$ nuclide to be $3/2^+$, distribute the 31 neutrons above the magic no. 50, then try to label the first excited state by moving one of these neutrons to to fill up the $2d_{3/2}$ state.*	12
2.a)	*Define the natural nuclear time & show when this time is much shorter than the decay time of the compound nucleus, the decay mode of this compound nucleus is independent of its way of formation.*	8
2.b)	*Show how the Auger electron emission is an alternative to the emission of X-ray, and calculate the K-x-ray energy, and the L- & M- Auger-electron kinetic energies, given the binding energies for the* ***K, L_I and M_I*** *electrons obtained from table of isotopes are respectively:* ***85.529, 15.347 and 3.704 keV.***	12
3.a)	*Mention the angular momentum & parity selection rules for a transition between an initial excited state (I_i, π_i) and final state (I_f, π_f), and having a multipole order L .*	9
3.b)	*In the level scheme of ^{72}Se nuclide, the level at energy 1317 keV has a half life of 8.7×10^{-12} sec & decays by three gamma transitions of energies 1317, 455 & 380 keV, knowing that the corresponding raios of their partial decay rates are : 51 : 39 : 10 respectively, calculate the total & partial decay constants of these transitions in sec^{-1}*	11
4	*Define the nuclear reaction cross-section, and then solve the following problem:* *One gram of natural neodymium is exposed for 4 days to thermal neutron flux = 1 x 10^{13} $n/cm^2/sec$. Calculate the amount & activity of $^{147}Nd^*$ given according to the following reaction:* $^{146}Nd + {}^1n \rightarrow {}^{147}Nd^* \rightarrow {}^{147}Pm + \beta^- + \upsilon$ *(σ= 2 barn, the natural abundance of ^{146}Nd is 17%, $t_{1/2}$ of $^{147}Nd^*$ =11.1d).*	20

WITH OUR BEST WISHES

EXAMINERS:	Prof. Dr Ali H. El-Farrash	Dr Ahmad Abou Ela Ahmad

Mansoura University Faculty of Science **PHYSICS DEPARTMENT** **Final Exam – 2nd Term** *(May 2015)*	**2014 – 2015**	**Fourth Year Students (*Physics*)** **Course: PHY 422 (Plasma Physics)** **Time allowed: 2 hours**

Answer the following questions

(Q1: 30 Mark, Q2: 30 Mark, Q3: 20 Mark) **Full Mark: 80**

Q1:

A) Define the term "***Plasma***" and explain briefly the plasma criteria.

B) Derive the cyclotron frequency and Larmor radius of a charged particle.

C) Define the magnetic mirrors and prove the invariance of the magnetic moment μ of a gyrating particle.

Q2:

A) Illustrate briefly the main differences between the single-particle model of plasma and the fluid model.

B) Obtain the different drift velocities (v_E, v_D) of a fluid drifts perpendicular to the applied magnetic field **B** and explain the origin the diamagnetic drift.

Q3:

Analyze **linearly** and **nonlinearly** a plasma system consisting of electrons and ions where the ions follow the thermal Boltzmann distribution. Derive the linear dispersion relation and the nonlinear K-dV equation and show the soliton solution that appear in the plasma system.

With my best wishes,,,,, *Dr. M. Sallah*

Mansoura University Faculty of Science Physics Department		2nd semester, 2014-2015 Time: 2 Hours Full mark: 80

Ph 423: Quantum Electronics

Answer the Following Questions		Mark
1.	Consider the case of an electron with energy E in a field of zero potential energy which encounters a potential field of magnitude $V_0 < E$. Find the reflection and transmission coefficients.	20
2.	Assuming a rectangular potential barrier of height (V_0), spacing (a) and thickness (b). Describe the allowed energy bands of electrons inside the crystal for all (V_0) values, assume a very small thickness ($b \to 0$) while ($V_0 b$) remains constant.	20
3.	Deduce the reciprocal lattice vectors $\vec{b}_1$, $\vec{b}_2$, $\vec{b}_3$ for a three-dimensional crystal of atoms arranged in a periodic pattern in space with lattice vector $\vec{R}$, number of atoms N_1, N_2, N_3 and lattice vectors $\vec{a}_1$, $\vec{a}_2$, $\vec{a}_3$ in the three directions, respectively. For a- Face centered cubic lattice form. b- Simple rhombic lattice form.	20
4.	Consider a metal of work function Φ and Fermi energy level E_f, derive the emission electron current density by the effect of temperature of the metal " Richardson equation".	20

With our Best wishes

Examiners	Prof. Dr. Abdel Razik R. Degheidy	Dr. Elkenany B. Elkenany (*)

Mansoura University Faculty of Science Physics Department Subject : Physics	Forth Year Physics	Second term Forth Year : Physics Date : 2/6/ 2015 Time allowed : 2 hours

Statis.Mech. ph (424)

Answer the following questions

(1) a – Write the physical meaning of the 6 – N dimensional phase space and the distribution function $W(\vec{X};t)$. Mark (20)

b – Derive the equation of motion for a phase space ensemble and discuss the physical meaning for each of the following relations,

(i) $[H, W] = 0$ (ii) $\dot{\vec{X}} = 0$ (iii) $\frac{d}{dt}\int_{G_t} W(\vec{X};t)\, d\vec{X} = 0$

(2) a – Obtain an expression for the entropy of an isolated closed system in terms of it's phase space volume . (25)

b – Find the phase space volume and the entropy for a system contains 5 particles moving freely in an isolated container of volume V at absolute temperature T.

(3) a – Gibb's canonical distribution is given by $W(\vec{X}) = e^{\frac{\psi(\theta,a)-H(\vec{X},a)}{\theta}}$, what is the Physical meaning of $\psi(\theta, a)$. Show that $\psi(\theta, a) = -\theta \ln z$ where z is the partition Function of the system . Obtain an expression for the entropy S in terms of ψ . (25)

b – The Hamiltonian of a system containing N independent one dimensional simple harmonic oscillators is given by $H = \sum_{i=1}^{n}\left(\frac{p_i^2}{2m} + \frac{1}{2} m\omega^2 q_i^2\right)$, find the partition function and the entropy of the system . (Note: $\int_0^\infty e^{-\alpha x^2}\, dx = \frac{1}{2}\sqrt{\frac{\pi}{\alpha}}$)

(4) State without prove the equipartition law of kinetic energy. Find the mean energy of a particle moving in a straight line under a damping force with potential $F = \alpha q^2 + \beta q^4$ where α and β are constants . (10)

With best wishes

Hayam mashaly .

Mansoura University
Faculty of Science
Physics department

2nd term. 2015
Time: 2 hours
Course: Phys420
Full Mark:80

Answer the following questions:

1.a. Write shortly on the physical items:

Current density in metals, mobility, means free path, thermal velocity and drift velocity. **[15 Mark]**

1.b. What is the maximum velocity of an electron in a metal which the Fermi energy has a value of 3.75 eV. Given: $e=1.602\times10^{-19}$ C and $m=9.1\times10^{-31}$ Kg. **[5 Mark]**

2.a. Discus Sommerfeld model, and explain the relation between energy and wavenumber. **[15 Mark]**

2.b. Briefly discus the factors affecting a resistivity of metals. **[5 Mark]**

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3. Give the main concepts of the following models:

Dulong-Petit, Einstein, and Debye, used for describing the relation between specific heat of solid and temperatures. **[20 Mark]**

4.a. What are dielectrics? And give the important points for the selections of dielectric materials. **[7.5 Mark]**

4.b. Write on the dielectric properties such as dielectric constants, dielectric loss, and dielectric strength. **[7.5 Mark]**

4.c. Discus the ferroelectric behavior and piezoelectric behavior with examples. **[5 Mark]**

With my best wishes
Prof. Dr.Fikry Reicha