Assiut University
Faculty of Science
Physics Department
M. Sc. Final Exam, Sep. 15, 2014
Course: Radiation doses measurement (662P)
Time: 3 hours
(Total mark= 100 Marks)

Answer the following questions:

Question 1 (25 marks)

(1-1) Derive the following equation

$$N(t) = N(0)e^{-\lambda t}$$

(1-2) Calculate the half-life of the radioactive sample from the following series of measurements:

Time (min)	0	1	2	3	4	5	6	7	8
Activity (counts/min)	.....	820	605	447	330	243	180	133	98

Question2 (25 marks)

(2-1) By using Bateman equations, distinguish between secular, transient and No equilibrium.

(2-2) A Vial containing $^{99m}T_c$ is labeled 3mCi @ 8 p.m. what is the activity at 8 a.m. on the same day? (DF (7 hr) =0.445).

Question 3 (25 marks)

(3-1) Distinguish between different types of radiation detectors.

Question 4 (25 marks)

(4-1) Explain the electronic instrumentation for radiation detection systems.

Good luck

Course coordinator: Dr. Hany Tawfik El-Gamal

Assiut University		Final Exam
Faculty of Science		15 / 09 / 2014
Department of Physics		Time: 3 hours

Programming and Computers – Code: P611

برمجة وحاسب آلي – ٦١١ف

All programs must be in **python** language.
Answer only **four** questions out of the following:

1.

a. The Catalan series of numbers are given by $C_0 = 1$, $Cn+1 = ((4n + 2)/(n + 2))Cn$. Write a program that prints in increasing order all Catalan numbers up to one billion.

b. Write a program to calculate and print the Madelung constant given by:
$M = \sum_{i,j,k=-L}^{L}(\pm \frac{1}{\sqrt{i^2+j^2+k^2}})$ for L = 100. The minus sign appears when i+j+k is odd.

2.

a. Explain the differences between trapezoidal and Simpson rules to evaluate integrals. Which one do you prefer for accuracy and speed?

b. Write a program to evaluate the integral x^4-2x+1 using the trapezoidal rule and another program using the Simpson rule.

3.

a. Given a file (test.txt) with data points for x and y in two column format, write the statements to read the file, slice data to x and y and show a plot of (x,y) on a PC screen.

b. Design a program to visualize 5 rotations of a planet in (xy) plane around the Sun. The program should ask the user for radius of planet, radius of orbit and period of rotation.

4. Explain and compare between the next python functions:

a. if and while.
b. list and array.
c. range and arange.
d. modulo and integer division
e. imshow and plot.

5.

a. Explain briefly with equations the use of Gaussian quadrature to fit a set of N points to a polynomial and to obtain a numerical integration.

b. Explain the use of the next function:

```
def gaussxw(N):
  a = linspace(3,4*N-1,N)/(4*N+2)
  x = cos(pi*a+1/(8*N*N*tan(a)))
  epsilon = 1e-15
  delta = 1.0
  while delta>epsilon:
    p0 = ones(N,float)
    p1 = copy(x)
    for k in range(1,N):
      p0,p1 = p1,((2*k+1)*x*p1-k*p0)/(k+1)
    dp = (N+1)*(p0-x*p1)/(1-x*x)
    dx = p1/dp
    x -= dx
    delta = max(abs(dx))
  w = 2*(N+1)*(N+1)/(N*N*(1-x*x)*dp*dp)
  return x,w
```

End of questions ***Good luck***

Assiut University Faculty of Science Department of Physics		Date: Sept. 18 /2014 Time: 3 hour

M. Sc. Exam. : Special Course – PHYS 619

Answer five of the following six questions (20 degree for every question)

(1) Explain how you can use the vibrating sample magnetometer as an experimental method for magnetization measurements.

(2) Define the magnetic susceptibility and explain an experimental method to measure it.

(3) Discuss the quantum theory of paramagnetism.

(4) Discuss the ferromagnetic behavior using the quantum mechanical exchange force used by Heisenberg.

(5) Explain the physical origin of magnetic anisotropy and how to extract the magnetic anisotropy constants from the magnetic curves of a single crystal.

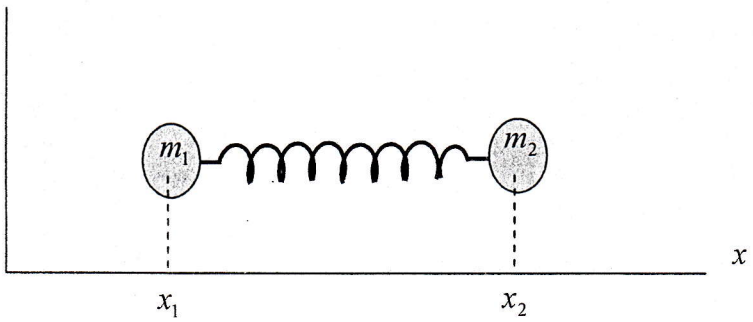
(6) a- Draw a diagram showing the Block wall and Neel wall, what are the conditions leading to the formation of each case.

b- Deduce the equations of energy and domain wall thickness in the case of 180^{o} domain wall in a material with uniaxial anisotropy

Best wishes
Dr. Mohamed Almokhtar

Assiut University, Physics Departmet. The master qualifying examination (2014). Statistical Physics. The allowed time:3hr
Answer only five out of the following.

1-a- Consider the system shown in the figure, reduce the two – body problem into the one – body problem.



1-b- Using Taylor expansion about an equilibrium position, discuss the harmonic and anharmonic model.

2-a- Calculate the total internal energy and molar heat capacity of CO_2 . at $(3000\,K)$ and at r00m temperature $(300\,K)$.

. 2-b- At those two temperatures which has higher energy CO_2 or H_2O

3- Starting from the distribution law in one – dimension, show that the distribution in two – dimension is

$$F(C)dC = \frac{m}{kT} C\, e^{-mC^2/2kT}\, dC$$

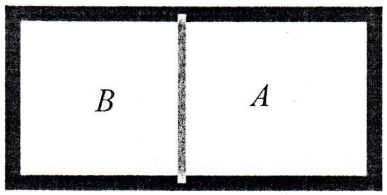
Write the same expression for one mole and then convert it to a distribution of energy.

Hint: the element of area in polar coordinate is

$$r\, dr\, d\theta$$

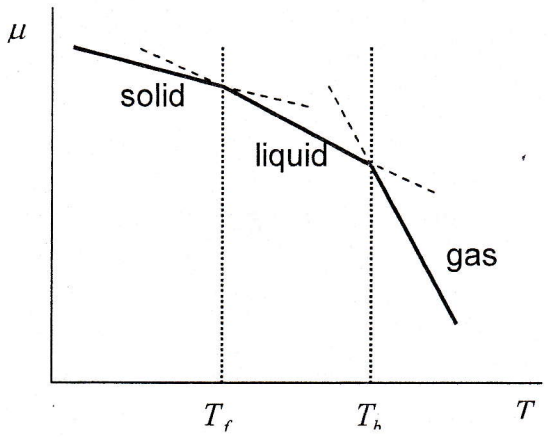
(2)

4- Discuss the second law of thermodynamics through heat transfer between two bodies in contact A and B , forming an isolated system (the figure) .



5- Use the $1/V$ virial expansion, obtain a virial equation in the entropy.

6- Consider the figure,



based on the concept of entropy, explain why the slope takes this shape μ is the chemical potential.

7- Considering the normal freezing point (1 atm, 298K) as one data point of the curve, calculate the freezing point for water at 1500 bar. The enthalpy of melting is $\Delta H_{m,m}(273\,K) = 6.01\,kJ\,mol^{-1}$

- assume it is constant over the pressure range. The change in the molar volume as a result of melting is

$$.\Delta V_{mm} = -1.7\,cm^3\,mol^{-1}$$

Assiut University | **M.Sc. Exam**
Faculty of Science | **Physics of thin films**
Physics Department | **Allowed time : 3 h**
Course : 614 Phys. | **Date : 11/ 9/2014**

Answer the following questions :

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1. a - Sketch the diagram of high vacuum system , then describe the function of each part and the operation steps to obtain high vacuum.
   b - Sketch the diagram for each of the following , then describe how it operates :
   - i - Vacuum rotary pump
   - ii - Diffusion pump
   - iii - Cold cathode vacuum gauge

2. Give reasons for each of the following statements :
   - a – The use of vacuum in thin film evaporation chamber
   - b – The use of Iodine in disproportionation reaction vessel
   - c – The use of Tungsten as evaporation source
   - d – The use of Argon in sputtering process

3. a – Discuss the basic principles of sputtering
   - b – Sketch the glow discharge sputtering method ,then discuss how it works
   - c - Sketch the triode sputtering method , then discuss its operation
   - d– Define the sputtering yield , then discuss the factors affecting its value .

4. Discuss briefly each of the following :
   - a – The factors affecting the properties of evaporated films
   - b – The difference between sputtered and evaporated films
   - c – The use of polymerization to obtain micro printed pattern
   - d – The calculation of the film thickness assuming emission from point source
   - e - The preparation of dielectric films using chemical methods
   - f - The flash evaporation technique

Dr. Mohamed M.Hafiz mmhafiz12@yahoo.co.uk

Assiut University	Graduate	Course	: Nuclear Structure
Faculty of Science	Final Exam	Code	: P 630
		Time	: 3 Hours
Department of Physics	September 2014	Date	: 11/9/2014

Answer four questions only of the following questions:

Question (1):

a) Write short notes about the properties of two-nucleon potential.

b) Discuss different types of equations that can be used to describe two-nucleon potential.

Question (2):

Derive ground state radial wave function of the deuteron using Schrödinger equation.

Question (3):

Derive the radial part of the Schrödinger equation.

Question (4):

Derive the differential scattering cross section for neutron proton scattering at low energies.

Question (5):

Find the spin dependence of scattering cross section for neutron proton scattering at low energies.

BEST WISHES **Instructor: Dr. Sherif Rashad MOKHTAR**

Faculty of science **Date: 11 December, 2014**
Physics Department **Time Allowed: 3 hours**
Written Examination for the Qualification of the M. Sc. Degree in Science (Physics)
[Crystal Structure 609 F]
Teaching Staff: Prof. Dr. Abdulaziz Abualfadl

Constants: h= 6.626 x 10^{-34}J.s, 1 eV= 1.6 x 10^{-19} J, k_B= 1.38 x 10^{-23}J/K, e=1.6 x 10^{-19}, c= 3 x 10^{8}m/s, N_A= 6.02 x1 0^{23} atom/mole. m_e=9.1x10^{-31} kg, m_n=6.7x10^{-27} kg

Answer 5 questions from the following: [20 marks for each]

1- (a): Write on both : i- the requirements for crystals used for collecting x-ray diffraction data ii- The advantages and disadvantages of using neutron diffraction in comparison with x-ray diffraction for determining material structure.

(b): Explain the following techniques used for practical x-ray diffraction:

i- A stationary single crystal can be irradiated by a range of x-ray wavelengths

ii- A monochromatic x-ray beam is allowed to irradiate a small specimen of the substance grounded to a fine powder

2- (a): Differentiate between four circule diffractometer and the powder techniques used for sample identification.

(b)- Determine the maximum wavelength for which Bragg reflection can be observed from a crystal with an atomic separation of 0.2 nm.

3- (a): Why is the energy of a neutron so much smaller than that of an electron in radiation beams employed in crystal diffraction? and why is the neutrons more useful in structure analysis?

(b)- A beam of thermal neutrons emitted from the opening in a reactor is diffracted by the (111) planes of a nickel crystal at an angle 21.5°. Calculate the effective temperature of the neutrons given that nickel is f.c.c. with a lattice parameter of 3.52 A° .

4- (a): Explain the following terms: 1) Bravais Lattice, 2) Basis, 3), Primitive Unit Cell, 4) Packing Fraction, 5) Coordination Number.

(b): Briefly Discuss:

-The crystal structure which has the highest packing fraction and what is it?

-The (geometrical) structure factor and for what can it be used?

- Data quality marks printed in ICDD or PDF cards.

5-(a)The coordinates of the A atom with scattering factors f_A in a cubic lattice are (0,0,0), (1,0,0), (0,1,0), (0,0,1) (0,1,1) (1,0,1) (1,1,0) and (1,1,1). There is also a B atom with scattering factor f_B at (1/2, 1/2, 1/2). Calculate the structure factor F_{hkl} for a general plane of Miller indices (hkl)?

- Determine the form of the polycrystalline or powder diffraction pattern (i.e. which planes actually diffract) when:

i- $f_A = f$ and $f_B = -f$,

ii- $f_A = f_B = f$

باقي الأسئلة في خلف الصفحة

(b)-Show that if the crystal undergoes volume expansion, then the reflected beam is rotated by the angle:

$$\delta\theta = -\frac{\gamma}{3} \tan\theta$$

5- (a) What is the meaning of the crystallographic symbols: 4/m, 2m, X3, X/mm, and show the equivalence of: $\bar{2}$, $\bar{3}$ and $\bar{6}$.

(b)- The crystal structure of copper is face-centered cubic (fcc) of lattice parameter *a* to be determined by x-ray diffraction (λ=17.89 nm) at room temperature (T=293 K).

(i) Determine the conditions on Miller indices of the diffraction peaks. What are the Miller indices of the first peak (i.e. smallest Bragg's angle θ)?

(ii) The θ of the first peak is measured to be 25.38°. What is the lattice parameter of copper?

(iii) The coefficient of linear thermal expansion is 1.91×10^{-5} K^{-1}. Where will be the first peek at T=1200 K?

Good Luck

(1)

Assiut University Faculty of Science Physics Department		Program: M. Sc. Date: 11/9/2014 Time Allowed: 3 hours

Course Title: Radiation Sources and Protection - Code: P666 - Final Exam (80 Marks)

Answer All the Following Four Questions.

Question 1 (20 Marks, 2 for each)

Circle the correct answer for the following TEN questions.

1. Which of the following couple of nuclei represents two isotones?
a) ${}^{35}_{17}Cl$ *and* ${}^{37}_{17}Cl$. b) ${}^{12}_{6}C$ *and* ${}^{14}_{6}C$. c) ${}^{13}_{6}C$ *and* ${}^{14}_{7}N$. d) ${}^{40}_{20}Ca$ *and* ${}^{40}_{18}Ar$.

2. Isobaric radioactive decay involves:
a) alpha decay. b) electron capture. c) internal conversion. d) none of them.

3. An example of cosmogenic radionuclides is:
a) ^{235}U. b) ^{40}K. c) ^{23}Na. d) ^{7}Be.

4. The stable lead isotope that terminates the actinium series is:
a) ^{207}Pb. b) ^{212}Pb. c) ^{212}Pb. d) ^{209}Pb.

5. Which of the following is considered an off-site radiation risk from a nuclear power plant?
a) release of iodine isotopes ^{129}I and ^{131}I.
b) inner surface core contamination.
c) release of a γ-ray emitter such as ${}^{56}_{25}Mn$.
d) none of the above.

6. In a squared cascade isotope separation plant,
a) the number of stages increases toward the product line.
b) the number of units increased toward the production line.
c) the number of units decreases toward the production line.
d) the number of units in every stage is constant.

7. A convenient separation factor of an isotope separation plant should be:
a) 1.0 b) 2.34 c) 0.005 d) none of them.

8. Which of the following has the highest linear energy transfer at the same energy and absolute charge?
a) a lithium ion. b) a helium ion. c) a muon. d) an electron.

9. To calculate the equivalent dose, which of the following must be given?
a) tissue weighting factor.
b) organ to be irradiated.
c) type and energy of radiation.
d) all of the above.

10. The minimum effective dose that causes a deterministic radiation effect is:
a) 250 mSv. b) 25 Sv. c) 50 mSv. d) 7 Sv.

(٢)

Question 2 **(20 Marks)**

A. Compare between controllable and uncontrollable technogenous sources. **(10 Marks)**

B. Illustrate schematically the isotope separation process by means of a gaseous diffusion. **(10 Marks)**

(٣)

Question 3 (20 Marks)

A. Discuss the differences between deterministic and stochastic effects of radiation in terms of the dose response curve giving examples for each effect. (10 Marks)

B. Calculate the quality factors of neutron whose energies are: i) 0.5 MeV and ii) 14 MeV. (10 Marks)

(4)

Question 4 **(20 Marks)**

A. In a nuclear reactor, 10 g of ^{235}U is irradiated with 2×10^{14} neutrons / (cm^2 s) for ten days. Calculate the radioactivity of ^{99}Mo produced if its $t_{1/2}$ is 66 h and formation cross-section by fission is 10^{-26} cm^2. **(10 Marks)**

B. (i) Given that the half-life time of ^{226}Ra is 1601 y, prove that the activity of 1 g of ^{226}Ra is approximately 1 Ci. (ii) What is the mass of ^{240}Pu ($t_{1/2}$ = 6563 y) that can radiate 1 Ci? **(10 Marks)**

End of the Exam.....*Good Luck*

Dr. Mohamed Omer

Assiut University — Physics Department

Master of Science Exam — Date: 15 /9/2014

Special course (667 Ph) — Time : 3 Hours

Part I : Answer the following questions (equal grades)

Write short notes on :

1. **Types of thermogravimetry**
2. **Interaction of gamma-ray with matter**
3. **Theories of solid state reactions**

Part II : أجب عن أربعة أسئلة فقط (الدرجات متساوية)

١-احسب معدل الجرعة الممتصة وكذلك المكافئة التى تنتج عن جسيمات بيتا اذا علمت ان تدفق هذه الجسيمات هو ٥٠٠ جسيم/سم٢ . ثانية ،. وان طاقتها المتوسطة 0.7 Mev

٢-لديك مصدر فوسفور ٣٢ رقيقه نشاطه الاشعاعى ٢ مللى كورى . احسب معدل الجرعة الممتصة تحت طبقة الجليد المثبت على مسافة ١ متر من هذا المصدر (اهمل الامتصاص فى الهواء)

٣-احسب معدل الجرعة المكافئة الناتج على مسافة ١٥٠ cm من مصدر سيزيوم ١٣٧ نشاطه الاشعاعى ٢٠ كورى اذا علمت ان طاقة اشعاعات جاما للمصدر هو 662 Kev

٤-احسب معامل جاما النوعى لنظير الكوبلت ٦٠ اذا علمت ان النيكل ٦٠ (النواة الوليدة للكوبلت٠) يصدر فوتونات جاما بطاقتين 1.173 Mev و 1.332 Mev وبنسبة تفرع ١٠٠% و ٩٩% على الترتيب

٥-من المعروف ان الحد السنوى للجرعة الفعالة للعاملين هو ٢٠ ميللى سيفرت / سنة . فكم ساعة يستطيع الفنى فى هذا المختبر ان يمكث في الاسبوع .

-- The End ------ Good Luck --- Prof. Dr. Refaat Mahfouz --- Dr.G.S. Hassan -----

Assiut University
Faculty of Science
Physics Department
M. Sc. Final Exam, Sep. 18, 2014
Course: Special course (667P)
Time: 3 hours
(Total mark= 100 Marks)

Answer only <u>one</u> part from the following:

Part one

Write short notes on

a- Interaction of gamma ray with matter **(50 marks)**

b- Techniques in nuclear chemistry **(50 marks)**

Part two

Question1 **(25 marks)**

1) What is radon?

2) Write on the sources of radon

3) Write on the units of radon measurements

Question 2 **(25 marks)**

Distinguish between the different methods used for measuring radon

Question 3 **(25 marks)**

Write short notes on

1) Health risks of radon
2) Specific genetic damage caused by radon

Question 4 **(25 marks)**

Write on the application of radon

Good luck

Course coordinator:
Prof.Dr. Refat Mahfouz
Dr. Hany Tawfik El-Gamal

Assiut University **Faculty of Science** **Department of Physics**		**Final Exam** **18 / 09 / 2014** **Time: 3 hours**
Special Topics – Code: P658 (Introduction to dislocations)		
مقرر خاص – ٦٥٨ف (مدخل الي الإنخلاعات)		

Answer only **five** questions out of the following: Every question carries 20 Marks.

1.

a. Demonstrate why some hcp metals slip on basal planes and others slip on prism plane.

b. Define stacking faults in general and explain the intrinsic and extrinsic faults introduced into the ABCABC stacking sequence of an hcp metal.

2.

a. On a plot of a cube, mark the nine components of the stress tensor. How these components are related to strain and to the effective pressure on a volume element.

b. Describe the two most probable slip systems for both fcc and bcc crystalline structures. By a slip system we mean Burgers vector and glide plane of slip dislocations.

3.

a. Discuss the concept of dislocation climb and factors that might assist this behavior.

b. Find equations describing the strain energy of edge and screw dislocations. How can someone get information on the core energy for a dislocation?

4. Write short account on **five** of the following:

a. Crystal decoration.
b. Burgers vector and circuit.
c. Thomson's tetrahedron.
d. Shockley and Frank partials.
e. Jogs.
f. Mixed dislocations.

5.

a. Explain how to estimate theoretically the value of the critical resolved shear stress for glide using a uniaxial tensile force.

b. Plot a [111] crystal projection in an fcc structure and index on it the Burgers vectors of three perfect dislocation and three partial dislocations. Write the decomposition equations for each perfect Burgers vector.

6.

a. Force between similar dislocations affect their glide, write what you know about this issue and use equations or plots when possible.

b. A dislocation with Burgers vector b moves an average distance $\bar{x}$ along b. Deduce a relation between strain rate and dislocation velocity.

End of questions

Good luck

Assiut University
Faculty of Science
Department of Physics

Final Exam
September 2014

Special Course 619 Phys
Master Degree
Time Allow: Three hours

Answer **all** the following questions. [10 Marks for each a, b or c].

1-a) Draw the optical processes observed in solid materials and write the expressing equation.

b) A material has a reflectivity of 40% and an absorption coefficient of 3.5×10^6 m^{-1} at 650 nm. Estimate the transmission and optical density of a sample with a thickness of 2 μm.

c) The complex refractive index of a material at 400 nm is given by

$n_c = 4.14 + 2.21^{*} i$. Calculate: (i) the absorption coefficient (ii) the reflectivity

2-a) Explain the interband optical transitions.

b) Deduce the frequency dependence of the absorption coefficient (the joint density of state).

c) A direct gap material with a band gap of 1.35 eV. The absorption coefficient at 775 nm is 3.5×10^6 m^{-1}. A platelet sample 1 μm is made with antireflection coated surfaces. Calculate the transmission of the sample at 620 nm.

3-a) Explain with drawing the schematic diagram the measurement of the absorption spectra.

b) Give a short account on the photovoltaic devices.

4-a) Discuss the band diagrams of direct and indirect gap for luminescent materials.

b) The band gap of the alloy $Al_x Ga_{1-x} As$ varies with composition according to

$E_g(x) = (0.438\, x^2 + 1.087\, x + 1.42)$eV. Calculate the composition emitting 800 nm.

With best wishes

Prof. Dr. Mostafa Boudi