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Assiut University **Faculty of Science** **Department of Physics**		**Final Exam 2014/2015** **Date : Jan. 9th , 2015** **Allowed Time: 3 hours**
Course Name: Amorphous Materials and Glasses **Coordinator:** Dr. Mansour Abdel Sattar		**Code:** 457 P

Answer only five of the following questions: **(50 Marks)**

Question 1: **(10 Marks)**

a. Compare between the amorphous and crystalline solids

b. Give a definition for the following:
the glass transformation-thermal analysis -the onset crystallization temperature

c. List the common methods used for preparing the amorphous materials?

Question 2: **(10 Marks)**

a. Draw the enthalpy-temperature diagram showing the behavior of a melt which cools to form glass and crystals and explain how cooling rate affect the glass transformation?

b. Calculate the specific refractivity (R_s) and the Abbe number (ν) of the sodium borate glass. Where $n_D = 1.47$, $n_F - n_C = 0.0079$, and Density = 1.89 g.cm^{-3}

c. Give a definition for the following:
Polarizability-Electronegativity- DSC

Question 3: **(10 Marks)**

a. Explain in detail how can the splat technique is used for preparing the amorphous metals?

b. What are the raw materials which are added to silica to produce Soda-lime glass? What is the reason for using these materials with silica?

c. Compare between the Goldschmidt and Zachariasen theory ?

Look at the back page

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Question 4: **(10 Marks)**

a. Show how the push-rod dilatometer is used to measure the thermal expansion of glass.

b. What are the mean parts of the thermal analysis apparatus?

c. List the production methods of glass containers. Explain in detail one method of them.

Question 5: **(10 Marks)**

a. Explain how the ultraviolet is absorbed by the glasses?

b. Explain how the electron beam Evaporator is working?

c. Draw the typical DSC curve of glass, showing the endothermic and exothermic peaks.

d. What are the two approaches which are used to analyze the dependence of the glass transition temperature on the heating rate

Question 6: **(10 Marks)**

a. What does happen for the 3d levels when the metal ions such as Fe ions are added to glass?

b. Compare among the amber, Gold ruby, and Colloidal Semi-conductor glasses.

c. Consider these materials: MgO, Al_2O_3 and SiO_2 According to Zachariasen rules, which materials can form glasses and which ones cannot? Where the ioic radius of Mg^{2+}, O^{2-}, Al^{3+} and Si^{4+} are 0.72, 1.40, 0.53 and 0.40, respectively.

End of questions---------- Best wishes

Dr. Mansour Abdel Sattar

جامعة أسيوط	الفصل الدراسي الثاني	المقرر : 491 ف
كلية العلوم	2014-2015	المادة : فيزياء رياضية
قسم الفيزياء	أختبار نهاية الفصل الاول	الوقت :3 ساعة

Answer the following questions:

1. a. State the 10 rules governing a mathematical space.
   b. Find out if the two 2x2 matrices:

$$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \; and \; \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$$

   make up a group under Matrix multiplication. What kind of a group?
   c. Discuss the symmetry of a triangle with two equal sides. Is this symmetry related to the above (b)? (الساقين متساوي مثلث)
   d. What these two matrices do to the 2D basis (I,j) in 2D geometric space?

2. Take the Linearly independent set: $\{x^i\}_{i=0}^{\infty}$. Get the first three components of c.o.n.s. of functions under the inner product:

$$\big(f(x), g(x)\big) = \int_0^2 f(x)g(x)dx$$

   Is there any relation between your answer and the following?

$$P_0 = \sqrt{\frac{1}{2}} \quad P_1 = \sqrt{\frac{3}{2}}\, x \quad P_2 = \sqrt{\frac{5}{2}}\, [\frac{3}{2}\, x^2 - \frac{1}{2}]$$

3. Find the coefficients $a_i's$ for the expansion $\Psi(\mathrm{x}) = \sum_{i=0}^{\infty} a_i\, \varphi_i(x)$ where $\{\varphi_i\}_{i=0}^{\infty}$ is a c.o.n.s. on the interval [0,+1].
   Take $\Psi(\mathrm{x}) = 3x^2 - 1$ and the first three components of $\{\varphi_i\}_{i=1}^{\infty}$ are : i. $\varphi_0 = 1$ ii. $\varphi_1 = \sqrt{3}[2x - 1]$
   iii. $\varphi_2 = \sqrt{5}\,[6x^2 - 6x + 1]$.
   Do you need more than the three components? Explain your Answer.

بالتوفيق ----------

(1)

Assiut University	**Physics & Physics and Chemistry**	**Magnetic Resonance and Mossbauer Spectroscopy**
Faculty of Science	**4th year**	**453 P**
Physics Department	**Exam date: 18 / 1 / 2015**	**Time allowed: 3 hours**

Exam in 2 pages (50 marks)

Use the following physical constants when you need:

Electron charge $e = 1.6x10^{-19}$ *Coulomb*, **Electron mass** $m_e = 9.11x10^{-31}$ *kg*,
Proton mass $m_p = 1.673x10^{-27}$ *kg*, **Planck's constant** $h = 6.626\,x10^{-34}$ *J.s*
The gyromagnetic ratio of H^1, $g = 5.586$ *Dielectric permittivity* $K = 9\,x10^{9}$ $Nm^2/Coul^2$
Boltzmann Constant $k = 1.38\,x\,10^{-23}$ *J/K*

Section (A): (15 marks)

Circle the correct answer for the following TEN sentences: (1.5 marks for each one)

1- The Larmor frequency of a magnetic moment around a magnetic field
(a) is constant and doesn't change with the applied magnetic field
(b) increases with increasing the applied magnetic field
(c) decreases with increasing the applied magnetic field

2- The L-S coupling splits the *d*-electrons levels *(l=2)* to
(a) six energy levels with $j=5/2$
(b) two groups with $j=5/2$, $j=3/2$
(c) four energy levels with $j=3/2$

3- The magnetic moment of an electron spin is
(a) μ_B (b) $\frac{1}{2}\mu_B$ (c) $2\mu_B$

4- The energy required for a spin flip of the electron in a magnetic field is
(a) smaller than the energy required for the proton
(b) larger than the energy required for the proton
(c) equal to the energy required for the proton

5- The photon frequency required in nuclear magnetic resonance experiment
(a) increases with increasing the applied magnetic field
(b) decreases with increasing the applied magnetic field
(c) doesn't depend on the applied magnetic field

6- The energy absorbed by the spin system conducted to the lattice is described by
(a) The spin-spin relaxation time
(b) The spin-lattice relaxation time
(c) neither of them

7- In an octahedral field, d_{z2} and d_{x2-y2} orbitals
(a) have higher energy than d_{xy}, d_{xz} and d_{yz} orbitals

(b) have smaller energy than d_{xy}, d_{xz} and d_{yz} orbitals
(c) have the same energy than d_{xy}, d_{xz} and d_{yz} orbitals

8- The energy of levels with quantum number j equals
(a) $E = g_j \mu_B m_j H$ (b) $E = \hbar \gamma_N m_j H$ (c) both are correct

9- In a Mossbauer spectroscopy, the energy of the emitted γ– photons from the source
(a) is proportional to the Doppler velocity of the source.
(b) is constant and doesn't change with the Doppler velocity of the source.
(c) is proportional to the Doppler velocity of the absorber.

10- In a Mossbauer spectroscopy, absorption resonance of γ– photons is due to
(a) overlapping between the absorption line and the emission line
(b) the recoil energy transferred to the source
(c) the high energy of the emitted γ–photons

Section B (15 marks):
Answer the following question:

In an ESR experiment, for a system with $l=2$ and $s=1/2$
a) Calculate the frequencies of resonance in a magnetic field of 0.2 T
b) Calculate the magnetic fields of resonance (H_1 *and* H_2) when the system is excited by photons with energy of 11.2 GHz

Section C (20 marks):
Answer two of the following three questions (10 marks for each one)

1) Calculate the energy required for a spin flip in a magnetic field of 0.1 T and the Larmor frequency for (a) the electron (b) the proton

2) Write the Bloch equations for the system of magnetic moments excited by photons in a constant magnetic field H and considering damping:

3) (a) Draw a diagram showing d_{z2}, d_{x2-y2}, d_{xy}, d_{xz} and d_{yz} orbitals and their energies levels in an octahedral field.
(b) Show the crystal field splitting diagram of the d-orbitals energy levels in a tetrahedral, an octahedral and a square-planer fields.

Best wishes
Examiner: Dr. Mohamed Almokhtar