RAJARATA UNIVERSITY OF SRI LANKA

FACULTY OF APPLIED SCIENCES

B.Sc. (Special) Degree in Applied Sciences
Third Year Semester II - Examination – October/November-2017

CHE 3212 – SOLID STATE CHEMISTRY

Answer **ALL** Questions — Time: 02 hours

The use of non-programmable calculator is permitted

1.

Gold has cubic crystals whose cell has an edge length of 4.079 A°. The density of the metal is 19.3 g cm^{-1}. From this data and the atomic mass, calculate the number of gold atoms in a unit cell. Assume all atoms are at the lattice points. What type of cubic lattice does gold have? Atomic mass of gold – 196.96 g mol^{-1}

(a) The metal M has a body centered cubic lattice structure with a unit cell edge 'L nm'. The density of metal M is 'X g cm^{-3}'. The molar mass of the metal M is 'Y g mol^{-1}'. Using these parameters, construct a relationship in order to find the Avogadro number 'A'.

(b) X-Rays of wavelength 0.150 nm are diffracted from a crystal at an angle of 20.17° Assuming that n= 2, what is the distance (in m) between layers in the crystal? Calculate the minimum interlayer spacing that can be measured using this X-Ray.

2.

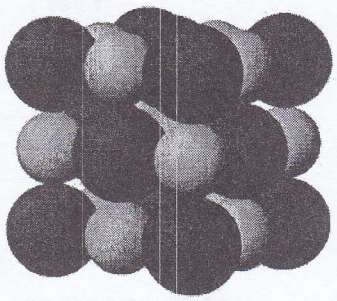
(a) 2.Unit cell of the MgO ionic crystal lattice is given bellow. Mg^{2+} and O^{2-} ions are indicated by small and large spherical shapes respectively

(i) What is the crystal structure of the MgO unit cell?

(ii) What is the coordination number of this crystal structure?

(iii) Calculate the radius ratio of this crystal structure.

(iv) If unit cell volume is 0.08 nm^3 calculate the packing fraction of this unit cell.



(b) For potassium chloride (KCl), (i) Determine the crystal structure and (ii) Calculate the packing factor. r^+- 0.133 nm, r^- - 0.181 nm.

ρ	Coordination number
≥ 0.732	8:8
0.414-0.732	6:6
0.225-0.414	4:4

3.

(a) What are the main crystal systems used in the crystallography

(b) How many bravais lattices are in the crystallography? Write the names of these lattices.

(c) What information could be obtained from the following symbols used in crystallography?

(111), [111], {111}, <111>

(d) Draw the following information in separate cubic unit cells

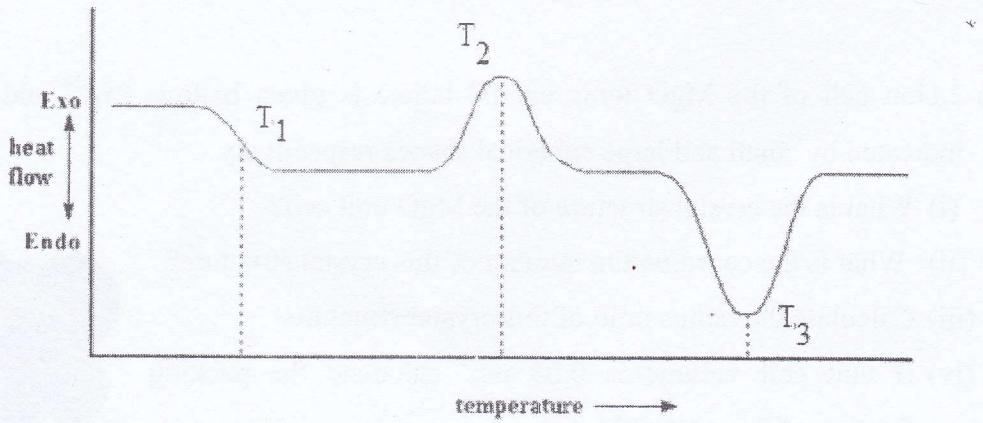
[212], [111], [110], [010], (212), (111), (110), (010), (113)

(e) Find the inter layer distances of two plains, those are indicated by the miller indices (121) and (212) in a cubic unit cell with a lattice parameter "a"

4.

(a) Explain the basic principles of Differential Scanning Calorimetry (DSC).

(b) DSC curve for amorphous polymer sample is given below. Explain this DSC cure using respective chemical or physical transformations at positions T_1, T_2 and T_3.



(c) What are the main component of Differential Thermal Analysis(DTA) instrument?

(d) Explain the basic principles of DTA

(e) Draw the TGA patterns for following conditions.

(i) The sample undergoes no decomposition with loss of volatile products over the temperature range.

(ii) The rapid initial mass loss is characteristic of desorption or drying.

(iii) Multi-stage decomposition with relatively stable intermediates.

(iv) Multi-stage decomposition with no stable intermediate product.

(v) Gain in mass due to reaction with atmosphere.

(f) A Pure $AgNO_3$ sample is analyzed by TG technique. Herein, the 50 mg of the $AgNO_3$ remains constant up to a temperature of 473 °C. At 473 °C it starts losing its weight and this indicates that the decomposition starts at this temperature. It decomposes to NO_2, O_2 and Ag. The loss in weight continues up to 608°C and beyond this temperature the weight of the sample remains constant. Draw the thermogram of pure $AgNO_3$

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