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**GARISSA UNIVERSITY**

**UNIVERSITY EXAMINATION 2019/2020 ACADEMIC YEAR TWO**

**SECOND SEMESTER EXAMINATION**

**SCHOOL OF SCHOOL OF PURE AND APPLIED SCIENCES**

**FOR THE DEGREE OF BACHELOR OF EDUCATION**

**COURSE CODE: CHE 202**

**COURSE TITLE: CHEMICAL THERMODYNAMICS AND PHASE EQUILIBRIA**

**EXAMINATION DURATION: 2 HOURS**

**DATE: 18/12/2020 TIME: 09.00-11.00 AM**

**INSTRUCTION TO CANDIDATES**

* **The examination has FIVE (5) questions**
* **Question ONE (1) is COMPULSORY**
* **Choose any other TWO (2) questions from the remaining FOUR (4) questions**
* **Use sketch diagrams to illustrate your answer whenever necessary**
* **Do not carry mobile phones or any other written materials in examination room**
* **Do not write on this paper**

**This paper consists of FOUR (4) printed pages *please turn over***

**QUESTION ONE (COMPULSORY)**

1. Give thermodynamics meaning of the following terms **[4 marks]**
2. Spontaneous process
3. Entropy
4. Gibbs free energy
5. (Work function
6. One mole of an ideal gas is allowed to expand isothermally from 0.02m3 to 0.2m3 at 300k. Calculate the entropy change for the system (ΔSsys) surrounding (ΔSsurr) and universe (ΔS univ) if the expansion is Irreversible against a constant external pressure of 0.1atmosphere **[6 marks]**
7. It is found that ΔH=-2810kJMol-1 and ΔS=182.4JK-1 when glucose is oxidized at 300K according to the reaction

C2H2O6(s) + 6O2(g) → 6CO2(g) + 6H2O(l) Calculate ΔG **[3 marks]**

1. Suggest whether the following statements are true or false **[5 marks]**
2. An invariant system has no degree of freedom
3. Systems with lower chemical potentials are more stable than those with higher chemical potentials
4. Information regarding the structure of matter can be obtained from studies of phase equilibria
5. The phase rule P+F=C+2 , is valid even if some of the components may not be present in all the phases
6. A eutectic is identical with a solid solution

(e) Explain the meaning the following terms as used in phase equilibria [**8 marks]**

(i) Phase

(ii) Degree of freedom

(iii) Component

(iv)An azeotrope

(iv) Invariant system

(f)

1. Distinguish between ideal solution and non-ideal solution **[2 marks]**
2. State any two characteristics of an ideal solution **[2 marks]**

**QUESTION 2**

1. State the third law of thermodynamics **[2 marks]**
2. For each of the following series of pairs indicate which one of each pair has the greater quantity of entropy and explain your answer
3. 1.0mol of carbon dioxide gas at 20oc, at 1atm or 2.0mol of carbon dioxide gas at 20oc, 1 atm **[2 marks]**
4. 1.0mol of Butane liquid at 20oc, 10atm or 1.0mol of Butane gas at 20oc, 10atm **[2 marks]**
5. 1.0mol of solid carbon dioxide at – 80oc, 1atm or 1.0mol of solid carbon dioxide at -90oc, 1atm **[2 marks]**
6. 25g of solid bromine at -7oc, 1atm or 25g bromine vapour at -7oc, 1atm **[2 marks]**
7. For the reaction

n-C4H10 (g) = iso-C4H10 (g)

at 298K, Enthalpies and entropies of formation of n-butane and iso-butane are as follows

|  |  |  |
| --- | --- | --- |
|  | ΔHf (kJmol-1) | ΔSf (JKmol-1) |
| n-butane | -124.7 | -365.8 |
| Iso-butane | -131.6 | -381.1 |

State whether the isomerization is spontaneous or not **[6 marks]**

1. One mole of gaseous oxygen is expanded from 10dm3 at 298K to 40dm3 at400K. If Cp = 29.4JK-1Mole-1. Estimate the entropy change associated with the expansion for a perfect gas. **[4 marks]**

**QUESTION 3**

(a) (i)State the relationship between Gibbs free energy and Equilibrium constant **[2 marks]**

(ii) Calculate the Equilibrium constant k for the conversion of Oxgen to Ozone

3O2 (g) O3 (g) at 298k; given that ΔGo = 163.2kJmole-1,

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R = 8.314JK-1mole -1 **[6 marks]**

(b) With the help of Gibbs – Helmholtz equation find ΔGo for the reaction at 310k

2CO (g) + O2 (g) 2CO2 (g)

Given the following data in KJmole-1 at 300k for:

For: (I) CO (g) ΔHof  = -110.5, ΔGof = 137.2

1. CO2 (g) ΔHof = -393.5, ΔGof = -394.4

Assume that ΔHo value, remain unchanged in this temperature range **[12 marks]**

**QUESTION 4**

1. Explain the following terms as used in the study of phase rule **[4 marks]**
2. Eutectic points
3. Peritectic temperature
4. A solid compound is said to have poses a incongruent melting point, what does it mean **[3 marks]**
5. Explain what’s meant by the term colligative properties of a system **[3 marks]**
6. Draw a diagram for liquid vapour composition curves for ideal solution **[6 marks]**
7. State any two limitations of phase rule **[4 marks]**

**QUESTION 5**

1. Define phase diagrams **[2 marks]**
2. Sketch a general shape of a phase diagram for a one-component system **[5 marks]**
3. Two elements A and B react to form a compound AxBy with an incongruent melting point. Draw and label a phase diagram representing this. Label all the regions, curves and points. **[13 marks]**