



EDO UNIVERSITY IYAMHO, EDO STATE

FACULTY OF SCIENCE

DEPARTMENT OF CHEMISTRY

FIRST SEMESTER EXAMINATION, 2017/18 SESSION

COURSE TITLE: BASIC PHYSICAL CHEMISTRY

COURSE CODE: CHM 211 TIME ALLOWED: 3 HOURS

INSTRUCTION: ATTEMPT FIVE QUESTIONS IN ALL

Question 1

- Explain the significance of the constants *a* and *b* in the Vander Waal equation for real gases.
- You are in charge of the manufacture of cylinders of compressed gas at a small company. Your company president would like to offer a 4.00 L cylinder containing 500 g of chlorine in the new catalog. The cylinders you have on hand have a rupture pressure of 40 atm. Use both the ideal gas law and the Vander Waals equation to calculate the pressure in a cylinder at 25°C. Is this cylinder likely to be safe against sudden rupture ($R = 0.08206$, $a = 6.26 \text{ L}^2\text{atmmol}^{-2}$ $b = 0.0542\text{Lmol}^{-1}$ for Cl_2).
- Account for the deviation of real gases from ideal gas behavior.
- A photochemical process consists of the following primary and secondary reactions:



Write the overall reaction for this process.

14 marks

Question 2

- The following gas phase reaction has been studied under different conditions:



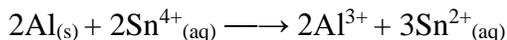
The rate constant *k*, at 30°C, has been determined to be $7.3 \times 10^{-5}\text{s}^{-1}$ and for a temperature of 60°C; $2.9 \times 10^{-3}\text{s}^{-1}$. What is the activation energy (*E_a*) for the reaction?

- Write short note on the following:

- i. intermediate ii. Photosensitizer iii. component iv. degree of freedom

c. State any two differences between a photochemical and thermochemical reaction.

d. Determine the feasibility of the reaction



Given

$$\text{Al}/\text{Al}^{3+} \quad E^{\circ} = -1.66\text{V}$$

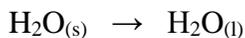
$$\text{Sn}^{4+}/\text{Sn}^{2+} \quad E^{\circ} = +0.15\text{V}$$

14 marks

Question 3

a. One mole of an ideal gas at 25°C is allowed to expand reversibly at constant temperature from a volume of 10 litres to 20 litres. Calculate the work done by the gas.

b. Given the equation for the melting of ice:



For which

$$\Delta H^{\circ} = 6.03 \times 10^3 \text{J/mol} \text{ and } \Delta S^{\circ} = 22.1 \text{J/K.mol}$$

Calculate ΔS_{uni} and ΔG° at 0°C

c. Identify the number of phases present in the following mixtures:

i. monoclinic and rhombic sulphur

ii. nitrogen, oxygen and carbon (iv) oxide

ii. ethanol and water

iv. chloroform and water

d. State any two uses of electrode potential table

marks

14

Question 4

a. When a substance A was exposed to light, 0.002 mole of it reacted in 20 minutes and 4 seconds. In the same time A absorbed 2.0×10^6 photons of light per second. Calculate the quantum yield of the reaction. (Avogadro number $N = 6.02 \times 10^{23}$)

b. Differentiate clearly between Intermediate Compound Formation theory and The Adsorption theory of catalysis

c. State and explain Stark-Einstein Law of Photochemical Equivalence.

d. Calculate the energy associated with (a) one photon; (b) one einstein of radiation of wavelength 8000 Å. $h = 6.62 \times 10^{-27}$ erg-sec; $c = 3 \times 10^{10}$ cm sec⁻¹.

14 marks

Question 5

a. Calculate the EMF of the cell : Zn/Zn²⁺ (0.001M)//Ag⁺ (0.1M)/Ag

The standard potential of Ag/Ag⁺ half-cell is + 0.80 V and Zn/Zn²⁺ is – 0.76 V.

b. Differentiate between enantiotropy and dynamic allotropy

c. Write short note on the following:

i. Phase diagram ii. Non-variant system iii. Transition point iii.quantum efficiency

d. Given that $\Delta G = \Delta H - T\Delta S$, show that

$$\Delta S_{\text{univ}} = -\Delta G/T$$

14 marks

Question 6

a. The initial rate of a reaction $A + B \rightarrow C$ was measured for several different starting concentrations of A and B, and the results are as follows:

Expt. No.	[A] (M)	[A] (M)	Initial Rate (M/S)
1	0.100	0.100	4.0×10^{-5}
2	0.100	0.200	4.0×10^{-5}
3	0.200	0.100	16.0×10^{-5}

Using these data, determine (a) the rate law for the reaction (b) the rate constant, (c) the rate of the reaction when $[A] = 0.050M$ and $[B] = 0.100 M$.

b. Give any two examples of autocatalytic reactions.

c. Explain the Michaelis and Menten mechanism for enzyme catalysis.

d. For the general equation: $aA + bB \rightarrow cC + dD$

Write an expression for the average rate of the reaction.

Question 7

- a. Given the K_a values of the acids: acetic acid (1.74×10^{-5}), carbonic acid (1.70×10^{-4}) and phosphoric acid (7.25×10^{-3}). With one reason, arrange the acids in the order of their strength.
- b. Define the term buffer and explain the role of the blood as a biological buffer.
- c. What is the pH of a mixture of 0.042M NaH_2PO_4 and 0.058M Na_2HPO_4 ?
- d. If 1.0 mL of 10.0M NaOH is added to a liter of the buffer prepared in (c), how will the pH change ?