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University Examinations 2023/2024

FIRST YEAR SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR
OF SCIENCE IN MICROBIOLOGY

HMM 3126: PHYSICAL CHEMISTRY

DATE: APRIL 2024

TIME: 2 HOURS

INSTRUCTIONS: Answer question *one* and any other *two* questions

QUESTION ONE (30 MARKS)

- a) Discuss briefly the following breed terms
- (i) Thermodynamics (2 marks)
 - (ii) Kinetics (2 marks)
- b) Distinguish between ideal and real gases (4 marks)
- c) Distinguish between
- (i) Reversible and irreversible reactions
 - (ii) Homogenous and heterogenous equilibrium (8 marks)
- d) Calculate the pH of 0.5 M acetic acid given that the K_a for the acid is $1.8 \times 10^{-5} M$ (4 marks)
- e) State the 5 postulates of the kinetic molecular theory (5 marks)
- f) Calculate the pressure exerted by 2 litres of nitrogen gas at $0^\circ C$ given that $N=14$ $R=0.821$
 $L(atm)mol^{-1}K^{-1}$ and assuming ideal gas behaviour (5 marks)

QUESTION TWO (20 MARKS)

- a) State
- (i) Zeroth law of thermodynamics (2 marks)
 - (ii) First law of thermodynamics (2 marks)
 - (iii) Boyles law (2 marks)
- b) Using a diagram explain the path point function (7 marks)
- c) Calculate the equilibrium constant for the reaction at 25°C $Zn/Zn^{2+} + 0.1M // Ag^2 (0.01M) / Ag$ $E^o = 0.93V$ given that $R = 8.314Jmol^{-1}$ and $F = 96500C$ (3 marks)
- d) Outline the characteristics of chemical equilibrium (4 marks)

QUESTION THREE (20 MARKS)

- a) State the law of mass action (2 marks)
- b) Using the kinetic theory show that kinetic energy is related to temperature as follows

$$E_k = \frac{3}{2} RT \text{ where}$$

E_k is the Kinetic Energy

T is the Temperature

R is the Universal gas law (5 marks)

- c) A mixture of gases contain 4.46moles of neon 0.74moles of argon and 2.15 moles of xenon. Calculate the partial pressure of the gases if the total pressure is 2.00 bars at 100k (10 marks)
- d) Explain what is equation of state (3 marks)

QUESTION FOUR (20 MARKS)

- a) Define the following
- (i) Internal energy
 - (ii) Enthalpy
 - (iii) Compressibility factor (6 marks)
- b) State the five assumptions of the ideal gas law (5 marks)

- c) Calculate the work done during the expansion of 3.2g of oxygen gas from 10.01 to 20.01 in an isothermal process at 127°C assume ideal gas behaviour given $O=16$ and $R=8.314$ ($\text{Jk}^{-1} \text{mol}^{-1}$) (6 marks)
- d) State causes of deviation of real gases from ideality (3 marks)