



# Technical University of Mombasa

*Faculty of Applied and Health Sciences*

DEPARTMENT OF **MEDICAL SCIENCES**  
DIPLOMA IN PHARMACEUTICAL TECHNOLOGY  
(DPT 12M)

## **ACH 2214: PHYSICAL CHEMISTRY II**

**SPECIAL/SUPPLEMENTARY: EXAMINATIONS**

**SERIES:** February 2013

**TIME:** 2 HOURS

### **INSTRUCTIONS:**

You should have the following for this examination

- *Answer booklet*

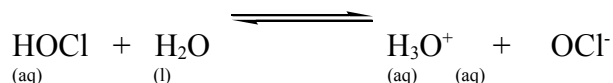
This paper consists of **THREE sections A, B and C.**

Answer all questions in section **A** and **B** and choose **THREE** out of **FIVE** questions in section **C.**

This paper consists of **10 PRINTED** pages

**SECTION A (40MARKS)**

1. For the following reaction of HOCl (hypochlorous acid) with water;



What would be the effect of adding sodium hypochlorite (NaOCl) to the reaction equilibrium?

- The concentrations of both HOCl and  $\text{H}_3\text{O}^+$  would increase.
  - The concentrations of both HOCl and  $\text{H}_3\text{O}^+$  would decrease
  - The concentration of HOCl would increase and the concentration of  $\text{H}_3\text{O}^+$  would decrease
  - The concentration of HOCl would decrease and the concentration of  $\text{H}_3\text{O}^+$  would increase
2. Given three separate solutions containing equal concentrations of formic acid ( $K_a = 1.7 \times 10^{-4}$ ) phenol ( $K_a = 1.3 \times 10^{-10}$ ) and acetic acid ( $K_a = 1.8 \times 10^{-5}$ ) select the response below that has the acids arranged in order of increasing percent dissociation at equilibrium.
- Formic < phenol < acetic
  - Formic < acetic < phenol
  - Acetic < formic < phenol
  - Phenol < acetic < formic
3. From the following choices, which one is the strongest base?
- $\text{NH}_4\text{OH}$
  - $\text{NaOH}$
  - $\text{Ba}(\text{OH})_2$
  - $\text{Mg}(\text{OH})_2$
4. Identify the acid that is monoprotic
- $\text{CH}_3\text{COOH}$
  - $\text{H}_2\text{SO}_4$
  - $\text{H}_3\text{PO}_4$
  - $\text{H}_2\text{CO}_3$
5. A solution is basic when its pH is:
- Less than 7
  - 7
  - Greater than 7
  - Between 0 and 7
6. Which one of the following is the strongest acid given the equilibrium dissociation constant value ?
- $\text{HF} \quad K_a = 7.2 \times 10^{-4}$
  - $\text{HCl} \quad K_a = 1.0 \times 10^6$

- c)  $\text{HBr}$   $K_a = 1.0 \times 10^9$   
 d)  $\text{HI}$   $K_a = 3.0 \times 10^9$

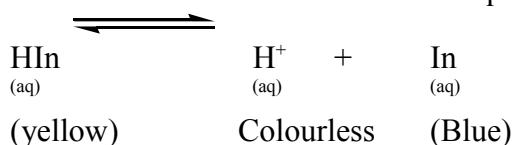
7. Which of the following weak acid dissociation constants would result in the smallest degree of dissociation?

- a)  $K_a = 1.0 \times 10^{-2}$   
 b)  $K_a = 1.0 \times 10^{-3}$   
 c)  $K_a = 1.0 \times 10^{-3}$   
 d)  $K_a = 1.0 \times 10^{-5}$

8. In an acid-base titration, the point at which an indicator changes colour is called the

- a) Endpoint  
 b) Equivalence point  
 c) Equilibrium point  
 d) Half-equivalence point

9. The dissociation of an indicator in aqueous solution can be described as



In the presence of an acid, the colour of the resulting solution would be:

- a) Yellow  
 b) Colourless  
 c) Blue  
 d) Yellow-Blue

10. Select the statement below that is correct

- a) All carbonates ( $\text{CO}_3^{2-}$ ) are soluble  
 b) All nitrates ( $\text{NO}_3^-$ ) are soluble  
 c) All hydroxides ( $\text{OH}^-$ ) are soluble  
 d) All chloride ( $\text{Cl}^-$ ) are soluble

11. The addition of  $\text{Ag}^+$  ions into a solution containing  $\text{NaCl}$  would lead to the formation of

- a) A colourless solution  
 b) A salty solution  
 c) A white precipitation  
 d) An emulsion

12. Given the following partially soluble salts and their solubility-product constants, which salt would be most soluble in water?

- a)  $\text{AgCl}$ ,  $K_{s.p} = 1.8 \times 10^{-10}$   
 b)  $\text{AgBr}$ ,  $K_{s.p} = 5.0 \times 10^{-15}$   
 c)  $\text{AgI}$ ,  $K_{s.p} = 8.3 \times 10^{-17}$   
 d)  $\text{AuCl}$   $K_{s.P} = 2.0 \times 10^{-13}$

13. Addition of calcium nitrate to a saturated solution of calcium phosphate would:

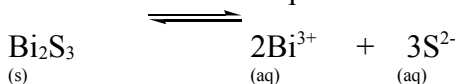
- a) Have no effect on the solubility of calcium phosphate

- b) Cause the solubility of calcium phosphate to decrease
- c) Would cause the solubility of calcium phosphate to increase
- d) None of the above

14. Which of the following hydroxides is least soluble in water?

- a)  $\text{Ba}(\text{OH})_2$ , Ks.p = 5.0 x  $10^{-3}$
- b)  $\text{Ca}(\text{OH})_2$ , Ks.p = 5.5 x  $10^{-6}$
- c)  $\text{Ca}(\text{OH})_2$ , Ks.p = 2.5 x  $10^{-14}$
- d)  $\text{Zn}(\text{OH})_2$ , Ks.p = 1.2 x  $10^{-17}$

15. What is the correct expression for the solubility product constant for the reaction



- a) Ks.p =  $[\text{Bi}^{3+}]^2 [\text{S}^{2-}]^3$
- b) Ks.p =  $[3\text{Bi}^{3+}]^2 [2\text{S}^{2-}]^3$
- c) Ks.p =  $[2\text{Bi}^{3+}]^2 [3\text{S}^{2-}]^3$
- d) Ks.p =  $2[\text{Bi}^{3+}]^2 [\text{S}^{2-}]^3$

16. The solubility of  $\text{Ag}_2\text{S}$  in pure water is  $2.5 \times 10^{-17}\text{m}$ . What is the solubility product constant for  $\text{Ag}_2\text{S}$ ?

- a)  $6.3 \times 10^{-24}$
- b)  $2.5 \times 10^{-17}$
- c)  $6.2 \times 10^{-50}$
- d)  $1.6 \times 10^{-50}$

17. Chemical equilibrium involving reactants and products in more than one phase is called

- a) Static
- b) Dynamic
- c) Homogeneous
- d) Heterogeneous

18. The value of  $K_p$  is greater than  $K_c$  for a gaseous reaction when;

- a) Number of molecules of products is greater than the reactants
- b) Number of molecules of reactants is greater than the products
- c) Number of molecules of reactants equal products
- d) A catalyst is added

19. The homogeneous equilibrium constant in terms of pressure is denoted

- a)  $K_c$
- b)  $K^1_c$
- c)  $K_p$

- d)  $K^1p$
20. A weak electrolyte undergoes
- Complete dissociation in water
  - Partial dissociation in water
  - Both (a) and (b)
  - None of the above
21. The solubility of a solute in a solvent mainly depends on:
- Equilibrium conditions
  - Temperature of solvent
  - Surface tension of solvent
  - Viscosity of solvent
22. A reaction whose rate is independent of the concentration of reactants is said to be:
- Zero order
  - First order
  - Second order
  - Third order
23. The minimum amount of energy, in addition to average kinetic energy which the particles should have in order to have effective collision is called
- Collision frequency
  - Energy barrier
  - Activation energy
  - Thermal energy
24. The collision theory stipulates that for products to be formed \_\_\_\_\_
- Reactants must collide with products
  - Actuation energy need be towered
  - Reactants must collide with each other in the right orientation
  - Products must collide to form reactants and more products.
25. When rate of forward reaction equals rate of backward reaction, then the equilibrium established is called
- Chemical equilibrium
  - Dynamic equilibrium
  - Static equilibrium
  - Physical equilibrium
26. For a reaction of the form
- $$aA + bB \rightleftharpoons cC + dD$$
- and rate law is given as  $\text{rate} = K[A]^x[B]^y$

The overall order of the reaction is

- a)  $x$
- b)  $y$
- c)  $x + y$
- d)  $x - y$

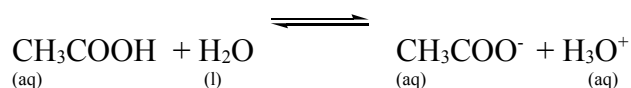
27. The slope of the graph for reactants or products is \_\_\_\_\_ at the beginning of reaction.
- a) Slowest
  - b) Steepest
  - c) Vertical
  - d) Horizontal
28. Identify the weakest electrolyte among the following
- a)  $\text{KOH (aq)}$
  - b)  $\text{NH}_4\text{OH(aq)}$
  - c)  $\text{Ca(OH)}_2\text{(aq)}$
  - d)  $\text{Mg(OH)}_2\text{(aq)}$
29. A solute in a solution is the chemical species present in
- a) large amount
  - b) Excess amount
  - c) Small amount
  - d) equal amount as the solvent
30. Which of the following affects the value of the equilibrium constant,  $K_c$ .
- a) Pressure
  - b) Concentration of species
  - c) Temperature
  - d) Catalyst
31. The equilibrium position for an aqueous endothermic reaction can be changed to form more products by:
- a) Increasing temperature
  - b) Describing temperature
  - c) Increasing pressure
  - d) Decreasing pressure
32. A chemical equilibrium reaction is said to be
- a) Reversible
  - b) Irreversible
  - c) Constant in all respects

- d) None of the above
33. A neutralization reaction yields
- a) Salts only
  - b) Water only
  - c) Water and salt only
  - d) None of the above
34. In pH scale, the base of the logarithm of molar concentration of  $\text{H}_3\text{O}^+$  is
- a) 10
  - b) 100
  - c) 2
  - d) 3
35. Generally,  $\text{pH} + \text{pOH}$
- a) 7
  - b) 0
  - c) 14
  - d) -14
36. According to Arrhenius, an acid is a species that dissolves in water to form
- a)  $\text{H}^+$
  - b)  $\text{OH}^-$
  - c)  $\text{O}^{2-}$
  - d)  $\text{NH}_4^+$
37. What are the units of reaction rate?
- a) M
  - b)  $\text{MS}^{-1}$
  - c)  $\text{SM}^{-1}$
  - d)  $\text{S}^{-1}\text{M}^{-1}$
38. A solution is neutral when its pH is
- a) 0
  - b) 7
  - c) -7
  - d) None of the above
39. The pH of a basic solution is
- a) 7
  - b) more than 7
  - c) less than 7
  - d) none of the above

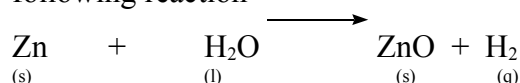
40. The pH of an acidic solution is
- 7
  - More than 7
  - Less than 7
  - none of the above

### SECTION B (Answer ALL questions)

41. Differentiate between valency and oxidation number **(4marks)**
42. Determine the oxidation number of Cr in  $\text{Cr}_2\text{O}_7^{2-}$  **(4marks)**
43. Calculate the molarity of a solution made by dissolving 12g NaOH in 500ml deionized water. (molar mass of NaOH = 40g/mol). **(4marks)**
44. What is the pOH of a solution made by dissolving 0.1M HCl **(4marks)**
45. The reaction between acetic acid ( $\text{CH}_3\text{COOH}$ ) with water is given as



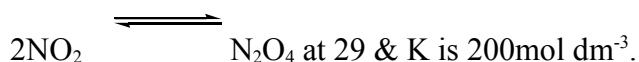
- Explain the effect of adding a solution containing  $\text{H}^+$  ions to the equilibrium **(4marks)**
46. Differentiate between bronsted acid and bronsted base. **(4marks)**
47. By the use of oxidation number, state which species undergo oxidation or reduction in the following reaction



- (4marks)**
48. You need to prepare as 0.0250M solution of  $\text{KMnO}_4$  for an experiment. How many grams of  $\text{KMnO}_4$  should be added with sufficient distilled water to a 1.00l volumetric flask to give the desired solution. (Molar mass of  $\text{KMnO}_4$ ) = 158.03 g/mol) **(4marks)**
49. Briefly define the following
- Strong base **(2marks)**
  - Weak electrolyte **(2marks)**
50. What is the pH of 0.02M KOH solution **(4marks)**

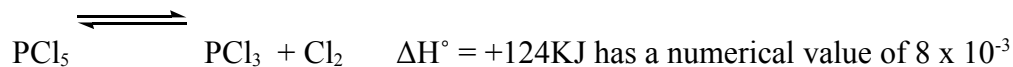
### SECTION C

51. a) The equilibrium constant for the reaction



- Write an expression for the equilibrium constant  $K_c$  for the reaction **(2marks)**
  - If  $[\text{N}_2\text{O}_4] = 2.0 \times 10^{-2} \text{ molm}^{-3}$ , what is the  $[\text{NO}_2]$  in the equilibrium mixture at this temperature. **(4marks)**
- b) At  $200^\circ\text{C}$ ,  $K_c$  for the reaction



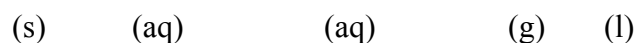
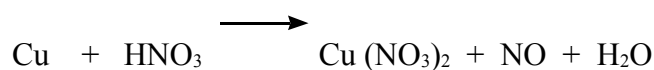


- i) Write an expression for  $K_c$  for this reaction **(2marks)**  
 ii) What are the units of  $K_c$  **(2marks)**  
 iii) Predict what will happen to the reaction when:  
 a) More  $\text{PCl}_5$  is added **(2marks)**  
 b) The pressure is increased **(2marks)**  
 c) The temperature is increased **(2marks)**  
 iv) A sample of pure  $\text{PCl}_5$  was introduced into an evacuated vessel at  $200^\circ\text{C}$ . When equilibrium was obtained, the concentration of  $\text{PCl}_5$  was  $0.5 \times 10^{-1} \text{ mol dm}^{-3}$ . What are the concentrations of  $\text{PCl}_3$  and  $\text{Cl}_2$  at equilibrium? **(4marks)**

52. i) Explain the following terms

- a) order of reaction **(2marks)**  
 b) Rate constant **(2marks)**  
 c) Half-life **(2marks)**

ii) Metallic copper and dilute nitric acid react according to this redox equation.



- a) Balance the equation **(3marks)**  
 b) Assign oxidation numbers for each atom in the equation **(5marks)**  
 c) Identify which element has been oxidized and which has been reduced **(2marks)**

53. i) For each of the following, does the oxidation number increase or decrease in the course of a redox reaction?

- a) An Oxidizing agent **(2marks)**  
 b) A reducing agent **(2marks)**  
 c) A substance undergoing oxidation **(2marks)**  
 d) A substance undergoing reduction **(2marks)**

ii) 4.90grams of pure  $\text{H}_2\text{SO}_4$ , solution was dissolved in water, the resulting total volume was  $250\text{cm}^3$ .  $21\text{cm}^3$  of this solution was found on titration to completely

neutralize  $10\text{cm}^3$  of  $\text{NaOH}$  solution (S=32, H =1 and O =16)

- a) Write a balanced equation for the titration reaction **(4marks)**  
 b) Calculate the molarity of the  $\text{H}_2\text{SO}_4$  solution **(4marks)**  
 c) Calculate the moles of  $\text{H}_2\text{SO}_4$  solution neutralized **(2marks)**  
 d) Calculate the moles of  $\text{NaOH}$  neutralized **(2marks)**  
 e) Calculate the molarity of  $\text{NaOH}$  solution **(2marks)**

