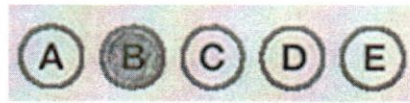
	Tanta University Faculty Of Pharmacy Department Of Pharmaceutical Analytical Chemistry			
	Examination For **1st level Pharmacy Students**			
	Course Title: **Pharmaceutical Analytical Chemistry II**			Course Code: **PA 202**
	Date: **27/ 6 /2021**	Term: **Second**	Marks: **50** **Total pages:** 10	Time Allowed: **2** hours

- Check that your exam booklet consists of (10) pages.
- Choose **ONE** best answer for each question and mark it in the separate answer sheet (pink bubble sheet). ***Answers anywhere else will not be marked.***
- **Instructions for using bubble sheet:**
  1. At the top section of the bubble sheet, write your name and your academic number.
  2. **Each bubble on the sheet stands for one answer.** Fill in the bubble completely, but do not make stray marks outside of the bubble.



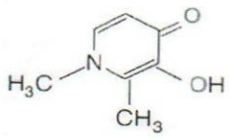
The right way to fill in the bubble sheet

- **An appendix** is provided at the last page of the exam. It contains tables and figures that are helpful in questions concerning complexometric titration.

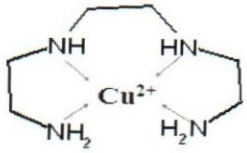
Don't stress, Do your best.
Best wishes in the Exam

You are provided with 4 compounds, Answer questions from 1 to 5

Compound 1



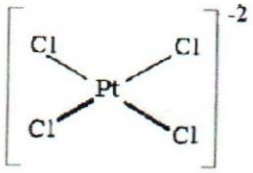
Compound 2



Compound 3

$[Ni(H_2O)_6]^{2+}$

Compound 4



1. **All of the previous compounds are metal complexes *EXCEPT*.....**

   a) Compound 1 **b)** Compound 2 **c)** Compound 3 **d)** Compound 4

2. **Compound ..... shows a bidentate ligand.**

   a) 1 **b)** 2 **c)** 3 **d)** 4

3. **The coordination number of the metal ion in compound 3 is .....**

   a) 2 **b)** 4 **c)** 6 **d)** 8

4. **Compound ..... represents a chelated complex.**

   a) 1 **b)** 2 **c)** 3 **d)** 4

5. **All of the previous compounds show a neutral ligand *EXCEPT* .....**

   a) Compound 1 **b)** Compound 2 **c)** Compound 3 **d)** Compound 4

The Table below shows a group of ions and their ionic radii. Answer questions 6 and 7.

Ion	Mn^{2+}	Fe^{2+}	Co^{2+}	Ni^{2+}	F^-	Cl^-	Br^-	I^-
Ionic radius (pm)	83	78	75	69	136	181	196	216

6. **Which of the following metal ions will form a complex of the highest stability?**

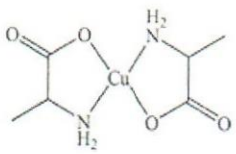
   a) Mn^{2+} **b)** Fe^{2+} **c)** Co^{2+} **d)** Ni^{2+}

7. **Which of the following anions will form a complex of the highest stability?**

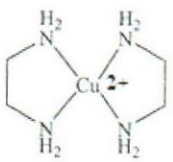
   a) F^- **b)** Cl^- **c)** Br^- **d)** I^-

Four copper (Cu^{2+}) complexes (I, II, III, IV) are formed with 4 different ligands. Answer questions 8 and 9.

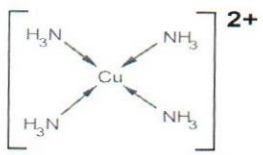
I



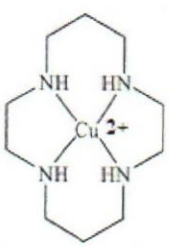
II



III



IV



8. **The number of rings/ligand in complex II is .....**

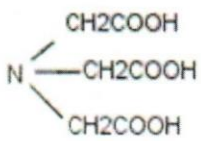
   a) 1 **b)** 2 **c)** 3 **d)** 4

9. **Complex …… is expected to have the largest K_f.**

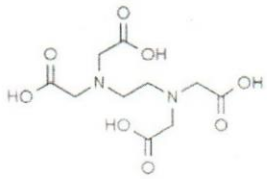
a) I b) II c) III d) IV

10. **All of the following are amino-carboxylic acid ligands *EXCEPT* ……..**

a

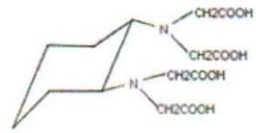


b



c

d



11. **Na_2H_2Y is a ……dentate/…….. acid ligand**

a) hexa/tetraprotic b) hexa/diprotic c) uni/hexaprotic d) tetra/triprotic

12. **Select the most appropriate complex to complete the following equation**

$$Th^{4+} + H_2Y^{2-} \rightleftharpoons \ldots. + 2H^+$$

a) ThY^- b) ThY^{-2} c) ThY^{-3} d) ThY

13. **The most suitable reagent added to adjust the suitable pH for the PREVIOUS titration is ……** *[N.B., attached appendix is helpful for you]*

a) acetate buffer b) hexamine c) HNO_3 d) NaOH

14. **Which of the following metals is expected to give the most stable EDTA chelate?** *[N.B., attached appendix is helpful for you]*

a) Au^{3+} b) Bi^{3+} c) Ca^{2+} d) Zn^{2+}

15. **All of the following metals must be titrated with EDTA in alkaline medium *EXCEPT*……** *[N.B., attached appendix is helpful for you]*

a) Ca^{2+} b) Hg^{2+} c) Mg^{2+} d) Ni^{2+}

16. **K'_f of MgY^{-2} is expected to be higher at pH ……**

a) 1 b) 5 c) 8 d) 10

17. **Which of the following is an indicator that is used in EDTA titration?**

a) Methyl orange b) Phenolphthalein c) Phenol red d) Potassium thiocyanate

18. **Which of the following metal ions is expected to react irreversibly with Eriochrome black T indicator?**

a) Al^{3+} b) Ca^{2+} c) Mg^{2+} d) Zn^{2+}

Match each metal ion (questions 19, 20, 21, 22) with the suitable type of EDTA titration (a, b, c, d).

19. **Cu^{+2}**
20. **Cr^{+3}**
21. **Mn^{+2}**
22. **Pt^{+2}**

a) Back titration
b) Displacement titration
c) Direct titration
d) Miscellaneous titration using $K_2Ni(CN)_2$

23. **The most appropriate indicator and pH for EDTA titration of $FeCl_3$ is ...../....**

a) EBT / pH 5
b) Murexide /pH 12
c) xylenol orange / pH 6
d) variamine blue / pH 2

24. **Which one of the following indicators is used at pH 6 during EDTA titration?**

a) EBT
b) Murexide
c) salicylate
d) xylenol orange

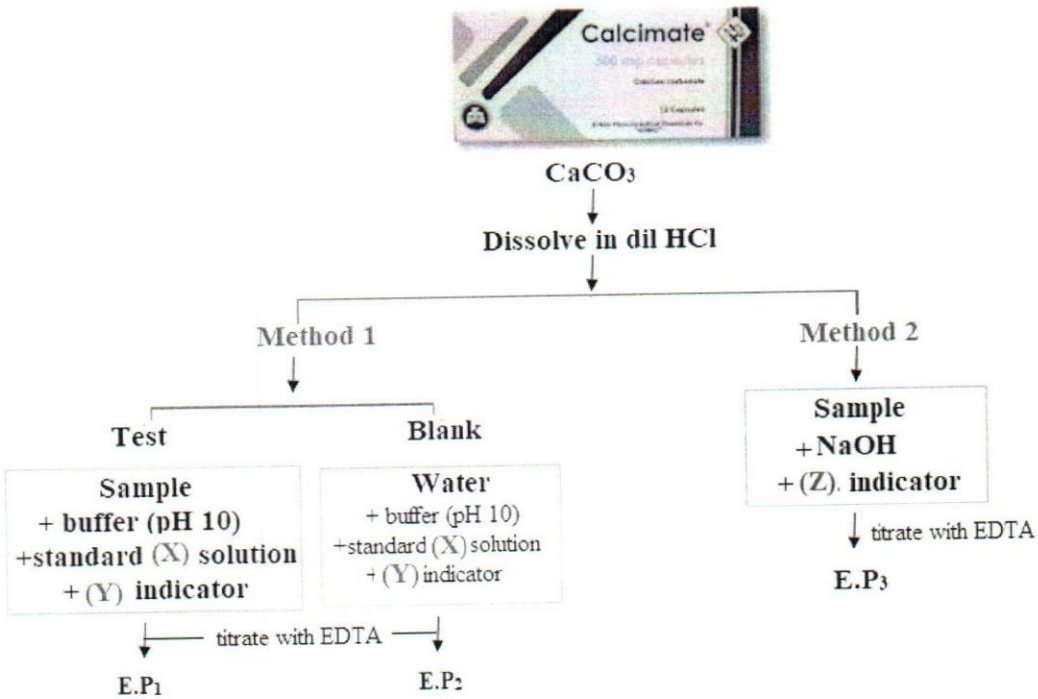
25. **In the following type of EDTA titration,**

$$M_2\text{-EDTA} + M_1 = M_1\text{-EDTA} + M_2$$

If M_2 is Mg^{2+}, M_1 must be ..... *[N.B., attached appendix is helpful for you]*

a) Ag^+
b) Ba^{2+}
c) Ca^{2+}
d) Na^+

The following figure represents the determination of Ca^{2+} in Calcimate® tablets by two different methods. Study well the figure, and then answer questions 26 to 28.



26. **Standard (X) solution used in Method I is used to .....**

a) adjust the pH of titration medium
b) prevent precipitation of Ca^{2+}
c) sharpen the end point
d) mask the effect of interferences

27. **The indicator (Z) in method 2 is .....**

a) EBT
b) murexide
c) methyl orange
d) xylenol orange

28. **The amount of Ca^{2+} in the sample is equivalent to .....**

a) $E.P_1$
b) $E.P_2$
c) $E.P_1 - E.P_2$
d) $E.P_3 - E.P_2$

Cal-Mag® tablets contain both Ca^{2+} and Mg^{2+} salts. A tablet is dissolved in a suitable solvent, and then the solution is divided into two aliquots and two titrations are performed. You are provided with a scheme of titrations, structures of titrants, and a table containing $LogK_f$ value of each titrant with each metal ion.

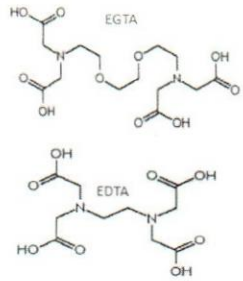
Answer questions 29 to 32.

"Titration 1"

Titrate with EGTA → $E.P_1$

"Titration 2"

Titrate with EDTA
+ buffer at pH 10 → $E.P_2$
+ EBT indicator



	$logK_f$ [Mg complex]	$logK_f$ [Ca complex]
EDTA	8.7	10.7
EGTA	5.4	10.9

29. **EGTA "the titrant in titration 1" is considered as ..... ligand.**

a) bidentate b) quadridentate c) hexadentate d) octadentate

30. **$E.P_1$ is equivalent to the amount of ..... in the sample.**

a) Ca^{2+} b) Mg^{2+} c) both Ca^{2+} and Mg^{2+}

31. **The reason for your answer in the *PREVIOUS* question is .....**

a) EGTA is Ca^{2+} selective ligand b) EGTA reacts first with Ca^{2+} then Mg^{2+}

c) EGTA is Mg^{2+} selective ligand d) EGTA reacts first with Mg^{2+} then Ca^{2+}

32. **$E.P_2$ is equivalent to the amount of ..... in the sample.**

a) Ca^{2+} b) Mg^{2+} c) both Ca^{2+} and Mg^{2+}

33. **Which of the following is the correct procedure for EDTA titration of $AgNO_3$?**

a) Direct titration / pH 10 / E.B.T indicator.

b) Replacement titration using Mg-EDTA complex/ pH 10 / E.B.T indicator.

c) Back titration / pH 5 / murexide indicator.

d) EDTA titration after displacement of Ni^{2+} in $Ni(CN)_4^{-2}$/ pH 10 / murexide indicator.

34. **The most suitable type of EDTA titration for analysis of Fe^{2+} is.....**

a) Back titration / pH 5 / st. $ZnSO_4$ solution (titrant) / xylenol orange indicator.

b) Direct titration / pH 5 / xylenol orange indicator.

c) Direct titration / pH 10 / variamine blue indicator.

d) Miscellaneous titration after reaction with $Ni(CN)_4^{-2}$/ pH 10 / murexide indicator.

35. **All of the following salts are determined with back EDTA titration *EXCEPT*.....**

a) $BaSO_4$ b) Ca-oxalate c) $Mg(NH_4)PO_4$ d) $ZnSO_4$

Four methods are used for increasing the selectivity of EDTA titration. Select the suitable method (questions 36 to 39) for determination of mixtures (a, b, c and d)

36. **Control of pH**
37. **Adjustment of oxidation state of M^{n+} by ascorbic acid**
38. **Use of triethanolamine as masking agent**
39. **Use of NaOH as selective precipitating agent**

a) Fe^{3+} and Bi^{3+}
b) Mg^{2+} and Al^{3+}
c) Ca^{2+} and Mg^{2+}
d) Bi^{3+} and Pb^{2+}

40. **Direct EDTA determination of Mg^{+2} in Mg^{+2}/Ni^{+2} mixture can be done after adding .....**

a) DMG b) NaOH c) KCN d) KF

41. **A 100 mL water sample is analyzed for hardness, requiring 25 mL of 0.01 M H_2Y^{2-}. The sample's calcium hardness in g/L is ..... (N.B., Mol. Wt. of $CaCO_3$ = 100.09)**

a) 0.0025 b) 0.250 c) 100.09 d) 250.225

42. **The concentration of EDTA solution was determined by standardization against 50 mL of 0.25M $CaCO_3$ solution. After pH adjustment and addition of the indicator, the solution was titrated with the EDTA, requiring 50 mL to reach the end point. The molar concentration of EDTA in the titrant is .....**

a) 0.25 b) 0.75 c) 12.5 d) 50

43. **In saturated solution of AgCl, ...**

a) $[Ag^+][Cl^-]=Ksp$ b) $[Ag^+][Cl^-]>Ksp$ c) $[Ag^+][Cl^-]<Ksp$

44. **DMG is a .....precipitant for Ni^{2+}in alkaline medium.**

a) selective b) specific c) universal

45. **Calcium oxalate is insoluble in.....**

a) alkaline pH b) acidic pH
c) neutral pH d) none of them

46. **Contamination of precipitate in gravimetry can be minimized by.....**

a) reprecipitation b) digestion
c) increasing particle size of precipitate d) all of them

47. **Types of gravimetry are.....**

a) precipitation b) volatilization

c) electrodeposition d) all of them

48. **Relative supersaturation increases by addition of dilute precipitating agent with stirring.**

a) true b) false

49. **Digestion is used for purification of thermolabile precipitate.**

a) true b) false

50. **All are steps for precipitation gravimetry *EXCEPT*.....**

a) preparation of solution b) washing by decantation

c) distillation d) drying

51. **Co^{2+} can be precipitated by.....**

a) $BaCl_2$ b) $(NH_4)_2S$

c) NH_3 d) none of them

52. **Particle size of precipitate is ..... proportional to Von Weimarn ratio.**

a) directly b) not c) inversely

53. **In gravimetric analysis precipitation should be carried out from.....**

a) hot solution b) cold solution

c) concentrated solution d) none of them

54. **When the precipitation is performed,finally a slight excess of precipitating reagent should be added to.....**

a) increase solubility of precipitate b) decrease solubility of precipitate

c) remove impurities d) prevent coagulation

55. **Peptization can be prevented by.....**

a) cooling b) addition of KCl

c) heating d) b & c

56. **The value of K_{sp} constant of a sparingly soluble salt is temperature independent.**

a) true b) false

57. **The solubility of AgCN increases in presence of.....**

a) HNO_3 b) NaOH

c) $AgNO_3$ d) HCl

58. **By addition of more solvent to a solution of sparingly soluble salt ; the solubility.....**

a) decreases while Ksp is constant b) increases due to increase in Ksp

c) increases while Ksp is constant d) none of them.

59. **The magnitude of the break of the precipitation titration curve at the equivalence point for argentometric titration of Cl^- lower than I^-.**

a) true b) false

60. **The reason for your answer in the previous point is due to**

a) Ksp for AgCl is more than AgI b) Ksp for AgCl is less than AgI

c) AgCl is more soluble than AgI d) a & C

61. **Argentometric titration should not be carried out in presence of formaline and sulfur dioxide because they are .....**

a) complexing agents b) precipitating agents

c) reducing agents d) oxidizing agents

62. **Mohr method is used for determination of .....**

a) Cl^- b) I^-

c) SCN^- d) All of them

63. **Ksp of AgCl is higher than Ksp of Ag_2CrO_4**

a) true b) false

64. **Argentometric titrations should be carried out away of sunlight due to.....**

a) unstability of the indicators b) good detection of the end point

c) unstability of silver halides d) none of these

65. **Mohr method should be carried out at pH lower than 4**

a) True b) false

66. **The reason for your answer in the previous point is due to.....**

a) formation of $Ag_2Cr_2O_7$ at pH < 4 b) decrease of Ksp of AgCl at pH < 4

c) increase of Ksp of AgCl at pH < 4 d) formation of $Ag(OH)_2$ precipitate at pH > 4

67. **Ions that interfere with Volhard method include.....**

a) Hg^{2+} & F^- b) citrate&phosphate

c) none of them d) All of them

68. **The reverse titration of silver ion with chloride ion using chromate as indicator is not feasible.**

a) True b) false

69. **Adsorption, a problem in many precipitation procedures, was used as advantage in.....**

a) Mohr method b) Fajans method

c) Volhard method d) Leibig"s method

70. **The indicators that are used in Fajans procedure are called.....**

a) screened indicators b) acid-base indicators

c) redox indicators d) none of them.

71. **In Fajans method the indicator ion must be.....**

a) of opposite charge to the ion of the precipitating agent

b) of the same charge as the ion of the precipitating agent

c) of the opposite charge as the ion to be determined

d) none of them

72. **During the titration of chloride ions using Fajans procedure, the formed silver chloride after the equivalence point, adsorbs .....**

a) Cl^- as a primary adsorption layer and Na^+ as a counter ion layer

b) Na^+ as a primary adsorption layer and Cl^- as a counter ion layer

c) Fluorescein as a primary adsorption layer and Cl^- as a counter ion layer

d) Ag^+ as a primary adsorption layer and fluorescein as a counter ion layer

73. **In Fajans method; on using rhodamine series the pH should be slightly alkaline.**

a) True b) false

74. **The indicator used to detect end point in Volhard method is.....**

a) potassium chromate b) Fe^{2+}

c) Fe^{3+} d) Eosin

75. **Volhard procedure are used for.....**

a) direct determination of Ag^+ b) direct determination of halides

c) indirect determination of halides d) a & c

76. **Volhard titration should be carried out in presence of .....**

a) HCl b) NaOH c) HNO_3 d) KOH

77. **The reason of your answer in the former point is .....**

a) to prevent precipitation of silver b) to prevent hydrolysis of ferric ion

c) to prevent oxidation of $AgNO_3$ d) none of them

78. **Consider the titration of 50.0 mL of 0.10 M NaCl solution with 0.10 M $AgNO_3$ solution, Knowing that: Ksp(AgCl)=1.0 x 10^{-10} $Mole^2/L^2$, Then pCl after addition of 50 mL $AgNO_3$ equals.....**

a) 5.0 b) 6.0 c) 10^{-5} d) 10

79. **The over consumption of thiocyanate on determination of Cl- by Volhard can be prevented by.....**

a) cooling b) filtration

c) addition of ethanol d) a & c

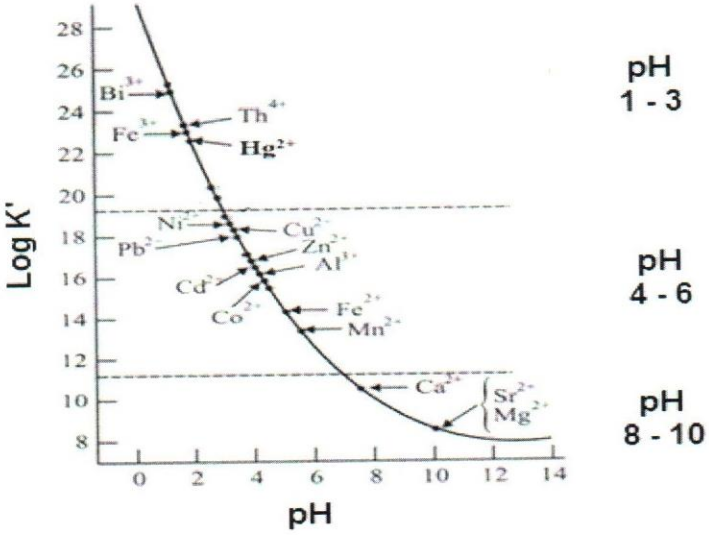
80. **Titration of Ag^+ with standard halide by Fajans method using.....**

a) fluorescein as indicator b) chromate as indicator

c) rhodamine as indicator d) none of them

Appendix

Minimum pH needed for satisfactory titration of various cations with EDTA.



Formation constants of some metal-EDTA complexes

Metal ion	Log K_f	Metal ion	Log K_f	Metal ion	Log K_f
Bi^{3+}	27.8	Mn^{2+}	13.8	Ba^{2+}	7.8
Hg^{2+}	21.8	Ca^{2+}	10.7	$Ag+$	7.32
Zn^{2+}	16.5	Mg^{2+}	8.7	Na^{+}	1.7

pM indicators and metals they are chelating

Eriochrome black T	Xylenol orange	Murexide
Mg, Zn, Cd, Sr, Mn, Pb, Hg.	Hg, Zn, Cd, Bi, Pb, Th, Co, Al.	Cu, Ni, Co, Ca.

Good luck!