



KIBABII UNIVERSITY

**UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR**

**FIRST YEAR SECOND SEMESTER
SUPPLEMENTARY EXAMINATIONS**

FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE

COURSE CODE: SCH 122

COURSE TITLE: ANALYTICAL CHEMISTRY

DURATION: 2 HOURS

DATE: 28/07/2022

TIME: 2:00PM-4:00PM

INSTRUCTIONS TO CANDIDATES

- Answer QUESTION ONE (Compulsory) and any other two (2) Questions.
- Indicate **answered questions** on the front cover.
- Start every question on a new page and make sure question's number is written on each page.

This paper consists of 4 printed pages. Please Turn Over



KIBU observes ZERO tolerance to examination cheating

Question 1

- a) Outline **Eight** steps in an overall analytical procedure. (4marks)
- b) State **four** applications of analytical chemistry. (4 marks)
- c) Give three types of systematic (determinate) errors in analytical chemistry. (3marks)
- d) Define the terms **precision** and **accuracy** as they are used in analytical chemistry. (2marks)
- e). The concentration of an additive in a standard sample of gasoline was measured 5 times with the following results: 0.13, 0.11, 0.12, 0.20, and 0.14 % by mass.
- Determine the median and mean (4marks)
 - Standard deviation of the data. (4marks)
 - If the accepted mean value for the standard sample is 0.11 % by mass, are the results for this set of measurements significantly different at the 95% confidence level by the *t*-test? (3marks).
- f) State three applications of statistics to data treatment and evaluation in analytical chemistry (3marks)
- g) State three factors that are important in determining the magnitude of break in titration curve at end point. (3marks)

Question 2

- a) Giving one example in each, distinguish between the following;
- Bronsted- Lowry acid and Lewis acid (4marks)
 - Binary acids and oxo-acids (4marks)
- b) State four limitations of Lewis Concept. (4marks)
- c) Calculate the pH if 1 mL of 13.6 M HCl is diluted with water to give 1 L of solution. (4mks)
- d) Explain any two factors in determining the relative acidity of an organic acid (4marks)

Question 3

- a) Explain the following;
- Triprotic acid, H_3PO_4 has K_{a1} is 7.5×10^{-3} and K_{a2} is 6.2×10^{-8} . (2 marks)
 - CH_3NH_2 is a stronger base than NH_3 (2marks)
- b) If the solubility product of lead(II) chloride is $1.71 \times 10^{-5} \text{ mol}^3 \text{ dm}^{-9}$ at 298 K, calculate its solubility in mol dm^{-3} at that temperature. (4marks)
- c) A solution is prepared by mixing 0.10 L of 0.12 M sodium chloride with 0.23 L of a 0.18 M Magnesium Chloride solution. What volume of a 0.20 M silver nitrate solution is required to precipitate all of the chloride ion as silver chloride? (4marks)

e) The % by mass of Γ in a 0.6712g sample was determined by a Volhard titration. After adding 50.0 mL of 0.05619 M AgNO_3 and allowing the precipitate to form, the remaining silver was back titrated with 0.05322 M KSCN , requiring 35.14 mL to reach the end point. Calculate the %by mass of Γ in the sample. **(5marks)**

f) State three ways by which the selectivity of an ion of interest from a mixture of metal ions is increased. **(3marks)**

Question 4

a) What is a chelating agent? **(1mark)**

b) Explain giving one example in each what is meant by each of the following terms **(4marks)**

- i. coordination number
- ii. monodentate ligand

c) Write the structural formula of the following complexes **(4 marks)**

- i. chloro pentaqua chromium (III) ions
- ii. hexacyano vanadate (III)ions
- iii. sulphatopentaamine cobalt (III) ions
- iv. pentacyanonitrosylferrate (II) ions

d) Explain FOUR types of Complexometric Titrations **(8 marks)**

e) State any **three** factors influencing EDTA reactions **(3 marks)**

Question 5

(a)What is solvent extraction? **(1mark)**

(b)Extraction has widely been used in modern analysis for separating and concentrating elements. State any two advantages of extraction. **(2marks)**

(c) succinic acid was shaken up with a mixture of water and ether. The concentrations of the acid in the two layers are as follows per 10 ml of solution.

In water layer	0.0244	0.071	0.121
In ether layer	0.0046	0.013	0.022

i. Find out the distribution coefficient in each case. **(6marks)**

ii. Calculate the average distribution coefficient. **(2mark)**

(d) Match the terms in the first list with the characteristics in the second list;

(5marks)

	Type of chromatography	Characteristics
1	adsorption	Ions in mobile phase are attracted to counterions attached to stationary phase.
2	partition	Solute in mobile phase is attracted to specific groups covalently attached stationary phase.
3	Ion exchange	Solute equilibrates between mobile phase and film of liquid attached to stationary phase.
4	Size exclusion	Different size solutes penetrate voids in stationary phase and large solutes eluted first.
5	affinity	Solute equilibrates between mobile phase and surface of stationary phase

e) Explain the basic principle of electrophoresis

(4marks)

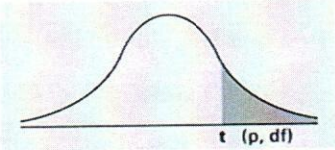
F Distribution Tables

<i>f</i>	<i>df</i> ₁ =1	2	3	4	5	6	7	8	9	10	12
<i>df</i> ₂ =1	161.4476	199.5000	215.7073	224.5832	230.1619	233.9860	236.7684	238.8827	240.5433	241.8817	243.9060
2	18.5128	19.0000	19.1643	19.2468	19.2964	19.3295	19.3532	19.3710	19.3848	19.3959	19.4125
3	10.1280	9.5521	9.2766	9.1172	9.0135	8.9406	8.8867	8.8452	8.8123	8.7855	8.7446
4	7.7086	6.9443	6.5914	6.3882	6.2561	6.1631	6.0942	6.0410	5.9988	5.9644	5.9117
5	6.6079	5.7861	5.4095	5.1922	5.0503	4.9503	4.8759	4.8183	4.7725	4.7351	4.6777
6	5.9874	5.1433	4.7571	4.5337	4.3874	4.2839	4.2067	4.1468	4.0990	4.0600	3.9999
7	5.5914	4.7374	4.3468	4.1203	3.9715	3.8660	3.7870	3.7257	3.6767	3.6365	3.5747
8	5.3177	4.4590	4.0662	3.8379	3.6875	3.5806	3.5005	3.4381	3.3881	3.3472	3.2839
9	5.1174	4.2565	3.8625	3.6331	3.4817	3.3738	3.2927	3.2296	3.1789	3.1373	3.0729
10	4.9646	4.1028	3.7083	3.4780	3.3258	3.2172	3.1355	3.0717	3.0204	2.9782	2.9130
11	4.8443	3.9823	3.5874	3.3567	3.2039	3.0946	3.0123	2.9480	2.8962	2.8536	2.7876
12	4.7472	3.8853	3.4903	3.2592	3.1059	2.9961	2.9134	2.8486	2.7964	2.7534	2.6866

Critical values for Dixon's Q-Test for 3 different confidence levels

N	Q90%	Q95%	Q99%
3	0.941	0.97	0.994
4	0.765	0.829	0.926
5	0.642	0.71	0.821
6	0.56	0.625	0.74
7	0.507	0.568	0.68
8	0.468	0.526	0.634
9	0.437	0.493	0.598
10	0.412	0.466	0.568
11	0.392	0.444	0.542
12	0.376	0.426	0.522

t-Distribution Table



df/p	0.40	0.25	0.10	0.05	0.025	0.01
1	0.324920	1.000000	3.077684	6.313752	12.70620	31.82052
2	0.288675	0.816497	1.885618	2.919986	4.30265	6.96456
3	0.276671	0.764892	1.637744	2.353363	3.18245	4.54070
4	0.270722	0.740697	1.533206	2.131847	2.77645	3.74695
5	0.267181	0.726687	1.475884	2.015048	2.57058	3.36493
6	0.264835	0.717558	1.439756	1.943180	2.44691	3.14267
7	0.263167	0.711142	1.414924	1.894579	2.36462	2.99795
8	0.261921	0.706387	1.396815	1.859548	2.30600	2.89646
9	0.260955	0.702722	1.383029	1.833113	2.26216	2.82144
10	0.260185	0.699812	1.372184	1.812461	2.22814	2.76377
11	0.259556	0.697445	1.363430	1.795885	2.20099	2.71808
12	0.259033	0.695483	1.356217	1.782288	2.17881	2.68100
13	0.258591	0.693829	1.350171	1.770933	2.16037	2.65031
14	0.258213	0.692417	1.345030	1.761310	2.14479	2.62449
15	0.257885	0.691197	1.340606	1.753050	2.13145	2.60248
16	0.257599	0.690132	1.336757	1.745884	2.11991	2.58349
17	0.257347	0.689195	1.333379	1.739607	2.10982	2.56693
18	0.257123	0.688364	1.330391	1.734064	2.10092	2.55238
19	0.256923	0.687621	1.327728	1.729133	2.09302	2.53948
20	0.256743	0.686954	1.325341	1.724718	2.08596	2.52798
21	0.256580	0.686352	1.323188	1.720743	2.07961	2.51765
22	0.256432	0.685805	1.321237	1.717144	2.07387	2.50832
23	0.256297	0.685306	1.319460	1.713872	2.06866	2.49987
24	0.256173	0.684850	1.317836	1.710882	2.06390	2.49216
25	0.256060	0.684430	1.316345	1.708141	2.05954	2.48511
26	0.255955	0.684043	1.314972	1.705618	2.05553	2.47863
27	0.255858	0.683685	1.313703	1.703288	2.05183	2.47266
28	0.255768	0.683353	1.312527	1.701131	2.04841	2.46714
29	0.255684	0.683044	1.311434	1.699127	2.04523	2.46202
30	0.255605	0.682756	1.310415	1.697261	2.04227	2.45726
z	0.253347	0.674490	1.281552	1.644854	1.95996	2.32635
CI	————	————	80%	90%	95%	98%