



MACHAKOS UNIVERSITY

University Examinations 2020/2021

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

FIRST YEAR SECOND SEMESTER SUPPLEMENTARY EXAMINATION

FOR BACHELOR OF SCIENCE

SAN 101: LABORATORY PROCEDURES AND CLASSICAL ANALYSIS

DATE:

TIME:

INSTRUCTIONS:

- Question **ONE** is **COMPULSORY (SECTION A)** (30 marks).
- Answer **ANY** other **TWO** questions (**SECTION B**) (each 20 marks).

SECTION A

QUESTION ONE

- Distinguish between qualitative and quantitative analysis (2mks)
- Calculate percentage by volume of ethanol, C_2H_6O in final solution when 85mL of ethanol is diluted to a volume of 250mL with water (3mks)
- Differentiate between theoretical and actual yield (2mks)
- Calculate the concentration of a solution that contains 5.85 g of sodium Chloride, NaCl, in $200cm^3$ of solution. (Na=23, Cl=35.5) (3mks)
- Differentiate between systematic errors and random errors (2mks)
- By giving suitable examples explain why most acids and alkalis cannot be used as a primary standard (3mks)

- g) Propose a method to prepare 100 ml of a 0.5 M glucose solution from a 5 M glucose solution (4mks)
- h) What is the mole fraction of each component in a solution in which 3.57 g of sodium chloride, NaCl, is dissolved in 25.0 g of water? (Na=23, Cl=35.5) (3mks)
- i) Identify two roles of research analytical chemist (2mks)
- j) Discuss two ways of increasing selectivity of EDTA in complexometric titration (4mks)
- k) What is a limiting reagent? (2mks)

SECTION B

QUESTION TWO

- a. Find the average, standard deviation, and coefficient of variation for 821, 783, 834, and 855. (6mks)
- b. The carbohydrate content of a glycoprotein is found to be 12.6, 11.9, 13.0, 12.7, 12.3 and 12.5 wt% (g carbohydrate/100 g glycoprotein) in replicate analyses. Using the six results, find the 90% confidence interval using student t test (4mks)
- c. A sample of calcium carbonate is dissolved in 20 mL of 0.225 M hydrochloric acid and the excess acid is titrated against 0.104 M sodium hydroxide. After dissolution a mass of 0.272 g of the calcium carbonate sample requires a titre of 12.39 mL of sodium hydroxide to reach phenolphthalein end point.
 - i. Identify this type of titration (1mk)
 - ii. Explain the difference between end point and equivalence point (2mks)
 - iii. Determine the percentage of the CaCO_3 in the sample (7mks)

QUESTION THREE

- a. The concentration of Cu in six replicates of sewage samples were found to be; 9.52, 10.7, 13.1, 9.71, 10.3, 9.99 mg/L.
 - i. Calculate mean, standard deviation and 95 confidence limits on the data (4mks)
 - ii. Perform a Q-test on the data set (3mks)
 - iii. Does the Q-test alter the results in part a? (4mks)
- b. Briefly define the following terms as used in gravimetric analysis (6mks)
 - i. Mixed crystal formation
 - ii. Occlusion
 - iii. Mechanical entrapment
- c. Identify three factors to consider when sampling (3mks)

QUESTION FOUR

- Values for concentration of a metal ore was found to be 116.0, 97.9, 114.2, 106.8, and 108.3, Using the Grubbs test at 95% confidence level, decide whether the value 97.9 should be discarded? (5mks)
- Discuss three types of EDTA titrations and identify at least one metal ion that can be analysed using the method (6mks)
- Soda fizz comes from sodium bicarbonate and citric acid ($\text{H}_3\text{C}_6\text{H}_5\text{O}_7$) reacting to make carbon dioxide, sodium citrate ($\text{Na}_3\text{C}_6\text{H}_5\text{O}_7$) and water. If 1.0 g of sodium bicarbonate and 1.0 g citric acid are reacted. Determine the limiting reagent and calculate the amount of carbon dioxide is produced. (Na = 23, C = 12, O = 16, H = 1) (6mks)
- Define a laboratory notebook and state two of its functions in the laboratory (3mks)

QUESTION FIVE

- Variances of two samples were given as $s^2 = 0.002^2$ (7 degrees of freedom) and $S^2 = 0.001^2$ (6 degrees of freedom), using F test at 95% confidence level, establish if the two samples are significantly different? (4mks)
- Perform a Q-test on the data set given below and determine if you can statistically designate data point 5 as an outlier within a 95% CL. If so, recalculate the mean, standard deviation and the 95% CL (7mks)

Cup Number	1	2	3	4	5	6	7	8	9	10
Caffeine in ppm	78	82	81	77	72	79	82	81	78	83

- Compare and contrast classical and instrumental methods as used in chemical analysis (6mks)
- State three properties of a good precipitate as obtained in gravimetric analysis (3mks)

TABLE 1: Student's t test critical values

TABLE 4-2 Values of Student's t

Degrees of freedom	Confidence level (%)						
	50	90	95	98	99	99.5	99.9
1	1.000	6.314	12.706	31.821	63.656	127.321	636.578
2	0.816	2.920	4.303	6.965	9.925	14.089	31.598
3	0.765	2.353	3.182	4.541	5.841	7.453	12.924
4	0.741	2.132	2.776	3.747	4.604	5.598	8.610
5	0.727	2.015	2.571	3.365	4.032	4.773	6.869
6	0.718	1.943	2.447	3.143	3.707	4.317	5.959
7	0.711	1.895	2.365	2.998	3.500	4.029	5.408
8	0.706	1.860	2.306	2.896	3.355	3.832	5.041
9	0.703	1.833	2.262	2.821	3.250	3.690	4.781
10	0.700	1.812	2.228	2.764	3.169	3.581	4.587
15	0.691	1.753	2.131	2.602	2.947	3.252	4.073
20	0.687	1.725	2.086	2.528	2.845	3.153	3.850
25	0.684	1.708	2.060	2.485	2.787	3.078	3.725
30	0.683	1.697	2.042	2.457	2.750	3.030	3.646
40	0.681	1.684	2.021	2.423	2.704	2.971	3.551
60	0.679	1.671	2.000	2.390	2.660	2.915	3.460
120	0.677	1.658	1.980	2.358	2.617	2.860	3.373
∞	0.674	1.645	1.960	2.326	2.576	2.807	3.291

TABLE 1: F test Critical values

Critical values of $F = s_1^2/s_2^2$ at 95% confidence level

Degrees of freedom for s_2	Degrees of freedom for s_1									
	2	3	4	5	6	7	8	9	10	12
2	19.0	19.2	19.2	19.3	19.3	19.4	19.4	19.4	19.4	19.4
3	9.55	9.28	9.12	9.01	8.94	8.89	8.84	8.81	8.79	8.74
4	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.91
5	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.68
6	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.00
7	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.58
8	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.28
9	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.07
10	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.91
11	3.98	3.59	3.36	3.20	3.10	3.01	2.95	2.90	2.85	2.79
12	3.88	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75	2.69
13	3.81	3.41	3.18	3.02	2.92	2.83	2.77	2.71	2.67	2.60
14	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60	2.53
15	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.48

TABLE 2: Q test Critical values for rejection quotient

Number of observations	90% CL	95%	99%
3	0.941	0.970	0.994
4	0.765	0.829	0.926
5	0.642	0.710	0.821
6	0.560	0.625	0.740
7	0.507	0.568	0.680
8	0.468	0.526	0.634
9	0.437	0.493	0.598
10	0.412	0.466	0.568

TABLE 3: Grubb's test Critical values for rejection quotient

TABLE 4-5 Critical values of G for rejection of outlier

Number of observations	G (95% confidence)
4	1.463
5	1.672
6	1.822
7	1.938
8	2.032
9	2.110
10	2.176
11	2.234
12	2.285
15	2.409
20	2.557