

SULIT



First Semester Examination
2024/2025 Academic Session

February 2025

**EBS236 – Analytical Chemistry
(Kimia Analitis)**

Duration : 2 hours
(Masa : 2 jam)

Please check that this examination paper consists of THIRTEEN (13) pages of printed material including THREE (3) APPENDIX before you begin the examination.

[Sila pastikan bahawa kertas peperiksaan ini mengandungi TIGA BELAS (13) muka surat yang bercetak termasuk TIGA (3) LAMPIRAN sebelum anda memulakan peperiksaan ini].

Instructions : Answer **FOUR (4)** questions. **Part A is COMPULSORY**. Answer ONE (1) question from Part B. All questions carry the same marks.

[Arahan : Jawab **EMPAT (4)** soalan. **Bahagian A WAJIB dijawab**. Jawab SATU (1) soalan daripada Bahagian B. Semua soalan membawa jumlah markah yang sama.]

In the event of any discrepancies, the English version shall be used.

[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah digunapakai].

PART A / BAHAGIAN A

- (1). (a). Outline the steps involved in preparing a standard HCl solution for titration and elaborate on the specific criteria that a substance must fulfill to qualify as a suitable reagent in the standardization process.

Gariskan langkah-langkah yang terlibat dalam menyediakan larutan piawai HCl untuk pentitratan, dan huraikan kriteria khusus yang sesuatu bahan mesti dipenuhi untuk dijadikan sebagai reagen yang sesuai dalam proses pempiawaian.

(5 marks/markah)

- (b). A 0.1M sodium hydroxide solution is to be standardized by titrating primary standard sulfamic acid ($\text{NH}_2\text{SO}_3\text{H}$). What is the weight of sulfamic acid should be taken so that the volume of NaOH titrated from the buret is about 40 ml?

Satu larutan sodium hidroksida 0.1M perlu dipiawaikan dengan mentitrasi asid sulfamik piawai primer ($\text{NH}_2\text{SO}_3\text{H}$). Berapakah berat asid sulfamik yang perlu diambil supaya isipadu NaOH yang dititrat daripada buret adalah kira-kira 40 ml?

(8 marks/markah)

- (c). Most analytical methods use a calibration plot of measured signal versus concentration. Below is the data collected for the plot. Assuming a linear relationship exists, and concentration is an independent variable with a high degree of certainty, by using the 'least square' method, calculate the slope (m), intercept (b), on the 'best fits' line.

Kebanyakan analisis kaedah analitikal menggunakan plot penentuan isyarat yang diukur melawan kepekatan. Di bawah diberikan data yang dikumpul untuk plot tersebut. Andaikan satu hubungan linear wujud dan kepekatan adalah pembolehubah bebas dengan darjah kepastian yang tinggi, dengan menggunakan kaedah 'least square', kirakan cerun (m), pintasan (b), pada garis paling sesuai tersebut.

...3/-

Table 1: Calibration plot of measured signal versus concentration
Jadual 1: Plot penentukuran isyarat yang diukur melawan kepekatan

Concentration/Kepekatan (ppm)	Signal/Isyarat
1.00	0.116
2.50	0.281
5.00	0.567
7.50	0.880
10.0	1.074

(12marks/markah)

(2). (a). Describe

Huraikan,

(i). Titration equivalent point and titration end point

Titik setara pentitratan dan titik akhir pentitratan

(ii). Acid-base titration curve (with the aid of diagram)

Keluk pentitratan asid-bes (dengan bantuan gambar rajah)

(4 marks/markah)

(b). Calculate the pH of a solution containing 50.0 ml, 0.10M NH_3 after the addition of the following volumes of titrant in a titration with 0.10M HCl.

Kirakan pH suatu larutan yang mengandungi 50.0 ml, 0.10M NH_3 selepas penambahan isipadu titran berikut dalam pentitratan dengan 0.10M HCl.

(i). 25.0 ml

(ii). 50.0 ml

(iii). 60.0 ml

(8 marks/markah)

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- (c). (i). Describe the principle of complexometric titration and provide an example to illustrate it.

Huraikan prinsip pentitratan kompleksometri dan berikan satu contoh untuk menggambarkan.

(4 marks/markah)

- (ii). A 100 ml aliquot of city drinking water was treated with a small amount of an ammonia-ammonium chloride buffer to bring the pH to 10. After the addition of calmagite indicator, the solution required 21.46 ml of 5.140×10^{-3} M concentration EDTA for titration. Calculate the water hardness in terms of parts per million calcium carbonates.

Sebanyak 100 ml alikuot air minuman di bandar telah dirawat dengan sedikit penimbal ammonia-ammonium klorida untuk menjadikan pH kepada 10. Selepas penambahan penunjuk calmagite, larutan memerlukan sebanyak 21.46 ml EDTA dengan kepekatan 5.140×10^{-3} M untuk pentitratan. Kira keliatan air dari segi bahagian per juta kalsium karbonat.

(4 marks/markah)

- (d). Briefly explain the gravimetry and steps required in gravimetry analysis.

Terangkan secara ringkas gravimetri dan langkah-langkah yang diperlukan dalam analisis gravimetri.

(5 marks/markah)

- (3). (a). With the aid of a diagram, explain the principal mechanism of the ultraviolet-visible spectrophotometer.

Dengan bantuan gambar rajah, terangkan mekanisme utama spektrofotometer 'ultraviolet-visible'.

(8 marks/markah)

...5/-

- (b). A solution was prepared by dissolving 118.9 mg of primary standard $K_2Cr_2O_7$ in dilute sulfuric acid and diluting to 1.000 L with water. A 10.0 mL aliquot was transferred to a 100.0 mL volumetric flask and diluted to mark. This solution has absorbance of 0.206 and 0.143 at 400 and 420 nm wavelength, respectively, in a 1.00 cm cell. Calculate the molar absorptivity of $K_2Cr_2O_7$ at the two wavelengths.

Satu larutan telah disediakan dengan melarutkan 118.9 mg $K_2Cr_2O_7$ standard primer dalam asid sulfurik cair dan dicairkan kepada 1.000 L dengan menggunakan air. 10.0 ml larutan alikuot dipindahkan ke dalam kelalang volumetrik 100.0 mL dan dicairkan sehingga tanda aras. Larutan ini memberi bacaan keserapan 0.206 dan 0.143 pada 400 dan 420 nm panjang gelombang, masing-masing, di dalam sel berukuran 1.00 cm. Kirakan penyerapan molar $K_2Cr_2O_7$ pada dua panjang gelombang tersebut.

(8 marks/markah)

- (c). Data below shows copper content in an unknown sample along with several standard solutions was analyzed using AAS. Construct the calibration curve to find concentration of the copper in the unknown sample:

Data di bawah menunjukkan kandungan tembaga di dalam sampel yang tidak diketahui bersama beberapa larutan piawai yang dianalisa menggunakan AAS. Plot keluk penentukuran untuk mencari kepekatan tembaga di dalam sampel yang tidak diketahui:

...6/-

Table 2 – Analysis of Cu concentration by AAS
Jadual 2 – Analisis kepekatan tembaga menggunakan AAS

Copper concentration (ppm) <i>Kepekatan Kuprum (ppm)</i>	Absorbance <i>Keserapan</i>
0.0	0.000
1.8	0.050
3.5	0.100
5.5	0.150
7.4	0.200
9.2	0.250
11.2	0.310
Unknown Sample <i>Sampel tidak diketahui</i>	0.257

(9 marks/markah)

PART B / BAHAGIAN B

- (4). (a). A 20.00 mL sample of HCl was titrated with the 0.1M NaOH solution. To reach the endpoint required 23.72 mL of the NaOH. Calculate the molarity of the HCl.

Sampel 20.00 ml HCl telah dititrat dengan larutan 0.1M NaOH. Untuk mencapai titik akhir diperlukan 23.72 mL NaOH. Kira kemolaran HCl.

(4 marks/markah)

- (b). The weight percentage of commercial concentrated perchloric acid is 70%. If the density of the acid is 1.664g/ml, calculate

Peratus berat asid perklorik pekat komersial adalah 70%. Jika ketumpatan asid adalah 1.664g/ml, kirakan

- (i). Weight of perchloric acid in 1.00 ml of solution
Berat asid perklorik dalam 1.00 ml larutan

- (ii). The molarity of perchloric acid
Kemolaran asid perklorik

(8 marks/markah)

- (c). An ore ship carrying copper ore from China has been bought by a metal refining company in Malaysia. The certificate of chemical analysis from the supplier shows that % Cu is 14.66 with a standard deviation of 0.07% for 5 measurements. When the ore arrived at the refining plant, the analysis gave the following results: %Cu: 14.58, 14.61, 14.69 and 14.64. Should this refining company accept the ore?

...8/-

Kapal bijih membawa bijih kuprum dari China telah dibeli oleh satu Syarikat penulenan logam di Malaysia. Sijil analisis kimia daripada pembekal menunjukkan bahawa % Cu adalah 14.66 dengan sisihan piawai sebanyak 0.07% bagi 5 pengukuran. Apabilah bijih sampai di loji penulenan, analisis memberikan keputusan berikutnya: %Cu: 14.58, 14.61, 14.69 dan 14.64. Patutkah syarikat penulenan ini menerima bijih tersebut?

(13 marks/markah)

- (5). (a). Describe the visual detection of the end point for redox titration below:

Terangkan pengesanan visual bagi titik akhir untuk pentitratan redoks di bawah:

- (i). Self-indication

Penunjuk-diri

- (ii). Starch indicator

Penunjuk kanji

- (iii). Redox indicator

Penunjuk redoks

(6 marks/markah)

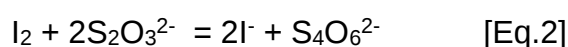
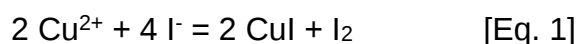
...9/-

- (b). A 0.200 g sample containing Cu is analyzed iodometrically. Cu (II) is reduced to Cu (I) by iodide:

Reaction Equation:

Sampel 0.200 g yang mengandungi Cu dianalisis secara iodometrik. Cu (II) dikurangkan kepada Cu (I) oleh iodida:

Persamaan tindak balas:



Calculate the percent copper in the sample if 25.0 mL of 0.100 M $\text{Na}_2\text{S}_2\text{O}_3$ is required for titration of the liberated I_2 ?

Kirakan peratus kuprum dalam sampel jika 25.0 mL 0.100 M $\text{Na}_2\text{S}_2\text{O}_3$ diperlukan untuk pentitratan I_2 terbebas?

(7 marks/markah)

- (c). (i). Describe the Volhard method and state the reaction involved in this method.

Huraikan kaedah Volhard dan nyatakan tindak balas yang terlibat dalam kaedah ini.

(5 marks/markah)

- (ii). A 500.0 mg sample of butter was warmed and shaken vigorously with water. The undissolved material was removed by filtering and the aqueous portion was made 1.0 M in HNO_3 and 0.025 M in $\text{Fe}(\text{NO}_3)_3$. This acidified solution was treated with 10.00 mL of 0.1755 M AgNO_3 to precipitate the chloride ion and, after the addition of a small amount of nitrobenzene, 14.22 mL of 0.1006 M KSCN was required to back titrate the excess Ag^+ . Calculate percentage of NaCl in the butter.

Reaction equation:

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Sebanyak 500.0 mg sampel mentega telah dipanaskan dan digoncang dengan kuat bersama air. Bahan yang tidak terlarut diasingkan dengan kaedah penurasan dan bahagian akues dilarutkan di dalam larutan 1.0 M HNO₃ and 0.025M Fe(NO₃)₃. Larutan berasid ini dirawat dengan larutan 0.01755 M AgNO₃ sebanyak 10.0 mL untuk memendakkan ion klorida dan selepas penambahan sedikit nitrobenzina, sebanyak 14.22 mL larutan 0.1006 M KSCN diperlukan dalam pentitratan balik lebihan Ag⁺. Kirakan peratus NaCl dalam mentega tersebut.

Persamaan tindakbalas:



(7 marks/markah)

...11/-

APPENDIX 1/ LAMPIRAN 1Table 1: Values of t for ν , Degrees of freedom for various confidence level*Jadual 1 : Nilai - nilai t bagi ν , darjah kebebasan bagi pelbagai aras keyakinan*

	Confidence Level/Aras keyakinan			
n	90 %	95 %	99 %	99.5 %
∞	6.314	12.706	63.657	127.32
1				
2	2.920	4.303	9.925	14.089
3	2.353	3.182	5.841	7.453
4	2.132	2.776	4.604	5.598
5	2.015	2.571	4.032	4.773
6	1.943	2.447	3.707	4.317
7	1.895	2.365	3.500	4.029
8	1.860	2.306	3.355	3.832
9	1.833	2.262	3.250	3.690
10	1.812	2.228	3.169	3.581
15	1.753	2.131	2.947	3.252
20	1.725	2.086	2.845	3.153
25	1.708	2.060	2.787	3.078
∞	1.645	1.960	2.576	2.807

* $n = N - 1$ = degrees of freedom/darjah kebebasan

APPENDIX 2/ LAMPIRAN 2

Table 2: Value of F at the 95% Confidence Level

Jadual 2: Nilai F bagi Aras Keyakinan 95%

	$v_1 = 2$	3	4	5	6	7	8	9	10	15	20	30
$v_2 = 2$	19.0	19.2	19.2	19.3	19.3	19.4	19.4	19.4	19.4	19.4	19.4	19.5
3	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.70	8.66	8.62
4	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.86	5.80	5.75
5	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.62	4.56	4.50
6	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	3.94	3.87	3.81
7	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.51	3.44	3.38
8	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.22	3.15	3.08
9	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.01	2.94	2.86
10	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.85	2.77	2.70
15	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.40	2.33	2.25
20	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35	2.20	2.12	2.04
30	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	2.16	2.01	1.93	1.84

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APPENDIX 3: Periodic Table / LAMPIRAN 3: Jadual Berkala

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About Chemistry

1A 1 H 1.00794 Hydrogen																	8A 2 He 4.002602 Helium																		
3 Li 6.941 Lithium	4 Be 9.012182 Beryllium																	5 B 10.811 Boron	6 C 12.0107 Carbon	7 N 14.0067 Nitrogen	8 O 15.9994 Oxygen	9 F 18.9984032 Fluorine	10 Ne 20.1797 Neon												
11 Na 22.989769 Sodium	12 Mg 24.3050 Magnesium	13 Al 26.9815386 Aluminum	14 Si 28.0855 Silicon	15 P 30.973762 Phosphorus	16 S 32.065 Sulfur	17 Cl 35.453 Chlorine	18 Ar 39.948 Argon											19 K 39.0983 Potassium	20 Ca 40.078 Calcium	21 Sc 44.955912 Scandium	22 Ti 47.867 Titanium	23 V 50.9415 Vanadium	24 Cr 51.9961 Chromium	25 Mn 54.938045 Manganese	26 Fe 55.845 Iron	27 Co 58.933195 Cobalt	28 Ni 58.6934 Nickel	29 Cu 63.546 Copper	30 Zn 65.38 Zinc	31 Ga 69.723 Gallium	32 Ge 72.64 Germanium	33 As 74.92160 Arsenic	34 Se 78.96 Selenium	35 Br 79.904 Bromine	36 Kr 83.798 Krypton
37 Rb 85.4678 Rubidium	38 Sr 87.62 Strontium	39 Y 88.90585 Yttrium	40 Zr 91.224 Zirconium	41 Nb 92.90638 Niobium	42 Mo 95.96 Molybdenum	43 Tc [98] Technetium	44 Ru 101.07 Ruthenium	45 Rh 102.90550 Rhodium	46 Pd 106.42 Palladium	47 Ag 107.8682 Silver	48 Cd 112.411 Cadmium	49 In 114.818 Indium	50 Sn 118.710 Tin	51 Sb 121.760 Antimony	52 Te 127.60 Tellurium	53 I 126.90447 Iodine	54 Xe 131.293 Xenon	55 Cs 132.9054519 Cesium	56 Ba 137.327 Barium	57-71 Lanthanides	72 Hf 178.49 Hafnium	73 Ta 180.94788 Tantalum	74 W 183.84 Tungsten	75 Re 186.207 Rhenium	76 Os 190.23 Osmium	77 Ir 192.217 Iridium	78 Pt 195.084 Platinum	79 Au 196.966569 Gold	80 Hg 200.59 Mercury	81 Tl 204.3833 Thallium	82 Pb 207.2 Lead	83 Bi 208.98040 Bismuth	84 Po [209] Polonium	85 At [210] Astatine	86 Rn [222] Radon
87 Fr [223] Francium	88 Ra [226] Radium	89-103 Actinides	104 Rf [267] Rutherfordium	105 Db [268] Dubnium	106 Sg [271] Seaborgium	107 Bh [272] Bohrium	108 Hs [270] Hassium	109 Mt [276] Meitnerium	110 Ds [281] Darmstadtium	111 Rg [280] Roentgenium	112 Cn [285] Copernicium	113 Uut [284] Ununtrium	114 Fl [289] Flerovium	115 Uup [288] Ununpentium	116 Lv [293] Livermorium	117 Uus [294] Ununseptium	118 Uuo [294] Ununoctium																		
Lanthanides			57 La 138.90547 Lanthanum	58 Ce 140.116 Cerium	59 Pr 140.90765 Praseodymium	60 Nd 144.242 Neodymium	61 Pm [145] Promethium	62 Sm 150.36 Samarium	63 Eu 151.964 Europium	64 Gd 157.25 Gadolinium	65 Tb 158.92535 Terbium	66 Dy 162.500 Dysprosium	67 Ho 164.93032 Holmium	68 Er 167.259 Erbium	69 Tm 168.93421 Thulium	70 Yb 173.054 Ytterbium	71 Lu 174.9668 Lutetium																		
Actinides			89 Ac [227] Actinium	90 Th 232.03806 Thorium	91 Pa 231.03588 Protactinium	92 U 238.02891 Uranium	93 Np [237] Neptunium	94 Pu [244] Plutonium	95 Am [243] Americium	96 Cm [247] Curium	97 Bk [247] Berkelium	98 Cf [251] Californium	99 Es [252] Einsteinium	100 Fm [257] Fermium	101 Md [258] Mendelevium	102 No [259] Nobelium	103 Lr [262] Lawrencium																		

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