Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	INSTRUMENTAL ANALYSIS
COURSE CODE	:	BWK 10703
PROGRAMME CODE	:	BWK
EXAMINATION DATE	:	JULY/AUGUST 2023
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS 2.THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK.** 3.STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

Q1 (a) The main principle involved in chromatography is adsorption of the solutes of a solution through a stationary phase and separates the mixture into individual components.

(i) Briefly relate the solute retention time with its affinity with the mobile and stationary phase.

(4 marks)

(ii) Clearly explain the relationship between the retention factor and retention time.

(3 marks)

(b) Ferrous sulphate heptahydrate is used to fortify foods with iron. A chemist analysing the iron content in wheat flour from **FIVE (5)** different batches of production. The mean and standard deviation of the data was found to be 24.6 and 1.8166 respectively.

(i) With the aid of Table **Q1(b)(i),** construct a 98% confidence interval based on the findings gained by the chemist.

(7 marks)

(ii) By evaluating the data given, identify if the data is precise or in contrary.

(6 marks)

Q2 (a) It is crucial to ensure the select the correct analytical method in evaluating environmental samples to ensure its accuracy.

(i) Briefly explain the simplest way to assess the performance of the method chosen towards the effects of interferences caused by the sample matrix which may lead to systematic error.

(3 marks)

(ii) Summarize the differences between reagent blank and sample blank in analytical evaluation of samples.

(4 marks)

(b) In one experiment, an unknown isomer mixture of straight chain hydrocarbon without any substituent samples are analysed by UV-Visible spectroscopy. The empirical formula for the hydrocarbon was found to be $(CH_2)_n(CH{=}CH_2)_2$ with molecular weight of 82.0 g/mol. The UV-visible spectrum shows **TWO (2)** peaks with λ_{max} relatively close with each other.

(i) With the aid of skeletal structure, identify the **TWO (2)** isomers in the mixture.

(6 marks)

(ii) From your answer in **Q2(b)(i)**, make a brief conclusion to explain on the of the actual value of λ_{max} (in nm) for both isomers identified. Given that the energy of electronic radiation of the isomers are 9.2456×10^{-19} and 8.5881×10^{-19}.

(7 marks)

Q3 (a) An unknown mixture of pesticides in a wastewater sample can be analysed using liquid chromatography. Examine how the results obtained can be interpreted in the determination of the unknown analytes.

(6 marks)

(b) The understanding of chemical shift is highly required in order to interpret the data obtained from nuclear magnetic resonance (NMR). One factor that affects chemical shift is the changing of electron density from around a nucleus, such as a bond to an electronegative group. Determine the chemical shift interpretation of the organic compounds in **Figure Q3(b)**.

(4 marks)

Q4 (a) Scanning electron microscopy (SEM) and Field emission scanning electron microscopy (FESEM) analysis are frequently used in morphological study of material. Compare and contrast the SEM and FESEM in terms of their principles.

(7 marks)

(b) Discuss **THREE (3)** of the most important applications for zetasizer analysis in understanding complex systems in industrial wastewater chemistry research.

(7 marks)

Q5 (a) The use of thermogravimetry (TGA) analysis can be one of the most frequent uses in plastic testing. Discuss **FOUR (4)** types of measurements using TGA analysis in the plastic manufacturing industry.

(8 marks)

(b) Produce a technique used for X-Ray Diffraction (XRD) analysis in ceramic samples by explaining briefly the steps in conducting XRD analysis on a ceramic sample and what information can be obtained from the XRD application.

(8 marks)

-END OF QUESTIONS –

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Table Q1 (b)(i): The *t*-table

***t* Table**

cum. prob	$t_{.50}$	$t_{.75}$	$t_{.80}$	$t_{.85}$	$t_{.90}$	$t_{.95}$	$t_{.975}$	$t_{.99}$	$t_{.995}$	$t_{.999}$	$t_{.9995}$
one-tail	0.50	0.25	0.20	0.15	0.10	0.05	0.025	0.01	0.005	0.001	0.0005
two-tails	1.00	0.50	0.40	0.30	0.20	0.10	0.05	0.02	0.01	0.002	0.001
df											
1	0.000	1.000	1.376	1.963	3.078	6.314	12.71	31.82	63.66	318.31	636.62
2	0.000	0.816	1.061	1.386	1.886	2.920	4.303	6.965	9.925	22.327	31.599
3	0.000	0.765	0.978	1.250	1.638	2.353	3.182	4.541	5.841	10.215	12.924
4	0.000	0.741	0.941	1.190	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	0.000	0.727	0.920	1.156	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	0.000	0.718	0.906	1.134	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	0.000	0.711	0.896	1.119	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	0.000	0.706	0.889	1.108	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	0.000	0.703	0.883	1.100	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	0.000	0.700	0.879	1.093	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	0.000	0.697	0.876	1.088	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	0.000	0.695	0.873	1.083	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	0.000	0.694	0.870	1.079	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	0.000	0.692	0.868	1.076	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	0.000	0.691	0.866	1.074	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	0.000	0.690	0.865	1.071	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	0.000	0.689	0.863	1.069	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	0.000	0.688	0.862	1.067	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	0.000	0.688	0.861	1.066	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	0.000	0.687	0.860	1.064	1.325	1.725	2.086	2.528	2.845	3.552	3.850
21	0.000	0.686	0.859	1.063	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	0.000	0.686	0.858	1.061	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	0.000	0.685	0.858	1.060	1.319	1.714	2.069	2.500	2.807	3.485	3.768
24	0.000	0.685	0.857	1.059	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	0.000	0.684	0.856	1.058	1.316	1.708	2.060	2.485	2.787	3.450	3.725
26	0.000	0.684	0.856	1.058	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	0.000	0.684	0.855	1.057	1.314	1.703	2.052	2.473	2.771	3.421	3.690
28	0.000	0.683	0.855	1.056	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	0.000	0.683	0.854	1.055	1.311	1.699	2.045	2.462	2.756	3.396	3.659
30	0.000	0.683	0.854	1.055	1.310	1.697	2.042	2.457	2.750	3.385	3.646
40	0.000	0.681	0.851	1.050	1.303	1.684	2.021	2.423	2.704	3.307	3.551
60	0.000	0.679	0.848	1.045	1.296	1.671	2.000	2.390	2.660	3.232	3.460
80	0.000	0.678	0.846	1.043	1.292	1.664	1.990	2.374	2.639	3.195	3.416
100	0.000	0.677	0.845	1.042	1.290	1.660	1.984	2.364	2.626	3.174	3.390
1000	0.000	0.675	0.842	1.037	1.282	1.646	1.962	2.330	2.581	3.098	3.300
z	0.000	0.674	0.842	1.036	1.282	1.645	1.960	2.326	2.576	3.090	3.291
	0%	50%	60%	70%	80%	90%	95%	98%	99%	99.8%	99.9%
	Confidence Level										

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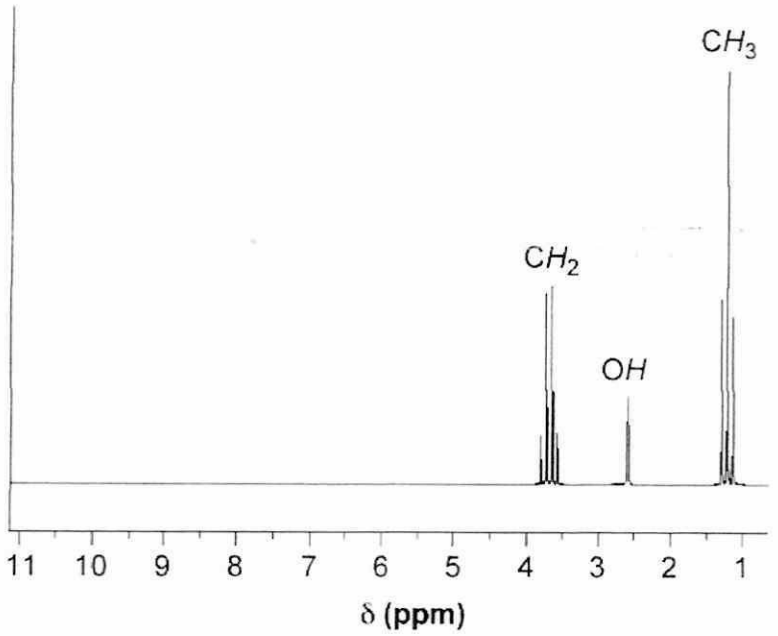

Figure Q3(b)