Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2013/2014

COURSE NAME	:	ANALYTICAL AND ORGANIC CHEMISTRY
COURSE CODE	:	BNQ 10203
PROGRAMME	:	1 BNN
EXAMINATION DATE	:	JUNE 2014
DURATION	:	3 HOURS
INSTRUCTION	:	THIS PAPER CONTAINS TWO PARTS (PART A AND PART B). ANSWER **TWO (2)** QUESTIONS FROM PART A AND **TWO (2)** QUESTIONS FROM PART B

THIS QUESTION PAPER CONSISTS OF **TWELVE (12)** PAGES

PART A (ANALYTICAL CHEMISTRY)

Q1 (a) Differentiate between sample standard deviation and population standard deviation. Give the equation involves in each meaning.

(4 marks)

(b) Describe the preparation of the following chemicals:

(i) 500 mL of 0.0750 M $AgNO_3$ from the solid reagent.
(ii) 1.00 L of 0.285 M HCl, with 6.00 M solution of the reagent.

(3 marks)

(c) A solution was prepared by dissolving 1210 mg of $K_3Fe(CN)_6$ in sufficient water to give 775 mL. Calculate the following:

(i) The molar analytical concentration of $K_3Fe(CN)_6$.
(ii) The molar concentration of K^+.
(iii) The molar concentration of $Fe(CN)_6^{3-}$.
(iv) The weight /volume percentage of $K_3Fe(CN)_6$.
(v) The number of millimoles of K^+ in 50.0 mL of this solution.

(10 marks)

(d) The measurements of dissolved oxygen from one river at the same locations were taken for two consecutive weeks as reported in Table **Q1(d)**. Examine whether the mean of dissolved oxygen concentration is less than 5 mg/L at the 90% confidence level. State clearly the null and the alternative hypothesis.

Table Q1(d)

Week number	Dissolved Oxygen, mg/L
1	4.9
2	5.1
3	5.6
4	4.3
5	4.7
6	4.9
7	4.5
8	5.1

(8 marks)

Q2 (a) Define population mean and sample mean.

(2 marks)

(b) Explain on instrumental errors and method errors. By using one example for each error propose on how these errors could effects the analytical results.

(8 marks)

(c) The following results were obtained for the determination of the Zn in blood in mg/L: 4.48, 4.43, 4.42, 4.65 and 4.51

(i) Determine whether the 4.65 mg/L result is an outlier or should be retained at the 95 % confidence level.

(4 marks)

(ii) If another three further measurements which are 4.40, 4.41 and 4.50 mg/L were taken, determine whether the 4.65 mg/L result is an outlier or should be retained at the 95 % confidence level.

(4 marks)

(iii). Evaluate the precision of result in (i) and (ii).

(7 marks)

Q3 (a) State the objective of the sampling process and list the steps involve in obtaining a laboratory sample.

(3 marks)

(b) Differentiate between random and systematic error. Briefly explain on how to quantify random error and how sysmatic error can be minimized or reduced.

(8 marks)

(c) The homogeneity of the chloride level in a water sample from Lake A, tested by analyzing portions drawn from the top and from the near bottom of 5 m lake's depth was tabulated in Table **Q3(c).** Determine if the means of two reading locations are different using *t-test* at the 95% confidence level.

(8 marks)

Table Q3(c)

Top	Bottom
26.30	26.22
26.43	26.32
26.28	26.20
26.19	26.11
26.49	26.42

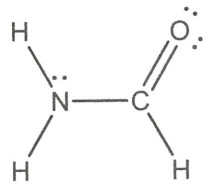
(d) With the aid of diagram, differentiate between internal standard methods and standard addition methods. Explaining on the usage of both standards in an analytical test.

(6 marks)

PART B (ORGANIC CHEMISTRY)

Q4 (a) Define ionic bond and covalent bond and give an example for each.
(3 marks)

(b) Show the resonance structure of the compound below by showing the delocalization of its electrons:

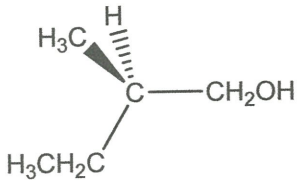


(3 marks)

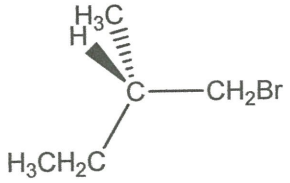
(c) Construct the energy level diagram for CO.
(6 marks)

(d) (i) Identify chiral centres, if any in 2-cyclopentenol and 3- cyclopentenol.
(3 marks)

(ii). Assign absolute configurations as R or S due to Cahn-Ingold-Prelog system to each of the the following compounds.

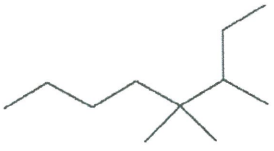


(+)-2-methyl-1-butanol

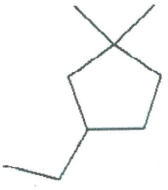


(+)-1-Bromo-2-methylbutane
(2 marks)

(e) (i) Give the IUPAC name for the following compounds.



(i)



(ii)

(2 marks)

(ii). Arrange the following isomeric alkanes in order of increasing boiling point.

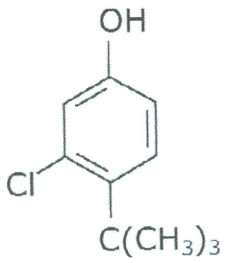
(a) n-heptane
(b) 2,3-dimethylpentane
(c) 2,2,3-trimethylbutane

(3 marks)

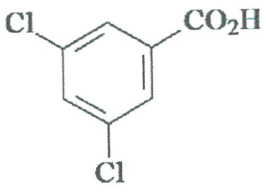
(iii). State the number of isomer C_6H_{14} could have. Draw and name **FOUR (4)** of it.

(3 marks)

Q4 (a) Give the IUPAC name for the compounds below.



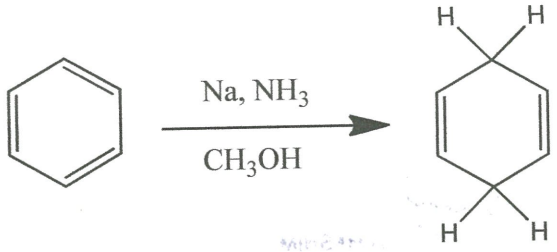
(i)



(ii)

(2 marks)

(b) In Birch reduction, reaction of benzene with sodium and methanol in liquid ammonia converts it to 1,4 cyclohexadiene as the following reaction equation. Write a mechanism involves in the reaction.

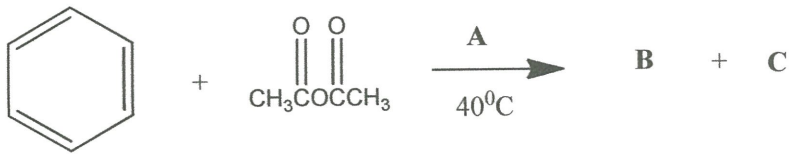


Benzene 1,4-cyclohexadiene

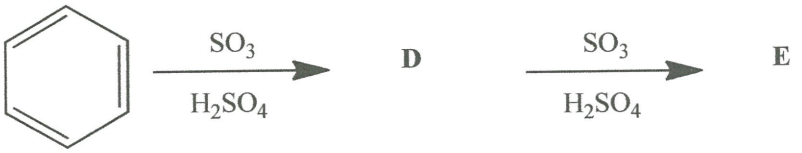
(6 marks)

(c) Complete the reaction below:

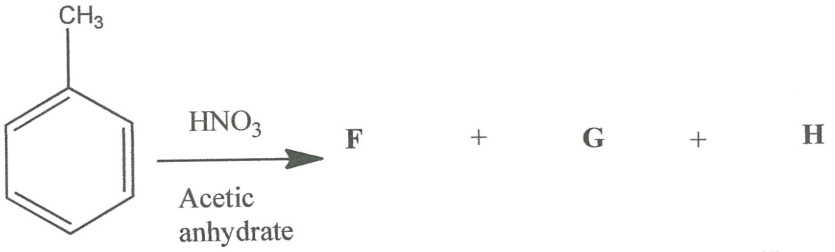
(i)



(ii)



(iii)



(5 marks)

(d) Write the structural formulas for each of the following.

(i) 3-ethyl-2-hexanone

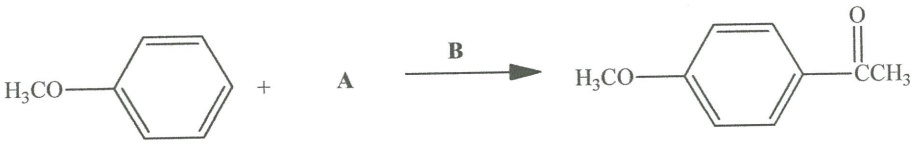
(ii) 2-phenylbutanedial

(iii) 4-methylcyclohexanone

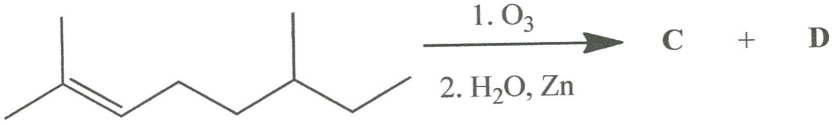
(3 marks)

(e) Complete the chemical reactions below.

(i)



(ii)



(4 marks)

(f) Aldehyde and ketone can be prepared by oxidation of alcohol in the laboratory. Suggest the reactions and chemicals or reagents involve by giving **ONE (1)** example of alcohol for each preparation.

(5 marks)

Q6 (a) Write the structural formulas for each of the following alcohols below.

(i) 2-ethyl-1-butanol

(ii) 5,5-dimethyl-2-hexanol

(iii) 6-methyl-3-propyl-2-heptanol

(3 marks)

(b) (i). Rank the following alcohols in order of increasing reaction rate with HBr.

$CH_3CH_2CH_2CH_2OH$, $(CH_3)_3COH$, $CH_3CH_2CHCH_3$ (OH)

(3 marks)

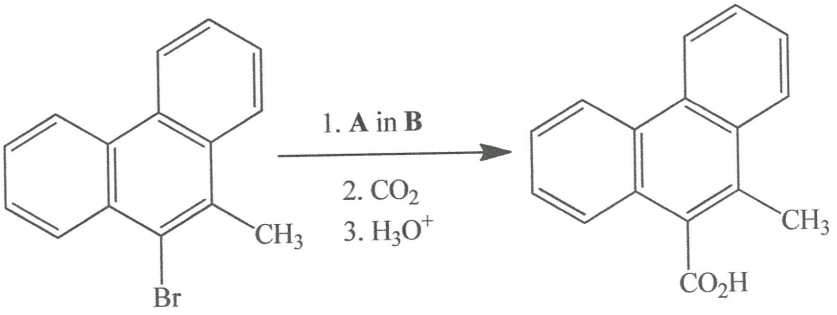
(ii). Write the mechanism involves of the reaction of alcohols with hydrogen halides below.

$$(CH_3)_3COH + HCl \rightarrow (CH_3)_3CCl + HOH$$

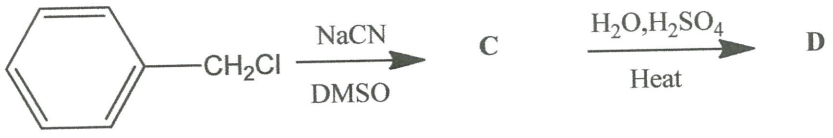
(4 marks)

(c) Complete the reactions below.

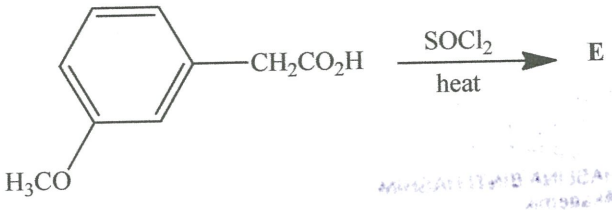
(i)



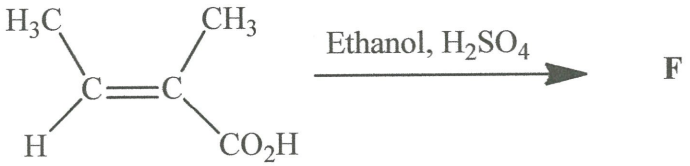
(ii)



(iii)

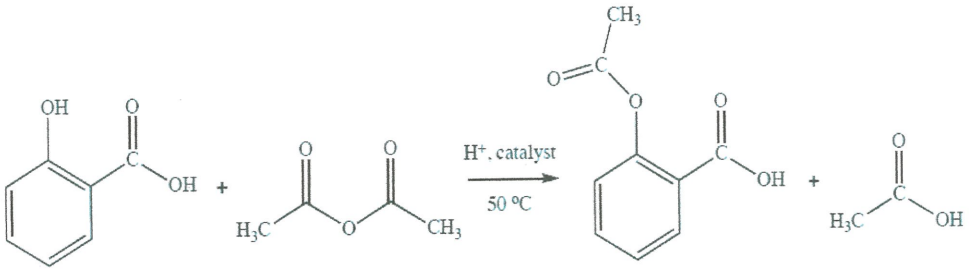


(iv)



(6 marks)

(d) In the laboratory, aspirin is synthesized by reacting the salicylic acid (a carboxylic acid) with acetic anhydrate in the presence of phosphoric acid as a catalyst due to the reaction below:



Calculate the percentage yield of the aspirin if the mass salicylic acid used is 2.0 g and mass of produced aspirin is 2.30 g.

(4 marks)

(e) (i). State the numbers of constitutionally isomeric ethers with a formula of $C_4H_{10}O$. Write all the structures.

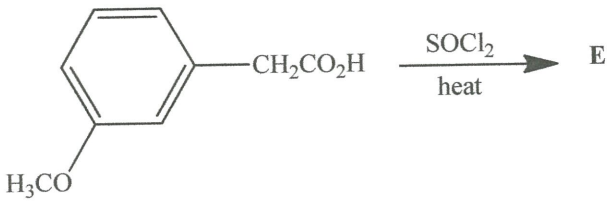
(2 marks)

(ii) Complete the reaction below.

(1) $2\ CH_3CH_2CH_2CH_2OH \xrightarrow[130^oC]{H_2SO_4} \mathbf{A} + H_2O$

(2) $(CH_3)_2CHCH_2ONa + CH_3CH_2Br \rightarrow \mathbf{B} + \mathbf{C}$

(3)



(3 marks)

- END OF QUESTION -

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Table 1: Periodic Table of Elements

Element	Symbol	Atomic number (*Z*)	Atomic mass (*A*)	Element	Symbol	Atomic number (*Z*)
Actinium	Ac	89	227.0278	Mercury	Hg	80
Aluminum	Al	13	26.98154	Molybdenum	Mo	42
Americium	Am	95	(243)	Neodymium	Nd	60
Antimony	Sb	51	121.75	Neon	Ne	10
Argon	Ar	18	39.948	Neptunium	Np	93
Arsenic	As	33	74.9216	Nickel	Ni	28
Astatine	At	85	(210)	Niobium	Nb	41
Barium	Ba	56	137.33	Nitrogen	N	7
Berkelium	Bk	97	(247)	Nobelium	No	102
Beryllium	Be	4	9.01218	Osmium	Os	76
Bismuth	Bi	83	208.9804	Oxygen	O	8
Boron	B	5	10.81	Palladium	Pd	46
Bromine	Br	35	79.904	Phosphorus	P	15
Cadmium	Cd	48	112.41	Platinum	Pt	78
Calcium	Ca	20	40.08	Plutonium	Pu	94
Californium	Cf	98	(251)	Polonium	Po	84
Carbon	C	6	12.011	Potassium	K	19
Cerium	Ce	58	140.12	Praseodymium	Pr	59
Cesium	Cs	55	132.9054	Promethium	Pm	61
Chlorine	Cl	17	35.453	Protactinium	Pa	91
Chromium	Cr	24	51.996	Radium	Ra	88
Cobalt	Co	27	58.9332	Radon	Rn	86
Copper	Cu	29	63.546	Rhenium	Re	75
Curium	Cm	96	(247)	Rhodium	Rh	45
Dysprosium	Dy	66	162.50	Rubidium	Rb	37
Einsteinium	Es	99	(254)	Ruthenium	Ru	44
Erbium	Er	68	167.26	Samarium	Sm	62
Europium	Eu	63	151.96	Scandium	Sc	21
Fermium	Fm	100	(257)	Selenium	Se	34
Fluorine	F	9	18.998403	Silicon	Si	14
Francium	Fr	87	(223)	Silver	Ag	47
Gadolinium	Gd	64	157.25	Sodium	Na	11
Gallium	Ga	31	69.72	Strontium	Sr	38
Germanium	Ge	32	72.59	Sulfur	S	16
Gold	Au	79	196.9665	Tantalum	Ta	73
Hafnium	Hf	72	178.49	Technetium	Tc	43
Helium	He	2	4.00260	Tellurium	Te	52
Holmium	Ho	67	164.9304	Terbium	Tb	65
Hydrogen	H	1	1.0079	Thallium	Tl	81
Indium	In	49	114.82	Thorium	Th	90
Iodine	I	53	126.9045	Thulium	Tm	69
Iridium	Ir	77	192.22	Tin	Sn	50
Iron	Fe	26	55.847	Titanium	Ti	22
Krypton	Kr	36	83.80	Tungsten	W	74
Lanthanum	La	57	138.9055	Uranium	U	92
Lawrencium	Lr	103	(260)	Vanadium	V	23
Lead	Pb	82	207.2	Xenon	Xe	54
Lithium	Li	3	6.941	Ytterbium	Yb	70
Lutetium	Lu	71	174.97	Yttrium	Y	39
Magnesium	Mg	12	24.305	Zinc	Zn	30
Manganese	Mn	25	54.9380	Zirconium	Zr	40
Mendelevium	Md	101	(258)			

Table 2

Values of *t* for Various Levels of Probability

Degrees of Freedom	80%	90%	95%	99%	99.9%
1	3.08	6.31	12.7	63.7	637
2	1.89	2.92	4.30	9.92	31.6
3	1.64	2.35	3.18	5.84	12.9
4	1.53	2.13	2.78	4.60	8.61
5	1.48	2.02	2.57	4.03	6.87
6	1.44	1.94	2.45	3.71	5.96
7	1.42	1.90	2.36	3.50	5.41
8	1.40	1.86	2.31	3.36	5.04
9	1.38	1.83	2.26	3.25	4.78
10	1.37	1.81	2.23	3.17	4.59
15	1.34	1.75	2.13	2.95	4.07
20	1.32	1.73	2.09	2.84	3.85
40	1.30	1.68	2.02	2.70	3.55
60	1.30	1.67	2.00	2.62	3.46
∞	1.28	1.64	1.96	2.58	3.29

Table 3

Confidence Levels for Various Values of *z*

Confidence Level, %	*z*
50	0.67
68	1.00
80	1.28
90	1.64
95	1.96
95.4	2.00
99	2.58
99.7	3.00
99.9	3.29

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Table 4

n	Q_{crit} CL at 90%	Q_{crit} CL at 95%	Q_{crit} CL at 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