B. Tech. [Group A]

MID SEMESTER EXAMINATION *First Semester*

(September-2016)

<u>AC-101 CHEMISTRY</u>

Q2. (b) Titration of Ca^{2+} and Mg^{2+} in a 50 mL sample of hard water required 23.65 mL of 0.01205 M EDTA. A second 50 mL aliquot of the hard water sample was made strongly basic with NaOH to precipitate Mg^{2+} as $Mg(OH)_2$ (*s*). The supernatant liquid required 14.53 mL EDTA of 0.01205 M for titration. Calculate:

(i) The total hardness of the water sample, expressed as ppm $CaCO_3$.

(ii) The concentration in ppm of $CaCO_3$ in the sample.

(iii) The concentration in ppm of $MgCO_3$ in the sample.

Ans. 2b:

(i) 23.65 mL of 0.01205 M EDTA was required

= 23.65 x 0.01205 x 10^{-3} moles of EDTA

EDTA reacts with equal moles of $CaCO_3$

= 23.65 x 0.01205 x 10^{-3} moles of $CaCO_3$

i.e. 23.65 x 0.01205 x 10^{-3} x 100 g $CaCO_3$ in 50 ml [MW_{CaCO3} = 100]

= 23.65 x 0.01205 x 10^{-3} x 100 x 20 g $CaCO_3$ in 1000 ml

Therefore, the total hardness (expressed as $CaCO_3$) = 0.570 g/l = 570 ppm

(ii) Similarly, after the precipitation of $Mg(OH)_2$,

Concentration of $CaCO_3$ = 14.53 x 0.01205 x 10^{-3} x 100 x 20 g $CaCO_3$ in 1000 ml = 0.350 g/l = 350 ppm

(iii) Concentration of $MgCO_3$ = 570 – 350 = 220 ppm.

Q3. (a) The arsenic in a 1.010 g sample of a pesticide was converted to H_3AsO_4 by suitable treatment. The acid was then neutralized, and 40.00 mL of 0.06222 M $AgNO_3$ was added to precipitate the arsenic quantitatively as Ag_3AsO_4. The excess Ag^+ in the filtrate and the washings from the precipitate was titrated with 10.76 mL of 0.1000 M KSCN; the reaction was: **[3 marks]**

$$Ag^+ + SCN^- \longrightarrow AgSCN\,(s)$$

Calculate the % As_2O_3 in the pesticide sample. [Atomic mass of As: 74.92, Ag: 107.86]

Ans. 3a.

40 ml of 0.06222 M $AgNO_3$ = 40 x 0.06222 x 10^{-3} moles of $AgNO_3$ was used.

10.76 mL of 0.1000 M KSCN = 10.76 x 0.1000 x 10^{-3} moles of KSCN used for rxn with excess $AgNO_3$

10.76 x 0.1000 x 10^{-3} moles of KSCN = 10.76 x 0.1000 x 10^{-3} moles of $AgNO_3$

Excess $AgNO_3$ = 10.76 x 0.1000 x 10^{-3} moles

Therefore, consumed $AgNO_3$ = (40 x 0.06222 x 10^{-3}) – (10.76 x 0.1000 x 10^{-3})

= (2.4888 – 1.076) x 10^{-3} = 1.4128 x 10^{-3} moles $AgNO_3$

1.4128 x 10^{-3} moles $AgNO_3$ = 1/3 x 1.4128 x 10^{-3} moles H_3AsO_4 [3 eq of $AgNO_3$ react with 1 eq of H_3AsO_4]

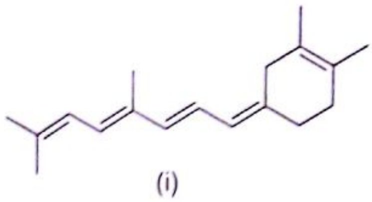
That corresponds to ½ x 1/3 x 1.4128 x 10^{-3} moles As_2O_3 in the pesticide sample.

½ x 1/3 x 1.4128 x 10^{-3} x 197.84 g in As_2O_3 the sample. [MW_{As2O3} = 197.84]

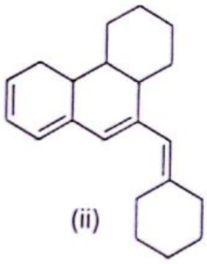
= 0.0466 g As_2O_3 in 1.010 g sample

= 4.61% As_2O_3

Q4. **(b)** Predict the λ_{max} for the following compounds using the Woodward-Fieser rules:



(i)



(ii)

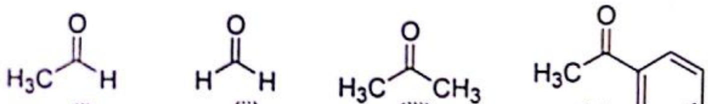
(i)

Base value (Acyclic diene):	217 nm
2 extra C=C bonds	+ 60
5 Me gps and/or Ring Residues	+ 25
1 exocyclic double bond	+ 5
λ_{max}	**= 307 nm**

(ii)

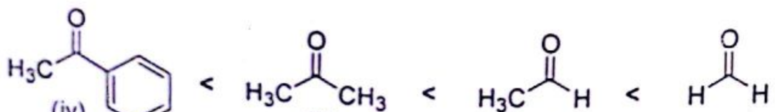
Base value (Homoannular diene):	253 nm
2 C=C bonds	+ 60
5 Me gps and/or Ring Residues	+ 25
2 exocyclic double bonds	+ 10
λ_{max}	**= 348 nm**

Q5. (a) Arrange the following compounds in the **increasing order** of their expected wave numbers for stretching vibrations of C=O functional group. Explain the trend.



(i) (ii) (iii) (iv)

Ans. 5a



(iv) (iii) (i) (ii)

Explanation: Due to the stabilization of carbocation (through + I effect and/or resonance), more single bond character in the C-O (overall weakening of the bond).

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B. TECH. (END SEM) EXAMINATION ***(November-2016)***

First Semester **(Group-A)**

AC-101 CHEMISTRY

Time: 3 Hours ***Max. Marks: 40***

Note:	Answer any **Eight** questions. Assume suitable missing data, if any.

Q1. (a) What are precipitation titrations? Explain with one example in detail. **[0.5 + 2]**

(b) A 3.00 L sample of urban air was bubbled through a solution containing 50 mL of 0.0116 M $Ba(OH)_2$, which caused the CO_2 in the sample to precipitate as $BaCO_3$. The excess base was back-titrated to a phenolphthalein end point with 23.6 mL of 0.0108 M HCl. What is the concentration of CO_2 in the air in ppm (that is, mL $CO_2/10^6$ mL air); use 1.98 g/L for the density of CO_2. **[2.5 marks]**

Solution:

Total $Ba(OH)_2$ used = 50 x 0.0116/1000 moles

HCl used for the neutralization of Excess $Ba(OH)_2$ = 23.6 x 0.0108/1000 moles

Excess $Ba(OH)_2$ neutralized by HCl = 23.6 x 0.0108/2000 moles

[1 mole $Ba(OH)_2$ reacts with 2 moles of HCl]

Moles of $Ba(OH)_2$ that reacted with CO_2: 50 x 0.0116/1000 – 23.6 x 0.0108/2000

= 0.00058 – 0.00013 = 0.00045 moles

That means 0.00045 moles of CO_2 in 3L air sample [1 mole CO_2 reacts with 1 mole of $Ba(OH)_2$]

= 0.0198 g CO_2/3L air [MW of CO_2 = 44]

= 0.01 L CO_2/3 L air [Density of CO_2 = 1.98 g/L]

= **<u>3.33 x 10^3 ppm CO_2</u>**

Q2. (a) List and briefly explain five important principles of Green Chemistry. **[0.5 x 5]**

(b) Using suitable examples, discuss two applications of Mass Spectrometry in detail. **[2.5 Marks]**

Q3. (a) Describe the principle of Differential Thermal Analysis (DTA) and discuss its comparisons with DSC. **[1.5 + 1]**

(b) Can you distinguish (Yes/No) between the two isomers CH_3COCH_3 and CH_3-CH_2-CHO on the basis of ^{1}H-NMR and IR spectroscopy? Explain in detail and justify your answer. **[0.5 + 2]**

Solution: Yes. (0.5 marks)

	CH_3COCH_3	CH_3-CH_2-CHO	
^{1}H-NMR:	One peak	3 peaks	**(1 mark)**
IR spectroscopy	Relatively Lower wave number for C=O stretching vibration (~ 1710 cm^{-1})	Relatively higher wave number for C=O stretching vibration (~ 1730 cm^{-1})	**(1 mark)**

Q4. (a) Alkanes can be cracked to form alkenes. Decane can be cracked to form two products:

$$C_{10}H_{22} \longrightarrow C_2H_4 + C_8H_{18}$$

If only the alkene is the desired product, what is the atom economy of this process? If both products are desired, what will be the atom economy?

Solution: Part a: 28/142 x 100 = 19.72% [2 marks]

Part b: 142/142 x 100 = 100% [0.5 marks]

(b) List and explain 5 important properties of batteries. **[0.5 x 5]**

Q5. (a) Draw the structure of Nylon-6,6 and Bakelite, and also mention their applications. **[1 + 1 + 0.5]**

(b) A polymer has been found to possess the population of various molecules as follows:

(i) 10 molecules of molecular mass each 20000.
(ii) 20 molecules of molecular mass each 24000.
(iii) 40 molecules of molecular mass each 40000.
(iv) 40 molecules of molecular mass each 60000.
(v) 20 molecules of molecular mass each 100000.

Calculate its Number Average Molecular weight, Weight Average Molecular weight and P.D.I. **[2.5 marks]**

Solution:

Mn = ΣNiMi/ΣNi = 66,80,000/130 = 51,384.62 [1 Mark]

Mw = ΣWiMi/ΣNiMi = 63,401.20 [1 Mark]

PDI = Mw/Mn = 1.23 [0.5 Mark]