

THE OPEN UNIVERSITY OF SRI LANKA
 B Sc Degree/ Stand Alone courses in Science
LEVEL 5- ASSIGNMENT TEST III 2007/2008
CHU 3238 / CHU 5238 -POLYMER CHEMISTRY
DURATION : 1 1/2 HOURS



DATE : 2008 - 03 - 07(Friday)

TIME : 3.30 p.m. to 5.00 p.m.

- Answer all questions
- Choose the most correct answer to each question and mark a cross "X" over the answer on the given answer sheet.
- Use a **PEN** (not a pencil) in answering.
- Any answer with more than one cross will not be counted.
- 1/6th marks will be deducted for each incorrect answer
- The use of a **non - programmable** electronic calculator is permitted.
- Logarithm tables will be provided.

Avogadro constant, (L)	$=6.022 \times 10^{23} \text{ mol}^{-1}$
Plank constant, (h)	$=6.63 \times 10^{-34} \text{ Js}$
Velocity of light, (c)	$=3 \times 10^8 \text{ ms}^{-1}$
Standard atmospheric pressure, (π)	$=10^5 \text{ Pa(Nm}^{-2}\text{)}$
Gas Constant (R)	$=8.314 \text{ J mol}^{-1} \text{ K}^{-1}$
Faraday constant (F)	$=96,500 \text{ C mol}^{-1}$
$\text{Log}_e(x)$	$=2.303 \text{ Log}_{10}(x)$

Part A (Answer all questions) (60 marks)

Questions 1-5 are based on the sample, X contains three molecules of molar masses 20, 40, 60 kg/mol.

1. The number average molar mass of the sample X, is

1. 20 kg/mol	2. 50 kg/mol	3. 40 kg/mol	4. 25 kg/mol	5. None of the above.
--------------	--------------	--------------	--------------	-----------------------

2. The weight average molar mass of the sample X, is

1. 26.7 kg/mol	2. 52.0 kg/mol	3. 10.5 kg/mol	4. 46.7 kg/mol	5. None of the above.
----------------	----------------	----------------	----------------	-----------------------

3. If the weight average degree of polymerization of sample X is 100, the molar mass of the repeat unit is

1. 0.47 kg/mol	2. 5.20 kg/mol	3. 1.25 kg/mol	4. 0.13 kg/mol	5. None of the above.
----------------	----------------	----------------	----------------	-----------------------

4. If the number average degree of polymerization of sample X is 10, the molar mass of the repeat unit is

1. 1 kg/mol	2. 2 kg/mol	3. 3 kg/mol	4. 4 kg/mol	5. None of the above.
-------------	-------------	-------------	-------------	-----------------------

5. Polydispersity factor of sample X is

1. 40/46.7	2. 46.7/40	3. 40/10.7	4. 10.7/40	5. None of the above.
------------	------------	------------	------------	-----------------------

6. The weight average molar mass can be measured using

1. Freezing point of polymers	2. Light scattering of polymers	3. Flow behavior of polymers
4. Method of polymerization	5. None of the above	

7. The polydispersity of five polymethyl methacrylate samples are given below.

1. 1.1	2. 1.6	3. 2.0	4. 2.5	5. 3.0
--------	--------	--------	--------	--------

 Which one has a comparatively narrower molar mass distribution curve?

8. Solubility of a polymer is favoured in a given solvent if

1. $\Delta H_m > T\Delta S_m$	2. $\Delta S_m < 0$	3. $\Delta G_m > 0$	4. $\Delta G_m = 0$	5. $\Delta H_m < T\Delta S_m$
-------------------------------	---------------------	---------------------	---------------------	-------------------------------

9. If flow time taken by a polymer solution and the solvent is 1200s and 100s, the specific viscosity is
1. 5 2. 3 3. 50 4. 4 5. None of the above.

10. Swelling of polymers can be enhanced by
a) increasing surface area. b) stirring c) increasing temperature

The correct statement/s is/are

1. a only 2. b only 3. c only 4. a and c only 5. b and c only

11. Which polymer is soluble in petrol?

1. vulcanized rubber 2. chloroprene rubber 3. unvulcanized rubber 4. nitrile rubber
5. phenol formaldehyde

12. At ceiling temperature

1. $k_p[M] = 2k_{dp}$ 2. $k_p[M] = k_{dp}$ 3. $k_p[M] = 3k_{dp}$ 4. $k_{dp}[M] = k_p$ 5. $k_{dp}[M] = 2k_p$

13. Consider following statements regarding the ceiling temperature.

- a) Polymerization is possible only below this temperature.
b) Polymerization is possible only below this temperature.
c) At this temperature, the monomer and the polymer exist in equilibrium.

The correct statement/s is/are

1. a only 2. b only 3. c only 4. a and c only 5. b and c only

14. Polydispersity factor for a linear poly-condensation reaction is given by

1. $(1+p)$ 2. $(1-p)$ 3. p 4. $(1+2p)$ 5. $(1-2p)$

15. You will not see the gel effect in a polymerization mixture with monomer concentration of

1. 90% 2. 50% 3. 60% 4. 10% 5. 70%

16. Osmometry is a technique to determine

1. the number average molar mass of a polymer. 2. the weight average molar mass of a polymer.
3. viscosity of a polymer. 4. the degree of polymerization 5. none of the above,

17. In osmometry,

1. a graph of πC versus C^2 gives a straight line. 2. graph of π/C versus C gives a straight line.
3. graph of π versus C gives a straight line. 4. graph of $\pi/2C$ versus C^2 gives a straight line.
5. graph of πC versus C gives a straight line.

18. In a diacid-dialcohol polymerization, if the diacid acts as a catalyst for the reaction too, the order of the polymerization reaction is

1. 0 2. 1 3. 2 4. 3 5. 4

19. Mark-Houwink equation is

1. $[\eta] = KM^a$ 2. $[\eta] = KM^{2a}$ 3. $[\eta] = KM^{3a}$ 4. $[\eta] = KM^{4a}$ 5. $[\eta] = KM^{-a}$

20. The degree of polymerization was found to be twice of the reaction. The reaction can be
a) free radical polymerization. b) a cationic polymerization. c) an anionic polymerization.

The correct statement/s is/are

1. a only 2. b only 3. c only 4. a and c only 5. b and c only



THE OPEN UNIVERSITY OF SRI LANKA
B. Sc. Degree Programme – 2007/2008
CHU 3238 / CHE 5238 – Polymer Chemistry
Assignment Test III



M.C.Q. ANSWER SHEET: Mark a cross (X) over the most suitable answer.

Reg. No:

FOR EXAMINERS USE ONLY			
Answers	No:	Marks	
Part A	Correct Answers		
	Incorrect Answers		
	Unmarked		
Part B			
Total			

1. 1 2 3 4 5

2. 1 2 3 4 5

3. 1 2 3 4 5

4. 1 2 3 4 5

5. 1 2 3 4 5

6. 1 2 3 4 5

7. 1 2 3 4 5

8. 1 2 3 4 5

9. 1 2 3 4 5

10. 1 2 3 4 5

11. 1 2 3 4 5

12. 1 2 3 4 5

13. 1 2 3 4 5

14. 1 2 3 4 5

15. 1 2 3 4 5

16. 1 2 3 4 5

17. 1 2 3 4 5

18. 1 2 3 4 5

19. 1 2 3 4 5

20. 1 2 3 4 5

Part B

(Answer all questions only in the space provided.) (40 marks)

1. (a) What are the factors that influence the solubility of polymers with solvents? Discuss.

(b) Following set of flow data was obtained from a viscosity measurement experiment on a dilute solution of polymer at 20°C.

Concentration of polymer (gL^{-1})	Flow time (s)
0.00	100
0.25	250
0.35	350

Calculate the intrinsic viscosity.

2. (a) Write down the modified Carother's equation for the polymerization of unequal stoichiometric ratio of diacid and dialcohol polymerization reaction and use this equation to derive the expression, when equal ratios are used.

(b) If 3% more diacid is used, the percentage conversion is 99.8%. Calculate the degree of polymerization.

ANSWER GUIDE
Polymer Chemistry – Level 5
CHU 3238 / CHU 5238
ASSIGNMENT TEST III (2007/2008)

Part A

01).3	02).4	03).1	04).4
05).2	06).2	07).1	08).5
09).1	10).1	11).3	12).2
13).all	14).1	15).4	16).1
17).2	18).4	19).1	20).1

Part B

01. You can use two methods to calculate K & α .

Method I

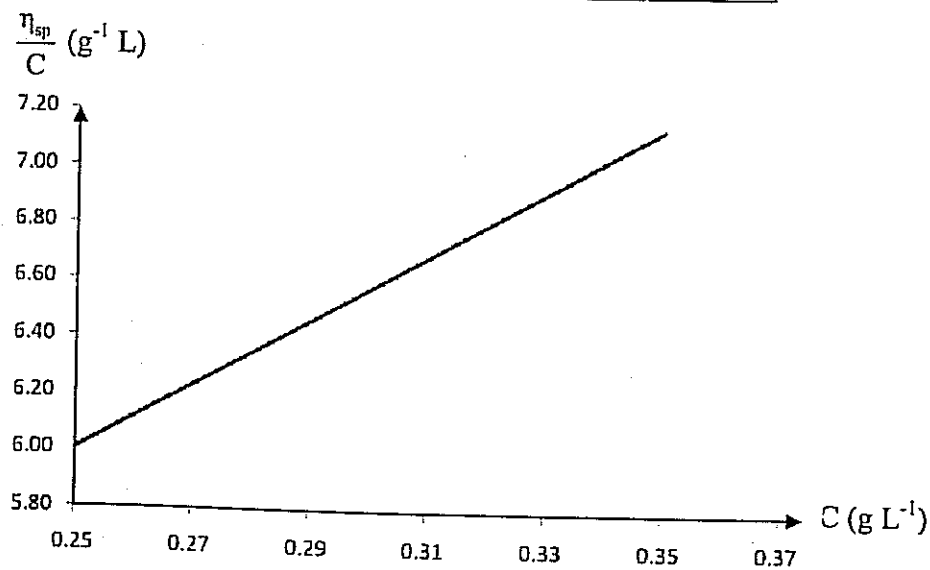
$$\frac{\eta_{sp}}{C} = K_1[\eta]^2 C + [\eta] \quad \text{and} \quad \eta_{sp} = \frac{t - t_0}{t_0}$$

We can plot a graph of $\frac{\eta_{sp}}{C}$ versus C. The intercept is equal to intrinsic viscosity.

$$\frac{\eta_{sp}}{C} = K_1[\eta]^2 C + [\eta]$$

$y = m x + c$

$\frac{\eta_{sp}}{C} \left(\frac{t - t_0}{t_0} / C \right)$	C
6.00	0.25
7.14	0.35



From the graph,

$$\text{Intercept} = \eta = \underline{3.0}$$

Method II

$$\frac{\eta_{sp}}{C} = K_1[\eta]^2 C + [\eta]$$

$$\frac{\eta_{sp}}{C} - [\eta] = K_1[\eta]^2 C \quad \text{apply this equation as,}$$

$$\frac{250-100}{100} / 0.25 - [\eta] = K_1[\eta]^2 \times 0.25 \quad \longrightarrow (1)$$

$$\frac{350-100}{100} / 0.35 - [\eta] = K_1[\eta]^2 \times 0.35 \quad \longrightarrow (2)$$

(1) / (2),

$$\frac{6 - [\eta]}{7.14 - [\eta]} = \frac{0.25}{0.35}$$

$$[\eta] = 3.15$$

02. (a)

$$\overline{X}_n = \frac{1+r}{1+r-2rp}$$

Where \overline{X}_n = Degree of polymerization

r = Stoichiometric ratio of monomer A-A to monomer B-B

p = Extent of reaction

If $N_A = N_B$

$$\text{then } \frac{N_A}{N_B} = r = 1$$

$$\text{Then } \overline{X}_n = \frac{1+1}{1+1-2 \times 1 \times p} = \frac{1}{1-p}$$

$$\overline{X}_n = \frac{1}{1-p}$$

(b)

$$\overline{X}_n = \frac{1+r}{1+r-2rp}$$

$$r = 100/103 = 0.971, \quad p = 0.998$$

$$\overline{X}_n = \frac{1+0.971}{1+0.971-(2 \times 0.971 \times 0.998)}$$

$$\overline{X}_n = 59.73$$