



The Open University of Sri Lanka
BSc Degree Programme/ Stand Alone Courses in Science/ 2007-2008
CHU 3238/CHE 5238 – Polymer Chemistry – Level V
Assignment II Test

Date: Thursday 07th February 2008

Time 3:30 pm – 5:00 pm

- Answer all the questions
- Choose the most correct answer to each question and mark this answer with an 'X' on the answer script
- Use a PEN (not a pencil) in answering
- Any question with more than one answer 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

$$\text{Gas Constant (R)} = 8.314 \text{ J mol}^{-1}\text{K}^{-1}$$

$$\text{Avogadro constant (L)} = 6.023 \times 10^{23} \text{ mol}^{-1}$$

$$\text{Planck's constant (h)} = 6.63 \times 10^{-34} \text{ Js}$$

$$\text{Velocity of light (C)} = 3.0 \times 10^8 \text{ ms}^{-1}$$

$$\text{Atmospheric pressure } (\pi) = 10^5 \text{ Pa (Nm}^{-2}\text{)}$$

$$\text{Faraday constant (F)} = 96,500 \text{ C mol}^{-1}$$

$$\text{Log}_e(X) = 2.303 \log_{10}(X)$$

Part A (Answer all questions)
(60 marks)

1. Storage hardening of natural rubber can be prevented by adding
(a) hydroxylamine
(b) semicarbazide
(c) hydrazine

The correct statement/s is/are

1. (a) only
2. (b) only
3. (c) only
4. (b) and (c) only
5. (a), (b) and (c) only

2. Common preservatives used in latex industry are

- (a) sodium sulphite
(b) ammonia solution
(c) formaldehyde
(d) sodium carbonate

The correct statements are

1. (a) and (b) only
2. (b) and (c) only
3. (a), (b) and (c) only
4. (a), (b), (c) and (d) only
5. (b), (c) and (d) only

3. Thermoplastics

1. are long chain linear polymers.
2. cannot be softened by heating.
3. are hard and brittle.
4. cannot be reclaimed.
5. insoluble in any solvent.

4. Plasticizers

1. increase the glass transition temperature.
2. are high molecular weight volatile substances.
3. are mostly solids.
4. reduce the cohesive forces of attractions between polymer chains.
5. are used in large quantities to get the required effect.

5. Thermosets are

1. slightly branched polymers.
2. highly branched polymers.
3. cross linked polymers.
4. linear polymers.
5. none of the above.

6. Thermosets can be

1. melt at high temperatures.
2. decomposed at high temperatures.
3. dissolved in organic solvents.
4. soften by heating.
5. recycled.

7. Chemicals used as foaming or blowing agents are

- (a) sodium bicarbonate (b) sodium nitrite
(c) sodium hydroxide

The correct statements are

1. (a) and (b) only 2. (b) and (c) only
3. (a) and (c) only 4. none of the above
5. (a), (b) and (c) only

8. Accelerators are used in the rubber industry

1. to increase the flexibility.
2. to decrease the flexibility.
3. to increase the rate of vulcanization reaction.
4. to activate the process of cross linking.
5. to deactivate the process of cross linking.

9. Isotactic and atactic polymers can be represented as

1. ~ddddd~ and ~lllll~ 2. ~ddddd~ and ~ddlddl~
3. ~dlldl~ and ~lllll~ 4. ~ddddd~ and ~dlldl~
5. ~lllll~ and ~ddddd~

10. Block copolymers can be represented as

1. -A-B-A-B-A-B-A- 2. -A-B-B-A-A-A-B-
3. -A-A-A-A-B-B-B- 4. -B-B-B-B-B-B-B-
5. -A-A-A-A-A-A-A-

11. Consider the following statements regarding T_g

- (a) Glass transition is a reversible physical change.
(b) Below T_g , the polymer is in glassy state.
(c) Above T_g , the polymer is in glassy state.

The correct statement/s is/are

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

12. Below the flow temperature (T_f), the polymer is in the

1. solid state. 2. gaseous state.
3. rubbery state. 4. visco fluid state.
5. glassy state.

13. In order to determine the T_g , using Dilatometry method, we need a plot of
1. volume against the temperature.
 2. volume change against the temperature.
 3. pressure against the temperature.
 4. pressure change against the temperature.
 5. density against the temperature.

14. Presence of an aromatic ring in the chain backbone of a polymer
1. increases the flexibility.
 2. decreases the chain stiffness.
 3. increases the chain stiffness.
 4. decreases T_g
 5. increases elasticity.

15. T_g is increased by
- (a) the presence of cross links among the polymer chains.
 - (b) addition of plasticizers.
 - (c) the presence of bulky groups.

The correct statement/s is/are

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

16. For symmetrical polymers T_g and T_m can be interrelated as
1. $T_g = 1/3 T_m$
 2. $T_g = 1/2 T_m$
 3. $T_g = 2/3 T_m$
 4. $T_g = T_m$
 5. $T_g = 3 T_m$

17. The dissolution of a polymer in a solvent is favoured if
- (a) $\Delta G = -ve$
 - (b) $\Delta G = +ve$
 - (c) $\Delta G = 0$

The correct statement/s is/are

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

18. Intermolecular bonding
- (a) decreases the T_m
 - (b) increases the T_m
 - (c) doesnot change the T_m

The correct statement/s is/are

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

19. Consider following statements regarding crystalline and amorphous polymers.

(a) Crystalline polymers are more soluble than amorphous polymers.

(b) Crystalline polymers are less soluble than amorphous polymers.

(c) Both have similar solubilities.

The correct statement/s is/are

1. (a) only

2. (b) only

3. (c) only

4. (b) and (c) only

5. (a) and (c) only

20. The relationship between T_g and the molar mass of polymer M is

1. $T_g^\infty = T_g + \frac{2k}{M}$

2. $T_g^\infty = T_g - \frac{k}{M}$

3. $T_g^\infty = T_g + \frac{k}{M}$

4. $T_g^\infty = T_g - \frac{2k}{M}$

5. $T_g^\infty = T_g + \frac{3k}{M}$

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POLYMER CHEMISTRY – Level 5 -CHU 3238/CHE 5238
Assignment Test II



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

Name:

Index. No.

FOR EXAMINERS USE		
Unanswered		
Correct Answers		
Wrong Answers		
Total		

- | | | |
|--|--|--|
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| 19. <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 | 20. <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 | |

Part B

(Answer all questions only in the space provided. Attached sheets will not be graded.) (40 marks)

1. (a) What do you mean by storage hardening of natural rubber? Explain.



(b) "Ribbed smoked sheets are less resistant to oxidation than pale crepe". Why is this so?

(c) By taking natural rubber as an example, explain why excess sulphur results hard rubber in the vulcanizing process.

(d) Natural rubber preservatives should have some properties. List four of them.

2. (a) Explain the variation of specific volume of a amorphous polymer with temperature using suitable diagram.

(b) How does chain flexibility affects the glass transition temperature?

(c) Densities of amorphous rubber and 100% crystalline rubber are 930 and 1100 kgm^{-3} respectively. Calculate the degree of crystallinity in crystalline rubber if the density of the crystalline rubber increases by 5% that of amorphous rubber.

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

Part A

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

Part B

01.

(a) Hardening of rubber during storage is called storage hardening. This can be occurred by cross linking of two rubber molecules by rubber bound aldehyde group. Cross linking occur mainly through the amino group present in proteins.

(b) Ribbed smoked sheets contain phenolic antioxidants which are absorbed by rubber during smoking.

Pale crepe doesn't have phenolic antioxidants.

(c) Excess sulphur results in three dimensional sulphur bridged network. It is less flexible & hard rubber.

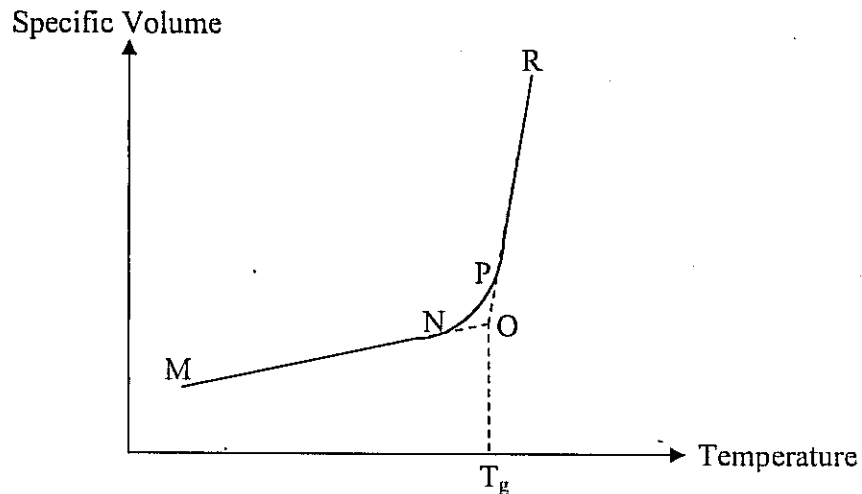
(d) 1. Prevent the lowering of pH below isoelectric point.

2. Ability to destroy bacteria.

3. Able to suppress dissolved oxygen.

4. Able to control Mg^{2+} which helps bacteria growth.

02. (a)



As shown in the above graph, the slope gradually changes near T_g and suddenly slope changes in the direction of NP from P again is a linear expansion with steady rise along the line PR. T_g is the temperature at which volume expansion coefficient changes from low to high or solid state to rubbery state. From M to N and P to R are the volume expansions of solid polymer and rubbery polymer.

(b) Chain flexibility is a measure of the ability of a chain to rotate about the constituent chain bonds, hence a flexible chain has a low T_g where as rigid chain have high T_g .

Density difference between 100% crystalline & 100% amorphous

$$\begin{aligned} \text{rubber} &= (1100-930) \text{ Kg m}^{-3} \\ &= 170 \text{ Kg m}^{-3} \end{aligned}$$

Increase in density of the 100% amorphous rubber

$$= 930 \times \frac{5}{100}$$

Degree of crystallinity

$$\begin{aligned} &= \frac{930 \times 5}{170} \times 100 \\ &= \underline{\underline{27.35 \%}} \end{aligned}$$