BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION)

CLASS: BE   SEMESTER: VI
BRANCH: CHEM   SESSION : SP/2019

SUBJECT : CL6007 POLYMER SCIENCE AND ENGINEERING

TIME: 1.5 HOURS   FULL MARKS: 25

INSTRUCTIONS:
1. The total marks of the questions are 30.
2. Candidates may attempt for all 30 marks.
3. In those cases where the marks obtained exceed 25 marks, the excess will be ignored.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. The missing data, if any, may be assumed suitably.

Q1   (a)   Determine M_v , M_w , M_n , PDI, if sum of N_i is 23 and numerator of M_v & N_iM_i relation is   [3]
           11661 x 10^8 Da for a condition where M_v and M_w are equivalent. Also determine K, if $[\eta]$
   is 0.58 dl/g. Use the GPC graph of a polymer below.
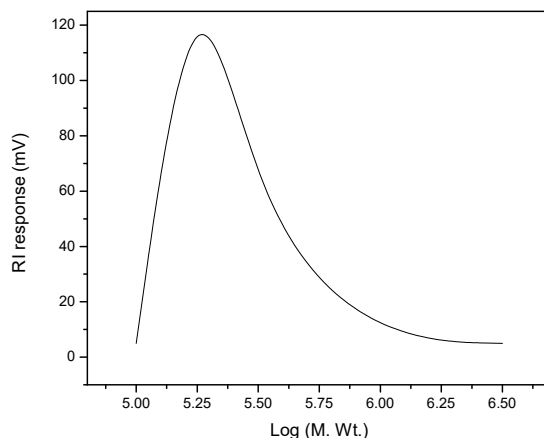
   (b)   Estimate the angular frequency of a sedimentation experiment, if polymer sample   [2]
         particle mass is 3.33 x 10^{-6} mg, partial sp. vol. is 0.73 mL/g, solution density is 0.97
         g/mL, translational friction coeff. Is 0.75, r is 0.5cm, linear velocity 3000 cm/s

Q2   Estimate M_w of a polymer having the following light scattering expt. data. Take incident   [5]
     light intensity as 2500 lux, solute-solvent const. as 0.000033. Also briefly explain
     principle of the experiment.

C (g/ml)	0.002	0.004	0.005	0.006
I (lux)	2000	1500	1450	1440
l (µm)	50	100	101	102

Q3   Determine $[\eta]$ by plotting reduced viscosity and C. Calculate M_v of PMMA dissolved in   [5]
     good solvent and if K = 5 x 10^{-5}. Also determine flow time of different solutions if
     solvent flow time is 45s. Briefly explain the procedure in both viscometers.

η_{inh} (dl/g)	0.58	0.56	0.52	0.5
C (g/dl)	0.3	0.4	0.9	1.2

PTO

Q4 (a) Calculate reciprocal dispersive power of PMMA using the plot below. Using the min. **[2]** & max. RI values determine applied stress if C is 4.7 x 10^{12} m^2/N if PMMA acts photoelastic. Also estimate permittivity of PMMA using max. RI value.
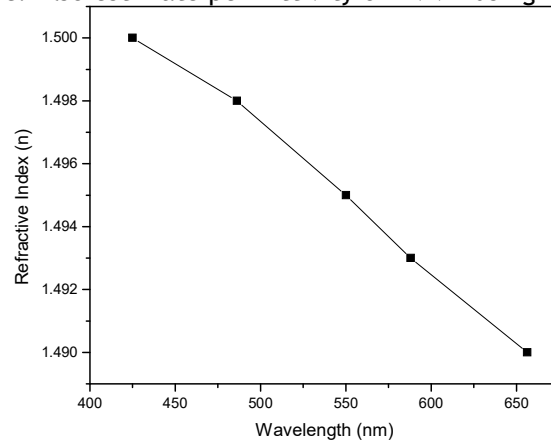

(b) Identify and describe the chemical structure and functions of materials associated **[3]** with following terms: (i) used at 0.1% in filled PVC (ii) rubber need this process for mechanical strength (iii) used at 0.02-1%

Q5 (a) Estimate mol. wt. and dissipation of a polymer sample having permittivity 2.8, **[3]** density 0.975 g/ml, molar polarizability 6153 cc/mol and if it is lossy by a value of 0.275. Also briefly describe methods used for studying creep and thermal stability

(b) Calculate heat of fusion in std. units of absolute crystalline PET, if a semi-crystalline **[2]** PET has 46.3% crystallinity with heat of fusion of 0.1356 J/mg. For the same sample calculate amorphous phase area, if crystalline area is 6.25 cm^2

Q6 (a) Extract the thermal transition values from the graph below using std. methods and **[3]** define them. Write discussion on the effect of PEG amount on the transitions. Illustrate the change in nature of the graph for exo up, endo up and endo down cases.
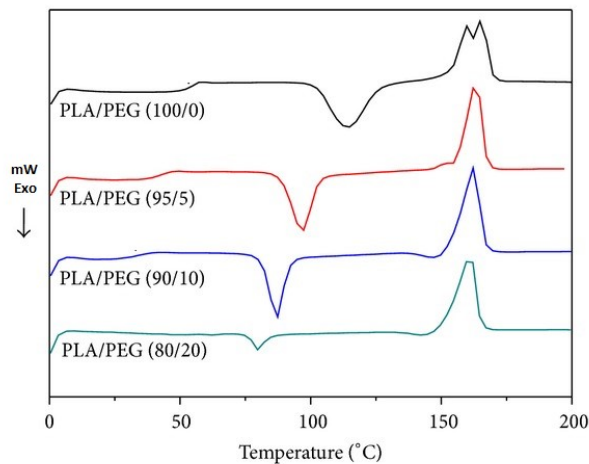
(b) Estimate gyromagnetic ratio, spin angular momentum and magnetic moment, if **[2]** applied magnetic field is 0.3 tesla, resonance frequency is 10 GHz and energy is 15J

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