SARDAR PATEL UNIVERSITY
M.Sc. (Polymer Science & Technology) Semester-IV Examination-2016
Monday, 4th April-2016
02:30 P.M. to 05:30 P.M.
PS04CPST08: POLYMER RHEOLOGY

Total Marks: 70

Note: (1) Attempt all questions.
      (2) Figures to the right indicate marks.

Q. 1   Answer the following multiple choice questions.   **08**

(1) Polymer chain _____ must have sufficient thermal energy to overcome energy barriers that impede motion.
(i) monomer (ii) molecule (iii) segment (iv) none of these.

(2) Avogadro's number is _____.
(i) 6.02×10^{23} (ii) 6.00×10^{24} (iii) $6.04 \times 10^{23,}$ 6.02×10^{22} (iv) 6.02×10^{22}

(3) The ratio of stress to corresponding strain below proportional limit of material is known as _____.
(i) modulus (ii) modulus of elasticity (iii) elasto-viscous (iv) creep

(4) Polymer exhibits a time dependant strain response to a constant applied stress. This behavior is called _____.
(i) fatigue (ii) creep (iii) Bingham plastics (iv) modulus.

(5) Swelling ratio = _____.
(i) Diameter of extrudate / Diameter of die (ii) Diameter of die / Diameter of extrudate (iii) Extrudate / Die (iv) Die / Extrudate.

(6) In order to get high rate of production, the moulding time must be _____.
(i) normal (ii) minimum (iii) average (iv) none of above.

(7) Free volume theory suggests that below glass transition temperature there is _____.
(i) complete free volume (ii) no free volume (iii) average volume (iv) all.

(8) $\tau =$ _____.
(i) $\frac{r}{R} \times \tau_w$ (ii) $r \times R \times \tau_w$ (iii) $\frac{rR}{\tau_w}$ (iv) $\frac{R}{r} \times \tau_w$

Q. 2   Attempt **any seven** of the following.   **14**

(1) Define rheology and state its importance in processing of polymer materials.

(2) Give the reasons and assumption for deriving relationships for flow through channel of simple cross-section.

(3) Define: (1) Elasto viscous behaviour (2) Stress.

(4) A rectangular box 150 mm long, 115 mm wide and 60 mm deep is thermoformed from flat sheet 150 mm × 100 mm × 2 mm. Estimate the average thickness of the walls of the final product if conventional vacuum forming is used.

(5) Prove $\eta = \dfrac{3T\alpha}{2\pi R^3 \theta}$

(6) Why polymeric liquids are non-newtonian?

(7) How Weissenberg effect is observed? Explain.

(8) Explain jetting and fountain effect.

(9) Explain the term thixotropic and antithixotropic fluid.

Q. 3 (a) Derive Rabinowitch equation used for flow through parallel plate.   **06**

(b) Answer following.   **06**

    1. Derive the relation used for the shear stress at the wall during flow through capillary.

    2. Write a note on eccentric rotating disk rheometer

OR

(b) Answer the following.   **06**

    1. What do you mean by die swell effect? Explain in detail.

    2. Write a note on frozen in orientation.

Q. 4 (a) Discuss the effects of temperature and pressure on viscous flow of polymer melts.   **06**

(b) Derive $Q = hVd - \dfrac{h^3}{12\eta}\dfrac{dp}{dx}$ for calendaring process.   **06**

OR

(b) Give an account on effects of molecular structure on rheology.   **06**

Q. 5 (a) What is melt fracture? How does it occur? Explain various observations are made during melt fracture.   **06**

(b) How strain enhancement under constant stress and stress relaxation under constant strain of viscoelastic materials can be understood using Maxwell model.   **06**

OR

(b) Write a note on capillary rheometer.   **06**

Q. 6 (a) Write a note on melting, material transfer, shaping and finishing in polymer melt process   **06**

(b) Discuss the flow properties of following polymers:
(i) Polyethylene (ii) Nylons (iii) Polystyrene.   **06**

OR

(b) Explain the effects of chain stiffness, conformation and molecular weight distribution on flow properties of thermoplastic polymer.   **06**

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