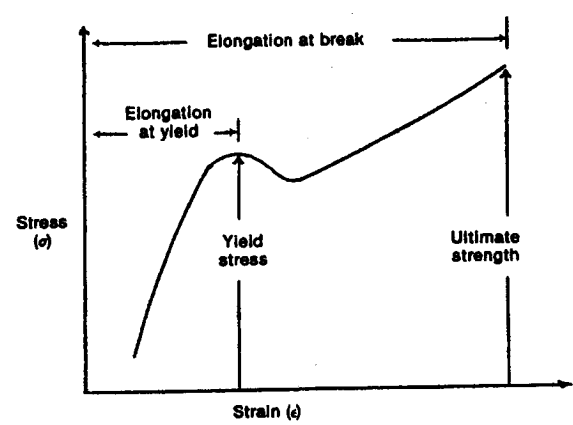


Polymer Science and Engineering

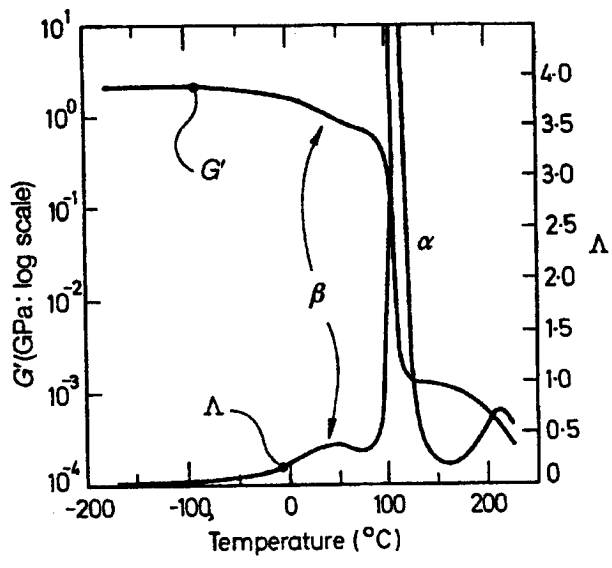
40% 1) Give examples and explain the following terms:

- (a) Dendrimer and hyperbranched polymer
- (b) Chemical and physical crosslinking
- (c) Ziegler-Natta and Metallocene catalysts
- (d) Kevlar fiber and liquid crystal polymers
- (e) Creep and Maxwell model

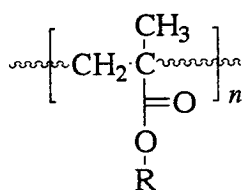
10% 2) Explain, in terms of structure and morphology, What is happening in the various regions of the stress-strain curve for the polymer of HDPE, as shown in the following figure.



15% 3) Explain, in terms of structure and morphology, What is happening in the various regions of the dynamic mechanical properties of poly(methyl methacrylate) with values of shear modulus (G') and logarithmic descrement (Δ) as a function of temperature at constant frequency near 1 Hz shown in the following figure. Data were obtained by torsion-pendulum measurement.



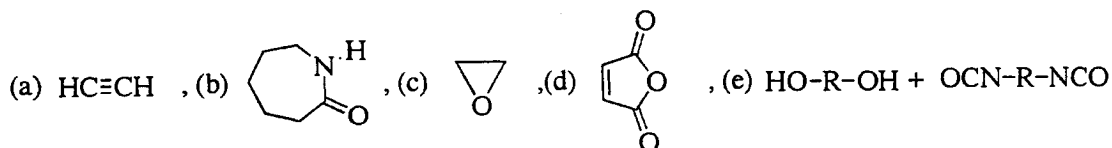
10% 4) Discuss the effect of side-chain length on the glass transition temperatures (T_g) in the methacrylates.



where:

R = Methyl -CH₃
 R = Ethyl -CH₂CH₃
 R = Propyl -CH₂CH₂CH₃
 R = Butyl -CH₂CH₂CH₂CH₃
 etc.

10% 5) Write down the chemical formulae for addition or condensation polymers from the following monomers.



15% 6) (a) Calculate the number average (M_n) and weight average (M_w) relative molecular mass for a sample of polystyrene made by blending eight separate fractions of which has a very narrow molecular mass distribution as follows.

Relative Molecular Mass	15,000	37,000	39,000	56,000	78,000	104,000	120,000	153,000
Weight (g)	0.10	0.18	0.25	0.17	0.12	0.08	0.06	0.04

(b) What is the value of M_n and M_w by adding 0.5 wt % of styrene monomer to the polymer defined in (a) ?