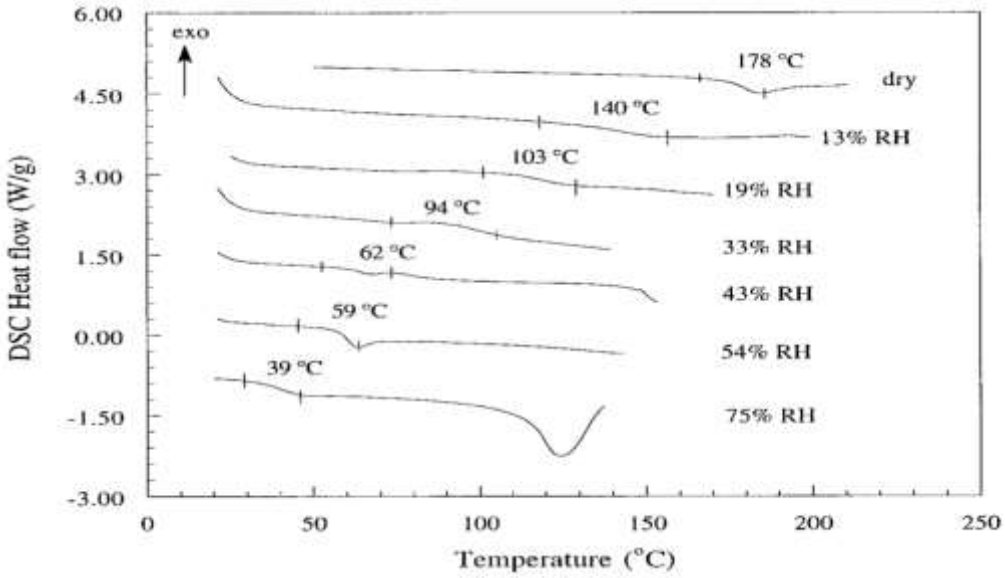
TTL212 Major Test Time 50 minutes

Answer all questions

1. DSC of a oven-dry silk film showed Tg around 178 ºC. When the film is exposed to 13% RH Tg reduced almost 38 ºC. At 75% RH it reduced to 39 ºC. Explain the phenomenon in terms of supramolecular structure of silk fibroin polymer. 5

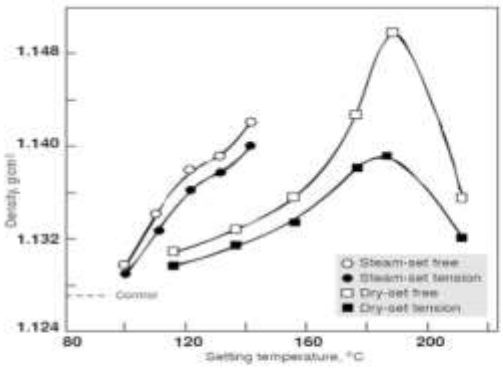


2. (a) Polyethylene can be made in linear (straight-chain) polymer or branched polymer form. Which is the high density form?
(b) Low density polyethylene (LDPE) is transparent, but High density polyethylene (HDPE) is opaque. Explain. 1+2+2
(c) What are fundamental differences between silk spinning by silkworm and HDPE spinning?

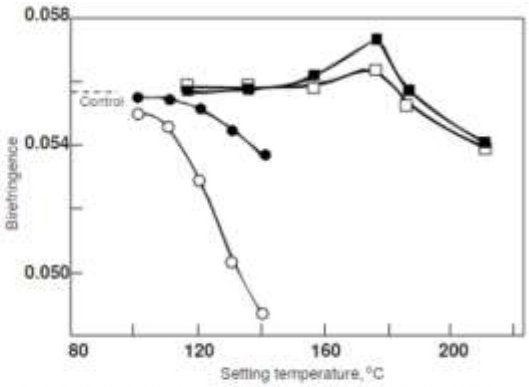
3. (a) Explain the basic principle of Ramachandran plot. 2+3
(b) Explain how cellulose can be dissolved in ionic liquid to produce Viscose.

4. (a) Why polymer chains fold to form lamellae?
(b) Why isotactic, syndiotactic polymers can crystallize relatively easily, but atactic polymers are difficult to crystallize? 2+2+1
(c) How to measure melt flow index of a polymer?

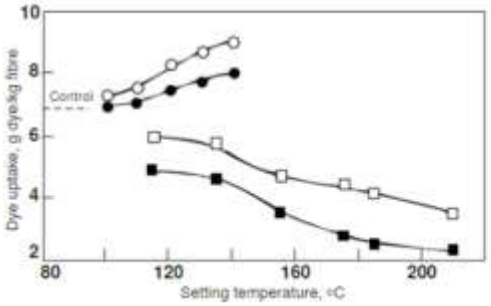
5. In our department some scientists were studying dye uptake of nylon-6 fiber, with increasing heat-setting temperature. Dye uptake decreased for samples that have been dry heat set. In the case of steam set samples, dye uptake first decreased and then increased at higher temperatures of heat setting. You also have results for density



Density values for the control, dry-set and steam-set nylon-6 fibres



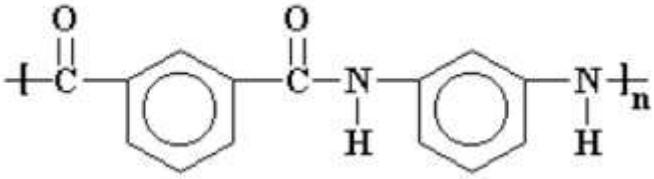
Birefringence values for the control, dry-set and steam-set nylon-6 fibres



Acid dye-uptake data for the steam-set and dry heat-set nylon-6 yarns

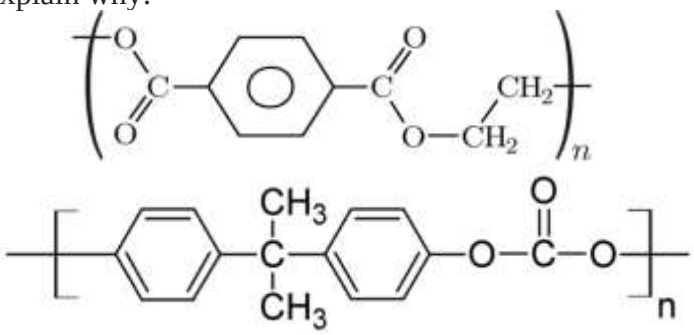
measurement as well as change in birefringence values. Please explain what type of structural changes took place, and why dye uptake was different. 10

6. Nomex is a polymer fibre with the following chemical formula.



It is used in aircraft composites, as a reinforcing fibrous material. By looking at the chemical formula, would you expect the polymer to be crystalline? Can you make comments about the effect of temperature on chain rotation and thermal properties of this material (such as thermal transitions and fire-resistance). 5

7. (a) Polyethylene terephthalate has a T_g of about 65 °C, but polycarbonate has T_g of about 149 °C. Explain why.



(b) Which factors cause resistance during flow of a polymer solution? Why some polymers show shear thinning behavior? 2+ 3