



MASENO UNIVERSITY

UNIVERSITY EXAMINATIONS 2012/2013

SECOND YEAR SECOND SEMESTER EXAMINATIONS FOR THE DEGREE OF BACHELOR OF SCIENCE IN INDUSTRIAL CHEMISTRY WITH INFORMATION TECHNOLOGY (MAIN CAMPUS)

SIC 205: FIBERS IN TEXTILE INDUSTRY

Date: 24th July, 2013

Time: 2.30 – 4.30 p.m.

INSTRUCTIONS:

- ◆ Attempt ANY FIVE questions.

QUESTION ONE

- (a) Orlon is an example of acrylic fibers. Originally orlon was a pure polymer of acrylonitrile, but today it is modified by the addition of upto 14% of a second component to give a copolymer.
- (i) What is a copolymer? [1 Mark]
- (ii) List the different types of copolymers. [2 Marks]
- (iii) Identify the monomers present in the following fibers: acrilan, creslan, zefran, nytril, darvan and saran [7 Marks]
- (b) The common modacrylic fibers are dynel and verel.
- (i) Identify the monomers present in both dynel and verel fibers
- (ii) Give a possible structure of dynel.
- (iii) Modacrylic fibers have the following listed properties.

Property	Dynel	Verel
tenacity	Dry 3.0	2.5-2.8
	Wet 3.0	2.4-2.7
Specific gravity	1.30	1.37
Elastic recovery at 2% elongation	100%	79%

What do the tenacity and elastic recovery values given above signify with respect to the two fibers (dynel and verel given above. [4 marks]

QUESTION TWO

- (a) Define the following terminologies:
- (i) Sericulture
 - (ii) Shearing
 - (iii) Tenacity
 - (iv) Abrasion
 - (v) Acrylic fiber [5 marks]
- (b) Vinyon is a copolymer of vinyl chloride (85%) and vinyl acetate (12%).
- (i) Draw a possible structure of vinyon.
 - (ii) What is the function of vinyl acetate in vinyon?
 - (iii) The molecular weight of vinyon is restricted in the range 10,000 to 28,000 amu. Explain why?
 - (iv) What are the uses of vinyon? [9 marks]

QUESTION THREE

- (a) Kevlar is a polyamide fiber prepared by reacting terephthalic acid with p-phenylenediamine.

- (i) Draw the structure of a segment of the fiber Kevlar.
- (ii) Kevlar fiber finds use in specialty clothing. Give an example of this type of clothing.

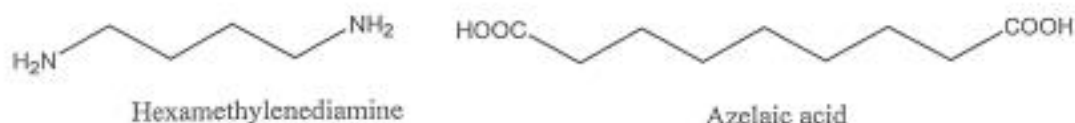
[2 marks]

(b) Nomex is a polyamide made from metaphthalic acid and m-diaminobenzene.

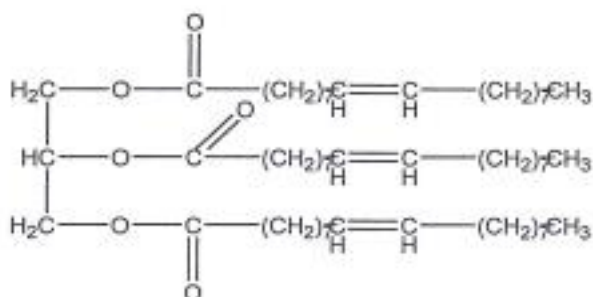
- (i) Draw the structure of a segment of nomex
- (ii) Give one common use of nomex fabric.

[2 marks]

© Nylon 6,9 is prepared from hexamethylene diamine and azelaic acid (see structures shown below)



- (i) Using equations, show how hexamethylenediamine can be prepared from benzene [5 marks]
- (ii) Azelaic acid is obtained from oleic acid which occurs in triglyceride ester form as shown below:



Give the structure of oleic acid and then show how oleic acid is converted to azelaic acid [3 marks]

(iii) Give two general uses of nylon fibers.

[2 marks]

QUESTION FOUR

(a) Wool is obtained mainly from sheep while silk is secreted by silkworm as two filaments encased in a proteinaceous gum.

(i) What are the two filaments encased in a gum secreted by silkworms [2 marks]

(ii) Give a possible structure of a segment of silk having the amino acids arranged in the order glycine-alanine-tyrosine-serine [2 marks]

(iii) Wool contains a much higher proportion of cysteine, while silk has none. What is the

effect of high proportion of cysteine on the structure of wool? [1 mark]

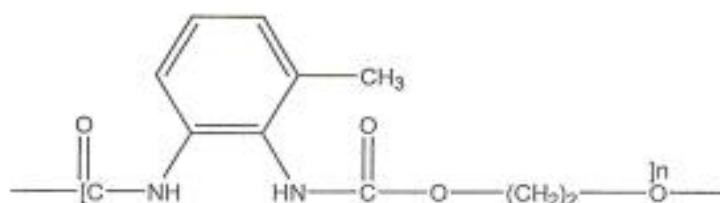
- (b) Vinylon fiber is a polyvinyl alcohol which has been treated with formaldehyde to give water resistance. The monomer used in the manufacture of polyvinyl alcohol is vinyl acetate.
- (i) Starting from acetylene, show how vinyl acetate can be prepared [1 mark]
- (ii) Polymerization of vinyl acetate initially gives polyvinylacetate (PVA). Give an equation for this reaction. [1 mark]
- (iii) Alcoholysis of polyvinylacetate gives rise to polyvinylalcohol. Give an equation for this reaction. Use methanol as the alcohol. [2 marks]
- (iv) The product formed in 4b (iii) above can undergoes cross-linking using a multifunctional compound that reacts with hydroxyl groups. One such compound is glyoxal which reacts with polyvinylalcohol to give a water resistant and increased viscosity polymer product. Give the structure of the product formed in the above reaction. [2 marks]

agent used to reduce brightness.

[2 marks]

QUESTION SIX

- (a) Polyester fibers are produced by reacting ethylene glycol and terephthalic acid. The polymer is used to make textile fibers Dacron and fortrel. Write a general equation for this reaction. [1 mark]
- (b) Spandex is a synthetic fiber known for its exceptional elasticity. It has the structure shown below:



Identify the monomers of this fiber. [2 marks]

© Interchain hydrogen bonding in nylon 6,6 enhances crystallinity. Using structures of nylon 6,6, shown how this takes place. [2 marks]

(d) Mention any two major spandex fiber uses

[2 marks]

(e) Azlon is a group of synthetic fibers derived from plant and animal proteins. Mention two natural sources of raw materials used for synthesizing azlon.

[2 marks]

(f) Explain why its not easy to dye polypropylene fiber.

[4 marks]

(g) Polypropylene is highly crystalline and geometrically regular. Explain this statement using a structure of polypropylene.

[1 mark]