

- (d) As the slime passes gently through the hole of the funnel, some crosslinks are broken and reformed, leaving the polymer with a new shape.
- (e) The presence of an acid hydrolyzes the crosslinks, causing the slime to turn into a liquid.

## Synthesis

(g)

Thickener	Source	Molecular structure	Reasons for similar properties
Cornstarch	germ of corn kernels	polysaccharides: amylose and amylopectin	These polymers react with water, usually when heated, to form hydrated crosslinked molecules throughout the solution, resulting in a thickening of the solution.
Carrageenan	varieties of red seaweed	long-chain carbohydrate polymer (polysaccharide) made up of repeating sugar units	
Gelatin	beef bones and skin, treated with bases	protein polymer made up of amino acids	

## PART 2: MAKING GLYPTAL—A POLYESTER

### Observations

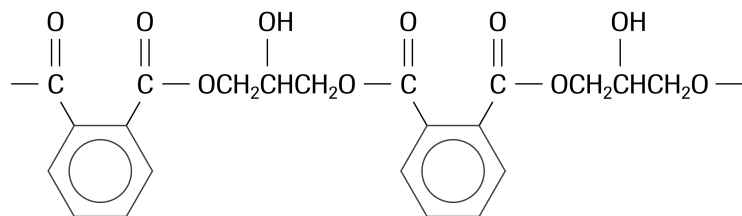
- (h) Glyptal is a hard clear plastic. It gets marred in contact with organic solvents such as acetone because it is soluble in acetone.

### Analysis

- (i) Sample properties: hard, clear, strong solid; insoluble in water but soluble in acetone (paint thinner or nail polish remover).

### Synthesis

- (j) It hardens quickly to form a protective coating that is insoluble in water. It is miscible with organic solvents that may be present in paints.
- (k) This polymer could also be used in varnishes and as a substitute for glass (e.g., plastic containers, drinking glasses).
- (l) The hydroxyl group on the middle carbon of glycerol provides opportunity to form ester bonds with orthophthalic acid, forming strong crosslinks. A hard plastic is therefore formed, which does not soften when heated. The hydrocarbon portions of the plastic molecule provide nonpolar groups, making the plastic insoluble in water, but soluble in an organic solvent such as acetone.



glyptal

## 3.21 CASE STUDY: CONTACT LENSES

### SECTION 3.21 QUESTIONS

(Page 248)

#### Understanding Concepts

- When a polymer is deformed, its polymer chains are forced out of alignment. Crosslinking pulls the polymer chains back together, returning the lens to its original shape.

## Making Connections

2. [Sample answer] This statement is valid. Properties of polymers can be changed by altering the type of functional groups and substituted groups on the monomers, and by altering the type of interchain linkages. There are numerous organic compounds that can act as monomers because carbon atoms can form four bonds and long carbon chains.
3. (a) Hard lenses: Plastic lenses (PMMA) replaced glass lenses for comfort, but did not allow sufficient oxygen to reach the eye. Soft lenses: PolyHEMA replaced hard contact lenses. Soft lenses are more comfortable and have improved oxygen permeability, but they are not long-lasting because they are easily deformed. Rigid gas-permeable lenses are made of a new polymer that is gas permeable and retains its shape; however, there is an increased risk of protein and lipid deposits on the lens.  
(b) New polymers were developed for rigid gas-permeable lenses, and research is ongoing to develop new organic compounds with desired properties for use in improving vision and eye care.
4. [Sample answers] Desirable features include lenses that are gas permeable, rigid, and easy to maintain, that can be worn for long periods of time. Future developments depend on the design and testing of polymers with different functional groups and substituted groups, and varying degrees of crosslinking.
5. (a) [Sample answers] Some crosslinking gives the lens elasticity and comfort for the wearer; however, elasticity is at the expense of the lens retaining its shape for correcting vision. High water content in the lens is needed to provide oxygen to the eye; however, increased water content decreases the refractive index of the lens and lowers the corrective effect.  
(b) [Sample answer] Some polymer molecules such as transparent plastics; some degree of crosslinking to provide rigidity as well as flexibility, and to keep shape with body temperature; selected functional groups that allow interaction with water but do not dissolve.

## Extension

6. [Sample answer]  
Drug delivery systems, e.g., nicotine patches, estrogen patches.  
Problem to be solved: Patients quitting smoking need a bridging program to relieve withdrawal from nicotine; patients requiring estrogen to relieve symptoms of menopause.  
Existing solution: nicotine gum, estrogen capsules.  
Problems: patients may forget to take medication. As well, a low but continuous dosage is most effective.  
Improved solution: Polymers may be used to provide an adhesive patch on the skin, allowing the nicotine or estrogen to be absorbed through the skin on a continuous basis.