**Structure and Properties of Polymers**

New Regents original practice • Name: _____ Date: _____
Show your work for written answers.

A polymer consists of long chains made of repeating units. Cross-links are bonds that connect separate chains.

**1** What makes a small starting molecule a monomer in polymer production?

(1) It forms a repeating part of a polymer chain.

(2) It must be a single atom.

(3) It dissolves all polymers.

(4) It stops a chain from forming.

**2** Explain why adding cross-links can make otherwise similar polymer chains less able to slide past one another. [1]

Answer and work

**3** In otherwise similar polyethylene samples, extensive branching prevents chains from packing tightly. Which feature directly changes?

(1) The number of protons in each carbon atom

(2) The average spacing between neighboring chains

(3) The sign of the charge on every carbon atom

(4) The number of valence electrons in a neutral hydrogen atom

**4** Explain why identifying the repeating unit alone may be insufficient to predict a polymer sample’s stiffness. [1]

Answer and work

**Reusable Straps**

Use the information below to answer the questions.

A team tests three straps of equal width, thickness, and original length. Each has the same polymer backbone. The team records extension under the same load. All three return to their original length after this test.

| Strap | Relative cross-link density | Extension (mm) |
|---|---|---|
| A | Low | 18 |
| B | Medium | 11 |
| C | High | 5 |

**5** Which strap is stiffest under the load used?

(1) A

(2) B

(3) C

(4) The straps have equal stiffness.

**6** A strap must extend at least 10 mm but no more than 15 mm under the tested load. Select a strap and use the measurements to justify your choice. [1]

Answer and work

**7** Describe the pattern in the measurements and connect it to how cross-links affect chain motion. [1]

Answer and work

**8** Which additional measurement would allow the team to compare the loads the straps can withstand before breaking?

(1) Initial strap length

(2) Load at break for each strap

(3) Extension under the original load only

(4) Color after unloading