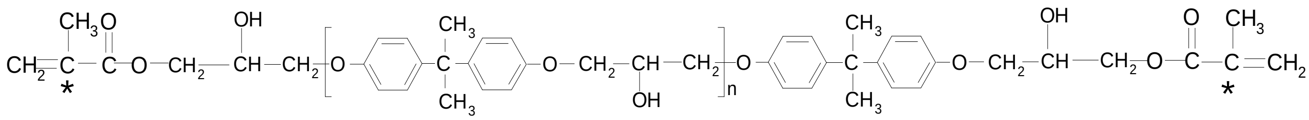
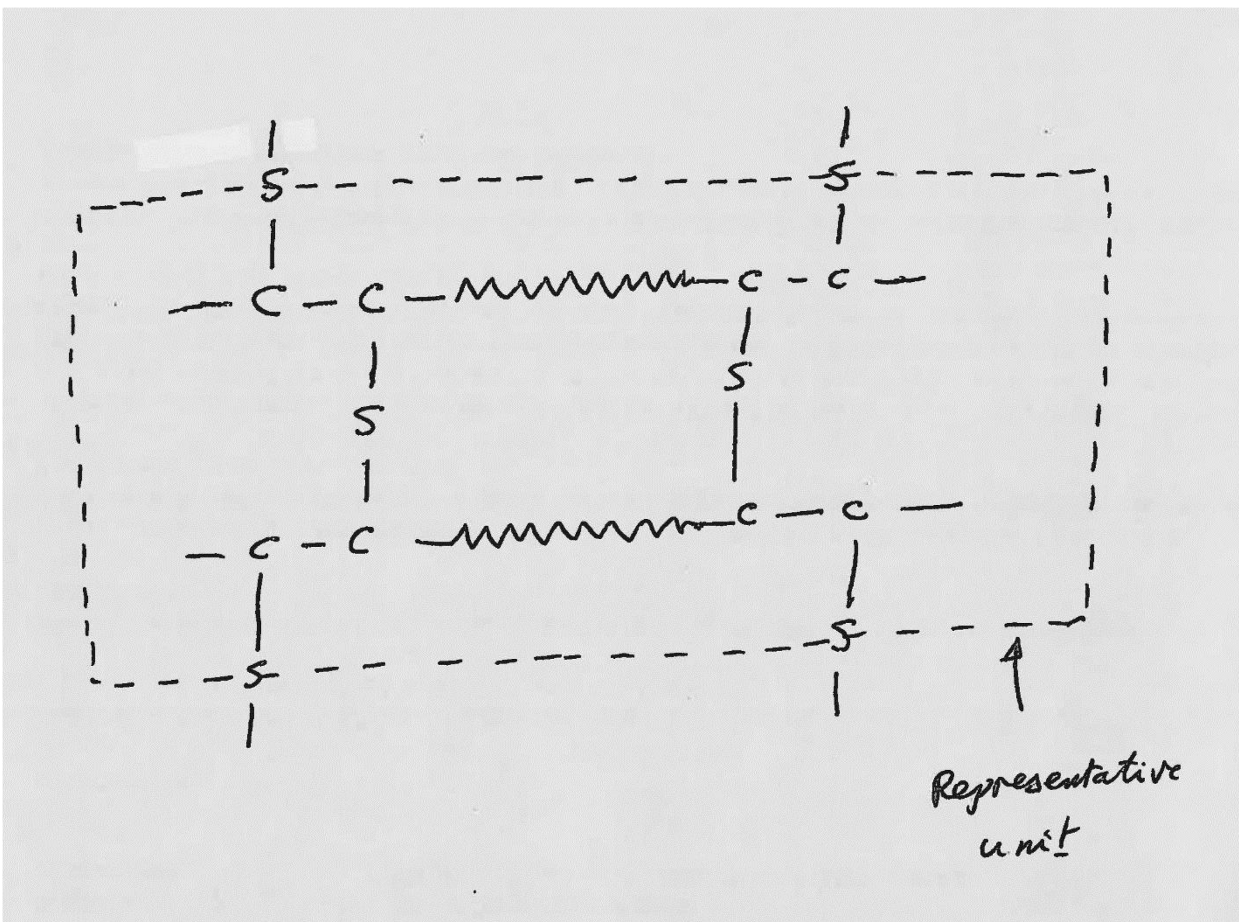
Solution for Homework # 4

Question 1:



BISPHENOL A EPOXY BASED (METHACRYLATE) VINYL ESTER RESIN (*n* = *0-3*)

One way to do the problem would be to identify a representative unit for the cross linking reaction (area within the dotted line in the figure below). The representative unit would consist of two molecules of vinyl ester (these are identified as the top and the bottom molecules). In between these two molecules, there are 2 styrene molecules (1 for each reactive end). In addition, there are two halves styrene molecules above the top vinyl ester molecule and there are two halves styrene molecules below the bottom vinyl ester molecule.



The corresponding number of molecules would be: 2 vinyl ester molecules corresponding to 4 styrene molecules (2 in between, two halves on top and 2 halves at bottom). As such, one vinyl ester molecule corresponds to 2 styrene molecule.

Mass of vinyl ester molecule (n = 1): 47 C + 10 O + 56 H = 780 g/mole.

Mass of the styrene molecule: 8C + 8 H = 104 g/mole.

For 100 g of vinyl ester, the mass of styrene would be: (100g)(208/780) = 26.7 g.

Question 2:

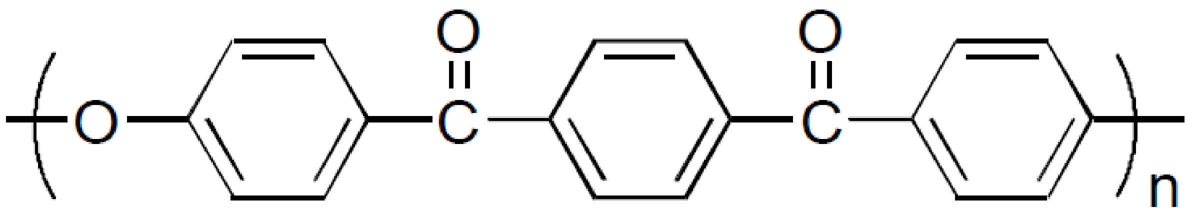


Figure 1: PEKK

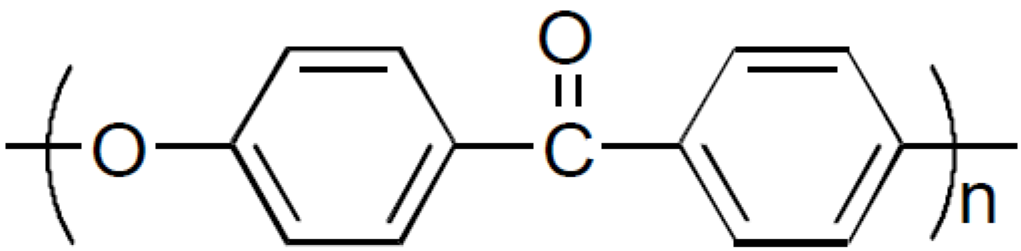


Figure 2: PEK

Question 3:

1. Largest maximum load: 50 N
2. Smallest maximum load can be denoted as x.

With this, start from 0 load and increase the load slowly. When the first fiber fails, the load in the first fiber would be x/5. Then there are 4 fibers left. If fiber 2 fails immediately after fiber 1, then the load for fiber 2 would be x/4. Then there are 3 fibers left. If fiber 3 fails immediately after fiber 2, then the load for fiber 3 would be x/3. Then there are 2 fibers left. If fiber 4 fails immediately after fiber 3, then the load for fiber 4 would be x/4. There is one fiber left. If this fiber also fails immediately after fiber 4, then the load in this fiber would be x.

The sum of all loads in all 5 fibers would be: x/5 + x/4 + x/3 + x/2 + x = 50 N

This gives x = 21.92 N.

The load distribution for smallest maximum load would be:

4.38 N , 5.48 N, 7.31 N, 10.96 N, 21.92 N.

The extracted conclusion is: For a dry bundle of fibers, the weakest fiber may dictate the strength of the whole bundle of fibers, depending on the strength distribution among the fibers.

If there is resin bonding the fibers together, there is shear transfer between the fibers. This can allow the stronger fiber to assist the weaker fibers. As such, the strength of the whole bundle of fibers (and resin) would not be dictated by the strength of the weakest fiber, and the whole composite would be stronger than the dry bundle of fibers.