

Solution corrections:

16-10 Analysis of a sample of polyacrylonitrile (PAN) (see Table 16-3) shows that there are six lengths of chains, with the following number of chains of each length. Determine (a) the weight average molecular weight and degree of polymerization and (b) the number average molecular weight and degree of polymerization.

	Number of chains	Mean Mol. Weight of chains (g/mol) M_i	number fraction x_i	number average molecular weight $x_i M_i$	weight	weight fraction f_i	weight average molecular weight $f_i M_i$
	10,000	3,000	0.137	411	3.00E+07	0.044	133
	18,000	6,000	0.247	1479	1.08E+08	0.159	956
	17,000	9,000	0.233	2096	1.53E+08	0.226	2031
	15,000	12,000	0.205	2466	1.80E+08	0.265	3186
	9,000	15,000	0.123	1849	1.35E+08	0.199	2987
	4,000	18,000	0.055	986	7.20E+07	0.106	1912
Totals	73,000	63,000 g/mol	1.000	9285 g/mol	6.78E+08 g	1.000	11204 g/mol

$$X_i = \# \text{ of chains} / \text{total} \# \text{ of chains} = 10,000 / 73,000 = 0.137$$

$$X_i M_i = 0.137 \times 3000 = 411$$

$$\text{Weight} = (\# \text{ chains}) (\text{Mean } M_i \text{ per chain}) = 10,000 \times 3,000 = 3.00 \text{ E}+07$$

$$F_i = \text{weight} / \text{total weight} = 3.00\text{E}+07 / 6.78\text{E}+08 = 0.044$$

$$F_i M_i = (0.044) (3000) = 133$$

$$\text{Average } M_w = \text{sum of } f_i M_i = 11204$$

$$DP_w = (11204 \text{ g/mol}) / (53 \text{ g/mol}) = 211$$

$$\text{Average } M_n = \text{sum of } x_i M_i = 9285$$

$$DP_n = (9285 \text{ g/mol}) / (53 \text{ g/mol}) = 175$$

The molecular weight of the acrylonitrile monomer is

$$MW = 3C + 1N + 3H = 53 \text{ g/mol}$$

(a) The weight average molecular weight and degree of polymerization are:

$$MW_w = 11204 \text{ g/mol} \quad DP_w = 11204 / 53 = 211$$

(b) The number average molecular weight and degree of polymerization are:

$$MW_n = 9285 \text{ g/mol} \quad DP_n = 9285 / 53 = 175$$