Name_____

1. In a free radical polymerization, 1 mol of acrylic acid monomer $CH_2=C(H)(COOH)$ is placed in a reactor with 0.001 mol of hydrogen peroxide. In this problem, ignore volume shrinkage during polymerization, and assume no chain transfer (no loss of radicals to anything except another monomer once a chain reaction has begun).
a. How much monomer remains at 75 % conversion?
b. If the initiator efficiency is 0.37, what is the average chain length in the reactor, including the remaining monomer? $(\bar{x}_n)$
c. After the monomer is removed (by evaporation under vacuum), what is the average chain length of PAA?
d. What is the number-average molecular weight of the PAA in part c?
(2 point)

a)
$$1 \text{ mol} \times (1-75\%) = 0.25 \text{ mol monomer left}$$

b) $f = 0.37$. no chain transfer. $H_2O_2 \longrightarrow 2OH\cdot$ $(I \rightarrow 2R\cdot)$

$$\Rightarrow 0.001 \times 0.37 \times 2 = 7.4 \times 10^{-4} \text{ mol polymer chain}$$

$$\bar{X}_{n_{polymer}} = 0.75 \text{ mol monomer} / 7.4 \times 10^{-4} \text{ mol polymer chain}$$

$$= 1013.5 \text{ repeat units} / \text{polymer chain.}$$

$$\bar{X}_{n_{total}} = (0.25 \times 1 + 7.4 \times 10^{-4} \times 1013.5) / (0.25 + 7.4 \times 10^{-4})$$

$$= 3.99$$

c) $\bar{X}_{n_{polymer}} = 1013.5$

d) $M_{repeat\ unit} = 72$

$$\bar{M}_n = M_r \times \bar{X}_{n_{polymer}} = 72 \times 1013.5 = 72972 \text{ g/mol.}$$