

37. The net charge carried by John whose mass is  $m$  is roughly

$$\begin{aligned} q &= (0.0001) \frac{m N_A Z e}{M} \\ &= (0.0001) \frac{(90 \text{ kg})(6.02 \times 10^{23} \text{ molecules/mol})(18 \text{ electron proton pairs/molecule}) (1.6 \times 10^{-19} \text{ C})}{0.018 \text{ kg/mol}} \\ &= 8.7 \times 10^5 \text{ C} , \end{aligned}$$

and the net charge carried by Mary is half of that. So the electrostatic force between them is estimated to be

$$F \approx k \frac{q(q/2)}{d^2} = \left( 8.99 \times 10^9 \frac{\text{N} \cdot \text{m}^2}{\text{C}^2} \right) \frac{(8.7 \times 10^5 \text{ C})^2}{2(30 \text{ m})^2} \approx 4 \times 10^{18} \text{ N} .$$