

$$(a) \quad p(\text{word} = \text{groot}) = \frac{1}{3} \cdot \frac{13}{12+12+1+1+13} + \frac{1}{3} \cdot \frac{17}{17+17+17} + \frac{1}{3} \cdot \frac{15}{14+14+2+2+15} \\ = \underline{\underline{0.3286}}$$

$$(b) \quad p(\text{word} = \text{we}) = \frac{1}{3} \cdot \frac{1}{12+12+1+1+13} + \frac{1}{3} \cdot \frac{0}{17+17+17} + \frac{1}{3} \cdot \frac{2}{14+14+2+2+15} \\ = 0.0227$$

$$p(\text{Document} = 1 \mid \text{word} = \text{we}) = \frac{p(\text{word} = \text{we} \mid \text{doc} = 1)}{p(\text{word} = \text{we})} \\ = \frac{\frac{1}{3} \cdot \frac{1}{12+12+1+1+13}}{0.0227} = \frac{0.0085}{0.0227} = \underline{\underline{0.3744}}$$

$$(c) \quad p(\text{word} = \text{am or are}) = \frac{1}{3} \cdot \frac{12+1}{12+12+1+1+13} + \frac{1}{3} \cdot \frac{17}{17+17+17} + \frac{1}{3} \cdot \frac{14+2}{14+14+2+2+15} \\ = 0.3357$$

$$p(\text{doc} = 2 \mid \text{word} = \text{am or are}) = \frac{1}{3} \cdot \frac{17}{17 \times 3} = 0.1111$$

$$\therefore p = \frac{0.1111}{0.3357} = \underline{\underline{0.3309}}$$

$$(d) \quad p(\text{word} = \text{groot}) = \frac{1}{6} \cdot \frac{13}{12+12+1+1+13} + \frac{1}{3} \cdot \frac{17}{17+17+17} + \frac{1}{2} \cdot \frac{15}{14+14+2+2+15} \\ = \underline{\underline{0.3262}}$$

$$(e) \quad p(\text{word} = \text{we}) = \frac{1}{6} \cdot \frac{1}{12+12+1+1+13} + \frac{1}{3} \cdot \frac{0}{17+17+17} + \frac{1}{2} \cdot \frac{2}{14+14+2+2+15} \\ = 0.026$$

$$p(\text{Document} = 1 \mid \text{word} = \text{we}) = \frac{p(\text{word} = \text{we} \mid \text{doc} = 1)}{p(\text{word} = \text{we})} \\ = \frac{\frac{1}{6} \cdot \frac{1}{12+12+1+1+13}}{0.026} = \frac{0.0043}{0.026} = \underline{\underline{0.1654}}$$

$$f) \quad p(\text{word} = \text{am or are}) = \frac{1}{6} \cdot \frac{12+1}{12+12+1+1+13} + \frac{1}{3} \cdot \frac{17}{17+17+17} + \frac{1}{2} \cdot \frac{14+2}{14+14+2+2+15}$$

$$= 0.3369$$

$$p(\text{doc} = 2 \mid \text{word} = \text{am or are}) = \frac{1}{3} \cdot \frac{17}{17 \times 3} = 0.1111$$

$$\therefore p = \frac{0.1111}{0.3369} = \underline{\underline{0.3298}}$$