Q1i: We claim the element x^2y is in $I \cap J$ but not in IJ. Note that it belongs to both the ideal I and J, since we can take $y \cdot x^2$, or $x \cdot xy$ respectively. However, every element of IJ can be written as

$$\sum_i a_i \cdot x^3 y$$

for some $a_i \in \mathcal{R}$. In this polynomial, x must have a degree of at least 3. Thus $x^2 y \notin IJ$.

Q1ii: Consider the ideals $I = (2), J = (4)$. It is clear that $I \cap J = J$, since every multiple of 4 is also a multiple of 2. However, we have that IJ is all elements of the form

$$\sum_i a_i(2 \cdot 4) = 8 \cdot \sum_i a_i,$$

for $a_i \in \mathbb{Z}$. Thus we have that $IJ = (8)$.