By Sauer's lemma, for each $i = 1, \dots, k$,

$$S_{A_i}(n) \le (n+1)^V.$$

As seen in class, $S_{\bigcup_{i=1}^k A_i}(n) \le \sum_{i=1}^k S_{A_i}(n) \le k(n+1)^V$

If we find an integer $n$ such that $k(n+1)^V < 2^n$, then $n$ is an upper bound for the VC-dimension of $\bigcup_{i=1}^k A_i$. But $k(n+1)^V < 2^n \iff n > \log_2 k + V \log_2(n+1)$

$$\Updownarrow$$

$$n+1 > \log_2(2k) + V\log_2(n+1)$$

which, by the hint, is implied by

$$n+1 > 4V\log_2(2V) + 2\log_2(2k)$$

Thus, the VC-dim is at most $4V\log_2(2V) + \underbrace{2\log_2(2k)}_{< 4k} - 1$

The second part is similar, using the fact that the shatter coefficient is bounded by

$$(n+1)^{kV}$$