Q2 The majority logic decoding algorithm is as follows —

1 FOR $l = r$ to 0 do
2 FOR each $A \subset \{1, \dots, m\}$, $|A| = l$ do :
3 FOR each $b \in \mathbb{F}_2^{m-l}$
4 $m_A(b) = \sum_{\substack{x_A = h \\ x_{\{1\dots m\}\setminus A} = b}} y$
5 cnt $[m_A(b)]$ += 1.
6 m_A = argmax cnt
7 let $M_r = \sum_{\substack{A \subset \{1\dots m\} \\ |A| = l}} m_A x_A$
8 For $c \in \mathbb{F}_2^m$ do
9 y_c -= $M_r|_c$

10 Output $\sum M_A x_A$

The outer loops in lines 1, 2 run $\sum_{l=0}^{r} \binom{m}{l} = k$ times.
The loop in like 3 runs 2^{m-l} times.
The summation in line 4 takes 2^l operations.

Thus these require $O(2^m)$ operations.

Line 7 requires $\binom{m}{l}$ operations.
∴ total of $\sum_{l=0} \binom{m}{l} = k$ operations.

Line 8 iterates $O(2^m)$ times. Evaluating M_r at each position requires $\binom{m}{l}$ operations.

$$\Rightarrow \sum_{l=0}^{r} 2^m \cdot \binom{m}{l} = k \cdot 2^m \text{ in total.}$$

Thus total time $= O(k \cdot 2^m) + O(k) + O(k \cdot 2^m)$

$$= O(k \cdot 2^m).$$