1. $\frac{n}{2}$ queries, each round query two new elements with two elements that are known to be the same.
2. solution sketch: consider the worst case (needs proof) where there are $\frac{n}{2}$ 0's and $\frac{n}{2}$ 1's. Randomly partition the elements into $\frac{n}{4}$ disjoint groups. In expectation, there are $\frac{6}{16} \cdot \frac{n}{4}$ $(2,2)$ groups (and w.h.p. plus $o(n)$ using Chernoff bound), $\frac{8}{16} \cdot \frac{n}{4}$ $(1,3)$ groups, and $\frac{2}{16} \cdot \frac{n}{4}$ $(0,4)$ groups. We can shrink each $(0,4)$ group to a single element, and we can ignore the $(2,2)$ groups because they cancel out. For each $(1,3)$ group, randomly pick two elements from it and query together with two elements that are known to be the same. If the two picked elements are different, then the remaining two elements are the same, and can be shrinked to a single element. Otherwise we know all four elements in this $(1,3)$ group. The running time recurrence is $T(n) = T(\frac{2}{16} \cdot \frac{n}{4}) + \frac{8}{16} \cdot \frac{n}{4} + T(\frac{8}{16} \cdot \frac{n}{4} \cdot \frac{1}{2}) + \frac{n}{4}$, which gives $T(n) = \frac{12}{29}n$.

Remark. lower bound?

References