

# PRACTICE PROBLEMS 1

## ANSWERS

**Problem 1.** AB, ABC, DE, DEF. ABCDEF would be called a clade if it were part of a larger tree with at least one more gene/species/taxon as an outgroup, but I don't think the term would normally be applied to a whole tree. AC isn't a clade because it isn't an *inclusive* group of individuals with a common ancestor; their most recent common ancestor is shared with B.

**Problem 2.** B

**Problem 3.** (a)  $5 \times 10^{-3}$  (I didn't correct for multiple hits, because the correction would be insignificant.) (b)  $T = d/2E = (5 \times 10^3)/(2 \times 5 \times 10^{-9}) = 5 \times 10^5$  years (c)  $5 \times 10^5$  years

**Problem 4.** Note that *B. permians* and *B. marismortui* have diverged very little. But if *B. permians* lay dormant 250 My while *B. marismortui* continued to reproduce, they should be very different. More specifically, *B. permians* should be an extremely short branch arising deep inside the tree because it ceased to evolve while all the other bacilli continued to evolve. These data argue against the hypothesis that *B. permians* is ancient.

