

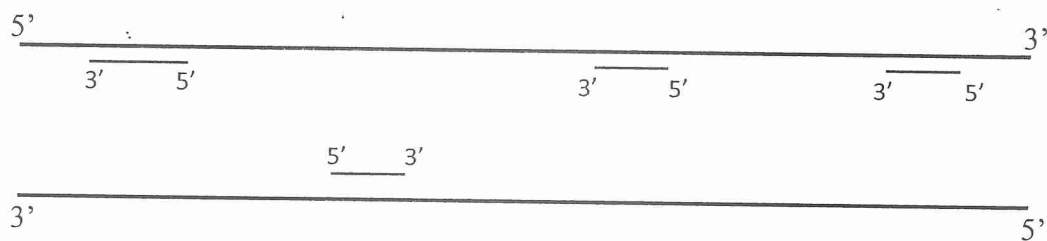
Equations and constants that you may need are provided on Page 2.

1. Please define or explain the followings:

- a. Anammox (4 points)
- b. Bacteriostatic effects (4 points)
- c. Horizontal gene transfer (4 points)
- d. Biomineralization (4 points)
- e. Point of zero charge (4 points)
- f. The octanol-water partition coefficient (K_{ow}) (4 points)
- g. The critical micelle concentration (4 points)
- h. Indirect photolysis (4 points)

2. Molecular biology techniques have been regularly employed in the studies of environmental microbiology and proved to be powerful tools in probing the mechanisms that may underlie microbially mediated processes.

- a. How would you identify a specific bacterium from a soil sample without prior cultivation using molecular techniques? (4 points)
- b. If you would like to use PCR to assess microbial activity, what type of PCR would you use and why? (4 points)
- c. At the beginning of PCR there are two template DNA strands (T). As amplification proceeds, short strands (S) and long strands (L) are generated. After 5 cycles of PCR, how many total strands each of T, S, and L are there? Show your calculations. (8 points)
- d. The schematic below shows the position and orientation of four primers used in nested PCR. How many amplification products will be obtained? Explain your answer. (4 points)



3. Why do we look at fecal indicator bacteria (i.e., total coliform, *E. coli*, and *Enterococcus*) rather than specific pathogens in routine water quality monitoring? (4 points)
4. Pure water has been brought into contact with excess $\text{CaCO}_{3(s)}$ (it will still be present at equilibrium). While $\text{CaCO}_{3(s)}$ dissolution takes place, the pH is fixed at 8.0 through the addition of either a strong acid (HCl) or a strong base (NaOH). The system is closed to the atmosphere.
 - a. Calculate $[\text{Ca}^{2+}]$ and $[\text{C}_T]$ (which is the sum of $\text{H}_2\text{CO}_{3(aq)}$, HCO_3^- and CO_3^{2-}) when saturation with respect to $\text{CaCO}_{3(s)}$ is attained? (15 points)
 - b. To keep the pH fixed at 8.0, was it necessary to add HCl or NaOH? How much? (5 points)

參考用

注意：背面有試題

