Biological Chemistry I

I　Answer the following questions.

（1）Serine proteases have a catalytic site consisting of three amino acid residues, called as the catalytic triad. Draw structural formulas for the typical three amino acids.

（2）Classify sidechains of lysine, valine, isoleucine, and tryptophan as hydrophobic or hydrophilic.

（3）Draw a structural formula for the alanine-arginine-proline-tyrosine peptide. In addition, indicate the main-chain dihedral angles, ϕ and ψ, in the structural formula.

（4）Explain the anti-parallel β-sheet structure.

（5）Answer four non-covalent interactions that contribute to the stabilization of protein tertiary structures.

II Answer the following questions.

II—a
Denaturation experiment for a monomeric protein X was performed. The Gibbs free energy change for the denaturation at equilibrium was 24.9 kJ mol^{-1} at 300 K. The denaturation of protein X follows a two-state transition mechanism between the native and the denatured state. What is the equilibrium constant for the reaction at 300 K?
If necessary, use the gas constant (8.3 J K^{-1} mol^{-1}) and $e^{-5} \doteqdot 6.7 \times 10^{-3}$.

II—b
Four different globular proteins (A, B, C, D) and their molecular weights per monomer, isoelectric points and oligomeric states are shown below. The oligomeric states of these proteins do not change during experiment.

Protein	Molecular weight per monomer	Isoelectric point	Oligomeric state
A	50,000	6	monomer
B	20,000	4	dimer
C	70,000	9	monomer
D	40,000	8	trimer

（1） Each of the four protein was subjected to the anion-exchange chromatography at pH 7.0. Answer all the proteins adsorbed to the column and explain the reason.

（2） A solution containing the four proteins was subjected to the size-exclusion chromatography. Answer the order of these proteins eluted from the column and explain the reason.

（3） A solution containing protein C showed an absorbance of 0.32 at 280 nm in a 1 cm optical path length cuvette. The molar extinction coefficient of protein C is 56,000 M^{-1} cm^{-1}. Answer the concentration of protein C in mg mL^{-1}.