國立臺北科技大學

九十二學年度生物科技研究所入學考試

生物化學試題

填准考證號碼

注意事項：

1. 本試題共【10】題，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在答案卷之答案欄內，否則不予計分。

Problem #1 (10 points)

You wish to measure the ΔG^{o} for the hydrolysis of ATP,

$$ATP + H_2O \rightarrow ADP + P_i + H^+$$

But the equilibrium for the hydrolysis lies so far toward products that analysis of the ATP concentration at equilibrium is neither practical nor accurate. However, you have the following data that will allow calculation of the value indirectly.

Creatine phosphate + ADP + H^+ → ATP + creatine $\quad K_{eq} = 59.5 \quad$ **(P1)**

Creatine + P_i → creatine phosphate + H_2O $\quad \Delta G^{o} = +10.5$ kcal/mol

Assume that 2.3 RT = 1.36 kcal/mol.

(a) Calculate the value of ΔG^{o} for reaction **(P1)**.

(b) Calculate the ΔG^{o} for the hydrolysis of ATP.

Problem #2 (10 points)

(a) A 10 mM solution of a weak monocarboxylic acid has a pH of 3.00. Calculate the values for K_a and pK_a for this carboxylic acid.

(b) You add 0.06 g NaOH (M_r = 40) to 1,000 ml of the acid solution in part (a). Calculate the final pH, assuming no volume change.

Problem #3 (8 points)

Outline the hierarchy of protein structural organization.

Problem #4 (10 points)

Molecular weight analysis of a protein yields the following information:

Solvent	M_r
Dilute buffer	200,000
6 M Guanidinium chloride (GuHCl)	100,000
6M GuHCl + 100 mM 2-mercaptoethanol	75,000 and 25,000

(Guanidinium chloride is a chaotropic (denaturing) reagent and 2-mercaptoethanol can reduce disulfide bonds.)

What can you deduce about the protein's quaternary structure?

Problem #5 (10 points)

(a) Although used effectively in the 6-phosphogluconate dehydrogenase isolation procedure, heat treatment cannot be used in the isolation of all enzymes. Explain.

(b) Assume that the isoelectric point (pI) of the 6-phosphogluconate dehydrogenase is 6. Explain why the buffer used in the DEAE cellulose chromatography must have a pH greater than 6 but less than 9 in order for the enzyme to bind to the DEAE resin.

Problem #6 (10 points)

Compare the Haworth projections of D-glucose, D-mannose, and D-galactose. Indicate the differences between the structures.

Problem #7 (10 points)

A tetrasaccharide has the following composition: D-Man (2), D-Gal (1), D-Glc (1). The tetrasaccharide gave a positive reducing sugar test in which the glucose residue was oxidized. Exhaustive methylation and mild acid hydrolysis released 2,3,4,6-tetra-*O*-methylmannose, 2,3-di-*O*-methylgalactose, and 2,3,6-tri-*O*-methylglucose. Treatment of the tetrasaccharide with an α-mannosidase released mannose and a trisaccharide that tielded the following methylation products: 2,3,4,6-tetra-*O*-methylmannose, 2,3,6-tri-*O*-methylgalactose, and 2,3,6-tri-*O*-methylglucose. Please deduce the sequence and specificity of anomeric linkages and indicate any ambiguity.

Problem #8 (10 points)

If the K_M for an enzyme is $1.0 * 10^{-5}$ M and the K_I of a competitive inhibitor of the enzyme is $1.0 * 10^{-6}$ M, what concentration of inhibitor is necessary to lower the reaction rate by a factor of 10 when the substrate concentration is $1.0 * 10^{-3}$ M?

Problem #9 (10 points)

(a) Draw the chemical reaction mechanism for the formation of a phosphodiester linkage during DNA synthesis.
(b) Discuss the significance of the pyrophosphate product that is formed.
(c) What is the significance of the Mg^{2+} requirement?

Problem #10 (12 points)

(a) Draw the chemical reaction mechanism for the formation of a peptide bond during protein synthesis.
(b) Please write down the full name, the three-letter abbreviate, and the one-letter abbreviate for each of the 20 amino acids.