

2011年2月17日実施

2011年度立命館大学大学院理工学研究科
博士課程後期課程
入学試験問題（外国語科目）

応用化学型

【注意事項】

1. 解答は問題番号1、2、・・・ごとに解答用紙1枚を使用すること。
2. 解答用紙には専攻名、課程、受験番号、氏名、問題番号を解答用紙すべてに記入すること。
3. 無記名答案は無効、問題用紙および解答用紙は持ち帰らないこと。
4. 解答用紙はホッチキス止めしてあるので、はずさないこと。
5. 問題用紙が事前に届けでている型の問題であるか確認し、解答すること。
6. 外国語科目試験時間
10:00～11:30（90分）
試験時間中の途中退室は認めない。

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以下の問題 1～4 から、2つの問題を選択して解答すること。

I. 次の英文を全文和訳せよ。

Biotechnology is an area of applied bioscience and technology which involves the practical application of biological organisms, or their subcellular components to manufacturing and service industries and to environmental management. Biotechnology utilizes bacteria, yeasts, fungi, algae, plant cells or cultured mammalian cells as constituents of industrial processes. Successful application of biotechnology will result only from the integration of a multiplicity of scientific disciplines and technologies, including microbiology, biochemistry, genetics, molecular biology, chemistry and chemical and process engineering.

Biotechnological processes will normally involve the production of cells or biomass, and the achievement of desired chemical transformations. The latter may be further subdivided into :

- (a) formation of a desired end product (e.g. enzymes, antibiotics, organic acids, steroids);
- (b) decomposition of a given starting material (e.g. sewage disposal, destruction of industrial wastes or oil spillages).

The reactions of biotechnological processes can be catabolic, in which complex compounds are broken down to simpler ones (glucose to ethanol), or anabolic or biosynthetic, whereby simple molecules are built up into more complex ones (antibiotic synthesis). Catabolic reactions are usually exergonic whereas anabolic reactions are normally endergonic.

Biotechnology includes fermentation processes (ranging from beers and wines to bread, cheese, antibiotics and vaccines), water and waste treatment, parts of food technology, and an increasing range of novel applications ranging from biomedical to metal recovery from low grade ores. Because of its versatility, biotechnology will exert a major impact in many industrial processes and in theory almost all organic materials could be produced by biotechnological methods.

(引用 : John E. Smith, Biotechnology Principles, American Society for Microbiology)

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2. 次の英文を全文和訳せよ。

Many important bacterial genes are not part of the main chromosome but are on separate circles of DNA called plasmids. A plasmid is a molecule which can be stably inherited without being linked to the chromosome. Plasmids are important in medicine and in agriculture because they confer antibiotic resistance on pathogens of animals and man, and because they can code for toxins and other proteins which increase the virulence of these pathogens. Other plasmid genes are more beneficial. Plasmids enable species of *Rhizobium* to fix nitrogen in the nodules of leguminous plants. They also code for antibiotics which can be used to control pathogenic bacteria. Plasmid genes code for a wide range of metabolic activities and enable bacteria to degrade compounds which would accumulate as pollutants if they were not degraded by micro-organisms. Among the many compounds degraded by plasmid-encoded enzymes are the widely used herbicide 2,4-D (2,4-diphenoxyacetic acid) and several components of mineral oils.

(引用 : K. Hardy, Bacterial Plasmids, American Society for Microbiology)

3. 次の英文を全文和訳せよ。

The electrons in the molecules cause the local magnetic fields to vary on a submolecular distance scale. The magnetic fields experienced by nuclei at two sites in the same molecule are different if the electronic environments are different. For example, protons located in the $-\text{CH}_3$ groups of ethanol molecules experience slightly different magnetic fields than protons located in the $-\text{CH}_2$ groups. This effect is called the chemical shift. It is of major importance of the chemical applications of NMR. The chemical shift is predominantly an intramolecular interaction, but it does have a significant intermolecular component as well. The mechanism of the chemical shift is a two-step process. (1) The external magnetic field B^0 induces current in the electron clouds in the molecule. (2) The circulating molecular currents in turn generate a magnetic field (called the induced field B^{induced}). The molecular spins sense the sum of the applied external field and the induced field generated by the molecular electrons:

$$B^{\text{loc}} = B^0 + B^{\text{induced}} \quad (1).$$

Typically, the induced field is only around 10^{-4} of the external field B^0 . This is small, but large enough to give rise to measurable shifts in the spin precession frequencies. The strength of the induced currents, and hence the induced field, is directly proportional to the applied field B^0 . The induced currents are due to the quantum-mechanical behavior of the electrons. Two contributions to the induced currents have been identified: (1) field-induced circulation of electrons in the ground electronic state (diamagnetic term) and (2) electron circulation through participation of excited electronic states (paramagnetic term). These terms have similar magnitudes but opposite signs.

(引用 Spin Dynamics, M. H. Levitt Eds. pp192-193 改編)

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4. 次の英文を全文和訳せよ。

The phase equilibrium between the native and denatured state $N \leftrightarrow D$ is controlled by the difference in the chemical potentials $\Delta\mu = \mu_D - \mu_N$. The ratio of concentrations of the denatured to the native form assuming a dilute solution is given by :

$$K_{DN} = c_D/c_N = \exp(-\Delta\mu/RT) \quad (1)$$

The chemical potential is the driving force that induces transport and transformations of a substance. Since the concentration of components, water, and protein is fixed, we restrict ourselves to one-component systems. The change $d\mu_i$ with temperature and pressure obeys the Gibbs-Duhem relation for each phase D and N:

$$d\mu_N = -S_N dT + V_N dP = -RT d(\ln c_N/c_0) \quad (2)$$

$$d\mu_D = -S_D dT + V_D dP = -RT d(\ln c_D/c_0)$$

where S_N , S_D and V_N , V_D are the partial molar entropy and volume of the protein in solution in the native and denatured phase, respectively. Since entropy and volume are generally positive quantities, the chemical potential always decreases with increasing temperature, while it increases with increasing pressure. The potentials of two phases, differing in entropy, will thus cross at a particular temperature where a transition to the phase with the lower potential occurs. A similar change in phase will take place with pressure when the volumes of the two phases differ. Thus the more compact phase will be stable at high pressure.

For proteins in particular, $S_D > S_N$ at higher temperature because of an excess in configurational entropy of the unfolded chain. Thus μ_D has the more pronounced temperature dependence and will fall below μ_N at T_H , the heat denaturation temperature. For myoglobin it is suggested in Figure 5.4 that the peculiar thermodynamic behavior of proteins arises from the strongly temperature-dependent entropy of the unfolded phase. The slope of $\mu_D(T)$ and thus the entropy $S_D(T)$ decreases with decreasing temperature.

(引用 Protein Folding Handbook Vol.1, pp103-108 改編)