2019 年 4 月入学　第 1 回
長浜バイオ大学大学院　バイオサイエンス研究科
博士課程前期課程　一般入学試験（筆記）

【注意事項】

1. 試験開始の合図があるまで、問題冊子には手を触れないこと。

2. 問題 1 部、解答用紙 2 枚を配付する。解答用紙下部には事前に受験番号が記入されているので、確認すること。あらためて科目名、受験番号、氏名を記入する必要はない。

3. 問題の印刷不鮮明、解答用紙の不足等に気付いた場合は、手を挙げて監督者に知らせること。

4. 大問 3 問のうち、2 問を選択して解答すること。

5. 解答の際には、必ず選択した問題の番号を記入すること。

6. 解答用紙はホッチキスどめをしているので、外さないこと。

7. 試験時間は、10:00～12:00（120 分）とする。

8. 電子辞書等の持ち込み、および試験時間中の途中退室は不可とする。

9. 入学試験終了後は、解答用紙のみ回収する。

問１．　次の文章は Essential Cell Biology に記載されているタンパク質の精製法に関する文章である。この文章を読んで、以下の問いに答えなさい。（35 点）

Whether starting with a fibroblast culture, a piece of liver, or cells that have been engineered to produce the protein of interest, the first step in any purification procedure is to break open the cells to release their contents; the resulting slurry is called a cell homogenate. This physical disruption is followed by an initial fractionation procedure to separate out the class of molecules of interest—for example, all the soluble proteins in the cell.

With this collection of proteins in hand, the job is then to isolate the desired protein. The standard approach involves purifying the protein through a series of chromatography steps, which separate the individual components of a complex mixture into different portions, or fractions. After each such step, one uses some sort of assay—for example, a test for the protein's activity—to determine which fractions contain the protein of interest. Such fractions are then subjected to additional chromatography steps until the desired protein is obtained in pure form. The most popular forms of protein chromatography separate polypeptides on the basis of their size,① their charge,② or their ability to bind to a particular chemical group. If antibodies that recognize a particular protein are available, they can be used to help extract that protein from a mixture.③

A similar approach can be used to isolate those proteins that interact physically with the protein being studied. In this case, the purified protein of interest is attached to the matrix of the chromatography column; the proteins that bind to this protein will collect in the column and can then be eluted by changing the composition of the washing solution.④

（fibroblast, 繊維芽細胞; slurry, 懸濁液; desired protein, 目的のタンパク質; matrix, 支持体; collect, たまる）

Ａ）上記の英文を和訳しなさい。（14 点）

Ｂ）下線部①と②に該当する分離様式を持つクロマトグラフィーを１つずつ挙げ、分離の原理をそれぞれ 3 行程度で説明しなさい。（7 点）

Ｃ）下線部③に関して、どのような手法か 5 行程度で説明しなさい。（7 点）

Ｄ）下線部④に関連して具体的な例を挙げ、カラムから目的タンパク質をどのように溶出させるか詳細に説明しなさい。（7 点）

問２． 次の文章は Essential Cell Biology に記載されている文章である。次の文章を読んで、以下の問いに答えなさい。（35 点）

Of course, a small number of extracellular signal molecules can change the behavior of a target cell in a large variety of ways. They can alter the cell's shape, movement, metabolism, gene expression, or some combination of these. As we will see, the signal from a cell-surface receptor is generally conveyed into the target cell interior via a set of intracellular signaling molecules, which act in sequence and ultimately alter the activity of effector proteins, which then affect the behavior of the cell. This intracellular relay system and the intracellular effector proteins on which it acts vary from one type of specialized cell to another, so that different types of cells respond to the same signal in different ways. For example, when a heart muscle cell is exposed to the neurotransmitter acetylcholine, the rate and force of its contractions decrease. When a salivary gland is exposed to the same signal, it secrets components of saliva, even though the receptors are the same on both cell types. In skeletal muscle, acetylcholine causes the cells to contract by binding to a different receptor protein. Thus, the extracellular signal molecule alone is not the message: the information conveyed by the signal depends on how the target cell receives and interprets the signal.

（convey, 運搬する、伝達する; interior, 内部; ultimately,究極的に; neurotransmitter, 神経伝達物質; contraction, 収縮; saliva, 唾液; gland, 腺; skeletal muscle, 骨格筋; interpret, 説明する、判断する、通訳する）

Ａ）上記の文章を和訳しなさい。（14 点）

Ｂ）細胞が extracellular signal molecule に反応しなかったとすると、その原因としてどのようなことが考えられるか。3 行以内で述べよ。（7 点）

Ｃ）下線部の現象を模式図で説明せよ。（7 点）

Ｄ）多細胞生物が上記のシステムを獲得することによってどのような利点が生じたか。5 行程度で述べよ。（7 点）

問３．　次の文章は Essential cell biology に記載されている遺伝情報の転写に関する文章である。この文章を読んで、以下の問いに答えなさい。（35 点）

The first step a cell takes in expressing one of its many thousands of genes is to copy the nucleotide sequence of that gene into RNA. The process is called transcription because the information, though copied into another chemical form, is still written in essentially the same language—the language of nucleotides. Like DNA, RNA is a linear polymer made of four different nucleotide subunits, linked together by phosphodiester bonds. It differs from DNA chemically in two respects: (1) the nucleotides in RNA are ribonucleotides—that is, they contain the sugar ribose (hence the name ribonucleic acid) rather than deoxyribose; (2) although, like DNA, RNA contains the bases adenine (A), guanine (G), and cytosine (C), it contains uracil (U) instead of the thymine (T) found in DNA. Because U, like T, can base-pair by hydrogen-bonding with A, the complementary base-pairing properties apply also to RNA.

Although their chemical differences are small, DNA and RNA differ quite dramatically in overall structure. Whereas DNA always occurs in cells as a double-stranded helix, RNA is single-stranded. This difference has important functional consequences. Because an RNA chain is single-stranded, it can fold up into a variety of shapes, just as a polypeptide chain folds up to form the final shape of a protein; double-stranded DNA cannot fold in this fashion. As we discuss later, the ability to fold into a complex three-dimensional shape allows RNA to carry out various functions in cells, in addition to conveying information between DNA and protein. Whereas DNA functions solely as an information store, some RNAs have structural, regulatory, or catalytic roles.

（convey, 運搬する、伝達する）

Ａ）上記の英文を和訳しなさい。（14 点）

Ｂ）生物（ウイルスを含めない）の遺伝情報の保存には、RNA ではなく DNA が用いられている。それは何故か説明せよ。（7 点）

Ｃ）「DNA の複製」と「DNA から RNA への転写」は、どちらも核酸の合成反応であるが、異なる酵素が関与する。複製で働く酵素と転写で働く酵素をそれぞれ挙げ、複製の過程と転写の過程の概要を説明せよ。（7 点）

Ｄ）遺伝情報の転写と翻訳では、立体構造を持つ RNA が重要な働きをする。遺伝情報の転写または翻訳で働く立体構造を持つ RNA の例を 2 種類挙げ、その機能を説明せよ。（7 点）