2015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 に記載されている翻訳後修飾に関する文章である。この文章を読んで以下の設問に答えなさい。(35 点)

Protein machines and other protein complexes play an important role in the life of the cell. But these complexes do not sit around in the cell interior, preassembled and poised for action. It has recently become clear that most protein machines form at specific sites in the cell and are activated only when and where they are needed. This mobilization is generally accomplished by the covalent addition of a modifying group of one or more specific amino acid side chains on the participating proteins. More than 200 types of covalent modifications can occur in the cell, each helping to regulate protein function. Each of these groups is enzymatically added or removed depending on the needs of the cell.

A large number of proteins are now known to be modified on more than one amino acid side chain. The p53 protein, which plays a central part in controlling how a cell responds to DNA damage, can be modified at 20 different sites. Because an enormous number of combinations of these 20 modifications is possible, the protein's behavior can in principle be altered in a huge number of ways. The set of covalent modifications that a protein contains at any moment constitutes an important combinatorial regulatory protein code. The attachment or removal of these modifying groups controls the behavior of a protein, changing its activity or stability, its binding partners, or its location inside the cell. This regulatory code enables the cell to make optimal use of its proteins, and it allows the cell to respond rapidly to changes in its condition or environment.

(interior, 内部;　poise, 用意を整える;　mobilization, 動員、移行; behavior, 行動、ふるまい)

A) 上記の英文を和訳しなさい。(14 点)

B) 生体内でタンパク質のリン酸化反応に用いられているドナー基質の名称、ならびに、リン酸化が起こりうるアミノ酸残基を 4 種類答えなさい。(7 点)

C) 上記英文中、下線部の文章で述べられていることの意味について、p53 タンパク質を例にして 5 行程度で具体的に説明しなさい。(7 点)

D) ヒストンタンパク質に起こる翻訳後修飾のパターンが変化すると、クロマチン構造が変化する。その仕組みについて 5 行程度で説明しなさい。(7 点)

問 2.　次の英文を読んで、以下の問いに答えなさい。(35 点)

Some of the proteins that process and package miRNAs also serve as a cell defense mechanism: they orchestrate the destruction of 'foreign' RNA molecules, specifically those that are double-stranded. Many viruses (and transposable genetic elements) produce double-stranded RNA some time in their life cycles. This targeted RNA degradation mechanism, called RNA interference (RNAi), helps to keep these potentially dangerous invaders in check.

The presence of foreign, double-stranded RNA in the cell triggers RNAi by first attracting a protein complex containing a nuclease called Dicer. Dicer cleaves the double-stranded RNA into short fragments (approximately 23 nucleotide pairs in length) called small interfering RNAs (siRNAs). These short, double-stranded RNAs are then incorporated into RISCs, the same complexes that can carry miRNAs. The RISC discards one strand of the siRNA duplex and uses the remaining single-stranded RNA to locate a complementary foreign RNA molecule. This target RNA molecule is then rapidly degraded, leaving the RISC free to search out more of the same foreign RNA molecules.

RNAi is found in a wide variety of organisms, including single-celled fungi, plants, and worms, indicating that it is evolutionarily ancient. In some organisms, including plants, the RNAi activity can spread from tissue to tissue by the movement of RNA between cells. This RNA transfer allows the entire plant to become resistant to a virus after only a few of its cells have been infected. In a broad sense, the RNAi response resembles certain aspects of the human immune system. In both cases, an infectious organism elicits the production of 'attack' molecules (either siRNAs or antibodies) that are custom designed to inactivate the invader and thereby protect the host.

(RISC, RNA-induced silencing complex; discard, 分解する; fungi, 菌類; worm, 線虫; elicit, 誘発する)

A)　上記の英文を和訳しなさい。(14 点)

B)　siRNAs と miRNAs の違いについて 5 行程度で説明しなさい。(7 点)

C)　RNAi の原理を使った手法が研究に取り入れられている。その方法について 5 行程度で説明しなさい。(7 点)

D)　上記の説明文では siRNAs と抗体分子を広い意味で類似の機能を持つものとして記載されている。その意味するところを 10 行以内で説明しなさい。(7 点)

問 3.　次の文章は Essential Cell Biology に記載されている、糖質の代謝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 synthesis and degradation of glycogen occur by quite separate metabolic pathways, which can be rapidly and coordinately regulated according to need. When more ATP is needed than can be generated from food molecules taken in from the bloodstream, cells break down glycogen in a reaction that produces *glucose 1-phosphate*, which is then converted to the glucose 6-phosphate that feeds into the glycolytic pathway.

The glycogen synthetic and degradative pathways are coordinated by enzymes in each pathway that are allosterically regulated by glucose 6-phosphate, but in opposite directions: *glycogen synthase* in the synthetic pathway is activated by glucose 6-phosphate, whereas the *glycogen phosphorylase* that catalyzes the breakdown of glycogen is inhibited by both glucose 6-phosphate and ATP. This regulation helps to prevent the breakdown of glycogen when ATP is plentiful and favors its synthesis when glucose 6-phosphate concentration is high. The balance between glycogen synthesis and breakdown is also regulated by intracellular signaling pathways that are controlled by the hormones insulin, adrenaline, and glucagon.

Quantitatively, fat is a far more important storage material than glycogen, in part because the oxidation of a gram of fat releases about twice as much energy as the oxidation of a gram of glycogen. Moreover, glycogen binds a great deal of water, producing a sixfold difference in the actual mass of glycogen required to store the same amount of energy as fat.

(coordinately, 協調的に; bloodstream, 血流; opposite directions, 反対の方向; plentiful, 豊富な; favor, 容易にする)

A) 上記の英文を和訳しなさい。(14 点)

B) 代表的な単糖の構造式をその立体配置が分かるように一つ描き、その単糖の名称を示しなさい。(7 点)

C) 動物の糖質代謝の中で重要な反応経路に「解糖」と「糖新生」がある。それぞれについて 3 行程度で簡潔に説明しなさい。(7 点)

D) グリコーゲンとはどういう物質か、その役割、合成、分解、および代謝制御について 10 行程度で説明しなさい。(7 点)