平成２０年度　大学院理学系研究科博士前期課程（生物科学専攻）
秋募集 入学試験問題

外国語

試験時間：10:30～12:00
配点：　　１５０点

注意

(1) 問題Ⅰから問題Ⅲに解答しなさい. 問題用紙は表紙を含めて５枚あります.

(2) 解答用紙は３枚あります. 問題ごとに，各々１枚の解答用紙を使用しなさい.

(3) それぞれの解答用紙に，問題Ⅰから問題Ⅲの問題番号，受験番号，氏名を記入しなさい.

(4) 解答用紙の表面に書ききれない場合には, 裏面の指定された部分を使用しなさい.

(5) 配布された解答用紙は，３枚とも提出しなさい.

問題Ｉ．　以下の英文（問１および問２）を日本語に訳しなさい.

問１.

The DNA in genomes does not direct protein synthesis itself, but instead uses RNA as an intermediary molecule. When the cell needs a particular protein, the nucleotide sequence of the appropriate portion of the immensely long DNA molecule in a chromosome is first copied into RNA (a process called *transcription*). It is these RNA copies of segments of the DNA that are used directly as templates to direct the synthesis of the protein (a process called *translation*). The flow of genetic information in cells is therefore from DNA to RNA to protein. All cells, from bacteria to humans, express their genetic information in this way — a principle so fundamental that it is termed the *central dogma* of molecular biology. Despite the universality of the central dogma, there are important variations in the way information flows from DNA to protein. Principal among these is that RNA transcripts in eucaryotic cells are subject to a series of processing steps in the nucleus, including *RNA splicing*, before they are permitted to exit from the nucleus and be translated into protein. These processing steps can critically change the "meaning" of an RNA molecule and are therefore crucial for understanding how eucaryotic cells read the genome.

(B. Alberts *et al.*　*Molecular Biology of the Cell*　4th *Ed*., Garland Science (New York), 2002 より抜粋・一部改変)

問２.

Temperature affects the rate of enzyme-catalyzed reactions in two ways. First, a rise in temperature increases the thermal energy of the substrate molecules. This raises the proportion of substrate molecules with sufficient energy to overcome the activation energy, and hence increases the rate of the reaction. However, a second effect comes into play at higher temperatures. Increasing the thermal energy of the molecules which make up the protein structure of the enzyme itself will increase the chances of breaking the multiple weak noncovalent interactions (hydrogen bonds, van der Waals forces, etc.) which hold the three-dimensional structure of the enzyme together. Ultimately this will lead to the denaturation (unfolding) of the enzyme, but even small changes in the three-dimensional shape of the enzyme can alter the structure of the active site and lead to a decrease in catalytic activity. The overall effect of a rise in temperature on the reaction rate of the enzyme is a balance between these two opposing effects. A graph of temperature plotted against the initial velocity of the enzyme-catalyzed reaction will therefore show a curve, with a well defined temperature optimum.

(B. Hames, N. Hooper and J. Houghton, *Instant Notes in Biochemistry*, Springer (New York), 1997 より抜粋・一部改変)

問題Ⅱ．　次の英文を読み，以下の問１～問８に答えなさい．

ア When a farmer or a gardener throws a seed into the ground, he doesn't have to worry which end of the seed is up and which down. Whatever the orientation happens to be, and barring the unusual, the root will go down and the stem will come up. イ From a functional point of view, this is, of course, as it should be. The root is designed to anchor the plant and to absorb water and mineral nutrients for growth and development. To do these things, it must penetrate downward into the soil. The stem, on the other hand, is an axis for holding the maximum number of leaves in the best position to carry out the process of [ウ] through light absorption. Obviously this activity has to be carried on above ground where the light is. But how does the plant distinguish up from down? What mechanism determines that the root will go down and the stem go up? These are complicated questions to which we have only partial answers despite a century of investigation.

If a germinated seedling is removed from the medium in which it has been growing and is laid on its side, the root will turn down, toward the center of the earth, and the stem will bend upward, away from the center of the earth. This curvature response is called [エ]. オ It is brought about by unequal rates of growth on the two sides of the cylindrical plant axis. In a horizontally placed seedling, the upper side of the root grows more than the lower side, and the resulting differential growth points the root tip down. The situation is reversed with the stem. When placed horizontally, the lower side of that organ grows more rapidly than the upper side, and the resultant growth curvature is therefore upward.

Seeds germinated in a satellite circling high above the earth, where the planet's gravitational field is very low, do not orient with their roots pointing down toward the center of the earth. This indicates that at least part of the reaction of seeds at the earth's surface is due to gravity. The gravitational stimulus, however, can be overcome by centrifugal force. Thus, カ if a plant is tied to the outer edge of a turntable that is spun with a force equivalent in the horizontal plane to the downward pull of gravity, the stem will grow partly inward instead of straight up, and the root partly outward instead of straight down. The root will, in effect, respond to a simple vectorial problem in which equal forces are exerted parallel and perpendicular to the earth's surface, and grow at an angle [キ] degrees below the horizontal. As the centrifugal force of the rotating turntable is progressively increased, the angle of the root will approach the horizontal until the root is parallel to the turntable.

ク These facts suggest that the gravitational response of roots and stems might be due to the dislocation of a heavy body, or statolith, within plant cells, which can also be displaced by centrifuging. This is called the statolith theory. It presumes a mechanism similar to that by which animals balance themselves through the displacement of small calcium carbonate crystals in the

semicircular canals of the ear. What could serve as a statolith in a plant cell? It appears that for the purpose of up-down orientation, plants employ very dense starch grains that fall to the bottom of specialized cells in response to gravity.

(A. W. Galston, *Green Wisdom*, Basic Books, Inc. Publishers (New York), 1981 より抜粋, 一部改変)

注） barring: ･･･がなければ; axis: 軸; seedling: 芽生え； spun: spin の過去分詞;
statolith: 平衡石; carbonate: 炭酸塩; semicircular canal: 三半規管

問１． ［ ウ ］ と ［ エ ］ に入る最も適当な英単語をそれぞれ答えるとともに，その日本語表記を答えなさい．なお，後者には，屈性（tropism）の一種が該当する．

問２．上の文章中の下線部**ア**を和訳しなさい.

問３．上の文章中の下線部**イ**の理由について記述しなさい.

問４．上の文章中の下線部**オ**を和訳しなさい.

問５．上の文章中の下線部**カ**を和訳しなさい.

問６． ［ キ ］ に該当する適当な数値を答えなさい.

問７．上の文章中の下線部**ク**を和訳しなさい.

問８．動物と植物の statolith の構成成分および存在場所について述べなさい.

問題Ⅲ．　以下の和文（問１～問３）を英文に訳しなさい．必要に応じて（　　）内の語句を使用してもよい．

問１．

得られた結果は非常に興味深いものでした．なぜなら，それらは，細胞生物学的に意味があるだけでなく，すぐにリューマチの治療に適用できそうに思われたからです．私たちは実験を繰り返し，データに再現性があるかどうか検討しました．

リューマチ（rheumatism),　治療（clinical treatment)

問２．

自然科学者として Charles Darwin は Beagle 号で南アメリカに旅をした. 彼はガラバゴス諸島のフィンチとカメに特に興味を持った. この旅での観察が彼独自の進化説を導いた.

ガラバゴス（Galapagos)，　フィンチ（finch),　カメ（tortoise)

問３．

Boston を訪ねるようにと誘っていただきありがとうございます．7 月に行われるアメリカ結晶学会の年会に参加するため渡米いたしますので，その際に Boston に立ち寄らせていただきます．貴方にお会いできることを楽しみにしています．

アメリカ結晶学会（the American Crystallographic Association)，
年会（the annual meeting）