

2008年度日本政府(文部科学省)奨学金留学生選考試験

QUALIFYING EXAMINATION FOR APPLICANTS FOR JAPANESE

GOVERNMENT (MONBUKAGAKUSHO) SCHOLARSHIPS 2008

学科試験 問題

EXAMINATION QUESTIONS

(学部留学生)

UNDERGRADUATE STUDENTS

生 物

BIOLOGY

注意 ☆試験時間は60分。

PLEASE NOTE : THE TEST PERIOD IS 60 MINUTES.

BIOLOGY

| | | | |
|-------------|---|--|-------|
| Nationality | No. | | |
| Name | (Please print full name, underlining family name) | | Marks |

Read the following passage and answer the subsequent questions 1-3 .

Chloroplasts are one of the cellular organelles, and the site of photosynthesis, a basic metabolism in plants. The structure of chloroplasts is shown in Figure 1 . Chloroplasts possess an inner system of membranes, called thylakoids, which are surrounded by fluid compartments called [(1)]. Thylakoids contain [(2)] where the [(3)] reaction occurs. In [(1)], carbon reduction is carried out through the [(4)] reaction. In the [(3)] reaction, [(5)], chemical energy, and [(6)], reduction power, are synthesized using light energy. The [(5)] and [(6)] generated by the [(3)] reaction system are transported to the [(4)] reaction system, where [(7)] is fixed and [(8)] are synthesized by the Calvin cycle. Some plants concentrate [(7)] into organic acids before the Calvin cycle.

In chloroplasts, there are independent genes. These are some of the [(9)]. Some chloroplast proteins are synthesized in chloroplasts. The complete chloroplast genomes of several plants have been sequenced. Chloroplasts reproduce by division rather than synthesis and are divided between the two daughter-cells during cell division. However, at the time of sexual reproduction, chloroplast genes are transferred only through the maternal gamete in most cases. For this reason characters based on differences in chloroplast genes do not follow the Mendelian pattern of inheritance. Chloroplast DNA also contains [(10)], i. e. base sequences that do not code for protein. When proteins are synthesized, the mRNA is processed to remove the [(10)] at first, and then the base sequences that code for protein are connected. This process is called [(11)].

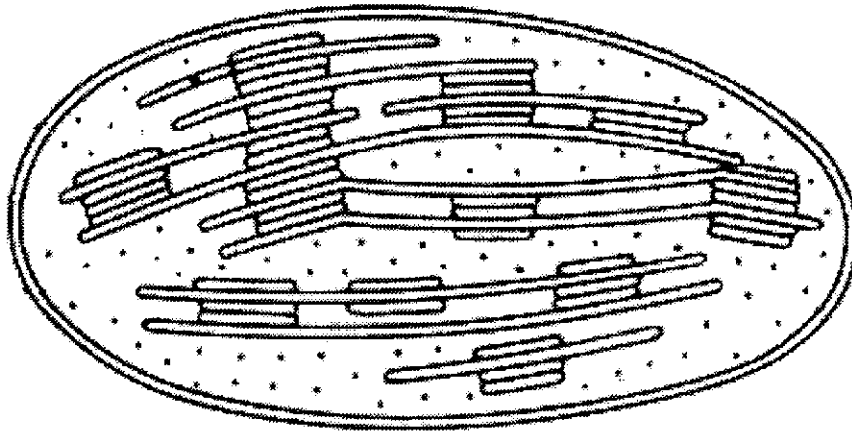


Figure 1

1. Fill the blanks (1)–(11) in the above passage by choosing the correct terms presented below. Put their letters in the designated spaces (I -1- (1)~(11)) of the answer sheet.

- | | | | | | |
|---|--------------------|---|----------|---|---------------|
| A | ADP | B | ATP | C | carbohydrates |
| D | carbon dioxide | E | carotene | F | chlorophyll |
| G | dark | H | light | I | exons |
| J | extranuclear genes | K | grana | L | introns |
| M | lipid | N | NADP | O | NADPH |
| P | nuclear genes | Q | oxygen | R | PCR |
| S | ribosomes | T | splicing | U | stroma |
| V | thick | W | thin | | |

2. As characteristics of plants described in the underlined part 1, choose the incorrect one from A–D and put its letter in the designated space (I -2) of the answer sheet.

- A Photorespiration is barely observed.
- B They are photo-saturated and cannot use strong light efficiently in photosynthesis.
- C Many of them are tolerant to heat.
- D They are mostly drought-tolerant.

3. Most [(9)], like chloroplast genes, show the characteristics described in the underlined part 2. Among the following, which is caused by [(9)]? Choose the correct one from A-D and put its letter in the designated space (I-3) of the answer sheet.

- A When a rice variety with glutinous grains was crossed with a rice variety with non-glutinous grains, all the F_1 plants had non-glutinous grains. When these F_1 plants were self-fertilized, both plants with glutinous and non-glutinous grains appeared at a ratio of 1 : 3 in the F_2 generation.
- B When an Akabana (a Japanese horticultural plant) variety with variegated leaves was crossed with an Akabana variety without variegated leaves, all the F_1 plants had variegated leaves. When these F_1 plants were self-fertilized, all the F_2 plants had variegated leaves too.
- C When a variety of four-o'clock (name of a plant) with red flowers was crossed with a four-o'clock variety with white flowers, the flowers of all the F_1 plants were pink. When these F_1 plants were self-fertilized, plants with red, white and pink flowers appeared at a ratio of 1 : 1 : 2 in the F_2 generation.
- D In the sweet pea, purple flower color shows genetic dominance over red flower color, and long-shaped pollen shows genetic dominance over round-shaped pollen. In the F_2 generation of a cross between a purple-flowered variety with long-shaped pollen and a red-flowered variety with round-shaped pollen, plants with purple flowers and long-shaped pollen, those with purple flowers and round-shaped pollen, those with red flowers and long-shaped pollen and those with red flowers and round-shaped pollen appeared at a ratio of 21 : 1 : 1 : 7.

II Read the following passage about animal development, and answer the subsequent questions 1-3 .

A fertilized egg undergoes [(1)] to become multicellular, during which [(2)] takes place among cells and various tissues and organs are formed. This process is called embryonic development.

Concerning the mechanism of embryonic development, there were once two different ideas. One is called [(3)], according to which the egg or sperm contains a completely formed miniature embryo that simply grows during its development. Another is called [(4)], in which the form of the embryo emerges gradually from a relatively formless egg.

In 1881 , the German embryologist [(5)] killed one of the blastomeres of a frog embryo at the two-cell stage with a hot needle, and later obtained a half-embryo with one side of the body formed. As seen in this experiment, eggs in which the fate of parts of the embryo is already determined are called [(6)] eggs. On the other hand, in 1891 another German embryologist [(7)] vertically split a sea urchin embryo at the eight-cell stage, which resulted in two normal larvae. As seen in this experiment, eggs in which parts of the embryo have the potential to form a complete individual are called [(8)] eggs.

At present, these two ideas are thought not to be incompatible. The difference between the two types of egg is attributable to differences in time when the fate of the part of the embryo is determined.

1. Choose the most suitable terms that match the blanks in the above passage from the following, and put their letters in the designated spaces (II-1-(1)~(8)) of the answer sheet.

- | | | |
|-------------------|-------------------|-----------------|
| A altricial | B cleavage | C complementary |
| D convergence | E differentiation | F epigenesis |
| G gastrulation | H germination | I invagination |
| J mosaic | K precocial | L preformation |
| M regulative | N speciation | O Hans Driesch |
| P Wilhelm Roux | Q Hans Spemann | |
| R August Weismann | | |

2. Which of the two ideas that match [(3)] and [(4)] is supported by the experimental result underlined 1 ? Put the letter in the designated space (II-2) of the answer sheet.

3. Choose an experiment that supports the idea suggested by the experimental result underlined 2 from the following experiments, and put its letter in the designated space (II-3) of the answer sheet.

- A When two blastomeres of a newt embryo at the two-cell stage were loosely ligatured or tied with a hair, they developed into two larvae whose body sides were fused posteriorly.
- B Splitting of four blastomeres of a ctenophore embryo, which otherwise develops eight rows of comb plates, at the four-cell stage produced four embryos each with two rows of comb plates.
- C When a newt egg was ligatured with a hair just after fertilization, shifting the nucleus to one side, no cell division took place in the nuclear-free side.

III The figure below shows the process of the formation of mature forests from bare land in a wet temperate zone like Japan. Answer the subsequent questions 1-5.

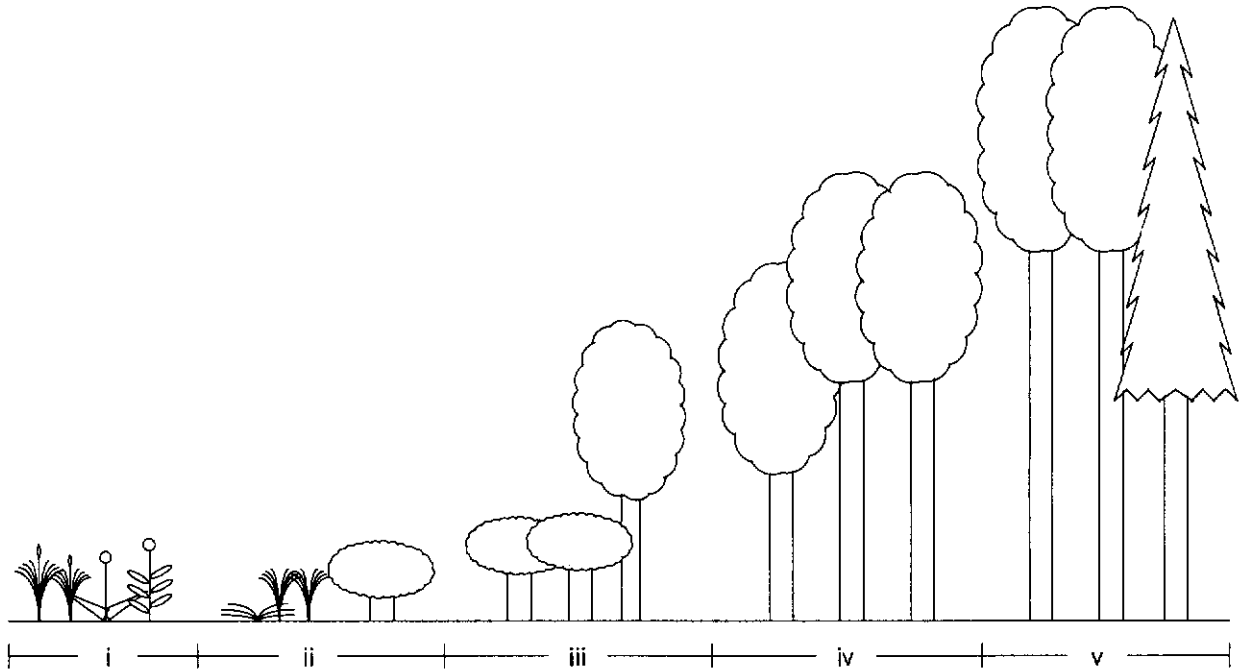


Figure 2

1. What is the change in vegetation like this called? Choose the correct name among A-E and put its letter in the designated space (III-1) of the answer sheet.

- | | | |
|--------------|--------------|---------------|
| A adaptation | B alteration | C disturbance |
| D dynamics | E succession | |

2. What do you call period v in particular? Choose the correct name among A-E and put its letter in the designated space (III-2) of the answer sheet.

- | | | |
|----------------|------------------|-----------------|
| A climax phase | B end phase | C initial phase |
| D middle phase | E terminal phase | |

3. Choose plants observed commonly during periods i, iii and v among A–E and put their letters in the designated spaces (III-3 – (i), (iii) and (v)) of the answer sheet.

A annual herbaceous plants

B bushes

C perennial herbaceous plants

D tall sun trees

E tall shade trees

4. Choose the correct characteristic of plants which appear during period i among A–D and put its letter in the designated space (III-4) of the answer sheet.

A fast growth

B high trees

C preferring shade

D sensitive to drought

5. Figure 2 shows the change in vegetation under a humid temperate climate. In the case of climate in lower latitude areas, in which clear dry and rainy seasons are observed, what kind of vegetation is expected? Choose the incorrect one among A–D and put its letter in the designated space (III-5) of the answer sheet.

A bush forests develop.

B dense rain forests develop.

C grasslands develop.

D sparse Dipterocarp forests develop.

IV The following sentences describe ideas and experiments about the origin of life and the evolution of organisms. Choose the term and the person that are most closely related to each sentence from the lists A and B, respectively, and put their letters in the designated spaces (IV-1-A, B~5-A, B) of the answer sheet.

1. When a solution of polypeptides, nucleic acids, and polysaccharides is shaken, colloidal droplets form, which incorporate enzymes, and absorb substances from their surroundings, releasing the catalyzed products.
2. Chloroplasts are the descendants of photosynthetic prokaryotes that became incorporated within larger cells.
3. The long neck of the giraffe evolved gradually as the cumulative product of a great many generations of ancestors stretching higher and higher.
4. A population of organisms can change over time as a result of individuals with certain heritable traits leaving more offspring than other individuals.
5. Organisms evolve along trends that are fairly constant in direction over long periods of time, owing to their inherent or immanent features.

Term group A :

- | | | | | | |
|---|--------------------------|---|--|---|----------------|
| A | abiogenesis | B | abiotic synthesis of organic molecules | | |
| C | allopatric speciation | D | biogenetic law | E | coacervates |
| F | endosymbiotic hypothesis | G | mutation theory | | |
| H | natural selection | I | orthogenesis | J | use and disuse |

Term group B :

- | | | | | | |
|---|------------------|---|----------------------|---|---------------|
| A | Edward D. Cope | B | Charles Darwin | C | Hugo de Vries |
| D | Ernst H. Haeckel | E | Jean B. Lamarck | F | Lynn Margulis |
| G | Stanley Miller | H | Aleksander I. Oparin | | |

V Choose the most suitable term that matches the following phrases 1~5 from the subsequent list, and put their letters in the designated spaces (V-1~5) of the answer sheet.

1. The final product of glycolysis in respiration, which is incorporated into the TCA cycle

- | | | |
|-----------|--------|----------------|
| A glucose | B PGA | C pyruvic acid |
| D PEP | E RuBP | F xanthophyll |

2. An organelle, which stores and/or decomposes and/or detoxicates metabolic products in the solution compartmented with membranes, in plant cells

- | | | |
|-------------|----------------|-----------|
| A lysosomes | B mitochondria | C nuclear |
| D ribosomes | E vacuoles | |

3. A plant that does not make double fertilization

- | | | |
|---------|----------------|-----------------|
| A cedar | B chili pepper | C morning glory |
| D lily | E rice | |

4. An animal that excretes ureic acid as nitrogenous waste

- | | | |
|---------|-------------|--------------|
| A hydra | B planarian | C carp |
| D frog | E swallow | F chimpanzee |

5. The phenomenon that a chick becomes strongly attached over its lifetime to an object that it has followed immediately after hatching.

- | | | |
|----------------|----------------|-------------------|
| A Bruce effect | B conditioning | C imitation |
| D imprinting | E learning | F vacuum reaction |