

2012 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 2012

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.		Marks	
	Name	(Please print full name, underlining family name)				

I. The following passage describes the basic structure of cells. Choose the most suitable terms or numerical values that match the blanks in the passage from the choices listed below, and record the appropriate letters in the designated spaces (I-1-10) on the answer sheet.

All cells have several basic features in common: they are all bounded by a selective barrier called the [1]. All cells contain chromosomes, which carry genes in the form of [2], and have [3], small complexes that synthesize proteins. In a [4] cell, most of the [2] is in an organelle called the [5], which is bounded by a double membrane named the [6]. The region between the [1] and [6] is called [7]. In a [8] cell, however, the [2] is concentrated in a region that is not membrane-enclosed. Generally [4] cells are much larger than [8] cells. Typical [4] cells are [9] μm in diameter, a dimension about ten times larger than that of [8] cells. In the [5], [10] is synthesized according to instructions provided by the [2]. The [10] is then transported to the [7], and [3] translate the genetic message of the [10] into the primary structure of a specific protein.

Choices:

- | | | |
|-------------------------|-----------------|--------------------|
| A basal membrane | B cell membrane | C cell wall |
| D central body | E cytoplasm | F DNA |
| G endoplasmic reticulum | H enzyme | I eukaryotic |
| J liposomes | K lysosomes | L mitotic |
| M mRNA | N nucleus | O nuclear membrane |
| P nucleoid | Q nucleolus | R prokaryotic |
| S ribosomes | T rRNA | U tRNA |
| V 0.1-1 | W 1-10 | X 10-100 |

II. Read the following passage and answer the subsequent questions 1–7.

In a human kidney, urine is produced by filtration in the glomerulus and re-absorption and secretion in the renal tubules. The table shows the concentrations (mg/ml) of [1], protein, and glucose in plasma and urine in a man. Urine was excreted at the rate of 0.9 ml/min.

	plasma	urine
[1]	0.3	20
proteins	70	0
glucose	1	0

- [1] is a waste product produced by protein metabolism. Choose the name of [1] from A–E and record the appropriate letter in the designated space (II–1) on the answer sheet.
 - amino acid
 - ammonia
 - creatinine
 - urea
 - uric acid
- In which part of the body is [1] listed above produced? Choose the most appropriate answer from A–E and record the correct letter in the designated space (II–2) on the answer sheet.
 - bladder
 - intestine
 - kidney
 - liver
 - skeletal muscle
- Re-absorption of water in the renal tubules is increased by a hormone. From the list A–E below, what is the name of the endocrine organ where this hormone is secreted into the blood? Record the most appropriate answer in the designated space (II–3) on the answer sheet.
 - adrenal medulla
 - anterior lobe of the pituitary gland

- C islets of Langerhans
 - D posterior lobe of the pituitary gland
 - E thyroid gland
4. From the list A–E below, what is the name of the hormone that increases re-absorption of water in the renal tubules? Record the most appropriate answer in the designated space (II–4) on the answer sheet.
- A adrenalin
 - B insulin
 - C prolactin
 - D thyroxin
 - E vasopressin
5. Why are proteins and glucose not excreted in the urine? Choose the most appropriate answer from A–D and record the correct letter in the designated space (II–5) on the answer sheet.
- A Both proteins and glucose are not filtrated in the glomerulus.
 - B Proteins are filtrated in the glomerulus but re-absorbed completely in the renal tubules. Glucose is not filtrated in the glomerulus.
 - C Proteins are not filtrated in the glomerulus. Glucose is filtrated in the glomerulus but re-absorbed completely in the renal tubules.
 - D Both proteins and glucose are filtrated in the glomerulus but re-absorbed completely in the renal tubules.
6. Inulin does not naturally exist in the human body. If this substance is injected into a blood vessel, it does not penetrate cells but the capillary walls, and is completely filtrated in the glomerulus. Inulin is not re-absorbed or secreted in the renal tubules. When the inulin concentration in the plasma was kept at 0.1 mg/ml by continuous injection, its concentration in the urine was 14 mg/ml. As the rate of filtration in the glomerulus (the amount of fluid filtrated in the glomerulus per minute), put the numerical value (ml /min) in the designated space (II–6) of the answer sheet.
7. After the inulin concentration in the plasma was kept at 0.1 mg/ml, the injection of inulin was stopped. Thereafter, the total excretion of inulin into the urine was 1.2 g. How much body fluid (extracellular fluid) is there in the human body in the above example? Put the numerical value (l) in the designated space (II–7) of the answer sheet.

III. Read the following passage and answer the subsequent questions.

A certain proportion of wild plant "Q", genetically close to a crop "P", shows a resistance to a disease "Z". This resistance to "Z" is controlled by 2 genes (dominant: R_1 and R_2 , recessive: r_1 and r_2). Both the crop "P" and wild plant "Q" are diploid and have homologous chromosomes. The crop "P" has recessive genes r_1 and r_2 on the corresponding chromosomes and does not have resistance to the disease "Z".

1. The resistance to the disease "Z" is not expressed when one of the two genes is recessive homozygous. Under this assumption, answer the following questions.

(1) Choose all the genotypes, in which the wild plant "Q" expresses the resistance to the disease "Z", from A-I below, and record the appropriate letter(s) in the designated space (III-1(1)) on the answer sheet.

- | | | |
|------------------|------------------|------------------|
| A $R_1R_1R_2R_2$ | B $R_1R_1R_2r_2$ | C $R_1R_1r_2r_2$ |
| D $R_1r_1R_2R_2$ | E $R_1r_1R_2r_2$ | F $R_1r_1r_2r_2$ |
| G $r_1r_1R_2R_2$ | H $r_1r_1R_2r_2$ | I $r_1r_1r_2r_2$ |

(2) Hybridization between the crop "P" and the wild plant "Q" resulted in the appearance of sensitive (not resistant) and resistant plants at the ratio of 1:3. What is the genotype of the 2 genes of the wild plant "Q" used for the hybridization? Choose the proper genotype from A-I below and record the appropriate letter in the designated space (III-1(2)) on the answer sheet.

- | | | |
|------------------|------------------|------------------|
| A $R_1R_1R_2R_2$ | B $R_1R_1R_2r_2$ | C $R_1R_1r_2r_2$ |
| D $R_1r_1R_2R_2$ | E $R_1r_1R_2r_2$ | F $R_1r_1r_2r_2$ |
| G $r_1r_1R_2R_2$ | H $r_1r_1R_2r_2$ | I $r_1r_1r_2r_2$ |

2. It is assumed that the resistance to the disease "Z" is expressed as complete resistance when both genes are not recessive homozygous, and that it is expressed as partial resistance when one of the 2 genes is dominant homozygous or heterozygous. Under this assumption, when the crop "P" was hybridized with the wild plant "Q", complete resistant and partial resistant plants appeared at the ratio of 1:1 in the F_1 generation. Among these F_1 plants, plants with complete resistance were hybridized again with the crop "P". As a result, complete resistant, partial resistant and

sensitive plants appeared at the ratio of 1:2:1. What is/are the genotype(s) of the disease “Z” resistance of the wild plant “Q” used in the first hybridization? Choose all the appropriate genotype(s) among A–I and record the appropriate letter(s) in the designated space (III–2) on the answer sheet.

- | | | |
|------------------|------------------|------------------|
| A $R_1R_1R_2R_2$ | B $R_1R_1R_2r_2$ | C $R_1R_1r_2r_2$ |
| D $R_1r_1R_2R_2$ | E $R_1r_1R_2r_2$ | F $R_1r_1r_2r_2$ |
| G $r_1r_1R_2R_2$ | H $r_1r_1R_2r_2$ | I $r_1r_1r_2r_2$ |

3. In order to introduce the disease “Z” resistance of the wild plant “Q” to the crop “P”, after the hybridization of “P” and “Q”, “P” is repeatedly hybridized with the hybrid. This procedure enables only the target gene to be replaced in the target chromosome, on which the target gene is located. For this, a phenomenon should occur among homozygous chromosomes at the time of hybridization. What is this phenomenon? Choose the appropriate answer among A–E and record the correct letter in the designated space (III–3) on the answer sheet.

- | | | |
|-------------|-----------------------|-----------------|
| A apomixis | B chromosome doubling | C crossing-over |
| D epistasis | E xenia | |

IV. Read the following passage and answer the subsequent questions.

1 Most herbicides, agricultural chemicals used for controlling or eradicating weeds, attack physiological processes that are only existent in plants. [1] is representative of such a process. [1] consists of the [2] reaction, in which [2] energy is converted into 2 chemical energy, and the [3] reaction, in which [4] is synthesized from [5] and [6] that is absorbed from the air through [7].

In the past, many pesticides, which are used for exterminating harmful insects and mites, attacked the metabolisms relating to [8]. In [8], 3 [4] is decomposed into pyruvic acid, which then is decomposed into [5] and [6] through 4 the [9] cycle. At the same time, chemical energy is produced through [10] transfer systems and utilized in various physiological reactions in organisms. At present, most of pesticides utilize neuro-toxicity for their effectiveness.

1. Why is it important that only the physiological processes in plants are affected by herbicide (the underlined statement 1)? Choose the most appropriate answer(s) below and record the correct letter(s) in the designated space (IV-1) on the answer sheet.
 - A In order to maintain effectiveness over a long period.
 - B In order to improve safety.
 - C In order to minimize the influence on ecosystems.
 - D In order to restrict the use in farmlands.
 - E In order to improve storability.
2. Fill in the blanks ([1]-[10]) in the above passage from the list of phrases given below and record the appropriate letter (A-AG) in the designated space (IV-2 (1)~(10)) on the answer sheet.
3. What is a substance that carries the chemical energy referred to in the underlined section 2? Choose the proper answer from the list A-AG below and record the correct letter in the designated space (IV-3) on the answer sheet.

4. What is the process called in the underlined section 3? Choose the appropriate answer from the list A–AG below and record the correct letter in the designated space (IV–4) on the answer sheet.

5. In what organelle does the process noted in the underlined section 4 take place? Choose the appropriate answer from the list A–AG below and record the correct letter in the designated space (IV–5) on the answer sheet.

- | | | | | | |
|----|------------------|----|----------------|----|-----------------|
| A | AMP | B | ATP | C | atom |
| D | bright | E | Calvin | F | carbohydrate |
| G | chlorophyll | H | chloroplast | I | CO ₂ |
| J | cuticle | K | dark | L | electron |
| M | fermentation | N | fluorescence | O | glycolysis |
| P | Golgi body | Q | heat | R | high |
| S | H ₂ O | T | light | U | low |
| V | mitochondria | W | N ₂ | X | O ₂ |
| Y | photosynthesis | Z | protein | AA | proton |
| AB | respiration | AC | root hair | AD | RuBP |
| AE | stomata | AF | TCA | AG | vacuole |

V. Choose the most appropriate answer from A–E for each of the statements 1–6 given below. Record this answer in the designated spaces (V-1~6) on the answer sheet.

1. A plant hormone that mainly accelerates cell division.

- A abscisic acid B auxin C cytokinin
D ethylene E gibberellin

2. A process in which introns are removed and exons are joined in a RNA after transcription.

- A fertilization B mutation C parthenocarpy
D pollination E splicing

3. A plant that can fix aerial N_2 through the activities of certain symbiotic bacteria.

- A dandelion B morning glory C onion
D rice E soybean

4. An animal phylum in which a mouth is formed secondarily at the opposite side of the blastopore in embryonic development.

- A Annelida B Arthropoda C Echinodermata
D Mollusca E Platyhelminthes

5. The role of an organism in a community in terms of its inhabiting place, its interactions with other organisms, and its effect on the environment.

- A ecosystem B niche C population
D sociality E territory

6. An organism that eats plants or other autotrophs.

- A decomposer B primary consumer C primary producer
D secondary consumer E tertiary consumer