

2013 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 2013

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. Read the following passage and answer the subsequent questions.

Respiration includes [1] and [2] processes. Some organisms perform [1] respiration under [1] conditions without consuming oxygen. Most organisms perform [2] respiration under [2] conditions. In [2] respiration, sugars (respiratory substrates) are decomposed into the final products, [3] and [4]. [2] respiration consists of 3 pathways, i.e. [5], [6] and [7]. The first pathway, [5], is located mainly at the cytosol. In this process, glucose, decomposed from various carbohydrates, is decomposed into [8]. In [5], 2 molecules of [9] (chemical energy) are produced and the dehydrogenation occurs at the same time. [8] produced in [5] is transported to [10], one of organelles, and introduced to [6] after combining with CoA, a coenzyme. In [6], 2 molecules of [8] are produced and decarboxylation and dehydrogenation occur. Hydrogen atoms, the product of the dehydrogenation in [6], together with Hydrogen atoms produced by the dehydrogenation in [5], are transported to [7] and 34 molecules of [9] are produced.

In [7] in [2] respiration, reactive oxygen, which is known to attack various metabolic processes, is produced as a byproduct. In animals, reactive oxygen is mainly produced in respiration, but in plants, a large amount of reactive oxygen is produced in [11], the other physiological reaction producing a significant amount of [9]. For this reason, systems scavenging reactive oxygen are developed in chloroplasts in plants.

In [1] respiration, [8] produced in [5] is decomposed into alcohol or lactates. When this process is carried out by microorganisms, this is called [12] or decay.

1. Fill in the blanks ([1]–[12]) in the above passage from the list of phrases given below and record the appropriate letter (A–AA) in the designated space (I–1 (1)~(12)) on the answer sheet.

2. Which one of the 3 respiratory pathways shown above consumes oxygen? Select an appropriate phrase in the list given below and record the letter (A-AA) in the designated space (I-2) on the answer sheet.

List of phrases

A ADP	B aerobic	C AMP
D anaerobic	E ATP	F Calvin cycle
G carbon dioxide	H dry	I electron transfer system
J fermentation	K germination	L glycolysis
M Golgi body	N humid	O hydrogen
P lactic acid	Q malic acid	R mitochondria
S nitrogen	T photorespiration	U photosynthesis
V pollination	W pyruvic acid	X ribosome
Y TCA cycle	Z vacuole	AA water

3. How many molecules of [9] are produced from a molecule of glucose in [2] respiration? Put the numerical value in the designated space (I-3) of the answer sheet.

4. One mol of [9] has about 7.3 kcal of chemical energy and one mol of glucose has about 688 kcal of chemical energy. Roughly what % is the energy conversion efficiency of [2] respiration? Select an appropriate answer and record the letter (A-E) in the designated space (I-2) on the answer sheet.

- | | | |
|------|------|------|
| A 30 | B 40 | C 50 |
| D 60 | E 70 | |

5. In [1] respiration, [9] is produced only in [5] and the [9] production efficiency is lower than [2] respiration. Roughly what % of the [9] production efficiency of [2] respiration is that of [1] respiration? Select an appropriate answer and record the letter (A-E) in the designated space (I-2) on the answer sheet.

- | | | |
|------|------|------|
| A 2 | B 5 | C 10 |
| D 20 | E 50 | |

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

Fig. 1 shows the transverse section of a plant leaf. Mesophyll consists of the [1] tissue (A in Fig. 1) and [2] tissue (B in Fig. 2). Inside a leaf, [3], also called leaf vein, penetrates the mesophyll. The surface of a leaf is covered with epidermis, and stomata (responsible for gas-exchange activities) are scattered. Epidermis consists of a single layer of epidermis cells and is covered with cuticles. Generally, plants transpire by opening stomata, but transpiration from epidermis cells is also observed. The transpiration from epidermis cells is restricted by cuticles.

Leaves show morphological diversity. For example, some of succulent plants, such as cactuses, have spines transformed from leaves. In such plants, stems develop like leaves and thick cuticles cover the surface of stems. In some other succulent plants, leaves are thickened and similarly covered with thick cuticles. Succulent plants close stomata during the daytime and open them in the night time. These changes minimize water loss from plants, and are considered to be the adaptation to dry climates, in which most of succulent plants are distributed.

These changes of leaf morphology are observed in carnivorous plants. Carnivorous plants catch small animals, mainly insects, decompose them and absorb them as nutrients. Most organs for catching small animals are transformed from the leaves.

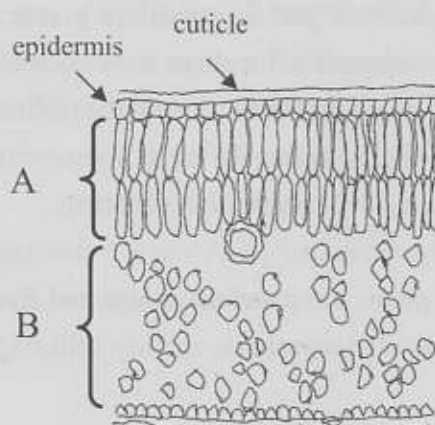


Fig. 1

1. Fill in the blanks ([1]-[3]) in the above passage from the list of phrases given below and record the appropriate letter (A-H) in the designated space (II-1 (1)~(3)) on the answer sheet.

- | | | |
|-----------------|---------------|-------------------|
| A bundle sheath | B cambium | C Casparian strip |
| D cotton | E leaf sheath | F palisade |
| G shelf | H spongy | I vascular bundle |

2. To estimate the extent of the restriction of the transpiration from the surface cells by cuticles, described in the underlined part 1, measurement is conducted using a machine measuring the transpiration rate. What kind of measurement is appropriate for the estimation? Select an appropriate answer and record the letter (A–D) in the designated space (II–2) on the answer sheet.

- A Measuring leaf transpiration rates in the daytime and at night and calculating the difference between them.
- B Measuring leaf transpiration rates in the daytime, then measuring them again after treating the leaf with organic solvent, which dissolves cuticles, and calculating the difference between them.
- C Measuring leaf transpiration rates at night, then measuring them again after treating the leaf with organic solvent, which dissolves cuticles, and calculating the difference between them.
- D During both daytime and night time, measuring leaf transpiration rates after treating the leaf with organic solvent, which dissolves cuticle, and calculating the difference between them.

3. As described in the underlined part 2, succulent plants close their stomata during the daytime. This makes it impossible for them to absorb CO_2 , making it difficult for plants to perform ordinary photosynthesis. From the following sentences explaining photosynthesis of succulent plants, select the most appropriate one and record the letter (A–D) in the designated space (II–3) on the answer sheet.

- A In areas where succulent plants are distributed, dry and fine weather prevails at night. Thus, these plants perform photosynthesis mainly utilizing the radiation of stars and the moon.
- B Succulent plants mainly perform photosynthesis in the daytime using CO_2 accumulated in leaf intercellular spaces at night, absorbed through open stomata.
- C Succulent plants mainly perform photosynthesis utilizing CO_2 released by respiration during the daytime.
- D Succulent plants mainly perform photosynthesis utilizing released CO_2 by the decarboxylation of organic acids, which are accumulated during the night time through special responses to fix CO_2 absorbed through open stomata.

4. How do you think carnivorous plants, described in the underlined part 3, have evolved? Among the following sentences, select the most appropriate one and record the

letter (A–E) in the designated space (II–3) on the answer sheet.

- A Carnivorous plants have evolved by increasing insects visiting their flowers utilizing strong smells of the decomposition of captured insects.
- B Carnivorous plants have evolved by using captured and decomposed insects as a nutrient source under poor-nutritious soil conditions.
- C Carnivorous plants have evolved under fertile soil conditions, under which many insects are able to be captured and utilized because of high bio-diversity.
- D Carnivorous plants have evolved in order to supply additional water by decomposing captured insects under dry conditions.
- E Carnivorous plants have evolved by utilizing some components of decomposed insects for improving their disease resistance under humid conditions.

III Read the following passage and answer the subsequent questions 1–5.

The femoral muscle of a frog was dissected out along with a nerve that triggers the contraction of the muscle. When a weak electric stimulus was given to the nerve 60 mm from the neuromuscular junction, the muscle did not contract. When a slightly stronger stimulus was given at the same point, however, the muscle contracted after 4.5 ms. Then the same stimulus was given 20 mm from the neuromuscular junction, and the muscle contracted after 3.5 ms.

1. Choose the name of this nerve from A–E, and record the appropriate letter in the designated space (III–1) on the answer sheet.
 - A central nerve
 - B motor nerve
 - C parasympathetic nerve
 - D sensory nerve
 - E sympathetic nerve
2. Calculate the conduction rate of this nerve, and record the numerical value (m/s) in the designated space (III–2) on the answer sheet.
3. Calculate the delay time from the excitation reaching the neuromuscular junction to the contraction of the muscle, and record the numerical value (ms) in the designated space (III–3) on the answer sheet.

4. There are both nervous and muscular factors for the delay from the excitation reaching the neuromuscular junction to the contraction of the muscle. The nervous factor is that after excitation reaches to the end of the nerve, [a] is released and diffuses in the synaptic cleft to the muscle cell. The muscular factor is that the excitation reaches the sarcoplasmic reticulum to release [b], and then [b] activates ATPase of [c]. Choose the most suitable terms that match the blanks in the passage from A–L, and put the letters in the designated spaces (III–4a–c) of the answer sheet.

- | | | |
|-------------------|---------------------------------|--------------------|
| A acetylcholine | B actin | C Ca^{++} |
| D cell membrane | E creatine | F K^{+} |
| G mitochondria | H myosin | I Na^{+} |
| J node of Ranvier | K noradrenalin (norepinephrine) | |
| L rhodopsin | | |

5. If a further stronger stimulus is given to this nerve, how does the strength of the muscle contraction change, if at all? Choose the most suitable answer from A–D, and put the letter in the designated space (III–5) of the answer sheet.
- A The strength of the muscle contraction does not change.
 - B The strength of the muscle contraction increases as the stimulus is stronger.
 - C The strength of the muscle contraction increases as the stimulus is stronger, but if it exceeds a certain value, the strength of the muscle contraction does not change.
 - D The strength of the muscle contraction increases as the stimulus is stronger, but if it exceeds a certain value, the strength of the muscle contraction decreases as the stimulus is stronger.

IV Read the following passage and answer the subsequent questions 1–3.

Biologists refer to organisms by Latin scientific names to avoid ambiguity. The two-part format of the scientific name, called [1], was proposed in the 18th century by a Swedish biologist [2]. The first part of a [1] is the name of the [3] to which the species belongs, and the second part is unique for each species. An example of a [1] is *Drosophila melanogaster*, the scientific name for the fruit fly. In addition to naming species, [2] also grouped them into hierarchy of increasingly inclusive categories. Species that appear to be closely related are grouped into the same [3].

Beyond [3], progressively more comprehensive categories for classification are employed. *Drosophila melanogaster* belongs to the [4] Drosophilidae. Drosophilidae belongs to the [5] Diptera, with other flies and mosquitoes. Diptera is one [5] in the class Insecta, which belongs to the [6] Arthropoda.

1. Choose the most suitable terms that match the blanks in the passage from A–O, and put the letters in the designated spaces (IV–1~6) of the answer sheet.

A common name	B binomial	C Darwin
D department	E domain	F family
G formal name	H genus	I grade
J group	K kingdom	L Lamarck
M Linnaeus	N order	O phylum

2. Choose the name of an animal or animals from A–F that does/do not belong to Arthropoda and record the appropriate letter(s) in the designated space (IV–7) on the answer sheet.

- A earthworm
- B horseshoe crab
- C millipede
- D sea urchin
- E spider
- F trilobite

3. Choose the appropriate item(s) from A–F that do not show a characteristic of Arthropoda and record the letter(s) in the designated space (IV–8) on the answer sheet.

- A exoskeleton
- B joint appendages
- C molting
- D most species-rich group in animals
- E open circulatory system
- F water vascular system

- V Choose the most suitable item from A–E that matches the following phrases 1–6, and record the corresponding letters in the designated spaces (V–1~6) of the answer sheet.

- 1 A major component of a cell membrane
A calcium B cellulose C organic acids
D phospholipid E starch
- 2 A nucleobase that is not contained in DNA
A adenine B cytosine C guanine
D thymine E uracil
- 3 The cause of an appearance of maize ears with different colored kernels
A apomixis B chimera C polination
D parthenocarpy E xenia
- 4 The location of Spemann's "organizer" in an amphibian embryo
A archenteron floor
B archenteron roof
C dorsal ectoderm
D dorsal lip of the blastopore
E ventral ectoderm
- 5 The animal that would have the highest energy expenditure per unit mass.
A beetle B elephant C human
D lizard E mouse
- 6 The relationship between coral polyps and algae in coral tissue
A competition B habitat segregation
C mutualism D parasitism E predation