

2007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 2007

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	

I Read the following passage and answer the subsequent questions 1 and 2.

Water absorbed by plant roots is transported to leaves through [(1)] in the stem or trunk, and released to the air mainly through [(2)]. This process is called [(3)]. When soil contains enough water, the amount of [(3)] is large. The amount of [(3)] of a full grown maize plant exceeds two liters on a fine summer day. Generally, the amount of water used for fundamental metabolism and plant quantitative growth is insignificant, and most of the water absorbed by roots is simply lost after passing through the plant body to the air.

The aperture of [(2)] is closely affected by solar radiation. When leaves are exposed to sun light, [(2)] are opened. [(2)] are distributed on leaf surfaces and consisted of two attached [(4)] (Figure1-1). [(4)] contain chloroplasts, which are not observed in ordinary epidermis cells. Sun light induces [(5)] at chloroplasts in [(4)], which reduces [(6)] concentration in intercellular air spaces just below [(2)]. In response to the reduction in [(6)] concentration, K^+ is accumulated in [(4)], which then induces water absorption, resulting in rapid swelling of [(4)]. The inner cell wall of [(4)] is [(7)], whereas the outer one is [(8)]. Water-absorbed [(4)] are swollen on the outside of the cell, whose cell wall is [(8)], and pull the inside cell wall outside. As a result, the adhesive cell walls of two [(4)] are parted and [(2)] are opened (Figure1-2). Therefore, the aperture of [(2)] is induced by the change in [(9)] of [(4)].

[(2)] act not only as pathways for water vapor for [(3)], but also as pathways for other gases. Thus the gas exchanges through [(2)] are impor-

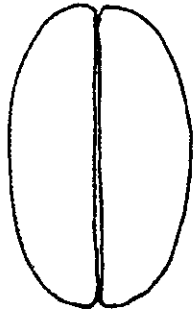


Fig. 1-1

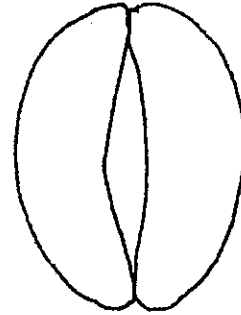


Fig. 1-2

tant for other metabolic processes too. When soil moisture contents are reduced by drought, plants close [(2)] to suppress water loss. The closure of [(2)] and the resultant retardation of gas exchanges directly affect various important metabolic processes such as [(5)] and [(10)].

1. Fill the blanks (1)-(10) in the above passage by choosing from the group of terms presented below. Put their letters in the designated spaces (I - 1 - (1)~(10)) of the answer sheet.

- | | | |
|---------------------|-----------------------|-------------------|
| A aging | B cambium | C CO ₂ |
| D cortex | E deep | F shallow |
| G guard cells | H hormone metabolism | I leaf vein |
| J O ₂ | K palisade parenchyma | L photosynthesis |
| M respiration | N root hair | O sieve tube |
| P spongy parenchyma | Q stomata | R thick |
| S thin | T transpiration | U turgor pressure |
| V vessel | | |

2. As shown in the underlined part, most water absorbed by roots simply passes through the plant body. What do you think is the role of the water, simply passing through the plant body? Choose the incorrect one from A-D and put its letter in the designated space (I -2) of the answer sheet.

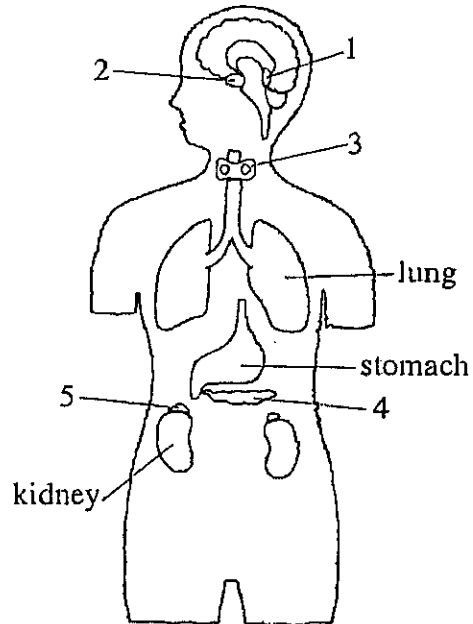
- A To evaporate at the leaves and reduce leaf temperatures.
- B To transport nutrients absorbed by roots to various above ground organs.
- C To transport materials synthesized by roots to various above ground organs.
- D To transport materials synthesized by leaves to roots.

II Table 1 summarizes hormones secreted in the body of humans, and Fig. 2 shows the site of endocrine glands. Fill the blanks 1-7 in Table 1 by choosing suitable terms from the choices listed below, and the blanks a-d by choosing suitable numbers from Fig. 2, and put the letters and the numbers in the designated spaces (II -1~7, II -a~d) of the answer sheet.

Table 1

Hormone	Gland	Site	Action
Cortisol	1	a	2
Melatonin	3	1	involved in biorhythms
Thyroxine	thyroid	b	4
Insulin	5	c	6
Growth hormone	7	d	to stimulate general growth

Fig. 2



Choices :

- A adrenal gland
- B corpus allatum
- C ovary
- D pancreas
- E pituitary
- F pineal gland
- G prothoracic gland
- H to increase blood sugar
- I to lower blood sugar
- J to promote reabsorption of water in the kidney
- K to stimulate metabolic process
- L to stimulate ovarian follicles
- M to stimulate secretion of gastric juices

III Read the following passage that describes a scale-eater living in Lake Tanganyika, Africa, and answer the subsequent questions 1-3.

A scale-eater is a fish that literally snatches scales from the flanks of other fish species and eats them as food. When it attacks, it approaches its prey from behind and suddenly rushes at the prey's flank to snatch some scales. Interestingly, the mouth of this fish is distorted to the right (dextral) or to the left (sinistral). From underwater observations, the dextral fish is known to attack the left flank of the prey, and the sinistral fish to attack the right flank.

1. Taxonomically, the scale-eater belongs to the same group as carp and sardines, different from another group that includes sharks and rays. Choose a suitable taxonomic group that includes the scale-eater (1) and one that includes sharks and rays (2) from the list below, and put their letters in the designated spaces (III-1-(1), (2)) of the answer sheet.

- | | | |
|----------------|--------------|-----------------|
| A Agnatha | B Amphibia | C Chonrichthyes |
| D Osteichthyes | E Placodermi | |

2. To investigate the heredity of the mouth handedness of the scale-eater, varied combinations of parents were made and the handedness of their offspring was checked, with the results shown in Table 2. From these results, it can be concluded that the handedness of this fish is determined by a simple Mendelian one locus-two alleles system. Choose the expected genotypes of the parents that yielded the offspring underlined (1), (2), (3) and (4) in Table 2 from the subsequent choices, and put their letters in the designated spaces (II-2-(1)~(4)) of the answer sheet.

Table 2 Numbers of dextral and sinistral offspring derived from varied combinations of parents.
Three examples are shown for each combination.

Combination of Parents	dextral × dextral		dextral × sinistral		sinistral × sinistral	
	dextral	sinistral	dextral	sinistral	dextral	sinistral
	23	0	<u>74</u> (2)	<u>0</u>	<u>0</u> (4)	<u>79</u>
Number of offspring	35	11	18	0	0	29
	<u>39</u> (1)	<u>14</u>	<u>55</u> (3)	<u>53</u>	0	19

Choices :

- A dominant homozygous × dominant homozygous
- B dominant homozygous × heterozygous
- C dominant homozygous × recessive homozygous
- D heterozygous × heterozygous
- E heterozygous × recessive homozygous
- F recessive homozygous × recessive homozygous

3. According to a survey carried out in a certain year, the abundance of dextral fish was rather more than that of sinistral fish. In this year, when the left and right flanks of the prey fishes were examined for numbers of removed scales (denuded spots), the results shown in Fig. 3 were obtained. In this figure, a fish which has the same numbers of denuded spots on the left and right flanks is plotted on the dotted line. What can be inferred from this figure? Choose a suitable sentence from the sentences listed below, and put the letter in the designated space (I-3) of the answer sheet.

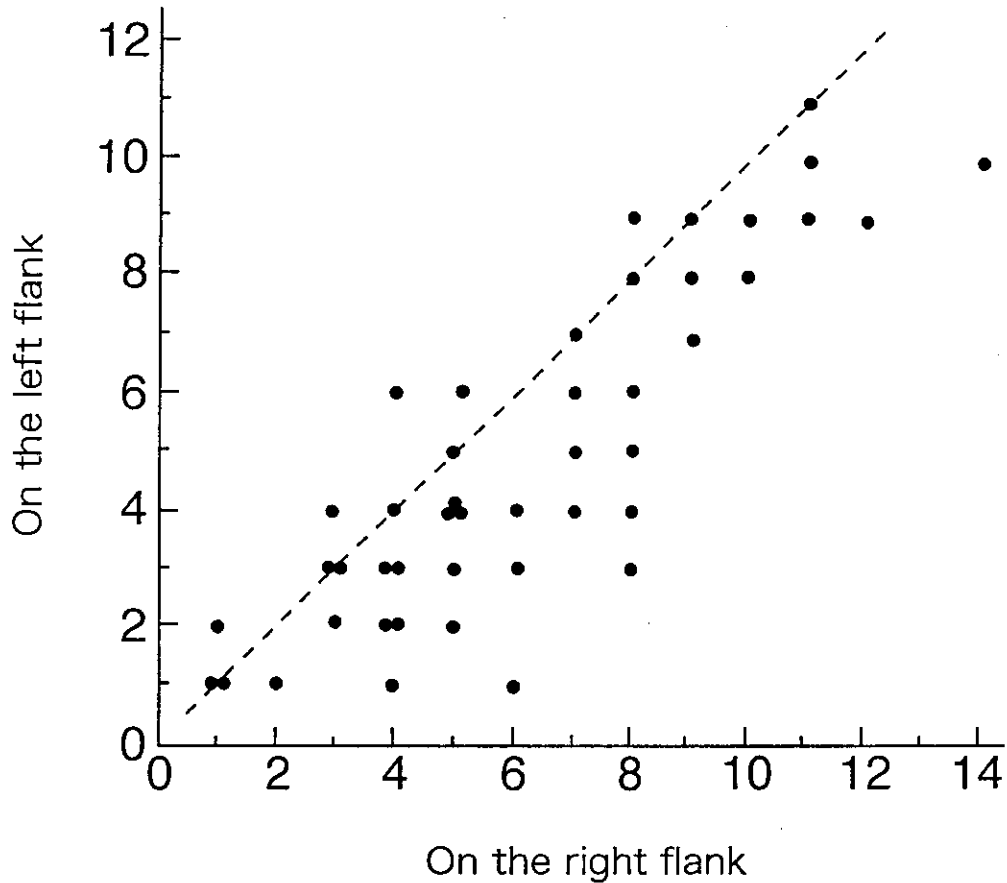


Fig. 3 Number of denuded spots

- A Prey fish paid much attention to the flank expected to be attacked with a higher probability, and less attention to the opposite side.
- B Even though there were many dextral scale-eaters, as there were also some sinistral individuals, prey fish paid equal attention to both flanks.
- C Prey fish were not alert to scale-eaters, and the result shown in Fig. 3 was obtained as a natural process.
- D In the lake, there were also some predatory fishes other than the scale-eater and prey fish paid as much attention to them.
- E There were many dextral scale-eaters, and thus, scales of the prey were more frequently removed from the flank that they attacked.

IV Read the following passage and answer the subsequent questions.

Most ecological and physiological traits of the plant result from the adaptation to the environment of its origin. For example, most plants originated in the tropics require short day conditions for flowering and fruiting. They prefer high temperature and suffer from damages by low temperature. On the other hand, plants originated at Mediterranean areas germinate in autumn, spend winter periods with little growth and start to grow rapidly to flowering and fruiting in response to warm temperature and long day length during the period from spring to early summer. They tolerate the hot and dry summer as seeds. Thus, plants originated at Mediterranean areas generally require high temperature and/or long day length and/or long-term low temperature for flower bud differentiation. As shown in these examples, to understand the origin of a plant means to understand the fundamental traits of that plant.

During the process of the expansion of habitat, plants come across new environments and adapt themselves there by using various strategies. In particular, crops, whose seeds or organs for vegetative propagation are frequently transported by human beings over long distances, experience drastic changes in the environment of habitats. Thus, human beings generally accelerate their adaptation to new environments by selecting varieties with specific characteristics. Rice and maize, which are considered to have originated in warm areas such as the tropics or subtropics, are now cultivated in relatively cool areas at high latitude such as Hokkaido (northern Japan) and southern Canada. What kind of adaptation enabled the cultivation of warm-climate crops at cool high latitude areas? On the contrary, what kind of problems would we have to solve for the cultivation of temperate crops at low latitude tropics?

1. Choose the proper one among A-C as a characteristic of short day plants shown in the underlined part 1 and put its letter in the designated space (IV-1) of the answer sheet.

A Flower bud differentiation occurs when the length of night is shorter than the critical night length.

B Flower bud differentiation occurs by interrupting the dark period with a flash of light.

C In general, flower bud differentiation occurs in autumn in high latitude areas.

2. What do you call the state, in which plants show little growth and wait for suitable seasons, as shown in the underlined part 2 ? Choose the proper one among A-E and put its letter in the designated space (IV-2) of the answer sheet.

A domestication B dormancy C growth stagnation

D hardening E vernalization

3. What do you call the effect of a long-term low temperature period for stimulating flower bud differentiation, shown in the underlined part 3 ? Choose the proper one among A-E and put its letter in the designated space (IV-3) of the answer sheet.

A dormancy B maturation C photoperiodism

D tropism E vernalization

4. Regarding the cultivation of crops originated at the tropics or subtropics in cool and temperate zones, shown in the underlined part 4, choose the incorrect one among A-D and put its letter in the designated space (IV-4) of the answer sheet.

- A Varieties with a long cultivation period were selected to compensate for low temperature and solar radiation in cool and temperate zones.
- B Varieties with early flowering were selected to avoid low temperature in autumn in cool and temperate zones.
- C Varieties with little short-day requirement for flowering were selected, because the day length in summer is long in cool and temperate zones.
- D Varieties with early growth were selected, because summer is short in cool and temperate zones.

5. Regarding the cultivation of temperate crops in low latitude tropics, as shown in the underlined part 5, choose the incorrect one among A-D and put its letter in the designated space (IV-5) of the answer sheet.

- A It is difficult to cultivate grain-harvested crops that require long day conditions for flowering in low latitude tropics.
- B It is difficult to cultivate grain-harvested crops that require long-term low temperature for flowering in low latitude tropics.
- C As it is relatively cool in tropical highlands, it is possible to cultivate temperate crops there to some extent.
- D If heat-tolerant varieties are selected, crops originated at Mediterranean areas can be cultivated without any problems.

V Choose a suitable term that matches the following phrases 1-6 from the subsequent term list, and put their letters in the designated spaces (V-1~6) of the answer sheet.

1 A base of nucleic acid included in RNA and not included in DNA

- A adenine B cytosine C guanine
D thymine E uracil

2 Number of ATP molecules synthesized by alcohol fermentation

- A 1 B 2 C 4 D 34 E 36

3 An organ derived from the mesoderm

- A crystalline lens B cerebrum C stomach
D liver E lung F esophagus

4 Relationship between two species in which the abundance of both species decreases

- A commensalism B competition C mutualism
D parasitism E predation

5 A plant that bears seeds and exposes the ovule

- A cherry tree B dandelion C flowering fern
D pine E rose

6 An animal without a backbone that belongs to the Deuterostomia

- A coelacanth B lamprey C paramecium
D planarian E sea anemone F sea cucumber