

2006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 2006

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 Answer the following questions 1 – 4.

- 1 The following passage describes how genetic information is transmitted in biological organisms. Choose the proper words from the choices ① listed below that indicate the processes explained by the underlined parts (1) and (2), and fill the blanks (1)~(5) in the passage by choosing the proper ones from the choices ② listed below. Put their letters in the designated spaces (I - 1 - ① (1) ~ (2), ② (1)~(5)) of the answer sheet.

The transmission process of genetic information needs a process to retain⁽¹⁾ the genetic information coded on DNA sequences in the beginning, whereby the same DNA sequences are reproduced. Subsequently RNA called [(1)]⁽²⁾ is formed on the basis of the genetic information of DNA to manifest different characters. Thereafter the genetic code is [(2)] to form [(3)]. In this process, RNA that reads codons on [(1)] to carry suitable [(4)] is called [(5)].

Choices ① :

A substiution B unification C transcription D replication

Choices ② :

A translated B mRNA C amino acids D tRNA
E proteins F rRNA G carbohydrate

2 What RNA chain is formed from the following DNA template chain? Put the obtained RNA chain in the designated space (I - 2) of the answer sheet. Read the code from left to right.

T-A-C-C-G-G-G-C-T-T-C-G

3 Use the genetic code reference table below and build the amino acid arrangement of the protein built by the RNA chain obtained in question 2, and put in the designated space (I - 3) of the answer sheet. This genetic code corresponds to a four amino acid arrangement.

Codon	Amino acid	Codon	Amino acid	Codon	Amino acid	Codon	Amino acid
UUU	Phenylalanine	UCU	Serine	UAU	Tyrosine	UGU	Cysteine
UUC	Phenylalanine	UCC	Serine	UAC	Tyrosine	UGC	Cysteine
UUA	Leucine	UCA	Serine	UAA	Stop codon	UGA	Stop codon
UUG	Leucine	UCG	Serine	UAG	Stop codon	UGG	Tryptophan
CUU	Leucine	CCU	Proline	CAU	Histidine	CGU	Arginine
CUC	Leucine	CCC	Proline	CAC	Histidine	CGC	Arginine
CUA	Leucine	CCA	Proline	CAA	Glutamine	CGA	Arginine
CUG	Leucine	CCG	Proline	CAG	Glutamine	CGG	Arginine
AUU	Isoleucine	ACU	Threonine	AAU	Asparagine	AGU	Serine
AUC	Isoleucine	ACC	Threonine	AAC	Asparagine	AGC	Serine
AUA	Isoleucine	ACA	Threonine	AAA	Lysine	AGA	Arginine
AUG	Methionine Start codon	ACG	Threonine	AAG	Lysine	AGG	Arginine
GUU	Valine	GCU	Alanine	GAU	Asparate	GGU	Glycine
GUC	Valine	GCC	Alanine	GAC	Asparate	GGC	Glycine
GUA	Valine	GCA	Alanine	GAA	Glutamate	GGA	Glycine
GUG	Valine	GCG	Alanine	GAG	Glutamate	GGG	Glycine

4 When there is a protein composed of the amino acid arrangement methionine-asparate-threonine-serine, how many base arrangements of DNA corresponding to this are there at most? Use above genetic code table as a reference, and put a numeral value in the designated space (I - 4) of the answer sheet.

II The following passage describes cellular respiration. Answer the subsequent questions 1 to 3.

The process of aerobic respiration is largely divided into three stages, (1), (2), and (3). In the first stage (1), glucose is broken into two molecules of (4). In the second stage (2), (4) is first converted to acetyl CoA which adds its two-carbon fragment to oxysaloacetate to produce (5). Subsequent steps of (2) decompose (5) back to oxysaloacetate, giving off CO₂ as “exhaust”. In the final stage (3), hydrogen atoms derived from steps in the first two stages are finally combined with (6) to form water, and a lot of energy is released in this stage.
(1)

1 Choose terms that match to the blanks of the passage above from the following list, and put the letters in the designated spaces (II-1-(1)~(6)) of the answer sheet.

- | | | |
|-------------------|-----------------------|----------------------------|
| A Calvin cycle | B carbon | C carbon dioxide |
| D citrate | E citrulline | F electron transport chain |
| G glycolysis | H hydrogen | I Krebs cycle |
| J lactate | K lactic fermentation | L nitrogen |
| M ornithine cycle | N oxygen | O pyruvate |

2 In what compound is the energy released in the underlined part (1) stored? Write the answer as three letters in the designated space(II-2) of the answer sheet.

3 In what part of the cell do the stages (1), (2), and (3) occur, respectively? Choose suitable sites from the following list, and put the letters in the designated spaces(II-3-(1)~(3)) of the answer sheet.

- | | |
|--------------------------------|-------------------|
| A cytosol | B Golgi apparatus |
| C inner mitochondrial membrane | D lysosome |
| E mitochondrial matrix | F nucleus |
| G plasma membrane | H plastid |

III Answer the following questions 1 and 2.

- 1 The following sentence describes the nervous system of an animal. Fill the blanks (1)~(10) in the passage by choosing the proper ones from the choices listed below. Put their letters in the designated spaces (III-1-(1)~(10)) of the answer sheet.

The nervous system of a vertebrate consists of the [(1)] nervous system and the peripheral nervous system. The brain and [(2)] belong to the former. The human brain is classified into the cerebrum, the midbrain, the interbrain, the cerebellum, and the medulla oblongata. The cerebrum is morphologically divided into two areas, [(3)] outside and [(4)] inside. The [(3)] is the area where the [(5)] of neurons gather, and the [(4)] is the area where the [(6)] of neurons gather. The brain stem is a general term given to the three portions of the brain, the midbrain, the interbrain, and the medulla oblongata, and contains the center of functions that are directly associated with life maintenance. The interbrain consists of the [(7)] and the [(8)], and the [(7)] is where the signal from a receptor is relayed to the cerebrum. The [(8)] is the center of the [(9)] nervous system, and it is connected with the [(10)], and plays an important role in the endocrine system. The [(10)] is an important endocrine gland which secretes several sorts of hormones including the growth hormone.

Choices :

- | | | |
|---------------------------|-------------------------|--------------------|
| A white matter or medulla | B hypophysis | C cell bodies |
| D an autonomic | E hypothalamus | F medulla spinalis |
| G thalamus | H nerve fibers or axons | |
| I central | J gray matter or cortex | |

2 The human brain is classified into five portions. Choose the portion which carries out work like the following (1) ~ (10) from the choices (A~E) which show the cerebral classification, and put their letters in the designated spaces (Ⅲ-2-(1) ~ (10)) of the answer sheet.

- (1) Regulation of heart beat
- (2) Regulation of temperature, blood pressure
- (3) Expansion and contraction of a pupil
- (4) Regulation of secretion of saliva
- (5) Performing an intellectual moral action
- (6) Maintaining bodily balance
- (7) Unifying sensory information
- (8) Regulation of breathing movements
- (9) Regulation of optional movements
- (10) Regulation of the movement of an eyeball

Choices :

- | | | |
|--------------|---------------------|--------------|
| A cerebrum | B midbrain | C interbrain |
| D cerebellum | E medulla oblongata | |

IV The following passage describes the homing behavior of a wasp. Answer the subsequent questions 1 to 3.

Females of a digger wasp, *Philanthus triangulum*, excavate their burrows on sand dunes, and transport there hunted prey (honey bees) on which they lay eggs. When a wasp leaves her burrow to go hunting, she covers up the opening by raking sand over it, hiding it from view, and yet when she comes back, she darts directly to her hidden nest entrance. How does a female wasp locate her hidden nest entrance? Niko Tinbergen, an ethologist, addressed this problem, carrying out the following experiments.

[Experiment 1] Twenty dried pinecones were arranged in a ring around a nest entrance (Fig.1 A). After the owner wasp had made several hunting trips, while she was off for hunting, the ring of pinecones was moved 30 cm from the nest (Fig.1 B). When the owner returned, the sites where she landed were observed. Table 1 shows numbers of landings on the real nest and the false nest (the moved ring).

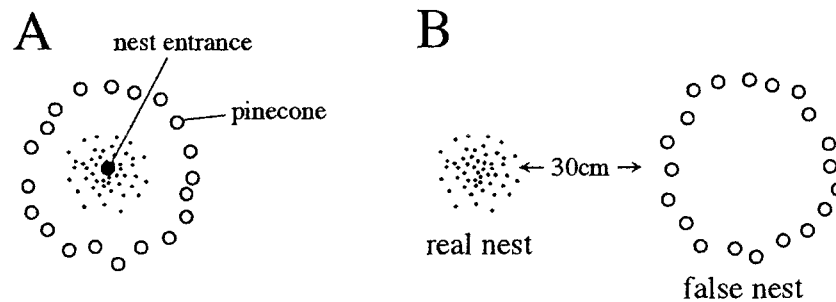


Figure 1

Table 1

wasp code	real nest	false nest
1	0	9
2	0	6
3	0	7
4	0	5
5	0	5
total	0	32

[Experiment 2] In this experiment, pieces of cardboard soaked with pine oil having a fragrance specific to pine were placed near the nest entrance along with a ring of pinecones (Fig. 2 C). In the absence of the owner, only the ring of pinecones was moved, and pieces of cardboard without pine oil were placed in this false nest (Fig. 2 D). The results are shown in Table 2.

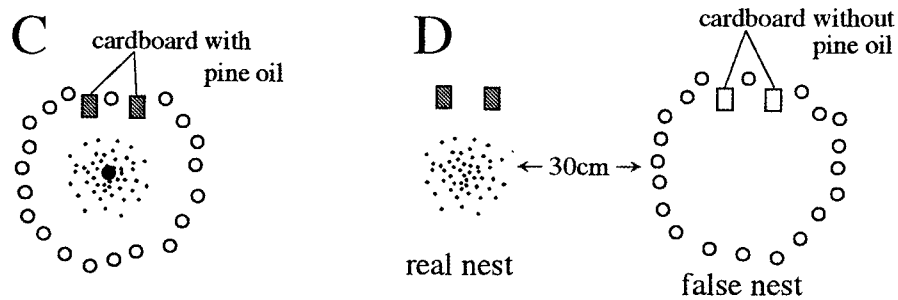


Figure 2

Table 2

wasp code	real nest	false nest
18	0	5
19	0	5
20	0	6
21	0	8
22	0	5
total	0	29

- 1 What can be concluded from the results obtained in the two experiments? Choose the most suitable sentence from the choices listed below, and put the letter in the designated space (IV-1) of the answer sheet.
- 2 If the results in Experiment 2 (Table 2) were perfectly reversed between the real nest and the false nest, what could have been concluded from these results and those of Experiment 1? Choose the most suitable sentence from the choices listed below, and put the letter in the designated space (IV-2) of the answer sheet.

Choices :

- A The wasp locates her nest by an optical cue.
 - B The wasp locates her nest by an olfactory cue.
 - C The wasp locates her nest by optical and olfactory cues of equal effect.
 - D The wasp locates her nest by both optical and olfactory cues, putting emphasis on the former.
 - E The wasp locates her nest by both optical and olfactory cues, putting emphasis on the latter.
- 3 What process is thought to participate in the homing behavior of this wasp from these experiments? Choose two suitable terms from the following list, and put their letters in the designated spaces (IV-3) of the answer sheet.

- A chemotaxis
- B color sense
- C learning
- D memory
- E phototaxis
- F sun-compass

V Choose the most suitable items from the lists, and put the letters in the designated spaces (V-1 ~ 6) of the answer sheet.

- 1 If the red flower and white flower of a certain plant are crossed, all the flowers of F_1 become pinkish. When mutually crossing these F_1 , what ratio does F_2 show as to red flower : pinkish flower : white flower?

- A 1 : 1 : 0
- B 9 : 3 : 1
- C 1 : 1 : 1
- D 1 : 2 : 1
- E 3 : 2 : 1

- 2 A plant with fertilization mode with a sperm

- A Japanese oak
- B cosmos
- C ginkgo tree
- D dandelion
- E pine
- F orchid
- G hibiscus

3 A plant which performs double fertilization

- A cherry tree B moss C cycas
D ginkgo tree E horsetail F pine
G lycopod

4 The ecosystem that has the highest net primary productivity among those listed below

- A agricultural garden B lakes and streams
C open ocean D temperate deciduous forests
E temperate grassland F tropical rain forests

5 The approximate quantity of carbon emitted in the atmosphere per year by human activities

- A 5×10^5 t B 5×10^6 t C 5×10^7 t
D 5×10^8 t E 5×10^9 t F 5×10^{10} t

6 The environmental problem resulting from carbon dioxide

- A acid rain B warming
C reduction of tropical forest D desertification
E destruction of the ozone layer F eutrophication