I. Read the following passage and answer the subsequent questions using the answer sheet.

As widely known, genetic information is transferred through a nucleic acid, [1]. [1] is a macro molecule in which large number of nucleotides, consisting of [2], deoxyribose and four kinds of [3], are combined. In a [1] molecule, the portions of [2] and deoxyribose form a long chain, and two such chains face each other, intertwined and connected horizontally by two [3], with the special combinations of [4] and [5] or [6] and [7] showing the [8] structure. Generally in higher plants, [1]s form chromosomes and are located in [9] in cells, but $_1$ some [1]s are found in other organelles.

[1] includes basic information for organisms; information to synthesize proteins. Within a [1] molecule, it is [3] that contain information to synthesize proteins and function as genes. Information in [1] located in [9] is transferred to [10], one of organelles, enabling specific proteins to be synthesized. Thus, for gene expression two processes are necessary; $_2$ a process, in which necessary information in [1] is copied to [11], and $_3$ another process, in which specific proteins are synthesized based on the copied information.

[3] encode the information of amino acid synthesis necessary for protein synthesis by their arrangements. $_4$ Each amino acid is encoded by the various combinations of [3]. Four kinds of [3] are capable of producing 64 cryptic codes, indicating 20 amino acids and codes for the start and cessation of amino acid synthesis.

1. Fill in the blanks ([1]–[11]) in the above passage from the list given below and record the appropriate letter (A–Z) in the designated space (I–1 (1)~(11)) on the answer sheet.

A	adenine	B	adenosine	C	ADP
D	ATP	E	cortex	F	cytosine
G	DNA	H	double helical	I	endoplasmic reticulum
J	fatty acids	K	Golgi body	L	guanine
M	lysosome	N	malates	O	nuclei
P	nucleobases	Q	NADP	R	oxaloacetates
S	phosphate	T	pyruvates	U	ribosome
V	RNA	W	single helical	X	stairs
Y	thymine	Z	uracil		

2. From the following sentences select the phenomenon that is considered to be caused by genes located outside [9], as described in the underlined part 1, and record the letter (A–D) in the designated space (I–2) on the answer sheet.

A Maize ears sometimes bear kernels with diversified color.

B When a male sterile maize variety was crossed with a normal variety, all F_1 plants showed male sterility. When the F_1 plants were crossed with the same normal variety, all the next-generation plants also showed male sterility.

C When a wild species resistant to a disease, closely related to maize, was crossed with a maize variety sensitive to this disease, all F_1 plants were sensitive to this disease. When the F_1 plants were crossed with the same wild species, sensitive and resistant plants appeared at the ratio of 1:1 in the next generation.

D When a red-flowered morning glory variety was crossed with a white-flowered morning glory variety, all the F_1 plants bore pink flowers.

3. What do you call the processes shown in the underlined parts 2 and 3 respectively? Select answers from the list of phrases given below and record the appropriate letter (A–E) in the designated space (I–3 (1) (underlined part 2) and (2) (underlined part 3)) on the answer sheet.

A messenger	B metabolism	C transcription
D transfer	E translation	

4. As shown in the underlined part 4, synthesized amino acids are encoded by the various combinations of [3]. How many [3] are necessary to determine one kind of amino acid? Put the numerical value in the designated space (I–4) of the answer sheet.

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

Plant cells differ from animal cells on many points. Firstly, plant cells are surrounded by the structure called [1], unlike animal cells. [1] consist mostly of cellulose, hemi-cellulose and lignin, which support the plant structure. [1] also play the role of being a pathway for water and nutrition in the plant body. Soil water containing nutrition is absorbed by roots, transported to aboveground organs and provided to each organ. $_1$At that time, water passes through xylem, intercellular spaces and [1]. Water, which is transported through interconnected [1], passes through [2] and finally enters into the cells. [2] are phospholipid bilayers with flexibility and $_2$various [3] are embedded.

A second difference between plant cells and animal cells is the existence of [4] in the former. $_3$[4] are one of the organelles, and are surrounded by phospholipid membrane and are responsible for photosynthesis. [4] contain large amounts of pigment

called [5]. The green color of plant leaves is generally caused by this pigment.

The third point of difference is the existence of [6]. [6] are also one of organelles and similar to other organelles in that they are surrounded by phospholipid membranes. 4[6] make up a large volume of the matured plant cell.

1. Fill in the blanks ([1]–[6]) in the above passage from the list of phrases given below and record the appropriate letter (A–Z) in the designated space (II–1 (1)~(6)) on the answer sheet.

A anthocyanin	B carbohydrates	C carotene
D cell walls	E centrosomes	F chlorophyll
G chloroplasts	H lipids	I lycopene
J mitochondria	K nuclear membranes	L peroxisome
M plasma membranes	N proteins	O vacuoles

2. The underlined section 1 is concerned with the movement of water in the plant body. Which of the following sentences is incorrect? Record the letter (A–D) of the incorrect sentence in the designated space (II–2) on the answer sheet.

A Water forms a continuous flow after being absorbed in at the roots until transpired mainly at the stomata.

B Water mainly passes through the outsides of the cells, because the resistance is smaller than passing through the insides of the cells.

C Water moves from tissues with higher osmotic pressure to those with lower osmotic pressure.

D The driving force of water movement in the plant body is the transpiration from the leaves. For this reason, there is little water movement at night.

3. As a function of [3], described in the underlined section 2, select the most appropriate of the following descriptions and record the appropriate letter (A–D) in the designated space (II–3) on the answer sheet.

A To detach from [1]

B A pathway of nutrients or water

C To strengthen the structure of membranes

D To fix the morphology of cells

4. Which of the following statements is incorrect in relation to [4] described in the underlined section 3. Record the letter (A–E) of the incorrect statement in the designated

space (II–4) on the answer sheet.

A [4] have a double membrane structure.
B Biosynthesis of carbohydrates by the Calvin cycle occurs in the stroma.
C ATP synthesis by the electron transfer system occurs in the stroma.
D Photochemical reactions occur in the thylakoid membrane.
E Decomposition of water occurs in the thylakoid membrane.

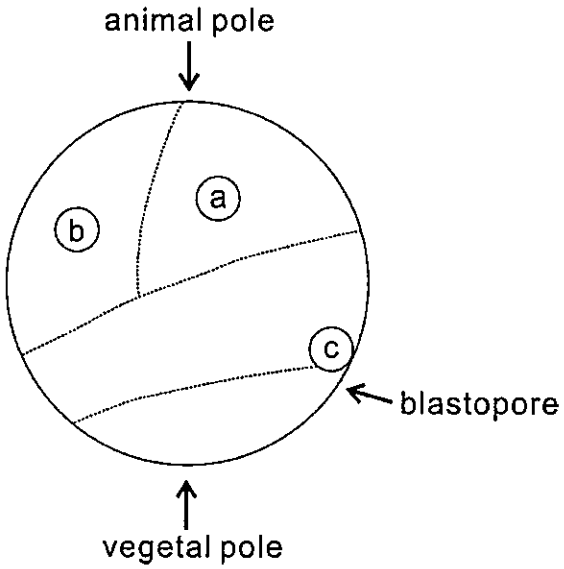
5. Which of the following statements is incorrect in relation to the function of [6], described in the underlined part 4. Record the letter (A–E) of the incorrect statement in the designated space (II–5) on the answer sheet.

A To isolate unnecessary salts from other parts of the cell, as frequently observed in halophytes (plants adapted to salt-accumulated soils)
B To keep turgor pressure by absorbing osmotic materials like salts during the drought period
C To keep appropriate concentration of cytoplasm by absorbing surplus water
D To synthesize proteins
E To absorb wastes and isolate it from the cytoplasm

III. Read the following passage and answer the subsequent questions 1–6.

In order to understand the mechanism of embryonic development, experiments I-V were performed on a gastrula of a newt. See the diagram below for reference.

Experiment I: A piece cut out from region **a** of an early gastrula was transplanted to region **b** of another early gastrula. The transplant developed to [1].
Experiment II: A piece cut out from region **b** of an early gastrula was transplanted to region **a** of another early gastrula. The transplant developed to [2].
Experiment III: A piece cut out from region **a** of a late gastrula was transplanted to region **b** of another late gastrula. The transplant developed to [3].
Experiment IV: A piece cut out from region **b** of a late gastrula was transplanted to region **a** of another late gastrula. The transplant developed to [4].
Experiment V: A piece cut out from region **c** of an early gastrula was transplanted into the blastocoel beneath region **b** of another early gastrula. The transplant developed to [5] and [6], and region **b** developed to [7] as a result of the influence of the transplant.



1. Choose the most suitable terms that match the blanks ([1]~[7]) in the passage from A–E, and record the letters in the designated spaces (III–1(1)~(7)) on the answer sheet.

   A digestive tract
   B epidermis (skin)
   C muscle
   D neural plate
   E notochord

2. What do you call the process by which an embryonic region directs a neighboring region to develop to a particular tissue as the transplant in Experiment V indicates? Choose the most appropriate answer from A–E and record the letter in the designated space (III–2) on the answer sheet.

   A determination
   B differentiation
   C fate map
   D growth
   E induction

3. What is the name of the embryonic region that directs a neighboring region to develop to a particular tissue as the transplant in Experiment V indicates? Choose the most appropriate answer from A–E and record the letter in the designated space (III–3) on the answer sheet.

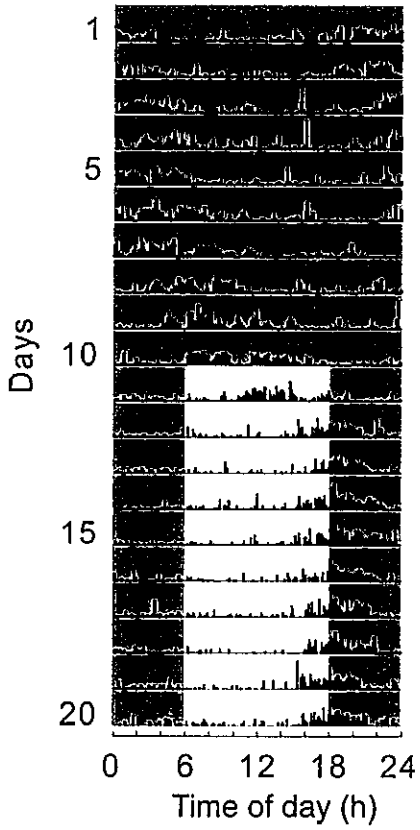
   A effector
   B germ layer

C producer
D organizer
E receptor

4. What is the name of the scientist who first performed these experiments? Choose the correct answer from A–E and record the letter in the designated space (III–4) on the answer sheet.
   A Driesch
   B Gurdon
   C Roux
   D Spemann
   E Vogt

IV. Read the following passage and answer the subsequent questions 1–6.

An adult cricket was kept in the laboratory at a constant temperature in constant darkness during the first 10 days and under a regime of 12-h light and 12-h darkness (06:00-18:00 lights on) during the subsequent 10 days. The locomotor activity of this cricket was recorded as the number of interruptions of the infrared beam (black bars in the figure). While in constant darkness, the active phase was delayed by about 1.5 h every day. One day after the transfer to light-day cycles, the active period became almost the same for every day. These results indicate that the period of the activity rhythm in this cricket is about [1] h, and that the active phase in a day is determined predominantly by the [2]. The [2] is shown by various organisms including humans.



1. Record the numerical value for blank [1] in the designated space (IV–1) on the answer sheet.

2. Choose the most suitable phrase or word that matches the blank [2] from A–E and record the letter in the designated space (IV–2) on the answer sheet.
   - A response to temperature
   - B direct response to light
   - C combination of responses to temperature and light
   - D circadian rhythm
   - E photoperiodism

3. In the field, when is this cricket active in a day? Choose the most appropriate answer from A–D and record the letter in the designated space (IV–3) on the answer sheet.
   - A morning
   - B mid-day
   - C evening
   - D mid-night

4. After the above experiment, this cricket was kept under 12-h light and 12-h darkness (00:00-12:00 light on) for an additional 10 days. During these 10 days, which pattern of

activity did this cricket present? Choose the most appropriate answer from A–D and record the letter in the designated space (IV–4) on the answer sheet.

A The same activity pattern continues as seen in days 11-20.
B The active phase immediately advances by 6 h.
C The active phase gradually changes, and finally the active phase becomes earlier by 6 h than that in days 11-20.
D The active phase is delayed by 1.5 h each day as in days 0-10.

5. Typical phenomena that humans display every day are the sleep-wakefulness rhythm and a daily fluctuation of body temperature. Which is determined by the [2]? Choose the most appropriate answer from A–D and record the letter in the designated space (IV–5) on the answer sheet.

A The [2] determines the sleep-wakefulness rhythm but not the daily fluctuation of body temperature.
B The [2] determines the daily fluctuation of body temperature but not the sleep-wakefulness rhythm.
C The [2] determines both the sleep-wakefulness rhythm and the daily fluctuation of body temperature.
D The [2] does not determine either the sleep-wakefulness rhythm or the daily fluctuation of body temperature.

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 phenomenon causing seeds not to germinate even under favorable conditions

A aging B development C dormancy
D maturation E wilting

2 A structure that covers leaf surface

A cambium B Casparian strips C cuticle
D palisade tissue E phloem

3 A gymnosperm plant

A Japanese black pine B mango C morning glory
D rhododendron E soybean

4 An area occupied and defended consistently by an animal or animals

A ecosystem B nest C niche

D population E territory

5 A phylum to which trilobites belong

A Annelida B Arthropoda C Echinodermata
D Mollusca E Platyhelminthes

6 A hormone that is produced by the pancreas and decreases the blood sugar

A adrenalin B glucagon C glucose
D glycogen E insulin