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

The first organism on the earth is thought to have been a single-cell microorganism such as a bacteria. When life on earth began, the atmospheric composition was very different from today and contained little [1]. This means that the first organism appeared under [2] conditions and $_1$ its activities were supported by the energy obtained from [2] respiration, not from [3] respiration, which is the dominant mode in present-day organisms. After the appearance of organisms that obtained energy for supporting their life $_2$ by the process in which the fixation of [4] and release of [1] occurs, the concentration of atmospheric [1] had already increased, resulting in the evolution of organisms practicing [3] respiration. Since organisms started to live on the ground, organisms practicing [3] respiration gradually dominated the earth. [3] respiration enabled $_3$ efficient production of [5], chemical energy essential for various metabolisms, and contributed to the flourishing of organisms on the earth.

In ancient times, some [3] bacteria was absorbed into the body of some [2] bacteria, survived in the body of the [2] bacteria without being digested, received nutrition from the [2] bacteria and practiced [3] respiration using [1] produced in the body of the [2] bacteria, gaining energy not only for self-consumption, but also for supplying the [2] bacteria. Both bacteria strengthened their mutual dependence and the [3] bacteria finally evolved into an organelle [6], whose major role is [3] respiration. Such a relationship is called [7]. [8] is another example of such evolutionary development of an independent microorganism into one of the organelles in the body of different organisms through [7] .

1. Fill in the blanks ([1]−[8]) in the above passage from the list given below and record the appropriate letters (A−U) in the designated spaces (I−1 (1)~(8)) on the answer sheet.

A	acidic	B	ADP	C	aerobic
D	anaerobic	E	ATP	F	basic
G	carbon dioxide	H	chloroplast	I	DNA
J	electron	K	endoplasmic reticulum	L	epiphytic
M	hydrogen	N	lysosome	O	mitochondria
P	nitrogen	Q	oxygen	R	parasitism
S	RNA	T	symbiosis	U	vacuole

2. Which of the following sentences is incorrect as an explanation of [2] microorganisms shown in the underlined part 1 above? Record the letter (A−D) of the incorrect sentence in the designated space (I−2) on the answer sheet.

A Some of them produce alcohol by fermentation.
B They generally die when the soil is waterlogged.
C Generally they are found more frequently in paddy fields than in upland fields.
D Some of them can tolerate very high temperatures.

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

A glycolysis B meiosis C mitosis
D nitrogen fixation E photosynthesis

4. Regarding the underlined part 3, theoretically how many times more efficient is the production of [5] through [3] respiration in comparison to that of [2] respiration? Select the answer from the list of phrases given below and record the appropriate letter (A−E) in the designated space (I−4) on the answer sheet.

A 3 times B 6 times C 9 times D 18 times E 36 times

5. Both [6] and [8] are considered to have evolved from independent microorganisms to organelles. Three of the following statements are the basis for this hypothesis. Select the incorrect statement from the four and record the appropriate letter (A−D) in the designated space (I−5) on the answer sheet.

A They have their own genes independent from nuclear ones.
B They have a double membrane structure.
C There is only one of them in a cell.
D They divide themselves.

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

Fern plants that we are usually able to observe are mostly [1], which form spores in sporangium on leaves. Spores fly out of the plant after drying, germinate in an appropriately humid place, and form [2]. [2] of fern are called [3]. Sperms synthesized in [4], formed on [2], move to [5], similarly formed on [2] and fertilize there with an egg. A fertilized egg develops into [1], $_1$ differentiating stems, leaves and roots.

There are [6] and [7] in seed plants, which have evolved from ferns. In [6] ovules are exposed, but in [7] they are protected by ovaries. Flowers are the reproductive organs of [7] and consist of calyxes, petals, stamens and pistils. In [8] at the tip of the stamen, pollens containing male gametes, are produced. In [8] pollen-mother cells are divided and mature pollens are developed through pollen tetrad. In pistils, egg cells containing female gametes are developed. Embryo-sac-mother cells are divided, resulting in the formation of embryo-sacs. A mature embryo-sac has an $_2$ egg cell, synergids, antipodes and a central cell containing 2 polar nuclei. A mature pollen contains a pollen-tube nucleus and 2 sperm, germinates on the stigma and extends a pollen tube. The pollen tube develops in the style and when it reaches the embryo-sac, one sperm fertilizes with the egg cell and the other sperm with the central cell. Fertilization with the egg cell produces embryo and with central cell produces [9]. Thus, in [7] two fertilization processes occur simultaneously and this is called double fertilization. $_3$ In [6], fertilization occurs basically in a way similar to that of [7], but it includes some differences.

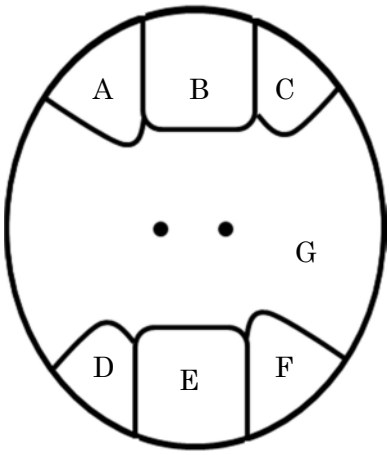
1. Fill in the blanks ([1]−[9]) in the above passage from the list given below and record the appropriate letters (A−W) in the designated spaces (II−1 (1)~(9)) on the answer sheet.

A	algae	B	angiosperms	C	anthers
D	antheridia	E	archegonia	F	bryophytes
G	cotyledons	H	endosperm	I	epiphytic
J	gametophytes	K	gymnosperms	L	halophytes
M	hygrophytes	N	hypocotyls	O	mesophyte
P	lichen	Q	pericarp	R	prothalli
S	protonema	T	sporophytes	U	testa
V	thalli	W	xerophytes		

2. Stems, leaves and roots, described in the underlined part 1, are connected by conducting tissues. What do we call these tissues? Select the answer from the list of phrases given below and record the appropriate letter (A-E) in the designated space (II−2) on the answer sheet.

A	annual ring	B	apical meristem	C	cambium
D	Casparian strip	E	vascular bundle		

3. The figure shown below indicates a mature embryo-sac. Which of the letters indicates the egg cell described in the underlined part 2? Select the correct letter from the figure and record the appropriate letter (A−G) in the designated space (II-3) on the answer sheet.



Figure

4. As shown in the underlined part 3, there are some differences in the process of reproduction of [6] and [7]. Among the following statements on the reproduction process of [7], select a statement that cannot be applied to [6], and record the appropriate letter (A-D) in the designated space (II-4) on the answer sheet.

A Pollen-mother cells develop into mature pollens through pollen tetrad.
B Double fertilization is the major mode of fertilization.
C An embryo-sac is developed from the embryo-sac-mother cells.
D After pollination, pollens develop pollen tubes.

5. The genome of diploid plants is shown as “2n”. As such, how are the genomes of pollens (II-5-(1)), embryo (II-5-(2)) and [9] (II-5-(3)) expressed? Select the appropriate answers from the following and record the letters (A−E) in the designated spaces (II-5-(1)~(3)) on the answer sheet.

A “n” B “2n” C “3n” D “4n” E “6n”

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

Animals oxidize organic substances in food and obtain energy from it. The table below shows the values of oxygen consumption, respiratory quotient, and obtained energy when 1g of one of the three major nutrients is oxidized in the body of a mammal. The respiratory quotient is calculated from the ratio of carbon dioxide volume eliminated to oxygen volume consumed when an organic substance(s) is oxidized during a certain period within a body of an organism. When 1.0 g of fat is oxidized in this mammal, [1] L of carbon dioxide is eliminated. When 60 L of oxygen is consumed, 54 L of carbon dioxide is eliminated, and 3.0 g of protein is oxidized during a certain period of time, we can estimate that [2] g of carbohydrate and [3] g of fat are oxidized in this period.

Table

oxidized substance	oxygen consumption (L/g)	respiratory quotient	obtained energy (kcal/g)
carbohydrate	0.84	1.0	4.2
fat	2.0	0.7	9.4
protein	0.96	0.8	4.3

1. Choose the most suitable numeral values that match the blanks ([1]−[3]) in the above passage from A–H, and record the letters in the designated spaces (III–1(1)〜(3)) on the answer sheet.

A	0.7	B	1.2	C	1.4	D	2.9
E	9.0	F	10.0	G	46.5	H	47.6

2. When these substances are oxidized not in an organism’s body but in a test tube, how much energy is obtained compared to the values in the above table? Choose the most

appropriate answer from A–E and record the letter in the designated space (III–2) on the answer sheet.

A The energy obtained is higher than indicated in the table for all three substances.
B The energy obtained is higher than that in the table only for protein, and the values are the same for carbohydrate and fat.
C The energy obtained is lower than that indicated in the table only for protein, and the values are the same for carbohydrate and fat.
D The energy obtained is higher than that indicated in the table only for fat, and the values are the same for carbohydrate and protein.
E The energy obtained is lower than that indicated in the table only for fat, and the values are the same for carbohydrate and fat.

3. Fat is a typical storage material in animals. Choose the most suitable reason for this from A–D, and record the letter in the designated space (III–3) on the answer sheet.

A Fat has the highest oxygen consumption (L/g) among the three substances.
B Fat has the lowest respiratory quotient among the three substances.
C Fat has the highest obtained energy (kcal/g) among the three substances.
D Oxidation of fat produces carbon dioxide and water only.

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

The eye color of the fruit fly, *Drosophila melanogaster*, is genetically determined. The wild-type gene (red eye) is dominant, and the white-eye gene is recessive. The base sequence of the initial portion of the wild-type gene is as follows, where each capital letter represents a base of DNA and -3' and-5' show the direction:

3'-AGGGCCGTTACCCGGTTCTCCTA…….-5'

1With this DNA as a template, mRNA is synthesized. This process is called [1]. Then, a protein is synthesized based on the sequence of this mRNA from the 5' terminal. This process is called [2]. The protein synthesis starts at the first sequence that corresponds to methionine, and stops at one of the three sequences for "stop".

1. Choose the most suitable base sequence synthesized in the underlined statement 1 from A–E, and record the letter in the designated space (IV–1) on the answer sheet.

A 5’-AGGGCCGUUACCCGGUUCUCCUA…….-3’
B 5’-UCCCGGCAAUGGGCCAAGAGGAU…….-3’
C 5’-CUUUAAUGGCAAAUUGGAGAAGC…….-3’
D 5’-GAAAUUACCGUUUAACCUCUUCG…….-3’
E 5’-AUCCUCUUGGCCCAUUGCCGGGA…….-3’

2. Choose the most suitable terms that match the blanks [1] and [2] from A–E, and record the letters in the designated spaces (IV–2(1)～(2)) on the answer sheet.

A differentiation
B replication
C transcription
D transformation
E translation

3. Choose the most suitable sites in the cell where the processes [1] and [2] occur, and record the letters in the designated spaces (IV–3(1)～(2)) on the answer sheet.

A cell membrane
B centrosome
C Golgi body
D nucleus
E ribosome

4. Choose the name of the fourth amino acid from the first methionine of the synthesized protein from A–E below referring to the genetic code dictionary, and record the letter in the designated space (IV–4) on the answer sheet.

A alanine
B arginine
C glutamine
D glutamic acid
E tryptophan

5. In wild-type flies, this protein is composed of approximately 600 amino acids. In white-eye flies, however, a mutation exists on the above-shown part of the gene, and the product of the gene is very short and does not function. Choose the most suitable base sequence of the gene in white-eye flies from A–E, and record the letter in the designated space (IV–5) on the answer sheet.

A 3’-GGGGCCGTTACCCGGTTCTCCTA…….-5’
B 3’-AGGGCCGTTACCCGGTCCTCCTA…….-5’
C 3’-AGGGCCGTTACCCGGTTATCCTA…….-5’
D 3’-AGGGCCGTTACCCGGTTCTTCTA…….-5’
E 3’-AGGGCCGTTACCCGGTTCTCCTG…….-5’

Genetic code table

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

V. Choose the most suitable biological 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 that describes how land is degraded with lack of succession under relatively dry conditions

A cooling B desertification C eutrophication
D extinction E warming

2. Partial exchanges that occur between homologous chromosomes

A apomixes B crossing-over C parthenocarpy
D splicing E xenia

3 The main component of cell wall

A anthocyan B cellulose C cutin D lipid E tannin

4 The trophic level at which the earthworm resides in the ecosystem

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

5 An organ derived from the ectoderm in the development of vertebrates

A brain B gill C lung
D notochord E skeletal muscle

6 A cell that produces immunoglobulin

A erythrocyte B glomerular cell C hepatocyte
D lymphocyte E macrophage