

2019 Enrolment The 1<sup>st</sup>  
Japan University Examination  
**Biology**

Examination Date: November 2017

( 60 min )

**Do not open the examination booklet until the starting signal for the exam is given.**

**Please read the following instructions carefully.**

**Please fill in the examinee no. and name below.**

**Instructions**

1. The booklet contains 13 pages.
2. The answer sheet is one piece of one sided paper.
3. In the case that you notice there are parts in the booklet where the print is not clear or there are missing pages or misplaced pages, or the answer sheet is soiled, raise your hand to report to the invigilator.
4. There are 5 questions to be answered.
5. Fill the examinee no. and name in the answer sheet.
6. Use black pencil to write answers in the designated section in the answer sheet.
7. Memos and calculations can be written on the examination booklet.
8. When the signal to end the exam is given, check again to see that the examinee no. and name is filled in and submit the answer sheet and the examination booklet according to the invigilator's instructions.

Examinee'sNo.	Name



Question 1 Read the following article about plant organization and answer the following questions (Q1 ~ Q4).

Cut the leaves, stems and roots of an angiosperm plants, and then cut the stems and roots into thin slices perpendicular to the growing direction. For the leaves, cut them into thin slices in the vertical direction of the surface of the leaves, and cut the parallel direction of the surface of the leaves. Made the above slices into preparations 1 to 4, and observed the preparations with an optical microscope. Table 1 shows the results of the observation. In addition, "+" in Table 1 indicates that the structure shown in the table was observed, and "-" indicates that no structure shown in the table was observed.

Table 1

Structure	Preparation 1	Preparation 2	Preparation 3	Preparation 4
Guard cell	+	—	—	—
<span style="border: 1px solid black; padding: 2px;">a</span>	+	—	+	—
Sieve tube	+	+	+	b
Cambium	—	c	—	+
Fibril	—	—	—	+

Q1 Please choose one of the following from ① to ④ which is the most appropriate as a in Table 1.

- ① Cortex                      ② Epidermis                      ③ Spongy tissue                      ④ Pith

Q2 In table 1, b and c should be filled in the correct combination of symbols, please choose a correct answer from the following ① to ④.

- |   |   |   |   |   |   |
|---|---|---|---|---|---|
|   | b | c |   | b | c |
| ① | + | + | ② | + | — |
| ③ | — | + | ④ | — | — |

Q3 About leaves, please choose one of the following ① to ④ which is most appropriate as a combination of numbers of preparations in which slices cut thinly in the vertical direction of the surface of the leaves, and slices cut thinly in the parallel direction of the surface of the leaves.

	①	②	③	④
Slices cut thinly in the vertical direction of the surface of the leaves	1	1	2	3
Slices cut thinly in the parallel direction of the surface of the leaves	3	4	4	1

Q4 About the tissue of a plant, please choose the appropriate two descriptions from the following ① to ⑦, regardless of the order of the answers.

- ① The sieve tube belongs to the vascular bundle, and there is no cytoplasm in the cell.
- ② The cambium is a meristem and is involved in secondary growth.
- ③ The guard cell belongs to the epidermal system, and there is no chloroplasts in the cell.
- ④ The endodermis develop a cuticular layer on the outside of the cell to prevent dryness of the plant body.
- ⑤ The palisade parenchyma develops more intercellular space than the spongy tissue, and the intercellular space is filled with water.
- ⑥ Cell walls can not be seen above and below the cells in the vessels, which are the passages of water and nutrients absorbed by the roots.
- ⑦ In the cortex layer of the stem, cell division is performed actively.

Question 2 Read the following articles (A · B) about genes and please answer the questions below (Q1~Q3).

A The body of the gene is DNA, and the DNA has four kinds of base pairs (A、T、G、C). In 1953, Watson and Crick proposed double helix structure of DNA model based on the regularity on the amount of four types of constitutional unit found by Chargaff and the X-ray diffraction pattern of crystals of DNA shown from Wilkins.

Q1 Since DNA was discovered in the late 19th century, facts suggesting that DNA is the body of the gene have been reported. Please choose one of the following ① to ④ that is not appropriate as a description to suggest that the body of the gene is DNA.

- ① DNA is a long, thread-like molecule.
- ② Most of the DNA is contained in the nucleus of the cell.
- ③ In the same kind of organism, the DNA quantity of somatic cells is the same regardless of different tissues.
- ④ The DNA quantity of a gamete such as a sperm and an egg produced by meiosis is half of the DNA quantity of a somatic cell.

Q2 About the base pairs (A、T、G、C) which construct DNA, please choose the most appropriate description from the following ① to ⑥.

- ① In double-stranded DNA, if one of the corresponding positions is A, the other is T. And if one of the corresponding positions is G, the other is C.
- ② In double-stranded DNA, if one of the corresponding positions is A, the other is G. And if one of the corresponding positions is T, the other is C.
- ③ In double-stranded DNA, if one of the corresponding positions is A, the other is C. And if one of the corresponding positions is T, the other is G.
- ④ In each single-stranded DNA, the quantity of A and T, G and C are equal.
- ⑤ In each single-stranded DNA, the quantity of A and G, T and C are equal.
- ⑥ In each single-stranded DNA, the quantity of A and C, T and G are equal.

B In order to prove that the body of the gene is DNA, Hershey and Chase carried out the following **Experiment 1** and **Experiment 2** using bacteriophage (phage) which is a type of virus which infects the bacterium Escherichia coli and propagates.

**Experiment 1** They put labels on the phage protein with radioactive sulfur and added Escherichia coli suspension to infect. They then followed the phages while they infected Escherichia coli. Suspension of Escherichia coli was divided into 6 test tubes, one was not agitated, and the others were agitated for different time (0.5 minute, 1 minute, 2 minutes, 4 minutes, 8 minutes) using different blenders. Next, they divided the suspension of each test tube into a supernatant and a precipitate by a centrifuge, and measured the ratio of the radioactivity contained in each of the supernatant. After that, they checked whether phage growth could be seen or not.

**Experiment 2** They put labels on the phage protein with radioactive phosphorus, conducted an same experiment as Experiment 1, and measured the ratio of the radioactivity contained in each of the supernatant. After that, they checked whether phage growth could be seen or not.

Table 1 shows the results of **Experiment 1** and **Experiment 2**. And in **Experiment 1** and **Experiment 2**, even if the agitation time was extended, the survival rate of Escherichia coli immediately after agitation did not decrease and there was no effect on the growth of phage after that.

Table 1

Agitation time Used phage		0 min	0.5 min	1 min	2 min	4 min	8 min
		Experiment 1 Phage labelled with radioactive sulfur	5%	42%	67%	75%	80%
Experiment 2 Phage labelled with radioactive phosphorus		17%	20%	25%	30%	33%	33%

Q3 About the results of **Experiment 1** and **Experiment 2**, please choose the most appropriate two descriptions from the following ① to ⑥, Here, answers can be in any order.

- ① The reason for the increase in the radioactivity of the supernatant after agitation is that Escherichia coli was destroyed by Escherichia, and the labeled substances flowed out into the suspension.
- ② Even if the agitation time was extended, the growth of the phage was not influenced because the substances in Escherichia coli acted on the growth of the phage.
- ③ The reason why the survival rate of Escherichia coli did not decrease even if the agitation time was extended was because the growth of the phage was suppressed by agitation.
- ④ In **Experiment 1**, the reason for the increase in the radioactivity of the supernatant after agitation is that the DNA of the phage entered Escherichia coli.
- ⑤ In **Experiment 2**, the reason why the radioactivity of the supernatant did not increase was because the DNA of the phage entered Escherichia coli.
- ⑥ In **Experiment 2**, the reason why the radioactivity of the supernatant did not increase was because the protein of the phage did not enter Escherichia coli.

Question 3 Read the following article about photosynthesis and please answer the following questions (Q1 ~ Q4).

Plants utilize light energy to photosynthesize organic matter from carbon dioxide and water and release  .In addition, plants constantly perform aerobic respiration to decompose organic matter using  and obtain the energy which is necessary for life activities. The carbon dioxide respiration rate of a plant A at 15°C and 30°C was measured ( $\text{mgCO}_2/\text{leaf area } 100\text{cm}^2 \cdot \text{hr}$ ) by changing the intensity of light, and the results shown in Table 1 were obtained.

Table 1

Light intensity (klux)		0	1	2	4	6	8	10	12
Carbon dioxide respiration rate ( $\text{mgCO}_2/\text{leaf area } 100\text{cm}^2 \cdot \text{hr}$ )	15°C	-1	0	1	3	4	4	4	4
	30°C	-3	-2	-1	1	3	5	6	6

Q1 Choose one of the following from ① to ④ which is the most appropriate as  in the article above.

- ① Hydrogen            ② Nitrogen            ③ Oxygen            ④ Ammonia

Q2 About photosynthesis, please choose the most appropriate description from the following ① to ④.

- ① Oxygen generated by photosynthesis is derived from water.
- ② In the process of photosynthesis, ATP is synthesized using the energy of hydrogen which is moving from the stroma to the thylakoid membrane.
- ③ Chlorophyll absorbs green light energy more efficiently than the blue light energy or red light energy.
- ④ In the Calvin–Benson cycle, carbon dioxide binds to a substance of number 2 carbon atom and becomes a substance of number 3 carbon atom.

Q3 As a description of the measurement results in Table 1, please choose the most appropriate two descriptions from the following ① to ⑧, regardless of the order of the answers.

- ① Either at 15°C or 30°C, the respiration rate is the same.
- ② The respiration rate is influenced by the temperature, and the influence is smaller at 30°C than at 15°C.
- ③ The respiration and photosynthesis can not be operated under the condition of 15°C and 1 klux.
- ④ Either at 15°C or 30°C, it is in the state of light saturation at more than 5 klux.
- ⑤ When the light intensity is 6 klux, it is in the state of light saturation at 15°C, but it is not in the state of light saturation at 30°C.
- ⑥ The light saturation point is 1 klux at 15°C and 3 klux at 30°C.
- ⑦ The compensation point is 1 klux at 15°C and 3 klux at 30°C.
- ⑧ The compensation point is 6 klux at 15°C and 10 klux at 30°C.

Q4 When the light intensity is 10 klux, how many times is the rate of photosynthesis at 30°C as fast as that at 15°C? Please choose the most appropriate one from the following ① to ⑤.

- ① 1.0                      ② 1.2                      ③ 1.5                      ④ 1.8                      ⑤ 2.0

Question 4 Read the following articles (A· B) about animal's nerve and blood, please answer the following questions (Q1 ~ Q5).

A Animals receive external stimuli with receptors and convey information of stimulation to the central nervous system by peripheral nerves. The central nervous system processes the information and transmits appropriate instructions to [ a ] through the peripheral nerve, so that a reaction occurs in [ a ]. The nervous system contains a large number of neurons (nerve cells), and in the unstimulated neurons the inside of the cell membrane is potentially [ b ] to the outside. When the neuron is stimulated above the value of threshold, the potential inside and outside the membrane at the stimulated part will reverse and excitement occurs. In the axon, an action potential flows between the excitatory part and the resting part, the contiguous resting part gets excited, and this process occurs repeatedly until the excitement is transmitted. This is called conduction. The connection between the axon terminal of neurons and other neurons or muscle cells is called a synapse. At a synapse, neurotransmitters are released from the axon terminal and excitement is transmitted. This is called transmission. Motor neurons release as a neurotransmitter [ c ].

Q1 Choose the most appropriate combination of words from the following ① to ⑥ which is the most appropriate combination of words that falls into [ a ] ~ [ c ] in the article above.

	a	b	c
①	Target organ	Positive	Noradrenaline
②	Target organ	Positive	Acetylcholine
③	Target organ	Negative	Noradrenaline
④	Effector (agonist)	Positive	Acetylcholine
⑤	Effector (agonist)	Negative	Noradrenaline
⑥	Effector (agonist)	Negative	Acetylcholine

Q2 About the conduction and transmission of excitement, please choose the most appropriate description from the following ① to ④.

- ① Medullated nerve with the myelin sheath has a lower conduction velocity than unmedullated nerve with no myelin sheath.
- ② When a stimulus with a strength higher than the threshold value is applied to the central part of the axon, the conduction of excitement occurs only in a one-way direction.
- ③ At the synapse, an action potential flows from the axon terminal toward the cell body as the neurotransmitters move between the cells.
- ④ At the synapse, excitement is transmitted only in a one-way direction from the axon terminal to the connecting neuron.

B Human blood a occupies a certain percentage of body weight. When the blood leaks out of the body due to trauma or something like that, there is a mechanism that blocks the wound immediately to prevent the outflow of blood. This mechanism is called blood coagulation.

After e collecting fresh blood in a test tube and leaving it for a while, the fibrous fibrin is formed and cell components such as Red blood cells and f white blood cells get stuck with it, resulting in precipitate and separating from the supernatant.

Q3 For the underlined part **d**, please choose the most appropriate blood volume for a man who weighs 60 kg from the following ① to ④. In addition, assume that 1g of blood is equivalent to 1ml of blood.

- ① 1500 ml      ② 3000 ml      ③ 4500 ml      ④ 6000 ml

Q4 Please choose the most appropriate term from the following ① to ④ as a combination of the name of precipitate and supernatant caused by the processing of the underlined part **e**.

- |   | Precipitate | Supernatant  | Precipitate  | Supernatant  |
|---|-------------|--------------|--------------|--------------|
| ① | Blood clot  | Blood plasma | ② Serum      | Blood plasma |
| ③ | Serum       | Blood clot   | ④ Blood clot | Serum        |

Q5 About the underlined part **f**, please choose one from the following ① to ④ that is **incorrect** as a description.

- ① They move not only inside the blood vessel but also out of the blood vessel.  
② Hemoglobin exists inside the cell.  
③ There are 6000 ~ 8000 cells in 1mm<sup>3</sup> of blood.  
④ Nuclear exists in the cell.

Question 5 Answer the following questions (Q1 ~ Q5).

Q1 Fig. 1 schematically shows the state of DNA replication. Among the positions a ~ d where DNA replication is performed, please choose one of the following ① to ⑥ which is the most appropriate combination of the positions where the Okazaki fragments are formed.

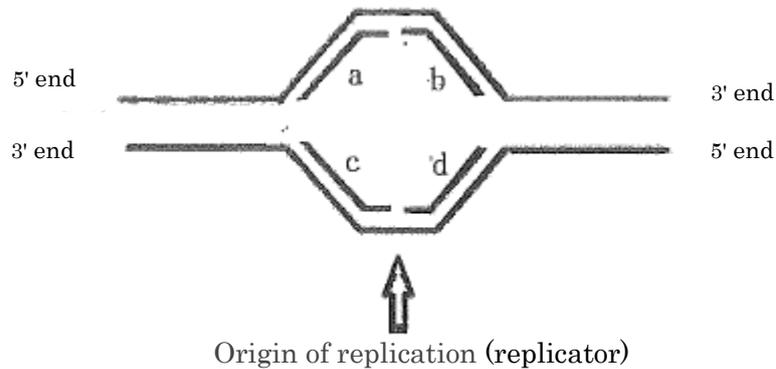


Fig. 1

- |           |           |           |
|-----------|-----------|-----------|
| ① a and b | ② a and c | ③ a and d |
| ④ b and c | ⑤ b and d | ⑥ c and d |

Q2 Please choose one of the following ① ~ ④ that is most appropriate as a description of the difference of protein synthesis process between prokaryotes and eukaryotes.

- ① Transcription is done by RNA polymerase in prokaryotes and DNA polymerase in eukaryotes.
- ② Splicing is seen in prokaryotes but not in eukaryotes.
- ③ In single mRNA, transcription and translation proceed simultaneously in prokaryotes, but not in eukaryotes at the same time.
- ④ Translation occurs in the cytoplasm in prokaryotes, but occurs in the nucleus in eukaryotes.

Q3 The growth curve of a population is generally an S-shaped curve. Answer the following questions about it.

(1) As the reason that the growth curve of the population becomes an S-shaped curve, the higher the population density, the lower the birthrate and the higher the mortality rate. About the reason mentioned above, please choose one that is incorrect as a description from the following ① ~ ④.

- ① Food shortages.
- ② It is difficult to find mates.
- ③ The habitat deteriorates due to the excrement etc.
- ④ Lack of living space.

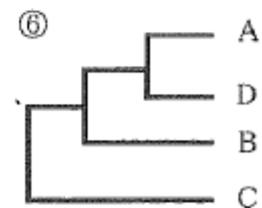
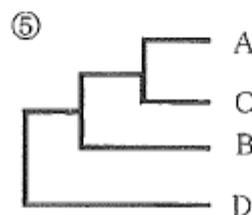
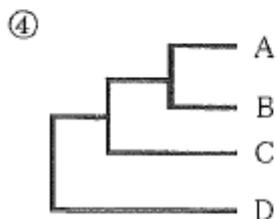
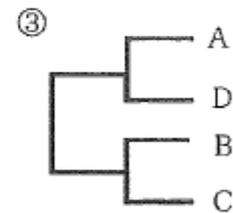
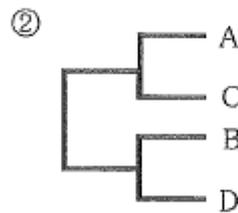
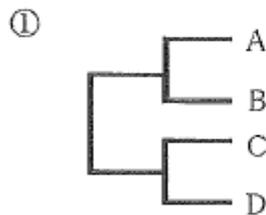
(2) As the population density increases, the rise in population density is suppressed. Please choose one of the following ① ~ ④ which is the most appropriate term to represent this phenomenon.

- ① Density effect
- ② Indirect effect
- ③ Alle effect
- ④ Founder effect

Q4 Table 1 below shows the comparison of the amino acid sequences of certain protein among four animal species which are differentiated from closely related animals (Type A ~ Type D) of common animals, and determine the number of different amino acids between the two species. Please choose one of the following ① to ⑥ which is the most appropriate phylogenetic tree of A ~ D based on this result.

Table 1

Type A				
Type B	30			
Type C	32	15		
Type D	16	29	31	
	Type A	Type B	Type C	Type D



Q5 Please choose one of the following ① to ⑤ which is the most appropriate description about the evolution that has occurred in the process of a human appearing from an anthropoid.

- ① The foramen magnum opened to the occipital region.
- ② Both eyes came to the front of the face.
- ③ The cranial capacity has decreased.
- ④ The supraorbital torus became large.
- ⑤ Heels and arch were formed on the foot.