第 1 問から第 4 問では、問題文の中の [　　] 内の数字はマークシートの問番号を示している。該当する問番号の解答記入欄に答をマークしなさい。

第 1 問　次の問 1 ～ 8 の空所 [　1　] ～ [　8　] に入れるのに最も適切なものを (1) ～ (4) から 1 つ選び、その番号をマークしなさい。

問 1.　Ann found out then that her daughter [　1　] with her dogs for the last two hours.

(1) had been playing　　(2) had played
(3) has been playing　　(4) has played

問 2.　Bill argued with his girlfriend that they should move in together, but I think she will [　2　] not to.

(1) avoid　　(2) decide　　(3) enjoy　　(4) stop

問 3.　His mother welcomed him [　3　] her arms wide open and tears in her eyes.

(1) after　　(2) of　　(3) to　　(4) with

問 4.　I won’t ever forget that a surgeon [　4　] he was familiar saved my father’s life.

(1) on which　　(2) on whom　　(3) with which　　(4) with whom

問 5.　Isn’t it inappropriate for high school students to take [　5　] in such a late-night event?

(1) apart　　(2) aside　　(3) part　　(4) place

問 6.　She smiled, finally [　6　] in turning on her new electronic device.

(1) succeed　　(2) succeeded　　(3) succeeding　　(4) success

問 7.　Their juvenile actions rendered the older folks [　7　] than excited.

(1) calm　　(2) calmer　　(3) more calm　　(4) much calm

問 8.　What would you [　8　] to studying together for tomorrow’s test?

(1) say　　(2) speak　　(3) state　　(4) talk

第 2 問　次の問 1 ～ 4 においては、それぞれ日本語の意味に合うように下の (1) ～ (7) の語句を並べかえて空所を補い、最も適切な文を完成させなさい。解答は [　9　] ～ [　16　] に入れるものの番号のみをマークしなさい。ただし文頭にくる文字も小文字にしてある。

問 1.　アジア諸国は温室効果ガス削減の合意に向けて一歩近づいている。

Asian countries are _____ [　9　] _____ _____ _____ [　10　] _____ greenhouse gasses.

(1) an agreement　(2) closer　(3) coming to　(4) cutting
(5) on　(6) one step　(7) to

問 2.　多くの部員が新しいことに挑戦するこの部活は、前途有望と評される。

_____ [　11　] _____ _____ _____ _____ [　12　] new challenges is deemed promising.

(1) many　(2) members　(3) of　(4) on
(5) take　(6) this club　(7) whose

問 3.　その計画は上手くいかなかったとだけ言っておこう。

_____ [　13　] _____ _____ _____ [　14　] _____.

(1) failed　(2) it　(3) say　(4) suffice
(5) that　(6) the plan　(7) to

問 4.　理不尽な要求には決して屈するべきではない。

At _____ _____ [　15　] _____ _____ [　16　] _____ unreasonable demands.

(1) give　(2) in　(3) no　(4) should
(5) time　(6) to　(7) you

第 3 問 Read the article and answer the questions that follow.

Traces of ancient DNA contained in old bones have revealed fascinating secrets about the past.

But extracting genetic material involves a certain amount of damage to the object in question, and many archaeologists have been reluctant to hand over their most precious finds to DNA labs.

Now, scientists have found a way to extract DNA in a non-invasive manner, applying the pioneering new technique to a pierced deer tooth likely worn as a pendant. The research, published in the journal *Nature* on Wednesday, revealed intriguing details about its ancient wearer and is the first time scientists have successfully isolated ancient human DNA from a Stone Age artifact.

Excavated from Denisova Cave in southern Siberia, the pendant was worn by a woman who lived between 19,000 and 25,000 years ago, according to the analysis of human genetic material preserved in the pendant. She belonged to a group known as Ancient North Eurasians, which has a genetic connection to the first Americans.

The new method will hopefully allow scientists to learn about the sex and genetic ancestry of the Stone Age makers, wearers and users of an array of bone tools and ornaments unearthed from digs around the world.

“It’s amazing. It means that we’ll be able to answer very simple questions such as what tasks males and females were doing at that point in time,” said study coauthor Marie Soressi, a professor and chair of human origins at the Faculty of Archaeology of Leiden University in the Netherlands. “We actually will have a direct line of evidence to tell us.”

The technique may also, for example, be able to reveal whether a tool was used by a Neanderthal or our own Homo sapiens ancestors, she added.

Human DNA was likely preserved in the deer bone pendant because it is porous and therefore more likely to retain genetic material present in skin cells, sweat and other body fluids.

Typically, researchers would use a small drill to extract bone powder from an artifact or bone. Lead study author Elena Essel, a molecular biologist at the Max Planck Institute for Evolutionary Anthropology, in Leipzig, Germany, described the newly developed technique as a “laboratory washing machine without the movement.”

The pendant was submerged in a sodium phosphate buffer solution while gradually increasing the temperature. This allowed the DNA to be released into the solution, where it was isolated, purified and sequenced using existing tools.

“If we want to stay in this image of the washing machine, it’s the wash water that was exciting for us,” Essel explained.

While bone tools and artifacts are rarer than stone ones, they are still much more common in the archaeological record than human remains, opening up new avenues for research.

The pendant study, however, is essentially a proof of concept, and it’s not clear how easy it will be to extract ancient human DNA from other bone ornaments and tools.

The technique, at least as it stands, only worked on freshly excavated material and where

archaeologists had taken steps to ensure that the artifact is “clean”—i.e. not contaminated with modern human DNA－by wearing gloves and a mask and making sure the object was sealed in a bag immediately after being unearthed.

The technique didn’t identify ancient DNA when applied to a set of bone tools from the French cave Quinçay excavated back in the 1970s to 1990s—when nobody had any idea that genetic material could be preserved for so long.

Nor was it possible to extract ancient DNA from three freshly excavated tooth pendants from Bacho Kiro Cave in Bulgaria, home to some of the earliest known modern humans in Europe, according to the study.

“Right now, it’s like this one sample. I would be really interested in learning more about how often we can extract ancient human DNA and if it’s like a specific type of artifact that is more promising or if it works equally well for (bone) tools,” Essel said.

It’s not known why the deer tooth pendant contained such a large amount of the ancient woman’s DNA (about the same amount as a human tooth)—perhaps it was well-loved and worn close to the skin for an exceptionally long period of time, Essel said.

“How we think it works is that the longer there was close body contact, the higher the chances that a lot of DNA is in the material … but we have no idea if we’re talking about days or months or years or decades.”

注 archaeologist: 考古学者　intriguing: 好奇心をそそる　artifact: 人工物
excavate: ～を発掘する　unearth: ～を掘り出す　porous: 多孔性の
submerge: ～を沈める　sodium phosphate: リン酸ナトリウム　buffer solution: 緩衝液
proof of concept: 概念実証　contaminate: ～を汚染する

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問 1. Choose the meaning of the underlined word “non-invasive” that best fits the context within the article. Write the number of your answer in [　17　].

(1) causing no damage
(2) involving no physical contact
(3) not harming living beings
(4) not requiring surgical cutting

問 2. According to the article, what is one potential application of the newly developed DNA extraction technique? Write the number of your answer in [18].

(1) to analyze dietary habits of Stone Age populations through fragment analysis
(2) to determine whether ancient tools were buried by Homo sapiens or Neanderthals
(3) to improve the accuracy of radiocarbon dating of archaeological artifacts
(4) to investigate sex-based divisions of labor in prehistoric societies

問 3. Which of the following statements about the newly developed DNA extraction technique is TRUE according to the article? Write the number of your answer in [19].

(1) It can be successfully applied to both bone artifacts and stone tools.
(2) It involves taking small samples of the artifact’s surface to retrieve DNA.
(3) It requires freshly excavated and uncontaminated artifacts to work effectively.
(4) It successfully extracted ancient DNA from bone tools excavated in the 1970s to 1990s.

第 4 問 Read the article and answer the questions that follow.

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この問題文は、著作権者の許可が得られた後に掲載します

注 microbiome: 微生物叢
antibiotic: 抗生剤（の）
mimic: ～をまねる
monopolize: ～を独占する
bolster: ～を支える、強化する
metabolite: 代謝物
susceptible: かかりやすい
resilient: しなやかで強い
robust: 力強い
inflammatory: 炎症性の
pathogen: 病原体
commensal: 共生の
immunosuppressant: 免疫抑制の

問 1. Based on the context of the article, which phrase best fits (あ)? Write the number of your answer in [20].

(1) power up (2) look after (3) take over (4) wipe out

問 2. Which statement is closest in meaning to what is mentioned in this article? Write the number of your answer in [21].

(1) A diet rich in plant-based foods helps renew a diversified gut microbiome after antibiotics.
(2) Antibiotics do not affect the gut microbiome when taken with a Mediterranean diet.
(3) Mediterranean diet-based food intake should be decreased when antibiotic use is called for.
(4) Plant-based diets slow down the recovery of the gut microbiome after antibiotic use.

問 3.　According to the article, what is necessary for the gut microbiome to fully recover after damage? Write the number of your answer in [　22　].

(1) a correct sequence of occurrences helping the recovery of healthy gut microbes
(2) completely removing all gut bacteria before starting antibiotics to prevent infections
(3) eating a diet rich in processed foods to encourage quick return of gut bacteria
(4) unplanned bacterial regrowth occurring regardless of nutrient supply or timing

この後の第 5 問と第 6 問は記述用解答用紙に解答しなさい。

第 5 問　次の英文を読み、後の問いに答えなさい。

What does it mean to be intelligent? If it's defined by having the biggest brain, then sperm whales—whose noggins are a hefty 20 pounds—would be the brightest creatures on Earth. But, more likely, it's how a brain is wired. Viewed in this way, intelligence is what gives an organism the best chance to survive and thrive in an environment. Language may be one of the best ways to demonstrate that kind of smarts.

Though all animals can communicate with others, humans are one of the few species to have a spoken language. Using speech, we could share complex ideas, pass knowledge through generations, and create communities. Whether spoken language actually helped us evolve as species into more advanced beings, however, has never really been tested.

"Language allowing humans to be a more advanced species is an assumption that somebody came up with one day without really trying [to prove] it," says Erich Jarvis, a professor at Rockefeller University who studies the neurobiology of vocal learning. The idea stuck around, but so have other common beliefs that are not really supported with evidence—like the myth that we only use 10 percent of our brains at any point in time, he points out.

【　あ　】

But Jarvis and his colleagues were able to examine this hypothesis with the help of songbirds. Jarvis' new study, published today in *Science*, provides some of the first evidence that ≪A≫vocal learning—one of the crucial components for a spoken language—is associated with problem-solving. Vocal learning is the ability to produce new sounds by imitating others, relying on experience rather than instinct. Birds who could do this and solve problems had bigger brain sizes, the research team found.

To get a better grasp of vocal learning and cognition, the study authors turned to songbirds. The majority of species in this avian suborder possess the vocal learning ability. They thrive on every continent except Antarctica. "Of all the bird species in the world, songbirds make up half that number," explains Jarvis. "It seems like once vocal learning evolved, there was a lot of speciation and diversity."

【　い　】

The team performed seven cognitive experiments on 214 songbirds from 23 different species. Of these, 21 species were caught from the wild in New York. Two songbirds studied, zebra finches and canaries, are domesticated. The behavioral tests examined the birds' problem solving, for instance by figuring out how to remove an object to access the food reward. The researchers also gauged two other

skills often associated with intelligence: learning by association, plus what's called reversal learning, in which an animal adjusts its behavior to get a reward. They then looked at whether being vocal learners helped develop the three skills, comparing 21 bird species to two others, which were vocal non-learners.

【 う 】

The biologists noticed a strong relationship between vocal learning and problem-solving skills. Vocal learning bird species could come up with innovative ideas, such as getting seeds or a worm trapped under a cup by removing the obstacle, piercing it, or pulling it apart. "It's pretty surprising that these two skills are related to intelligence but not the other traits we measured," explains Jean-Nicolas Audet, an ecologist and neurobiologist at Rockefeller University who served as the lead study author. All three abilities—problem solving, associative learning, and reversal learning—are typically considered "components of intelligence," he says.

【 え 】

Brain size was another benefit to vocal learning that may have supported these problem-solving abilities. The 21 vocal-learning species had slightly larger brains, relative to their body size, than the two who weren't. Jarvis says it's possible these big-noggined birds packed more neurons. Or perhaps they evolved to have larger skull space, which gave rise to extra circuits for vocal learning and problem-solving skills. "This suggests to me that there's something special about problem solving," he says. "Like spoken language, it made some species more advanced than others."

One question left unanswered is why there's such a strong relationship between problem-solving abilities and vocal learning. The brain areas in charge of vocal learning are not the same ones that get activated when we need to troubleshoot an issue, says Audet. The next step for this team is to take a deeper look into the brains of songbirds and figure out what genes or other brain regions connect these two areas. Some bridge yet undiscovered helps form this type of intelligence.

注
- sperm whales: マッコウクジラ
- wire: ～を配線する
- avian: 鳥類の
- zebra finch: キンカチョウ
- noggin: 頭
- stick around: 残っている
- suborder: 亜目
- gauge: ～を測定する
- hefty: 重い
- songbird: 鳴鳥
- speciation: 種分化

問1.　鳴鳥に関する Jarvis たちの研究結果は、これまで立証の試みがなされていなかったどのような説を検証するに至ったのか、本文の内容に即して日本語で答えなさい。

問2.　下線部≪A≫は、Jarvis たちが行った実験における音声学習を行う鳥のどのような具体的行動によって証拠づけられたのか、本文の内容に即して 50 字～60 字の日本語で答えなさい。

問 3.　(i)　Jarvis たちがまだ明らかにしていないことは何か、本文の内容に即して 60 字～70 字の日本語で答えなさい。

(ii)　それを明らかにするために今後どのようなことをする必要があるのか、本文の内容に即して日本語で答えなさい。

問 4.　次の段落は本文のどの位置に置くのが最も適切か、【あ】～【え】の記号で答えなさい。

This doesn’t mean that the two bird species who were not vocal learners were stupid. Instead, it shows they did not evolve this one particular form of intelligence. “We have to be careful and very specific when we talk about intelligence because it really depends on which traits we are talking about,” he explains.

第 6 問　次の英文を読み、下線部(1)～(3)の内容を英語にしなさい。

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注　deforestation: 森林伐採　　replenish: ～を補充する　　oil palm: アブラヤシ
　　stipulate: ～を規定する