2024 M

英　　語

〔注　意　事　項〕

1. 監督者の指示があるまでは，この問題冊子を開かないこと。
2. 解答用紙は，コンピュータで処理するので，折り曲げたり汚したりしないこと。
3. 解答用紙に，**氏名・受験番号を記入し，受験番号をマークする。**マークがない場合や誤って記入した場合の答案は無効となる。

受験番号のマーク例(13015の場合)

受	験	番	号	
1	3	0	1	5
万位	千位	百位	十位	一位
	⓪	●	⓪	⓪
●	①	①	●	①
②	②	②	②	②
③	●	③	③	③
④	④	④	④	④
⑤	⑤	⑤	⑤	●
⑥	⑥	⑥	⑥	⑥
⑦	⑦	⑦	⑦	⑦
⑧	⑧	⑧	⑧	⑧
⑨	⑨	⑨	⑨	⑨

4. 解答用紙にマークするときは，HB またはＢの黒鉛筆を用いること。**誤ってマークした場合には，消しゴムで丁寧(ていねい)に消し，消しくずを完全に取り除いたうえで，新たにマークし直す**こと。
5. 下記の例に従い，**正しくマークする**こと。

（例えば３と答えたいとき）

正しいマーク例

① ② ● ④ ⑤ ⑥ ⑦

誤ったマーク例

① ② ③ ④ ⑤ ⑥ ⑦	マークが薄い
① ② ④ ⑤ ⑥ ⑦	マークが不完全
① ② ⑥ ④ ⑤ ⑥ ⑦	マークが○印
① ② ✓ ④ ⑤ ⑥ ⑦	マークがV印

6. 解答は，すべて解答用紙の所定の位置に記入すること。
7. 最後の問題 V に自由英作文があるので，時間配分に注意すること。

I 次のインタビュー記事を読み，以下の設問に答えなさい。

以下は，医療系雑誌 *The New England Journal of Medicine* の企画で２名の医師に行ったインタビューの内容である。

***Interviewer*:** This is "Intention to Treat," from *The New England Journal of Medicine* (NEJM). I'm Rachel Gotbaum. Artificial intelligence (AI) holds the promise of revolutionizing how we deliver health care. Today we're going to explore how artificial intelligence, machine learning, is being used in medicine. How is AI helping our doctors, and how might it be hurting our patients? I'm joined by Dr. Isaac Kohane. He's chair of the Department of Biomedical Informatics at Harvard Medical School, and he's also coeditor of the "AI in Medicine" series in NEJM. And also Dr. Maia Hightower. She's chief digital and technology officer at University of Chicago Medicine and the CEO of Equality AI. So, Dr. Hightower, I'd like to start with you. Where is AI being used in medicine?

***Maia Hightower*:** Right now, AI is being used in medicine in two main categories. First is operational and administrative. The second is in clinical use. I would say there's far higher adoption in operational and administrative tasks than currently in clinical AI.

***Interviewer*:** So, can you give us some examples of how AI is being used on the administrative side of medicine?

***Maia Hightower*:** Yeah. So, in order to communicate with payers, in other words, with our insurance companies, we'll often have bots or automation that (　A　) information from the health system to the insurance company and back. In the case of insurance companies, we know that they often will use AI algorithms for prior authorization of procedures, whether or not to cover a particular medication or test. And in those cases, there isn't much transparency. (途中略)

***Interviewer*:** OK, so that's some examples of AI on the administrative side. Dr. Kohane, tell us about AI on the clinical side.

***Isaac Kohane*:** There are two kinds of (　B　) that AI seems to me like a particularly exciting way to help our patients. The first is understanding that we as humans do some things very well, but we're not very good at being alert around the clock and being fastidious[(a)] about knowing everything about our patients, all the details, all the adverse events[注1], all the allergies, all their history. There are so many such details that if we can have AI be part of the decision-making loop (so that things that we forgot about are in fact not forgotten), I think that for the routine care of patients,

having AI as an assistant to the doctor is going to play to the strength of the doctor as an intellectual, compassionate (b) provider of care, and this will be a significant boost in quality of care. I'd like to add one other area. . . （途中略）

***Interviewer*:** So, Dr. Hightower, I'd like to turn back to you. Patients are obviously vulnerable to AI in other ways — for example, to bias. You founded a company called Equality AI. How did you get involved with this area of work?

***Maia Hightower*:** Since the day I entered into medical school and you get your white coat and there's a white coat ceremony, and you look up and you see all of the leaders of the health system greeting you to this wonderful profession. It didn't take rocket science for me to reflect and say, "Hmm. That population doesn't look like the community I come from." So, the question about Equality AI, how did I come to that? I was the chief population health officer at the time when Dr. Obermeyer's paper on dissecting[注2] racial bias in algorithms used to manage the health of populations was published. And at the time, that study showed that a widely used algorithm had a flaw[注3] that resulted in a decrease by half in the rate of referral[注4] to case management for Black patients compared to White patients who were equally sick. And they were able to identify the bias and then mitigate[注5] the bias in the algorithm and fix it. And at the time, I remember, I was the chief population health officer, and I wish I could say I had this epiphany[注6] moment and I was ready to combat (c) bias in AI. No, instead it was a moment where I, like many, probably thought it was a one-off[注7] — the algorithm was fixed, and we could all move on our way. A few years later, of course, Covid happened, and there was this real awareness of social injustice and the dual pandemic of healthcare inequity[注8]. And it was showing in the numbers — like Black patients and Latino patients and the South Pacific Islander patients, Native American patients were dying a lot more frequently from Covid. And so I developed what's called the Healthcare IT Equity Maturity model, looking for all of the different areas within health care where systemic bias is embedded in our healthcare IT systems, and recognizing that my workforce is not very diverse.

And that was really what Obermeyer was highlighting in his paper, there was that lack of diversity. And if there had actually been a more diverse team on creating the algorithm, that most likely some of the errors that had been made would've been avoided. （途中略）

***Interviewer*:** And let's talk a little bit more about the other benefits we're seeing with AI. Dr. Kohane, I know you believe AI can be used to address physician burnout, for example.

***Isaac Kohane*:** The pressures to provide sufficient revenue[(d)], those pressures push us to see a lot of patients and therefore to see patients in shorter and shorter intervals. And at the same time, the technology that we've used to date, electronic health record systems, have been optimized for billing but not for clinical care. And that combination has really sucked the marrow, the excitement, the joy of practice out of many clinicians. If, (C) the right governance, we have, for example, the conversations that are occurring between doctors and their patients automatically turned into the documentation that needs to go into the health record, that needs to go in for billing, that needs to be sent back to a referring doctor or to the patient, all these things — which are technically possible — could take a huge administrative load off of physicians. (途中略)

***Interviewer*:** Thank you both very much.

注1：adverse events　有害事象　　注2：dissect　～を詳細に吟味する

注3：flaw　不備な点，欠陥　　注4：referral　(専門医への)紹介

注5：mitigate　～を軽減する　　注6：epiphany　ひらめき

注7：one-off　一度限りのこと　　注8：inequity　不公平

出典：The New England Journal of Medicine. (2023). *Intention to Treat Episode 6*. April 6, 2023. Retrieved from https://www.nejm.org　分かりやすさのために，表現を修正した箇所がある。

問 1　英文の内容に合うように，(1)～(4)の各文の空所を補うものとして最も適したものを，それぞれ選択肢1～4の中から一つ選びなさい。

(1) The word fastidious[(a)] is closest in meaning to _____.
1. selfish　2. complicated　3. satisfied　4. careful

(2) The word compassionate[(b)] is closest in meaning to _____.
1. quiet　2. sympathetic　3. hesitant　4. doubtful

(3) The word combat[(c)] is closest in meaning to _____.
1. resist　2. compromise　3. train　4. invite

(4) The word revenue[(d)] is closest in meaning to _____.
1. service　2. communication　3. income　4. expense

問 2 英文の内容に合うように，(　　A　　)，(　　B　　)，および(　　C　　)に入る語として適切なものを，それぞれ選択肢１～４の中から一つ選びなさい。

(1) (　　A　　)

1. freezes　　2. composes　　3. transfers　　4. elaborates

(2) (　　B　　)

1. frequencies　　2. applications　　3. codes　　4. sensations

(3) (　　C　　)

1. under　　2. across　　3. upon　　4. against

問 3 英文の内容に合うように，(1)～(3)の質問に対する答えとして最も適したものを，それぞれ選択肢１～４の中から一つ選びなさい。

(1) What can be inferred about AI that is used for administrative purposes?

1. There is lack of information about how the payment algorithm works.
2. Clinicians are using it to understand patients' medical histories.
3. Patients can use bots to communicate with insurance companies.
4. The AI algorithm has not been tested enough to be safely used.

(2) According to the interview, what can be said about algorithms historically used in population-based healthcare management?

1. They helped Dr. Obermeyer find the right treatment algorithm for individual patients.
2. They played an important role in raising patient awareness of social discrimination.
3. They showed that there are half as many Black patients as there are White patients.
4. They motivated Dr. Obermeyer to investigate racial imbalances in healthcare algorithms.

(3) According to the interview, how could AI solve the problem of physician burnout?

1. It could increase the speed that doctors see patients.
2. It could decrease the cost of healthcare service.
3. It could allow physicians to focus more on patients.
4. It could replace electronic health record systems.

Ⅱ 次の英文を読み，下記の設問に答えなさい。①～⑩は段落番号を表す。

① The flags of two countries hang unfurled[(a)] — not by any breeze but by metal wiring — over the desolate, eerily[注1] still surface of the moon. One is the stars and stripes of the United States; the other, the crimson of China. But if you ask any official from these countries, they will tell you that these flags do not represent a property claim of any kind. They're more like extraterrestrial graffiti[注2]. But if planting a flag on the moon doesn't count as a property claim, then what does? And when you get down to it, can anyone actually own the moon?

② When the Soviet Union's Sputnik 1, the world's first artificial satellite, streaked across the sky in October 1957, it opened up a whole new realm of possibilities. Some of those possibilities were scientific, but others were legal. Over the following decade, the international community drafted the Outer Space Treaty of 1967 (OST), the world's first legal document explicitly pertaining[(b)] to space exploration.

③ This treaty remains the most influential piece of space law, despite the fact that it's very difficult to enforce. "It's not a code of conduct," said Michelle Hanlon, a space law expert at the University of Mississippi School of Law. "It's just guidelines and principles."

④ Despite the lack of enforceability, the OST is clear about countries making land grabs in space. Article 2 of the treaty explicitly rules out the possibility of a country claiming ownership of parts of space or any celestial bodies. "A state cannot claim sovereignty[注3] on the moon, period," Hanlon told *Live Science*. But when it comes to building structures like bases and habitats on lunar soil, Hanlon said, things get murkier[注4]. "They are a kind of territory by another means, right?"

⑤ The Universal Declaration of Human Rights — which holds sway[(c)] in space under Article 3 of the OST — states that individuals have a fundamental right to own property. This means that, hypothetically, any person could build a house on the moon and claim it as their own. And several people have claimed to own parts of the moon, including Robert R. Coles, the former chairman of New York City's Hayden Planetarium at the American Museum of Natural History, who attempted to sell off acres of the moon for $1 each in 1955, *The New York Times* reported.

⑥ However, the OST's Article 12 includes a provision[注5] that could thwart[(d)] such an attempt. It states that any installation on another celestial body must be usable by all parties. In other words, Hanlon said, it would have to function as a public space. The Moon Treaty of 1979 would have helped reconcile[注6] Article 2 with Article 12 by stipulating[注7] that any commercial or individual party acting in space be considered part of its nation of origin, rather than an independent entity. But the United States, China and Russia have so far failed to ratify[注8] this agreement, and so it is largely considered impotent. As missions like NASA's Artemis Program

and China and Russia's joint moon base project kick into gear, space lawyers like Hanlon will have to do the hard work of reconciling Article 2 with Article 12.

⑦ More recently, NASA attempted to fill in some of the space law gaps with the Artemis Accords, an international agreement designed to smooth future exploration. Building on the OST, the accords lay out a series of non-binding[注9] principles governing activity on several celestial bodies, including the moon. Among its provisions is a recognition of certain lunar regions, like Russia's Luna probe landing site and Neil Armstrong's footprints, as protected outer space heritage.

⑧ But notably, the accords also allow for entities to extract and use extraterrestrial resources, which not every country is thrilled about. Twenty-one countries have signed the accords so far, though some major players, including Russia, have refused based on this clause, which they see as providing an unfair advantage to American business interests, *Science* reported. And some scholars have pointed out that literally[(e)] taking dirt from the moon feels suspiciously like owning land.

⑨ There are other avenues for claiming property without actually claiming property on the moon. For example, using scientific equipment, like rovers or stationary seismometers, could potentially turn into de facto[注10] land claims if the research team forbids other people from coming too close to their equipment. All of these are sure to become legal sticking points in the next few decades.

⑩ "In many ways, this is not an immediate issue," Hanlon said. "And in many ways, it is." But at the end of the day, "we have to be really, really careful about how we proceed responsibly," she said.

注１：eerily　不気味に　　注２：extraterrestrial graffiti　地球外にある落書き
注３：sovereignty　統治権　　注４：murky　曖昧な
注５：provision　規定　　注６：reconcile　～を調和させる
注７：stipulate　～を明記する　　注８：ratify　～を承認する
注９：non-binding　拘束力のない　　注10：de facto　事実上の

出典：Thompson, J. (2022). *Live Science*. May 24, 2022. Retrieved from https://www.livescience.com　分かりやすさのために，表現を修正した箇所がある。

問 1 英文の内容に合うように，(1)～(5)の各文の空所を補うものとして最も適したものを，それぞれ選択肢１～４の中から一つ選びなさい。

(1) The word unfurled (a) in paragraph ① is closest in meaning to _____.

1. planted　2. stained　3. damaged　4. opened

(2) The word pertaining (b) in paragraph ② is closest in meaning to _____.

1. relating　2. opposing　3. eliminating　4. simplifying

(3) The phrase holds sway (c) in paragraph ⑤ is closest in meaning to _____.

1. stands back　2. stands by　3. has influence　4. has movement

(4) The word thwart (d) in paragraph ⑥ is closest in meaning to _____.

1. enhance　2. block　3. trap　4. support

(5) The word literally (e) in paragraph ⑧ is closest in meaning to _____.

1. secretly　2. greedily　3. possibly　4. actually

問 2 英文の内容に合うように，(1)～(5)の質問に対する答えとして最も適したものを，それぞれ選択肢１～４の中から一つ選びなさい。

(1) According to the passage, what can be implied by calling the flags that are placed on the moon graffiti?

1. They were placed for the purpose of adding color to the moon.
2. They are merely symbolic because they do not grant ownership.
3. They were placed without consent from other countries.
4. They are considered illegal according to the Outer Space Treaty.

(2) According to the passage, which of the following is true about the Outer Space Treaty of 1967?

1. It is a legal document that was created to regulate artificial satellites.
2. It allows countries to claim ownership of celestial bodies except the moon.
3. It defines significant punishments for countries that do not follow its rules.
4. It is a widely recognized document that provides suggestions about space.

(3) According to the passage, what can be inferred about the legal status of lunar bases and habitats?

1. Only the United States, China, and Russia can build lunar bases and habitats on the moon.
2. The legal status of private lunar bases and habitats is uncertain due to conflicting provisions.
3. Countries are allowed to establish private ownership of lunar bases and habitats.
4. Lunar facilities must be publicly accessible according to established international law.

(4) According to the passage, which of the following is mentioned as an objective of the Artemis Accords?

1. It aims to permit the collection of space resources for commercial purposes.
2. It aims to provide clear laws for property ownership in space.
3. It aims to restrict access to certain lunar regions for scientific research.
4. It aims to limit provisions that provide protection for lunar heritage sites.

(5) What does the passage suggest about the future of property claims on the moon?

1. It is an important problem that requires immediate attention.
2. It is an issue that has already been solved by international agreements.
3. It is a complex legal situation that will be debated for many years.
4. It is a minor concern compared to other space-related challenges.

Ⅲ 次の英文を読み，下記の設問に答えなさい。①～⑦は段落番号を表す。

① There comes a time in a plant's life when the head sags[(a)], the leaves go pale and the body releases a barrage of sounds that are the ultrasonic equivalent of stamping on bubble wrap. While any gardener is familiar with the wilting[注1] and discoloration that comes with drought[注2], a shortage of water or a sudden wound can also prompt[(b)] plants to produce staccato pops, which nearby creatures may respond to, scientists say.

② The discovery, described as "exciting and thought-provoking" by one independent expert, suggests the plant kingdom is not as silent as it seems, and that ultrasonic sounds emitted[注3] from plants might even help shape their ecosystems. "When these plants are in good shape, they produce less than one sound per hour, but when stressed they emit many more, sometimes 30 to 50 per hour," said Professor Lilach Hadany, an evolutionary biologist and theoretician at Tel Aviv University. "They are potentially important because other organisms could have evolved[注4] to hear these sounds and interpret them," she added. "We are now testing both animals and plants to see if they respond."

③ Hadany and her colleagues recorded sounds produced by tomato and tobacco plants raised in greenhouses. Healthy plants emitted clicks and pops, but the sounds came in far more rapid bursts when the plants were deprived of water or had their stems cut. The noises could be picked up 3-5 metres away. At 40 to 80kHz, the sounds are too high-pitched for the human ear, which has an upper range of about 20kHz. But insects such as moths and small mammals including mice can detect such frequencies, raising the prospect[(c)] that the noises might influence their behaviour.

④ Writing in *Cell*, the scientists describe how the plants' sounds are as loud as human speech and are emitted more frequently after two days without water. The pops peak at day five or six and then subside[(d)] as the plant dries up. On recording the sounds, the researchers trained an artificial intelligence (AI) algorithm to identify the plant and the cause of its stress from the popping noise alone. It was not 100% accurate, but demonstrates that the sounds contain information that might be useful to organisms in the environment, they say.

⑤ There is no evidence the sounds are an attempt to communicate, any more than a log declares distress by crackling[注5] on a fire. But Hadany said the sounds might nonetheless be useful for nearby creatures, perhaps affecting which plants animals feed on or where insects lay their eggs. It is unclear what creates the sounds, but the authors suspect a process called cavitation, where water columns in dehydrated[注6] plant stems break down, generating air bubbles. Whether or not anything is listening to the sounds, Hadany says the discovery could make irrigation[注7] more efficient by using microphones alongside other sensors to detect when plants are short on water.

⑥ "This is exciting and thought-provoking: plants that are vocal about their stress level — who'd have thought," said Marc Holderied, a professor of sensory biology at Bristol University. "While this appears to be a byproduct of physiological stress rather than intentional communication, nothing can stop nearby organisms from trying to exploit(e) that information." "Nobody has yet discovered an ear in a plant, but plants sure respond to many mechanical stimuli, so scientists might want to look for ultrasound detectors in such plants," he added.

⑦ In 2017, Carlos Vicient, a researcher at the Centre for Research in Agricultural Genomics in Barcelona, reported that playing loud sounds to plants for hours made them more resistant to drought. But he is sceptical[注8] that they would respond to quieter sounds in a noisy natural environment. "It seems much more probable that if such communication exists, it is carried out through the emission of volatile[注9] substances," he said. "The fact that a plant emits sounds does not mean that it is communicating with its congeners[注10]," he added. "Any system of pipes that transports a fluid generates sounds and that does not mean that a water pipe is trying to communicate with anyone."

注1：wilt　(草花などが)しおれる
注2：drought　干ばつ
注3：emit　～を放つ
注4：evolve　進化する
注5：crackle　(火などが)パチパチ音を立てる
注6：dehydrate　～を乾燥させる
注7：irrigation　灌漑(かんがい)
注8：sceptical　懐疑的な
注9：volatile　揮発性の
注10：congener　同属種

出典：Sample, I. (2023). *The Guardian*. March 30, 2023. Retrieved from https://www.theguardian.com　分かりやすさのために，表現を修正した箇所がある。

問 1 英文の内容に合うように，(1)～(5)の各文の空所を補うものとして最も適したものを，それぞれ選択肢１～４の中から一つ選びなさい。

(1) The word sags[(a)] in paragraph ① is closest in meaning to _____.

1. bends down　　2. reforms　　3. grows up　　4. explodes

(2) The word prompt[(b)] in paragraph ① is closest in meaning to _____.

1. delay　　2. encourage　　3. fail　　4. command

(3) The word prospect[(c)] in paragraph ③ is closest in meaning to _____.

1. practicality　　2. performance　　3. problem　　4. possibility

(4) The word subside[(d)] in paragraph ④ is closest in meaning to _____.

1. move　　2. maximize　　3. decrease　　4. develop

(5) The word exploit[(e)] in paragraph ⑥ is closest in meaning to _____.

1. use　　2. ignore　　3. suppress　　4. provide

問 2 英文の内容に合うように，(1)～(5)の質問に対する答えとして最も適したものを，それぞれ選択肢１～４の中から一つ選びなさい。

(1) What scientific finding did an expert describe as “exciting and thought-provoking”?

1. Sounds produced by creatures eating plants shape ecosystems.
2. Sounds emitted from plants cause discoloration of leaves.
3. Animals rely on ultrasonic sounds when there is a shortage of water.
4. Plants produce more sounds when they are under stress.

(2) What does the research done by Hadany’s group imply?

1. Plants in good condition might produce sounds loud enough for human ears to hear.
2. Insects and small mammals might respond to the higher range of plant sounds.
3. Plants raised in greenhouses might produce more rapid sound bursts when watered.
4. Plant sounds might benefit the ecosystem as much as animal sounds do.

(3) How did the use of AI contribute to the research conducted by Hadany's group?

1. It suggested the cause of the sounds that plants emitted.
2. It trained plants to communicate with other living things.
3. It found a more efficient way to feed small animals.
4. It counted the number of times the plants popped per hour.

(4) What is implied by paragraph ⑤?

1. Insects might prefer to lay eggs on plants that are emitting loud sounds.
2. The sound of logs crackling on a fire might reflect active communication.
3. The research findings might contribute to improvements in crop production.
4. Attaching microphones to animals might help scientists detect plant sounds.

(5) Which of the following is closest to the argument made by Carlos Vicient?

1. Plant sounds are not a form of intentional communication.
2. Playing quiet sounds makes plants resistant to drought.
3. Plants produce louder sounds in noisy environments.
4. Humans can communicate with plants through loud noises.

Ⅳ 次の英文を読み，下記の設問に答えなさい。①～⑭は段落番号を表す。

① Tardigrades, also known as "water bears," are microscopic animals capable of withstanding some of the most severe environmental conditions. Researchers from Japan have now created the most accurate picture yet of the tardigrade genome, revealing the neat[(a)] tricks it uses to stay alive.

② In a new study published in *Nature Communications*, geneticist Takekazu Kunieda and his colleagues from the University of Tokyo present a genetic analysis of *Ramazzottius varieornatus* (*R. varieornatus*), arguably the toughest and most resilient species found in the entire tardigrade clan[注1]. Their results show that tardigrades have evolved a unique arsenal[注2] of strategies to cope with stressful conditions, including a protein that protects its DNA from radiation damage.

③ Tardigrades are strangely adorable microscopic creatures that are capable of withstanding some of the worst that nature can throw at them. Classified as "extremophiles," they can survive freezing, total dehydration, radiation, and even the vacuum of space. Tardigrades are an ancient species that diverged from ancestral animals back in the pre-Cambrian period (~600 million years ago), and likely evolved their own unique genes over a protracted[注3] period of time.

④ Earlier this year, scientists successfully revived a tardigrade that had been frozen solid for more than three decades — a new record for this durable species. Needless to say, scientists are understandably curious about tardigrades; research into these ancient creatures could tell us something about alien life on other planets, and how we might be able to leverage[注4] tardigrade biology in medicine and genetics.

⑤ This isn't the first time that scientists have sequenced a tardigrade genome. Last year, geneticists from the University of North Carolina at Chapel Hill performed similar research, revealing the tardigrade's truly bizarre[注5] genetic constitution. These researchers found that 17.5 percent of the tardigrade genome comes from other organisms, including plants, fungi, bacteria, and viruses. The water bear, it would seem, acquired many of its characteristics not as a result of its own evolution, but through the toil[注6] of others in a process called horizontal gene transfer.

⑥ The new research from the University of Tokyo challenges this assumption, showing that the vast majority of tardigrade characteristics are truly "proprietary[注7]," and not the result of horizontal gene transfer. The new study differed from the previous one in some very important ways. The researchers used one of the most resilient[(b)] tardigrade species on the planet, *R. varieornatus*, whereas the previous study looked at *Hypsibius dujardini*, which is among the least tolerant[注8] freshwater species of tardigrade.

⑦ Also, the researchers successfully eliminated all extraneous bacteria (using commercial chlorine bleach, among other measures), which allowed them to scan the tardigrade genome

without any contaminants[注9]. This is important because the authors of the original study claimed that an incredible amount of bacterial genes were included in the tardigrade genome. Lastly, the researchers were able to sequence the tardigrade genome at a much higher level of accuracy, creating a genetic profile that was 100 times less fragmented than the previous one.

⑧ Looking at the newly sequenced genome, the researchers observed that the proportion of foreign genes is closer to 1.2 percent, which is much lower than the 17.5 percent claimed last year. "The proportion of 1.2 percent is not so special in the animal kingdom, and thus extensive horizontal gene transfer is not common in tardigrades, if any," Kunieda told *Gizmodo*. "A striking feature of tardigrades is that they have developed — and abundantly express — tardigrade-unique genes, and some of them likely play important roles in tolerance."

⑨ The authors of the new study were able to pinpoint a number of genes and biological processes responsible for the tardigrades' remarkable survival skills. For example, its genome contains more copies of an anti-oxidant enzyme and a DNA-repair gene than any other animal. Kunieda says these tools help the tardigrade counteract(c) oxidative stress when it's dehydrated, and to efficiently repair its damaged DNA.

⑩ They also found that the hardy water bear expresses a tardigrade-specific protein that binds itself to DNA. This unique protein, dubbed Dsup, acts like a shield against x-ray radiation, preventing the DNA from snapping apart. This would help to explain why tardigrades are seemingly impervious to(d) radiation, and why they can survive the vacuum of space.

⑪ This tolerance to x-rays can be transferred to the cells of other animals. On tests using cultured human cells, the researchers demonstrated that Dsup suppresses x-ray-induced DNA damage by a whopping 40 percent. If this tardigrade-specific protein could be transplanted to live humans, it could improve our own tolerance against X-rays. And perhaps tardigrade biology could be used to make humans more adaptable to space.

⑫ "Once Dsup can be incorporated into humans, it may improve radio-tolerance," said Kunieda. "But at the moment, we'd need genetic manipulations to do this, and I don't think this will happen in the near future." He also says that Dsup isn't perfect, as it reduces the damage done by radiation to DNA by approximately half, "which is significant, but still only half." What's more, he's confident that tardigrades use other strategies in addition to Dsup to fend off the effects of radiation.

⑬ That said, Kunieda sees big things for Dsup, and other "extremotolerant[注10]" characteristics, both those that have already been discovered, and those still waiting to be found. "Using these tolerance genes collectively, we could confer enhanced tolerance to other animals," he said. "Especially, if dehydration-tolerance can become transferable, I hope it will transform the way we preserve various biological materials, including cells, crops, meats, fish, and so on."

⑭ More work still needs to be done to fully understand the remarkable tardigrade genome. But one thing's for certain — this creature is a survivor, and we would do well to learn its many tricks.

注１：clan　仲間　　注２：arsenal　有力な手段
注３：protracted　長引いた　　注４：leverage　～を巧みに活用する
注５：bizarre　奇怪な　　注６：toil　苦労
注７：proprietary　独自の　　注８：tolerant　耐性がある
注９：contaminant　汚染物質　　注10：extremotolerant　極限環境に耐える
出典：Dvorsky, G. (2016). *Gizmodo*. September 20, 2016. Retrieved from https://gizmodo.com　分かりやすさのために，表現を修正した箇所がある。

問 1　英文の内容に合うように，(1)～(4)の各文の空所を補うものとして最も適したものを，それぞれ選択肢１～４の中から一つ選びなさい。

(1) The word neat (a) in paragraph ① is closest in meaning to _____.
1. suspicious　2. dumb　3. interesting　4. happy

(2) The word resilient (b) in paragraph ⑥ is closest in meaning to _____.
1. precious　2. weak　3. simple　4. tough

(3) The word counteract (c) in paragraph ⑨ is closest in meaning to _____.
1. work against　2. build up　3. expire　4. sustain

(4) The phrase impervious to (d) in paragraph ⑩ is closest in meaning to _____.
1. not saved by　2. not affected by　3. motivated by　4. challenged by

問 2　英文の内容に合うように，(1)～(6)の質問に対する答えとして最も適したものを，それぞれ選択肢１～４の中から一つ選びなさい。

(1) According to the article, what did researchers from the University of Tokyo achieve?
1. They found and classified new tardigrade species.
2. They gained an understanding of the tardigrade life cycle.
3. They created an improved map of tardigrade DNA.
4. They discovered ways to make tardigrades live longer.

(2) What is implied by paragraphs ③ and ④?

1. Tardigrade DNA was used to cure a human disease.
2. Tardigrades have survived being frozen for 300 years.
3. Tardigrades may have come to earth from another planet.
4. Tardigrade studies may be useful to health science.

(3) What is the main point of paragraphs ⑤ through ⑧?

1. Most water bear DNA comes from other living things.
2. New water bear research has challenged old research.
3. Water bears are categorized as a kind of bacteria.
4. Genetic transfer was found to be unique to water bears.

(4) Based on the article, which of the following statements is true?

1. Tardigrade resistance to radiation may be transferable to other species.
2. A lack of water helps repair environmental damages to tardigrade DNA.
3. X-rays help scientists to better understand how tardigrades reproduce.
4. Tardigrade DNA could someday reduce the need to move to space.

(5) According to the article, what can be inferred about Kunieda from the University of Tokyo?

1. He believes that tardigrade DNA could be the key to curing human diseases.
2. He wants to modify tardigrade DNA using the knowledge he has gained.
3. He is optimistic about future scientific achievements using tardigrade DNA.
4. He doubts that resistance to dehydration can be achieved in other species.

(6) Which of the following would be the best title for the article?

1. Unlocking the history of an alien species found on Earth.
2. Scientists have finally figured out why the water bear exists.
3. Science uncovers many secrets of an extraordinary animal.
4. Mixing tardigrade and human DNA is key to human survival.

V 自由英作文問題

下記テーマについて，英語で自分の考えを述べなさい。書体は活字体でも筆記体でもよいが，解答は所定の範囲内に収めなさい。

You are expected to write one complete essay. Your essay should include an introduction, main text, AND conclusion. Please write as if you are writing for someone who has not read the topic question.

The writing will be evaluated from the viewpoint of both quantity and quality. The evaluation will also consider whether what you write responds to the question.

Everyone belongs to one or more groups whether they are social, cultural, ethnic, etc. The groups we belong to help form our identities. Please describe how your experiences with the groups you belong to (1) have formed your identity and (2) will help you contribute to a multicultural environment. Exclude sports and other school club activities.