01　【医学科】

英語問題

2022(令和4)年度

【注意事項】

1. この問題冊子は「英語」である。
2. 試験時間は90分である。
3. 試験開始の合図まで，この問題冊子を開いてはいけない。ただし，表紙はあらかじめよく読んでおくこと。
4. 試験開始後すぐに，以下の5および6に記載されていることを確認すること。
5. この問題冊子の印刷は1ページから12ページまである。
6. 解答用紙は問題冊子中央に3枚はさみこんである。
7. 問題冊子に落丁，乱丁，印刷不鮮明な箇所等があった場合および解答用紙が不足している場合は，手をあげて監督者に申し出ること。
8. 試験開始後，3枚ある解答用紙の所定の欄に，受験番号と氏名を記入すること(1枚につき受験番号は2箇所，氏名は1箇所)。
9. 解答は必ず解答用紙の指定された箇所に記入すること。解答用紙の裏面に記入してはいけない。
10. 問題番号に対応した解答用紙に解答していない場合は，採点されない場合もあるので注意すること。
11. 問題冊子の中の白紙部分は下書き等に使用してよい。
12. 解答用紙を切り離したり，持ち帰ってはいけない。
13. 試験終了時刻まで退室を認めない。試験中の気分不快やトイレ等，やむを得ない場合には，手をあげて監督者を呼び，指示に従うこと。
14. 試験終了後は問題冊子を持ち帰ること。

〔 I 〕 次の文章を読んで，下の問いに解答欄の範囲内で答えなさい。

＊が付いている語句には本文の後ろに注があります。

Numbers do not exist in all cultures. There are numberless hunter-gatherers embedded deep in Amazonia, living along branches of the world's largest river tree. Instead of using words for precise quantities, these people rely exclusively on terms *analogous to "a few" or "some."

Cultures without numbers, or with only one or two precise numbers, include the Munduruku and Pirahã in Amazonia. Researchers have also studied some adults in Nicaragua who were never taught number words.

Without numbers, healthy human adults struggle to precisely differentiate and recall quantities as low as four. In an experiment, a researcher will place nuts into a can one at a time, then remove them one by one. The person watching is asked to signal when all the nuts have been removed. Responses suggest that anumeric (ア) people have some trouble keeping track of how many nuts remain in the can, even if there are only four or five in total.

This and many other experiments have *converged upon a simple conclusion: When people do not have number words, they struggle to make quantitative *distinctions that probably seem natural to someone like you or me. While only a small portion of the world's languages are anumeric or nearly anumeric, they demonstrate that number words are not a human universal (イ).

It is worth stressing that these anumeric people are *cognitively normal, well-adapted to the environs they have dominated for centuries. As the child of *missionaries, I spent some of my youth living with anumeric *indigenous people, the aforementioned Pirahã who live along the sinuous banks of the black Maici River. Like other outsiders, I was continually impressed by their superior understanding of the riverine ecology we shared.

Yet numberless people struggle with tasks that require precise *discrimination between quantities. Perhaps this should be unsurprising. After all, without counting, how can someone tell whether there are, say, seven or eight coconuts in a tree? Such seemingly straightforward distinctions become *blurry through numberless eyes.

This conclusion is echoed by work with anumeric children in industrialized societies.

Prior to being spoon-fed number words, children can only approximately discriminate quantities beyond three. We must be handed the cognitive tools of numbers before we can consistently and easily recognize higher quantities.

In fact, acquiring the exact meaning of number words is a painstaking process that takes children (ウ) years. Initially, kids learn numbers much like they learn letters. They recognize that numbers are organized *sequentially, but have little awareness of what each individual number means. With time, they start to understand that a given number represents a quantity greater by one than the *preceding number. This "successor principle" is part of the foundation of our *numerical cognition, but requires extensive practice to understand.

None of us, then, is really a "numbers person." We are not *predisposed to handle quantitative distinctions adroitly. In the absence of the cultural traditions that *infuse our lives with numbers from infancy, we would all struggle with even basic quantitative distinctions.

Number words and written numerals transform our quantitative reasoning as they are *coaxed into our cognitive experience by our parents, peers and school teachers. The process seems so normal that we sometimes think of it as a natural part of growing up, but it is not. Human brains come equipped with certain quantitative instincts that are refined with age, but these instincts are very limited. For instance, even at birth we are capable of distinguishing between two markedly different quantities—for instance, eight from 16 things.

So, how did we ever invent "unnatural" numbers in the first place?

The answer is, literally, at your fingertips. The *bulk of the world's languages use base-10, base-20 or base-5 number systems. That is, these smaller numbers are the basis of larger numbers. English is a base-10 or decimal language, as evidenced by words like 14 ("four" + "10") and 31 ("three" × "10" + "one").

We speak a decimal language because an ancestral tongue, proto-Indo-European, was decimally based. Proto-Indo-European was decimally oriented because, as in so many cultures, our linguistic ancestors' hands served as the gateway to realizations like "five fingers on this hand is the same as five fingers on that hand." Such transient thoughts were manifested into words and passed down across generations. This is why the word "five" in many languages is derived from the word for "hand."

Cultures without numbers also offer insight into the cognitive influence of particular numeric traditions. Consider what time it is. Your day is ruled by minutes and seconds, but these *entities are not real in any physical sense and are nonexistent to numberless people. Minutes and seconds are the verbal and written *vestiges of an uncommon base-60 number system used in Mesopotamia millennia ago. They *reside in our minds, numerical *artifacts (エ) that not all humans inherit conceptually.

Research on the language of numbers shows, more and more, that one of our species' key characteristics is tremendous linguistic and cognitive diversity.

(出典　Caleb Everett, "'Anumeric' People: What Happens When a Language Has No Words for Numbers?," *The Conversation*, April 26, 2017, 一部改変)

Notes

analogous: similar.
converge: to come together.
distinction: difference.
cognitively (*adv.*) < cognitive (*adj.*): connected with mental processes of understanding.
missionary: a person who is sent to a foreign country to teach people about religion, especially Christianity.
indigenous: living natively in a particular place.
discrimination: the ability to understand small differences.
blurry: difficult to see clearly.
sequentially (*adv.*) < sequential (*adj.*): having a particular order.
preceding: existing before something.
numerical: expressed in numbers.
predispose: to make someone more likely to behave in a particular way.
infuse: to fill something with a particular quality.
coax: to persuade somebody to do something.
bulk: most of something.
entity: something that exists as a single unit.
vestige: a small part of something that existed in the past; trace.
reside: to stay in a place.
artifact: an object that is made by a person.

（1） 下線部 (ア) と同じ意味で使われている単語を本文より1つ抜き出しなさい。

（2） 下線部 (イ) の事柄を明らかにした実験の方法を，本文に即して日本語で具体的に説明しなさい。

（3） 下線部 (ウ) を和訳しなさい。

（4） インド・ヨーロッパ祖語に由来する英語のような言語が十進法を用いるのはなぜか。その理由を本文に即して日本語で簡潔に述べなさい。

（5） 下線部 (エ) とはどのような概念か。本文に即して日本語で具体例を挙げながら説明しなさい。

〔 II 〕 次の文章を読んで，下の問いに解答欄の範囲内で答えなさい。

＊が付いている語句には本文の後ろに注があります。

The man came on the bus quite early and Esther Kuroiwa noticed him briefly as he entered because he said *gaily to the driver, "You robber. All you guys do is take money from me every day, just for giving me a short *lift!"

Handsome in a red-faced way, greying, medium of height, and dressed in a dark grey sport suit with a yellow-and-black flowered shirt, he said this in a nice, *resonant, carrying voice which got the response of a scattering of *titters from the bus. Esther, somewhat amused and classifying him as a *somatotonic, promptly forgot about him. And since she was sitting alone in the first regular seat, facing the back of the driver and the two front benches facing each other, she returned to looking out the window.

At the next stop, a considerable mass of people piled on and the last two climbing up were (ア) an elderly Oriental man and his wife. Both were neatly and somberly clothed and the woman, who wore her hair in a *bun and carried a bunch of yellow and dark red *chrysanthemums, came to sit with Esther. (イ) Esther turned her head to smile a greeting (well, here we are, Orientals together on a bus), but the woman was watching, with some concern, her husband who was asking directions of the driver.

His faint English was *inflected in such a way as to make Esther decide he was probably Chinese, and she noted that he had to repeat his question several times before the driver could answer it. Then he came to sit in the seat across the aisle from his wife. It was about then that a man's voice, which Esther recognized soon as belonging to the somatotonic, began a loud *monologue in the seat just behind her. It was not really a monologue, since he seemed to be addressing his seat companion, but this person was not heard to give a single answer. The man's subject was a *figure in the local sporting world who had a nice fortune invested in several of the shining buildings the bus was just passing.

And he continued in this *vein, discussing the private life of the famous man so frankly that Esther knew he must be quite drunk. But she listened with interest, wondering how much of this *diatribe was true, because the public legend about the famous man was *emphatic about his charity. Suddenly, the woman with the chrysanthemums jerked around to get a look at the speaker and Esther felt her giving him a quick but thorough examination before she turned back around.

(ウ) "So you don't like it?" the man inquired, and it was a moment before Esther realized that he was now directing his attention to her seat neighbor.

"Well, if you don't like it," he continued, "why don't you get off this bus, why don't you go

back where you came from? Why don't you go back to China?"

Then, his voice growing *jovial, as though he were certain of the support of the bus in this at least, he *embroidered on this theme with a new eloquence.

彼が話し続けているとき，エスターは窓の外をみているふりをしながら，自分の隣りの婦人が体を(エ)こわばらせているのを感じた. The only movement from her was the trembling of the chrysanthemums with the motion of the bus. Without turning her head, Esther was also aware that a man, a mild-looking man with thinning hair and glasses, on one of the front benches was smiling at the woman and shaking his head *mournfully in sympathy, but she doubted whether the woman saw.

Esther herself, while believing herself properly annoyed with the speaker and sorry for the old couple, felt quite detached. She found herself wondering whether the man meant her in his exclusion order or whether she was identifiably Japanese. Of course, he was not sober enough to be interested in such fine distinctions, but it did matter, she decided, because she was Japanese, not Chinese, and therefore in the present case immune. Then she was startled (オ) to realize that what she was actually doing was *gloating over the fact that the drunken man had specified the Chinese as unwanted.

(出典　Hisaye Yamamoto, "Wilshire Bus," *Pacific Citizen*, December 23, 1950 初出, *Seventeen Syllables and Other Stories*, Rutgers University Press, 2001 収録, 一部改変)

Notes

gaily (*adv.*) < gay (*adj.*): full of joy.

lift: a ride in a car, etc.

resonant: producing a loud, clear, deep sound.

titter: quiet and nervous laughter.

somatotonic: a person having the type of aggressive personality.

bun: a way of arranging long hair by twisting it into a round shape.

chrysanthemum: a kind of flower.

inflect: to change the form of a word when using it in a particular way.

monologue: a long speech made by one person that prevents anyone else from talking.

figure: a person who has a specified status.

vein: a particular style, quality, etc.

diatribe: a speech or writing directed against some person or work; a bitter and violent criticism.

emphatic: expressing an opinion in a clear, strong way.

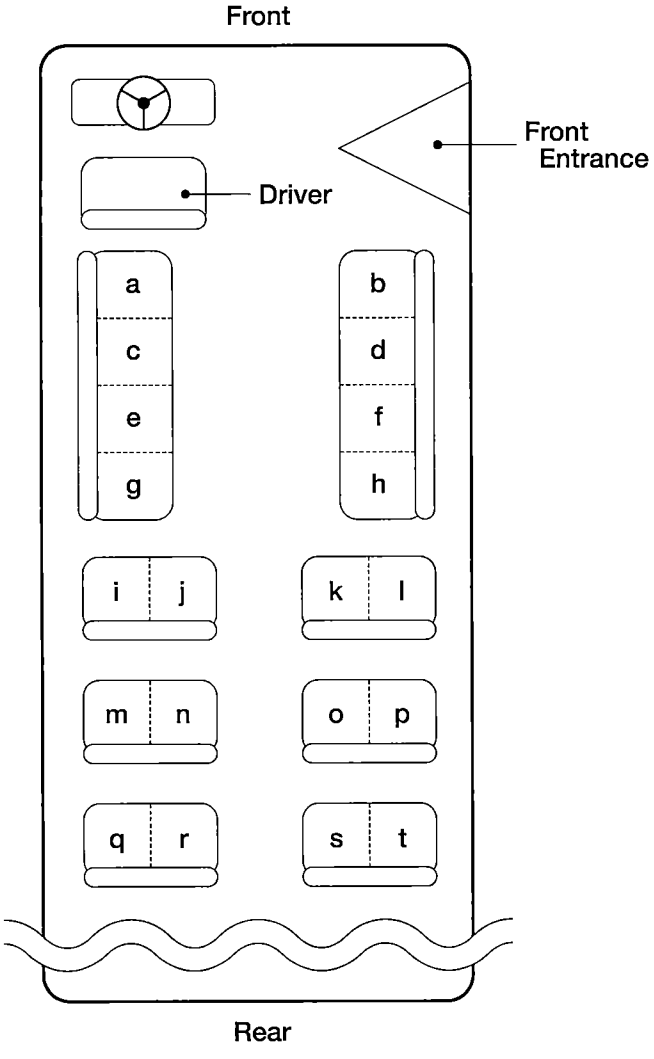
jovial: full of happiness and joy; cheerful.

embroider: to make (a story) more interesting by adding details that are not accurate.

mournfully (*adv.*) < mournful (*adj.*): very sad.

gloat: to feel great pleasure because of someone else's failure or bad luck.

（1） Esther と下線部 (ア) で示された夫婦それぞれが座った場所を，下の図から記号で選びなさい。



（2） 下線部 (イ) のような行動をしたのはなぜか。本文に即して日本語で簡潔に説明しなさい。

（3） 下線部 (ウ) のような発言をしたのはなぜか。本文に即して日本語で簡潔に説明しなさい。

（4） 下線部 (エ) を英訳しなさい。

（5） 下線部 (オ) について，Esther は自分のどのような心情に気づいて驚いたのか。本文に即して日本語で簡潔に説明しなさい。

〔Ⅲ〕 次の文章を読んで，下の問いに解答欄の範囲内で答えなさい。

＊が付いている語句には本文の後ろに注があります。

Sitting on a stool several feet from a long-armed robot, Dr. Danyal Fer wrapped his fingers around two metal handles near his chest.

As he moved the handles—up and down, left and right—the robot *mimicked each small motion with its own two arms. Then, when he pinched his thumb and forefinger together, one of the robot's tiny claws did much the same. This is how *surgeons like Dr. Fer have long used robots when operating on patients. They can remove a prostate from a patient while sitting at a computer console across the room.

But after this brief demonstration, Dr. Fer and his fellow researchers at the University of California, Berkeley, showed how they hope to advance the state of the art. Dr. Fer let go of the handles(ア), and a new kind of computer software took over. As he and the other researchers looked on, the robot started to move entirely on its own.

With one claw, the machine lifted a tiny plastic ring from an equally tiny *peg on the table, passed the ring from one claw to the other, moved it across the table and *gingerly hooked it onto a new peg. Then the robot did the same with several more rings, completing the task as quickly as it had when guided by Dr. Fer.

The training exercise was originally designed for humans; moving the rings from peg to peg is how surgeons learn to operate robots like the one in Berkeley. Now, an automated robot performing the test can match or even exceed a human in *dexterity, precision and speed, according to a new research paper from the Berkeley team.

The project is a part of a much wider effort to bring artificial intelligence into the operating room. Using many of the same technologies that *underpin self-driving cars, autonomous drones and warehouse robots, researchers are working to automate surgical robots too. These methods are still a long way from everyday use, but progress is *accelerating.

"It is an exciting time," said Russell Taylor, a professor at Johns Hopkins University and former IBM researcher known in the academic world as the father of robotic surgery. "It is where I hoped we would be 20 years ago."

(イ) The aim is not to remove surgeons from the operating room but to ease their *load and perhaps even to raise success rates—where there is room for improvement—by automating particular phases of surgery.

Robots can already exceed human accuracy on some surgical tasks, like placing a pin into a bone (a particularly risky task during knee and hip replacements). The hope is that automated robots can bring greater accuracy to other tasks, like *incisions or suturing, and reduce the risks that come with overworking the surgeon.

Five years ago, researchers with the Children's National Health System in Washington, D.C., designed a robot that could automatically suture the intestines of a pig during surgery. It was a notable step toward the kind of future envisioned by Greg Hager, a computer scientist at Johns Hopkins. But it came with an asterisk: The researchers had implanted tiny markers in the pig's intestines that emitted a near-infrared light and helped guide the robot's movements.

The method is far from practical, as the markers are not easily implanted or removed. But in recent years, artificial intelligence researchers have significantly improved the power of computer vision, which could allow robots to perform surgical tasks on their own, without such markers.

The change is driven by what are called *neural networks, mathematical systems that can learn skills by analyzing vast amounts of data. By analyzing thousands of cat photos, for instance, a neural network can learn to recognize a cat. In much the same way, a neural network can learn from images captured by surgical robots.
(ウ)

Surgical robots are equipped with cameras that record three-dimensional video of each operation. The video streams into a viewfinder that surgeons peer into while guiding the operation, watching from the robot's point of view.

But afterward, these images also provide a detailed road map showing how surgeries are performed. They can help new surgeons understand how to use these robots, and they can help train robots to handle tasks on their own. By analyzing images that show how a surgeon guides the robot, a neural network can learn the same skills.

This is how the Berkeley researchers have been working to automate their robot, which is

based on the da Vinci Surgical System, a two-armed machine that helps surgeons perform more than a million *procedures a year. Dr. Fer and his colleagues collect images of the robot moving the plastic rings while under human control. Then their system learns from these images, pinpointing the best ways of grabbing the rings, passing them between claws and moving them to new pegs.

But this process came with its own asterisk. When the system told the robot where to move, the robot often missed the spot by millimeters. Over months and years of use, the many metal (エ) cables inside the robot's twin arms have stretched and bent in small ways, so its movements were not as precise as they needed to be.

Human operators could compensate for this shift, unconsciously. But the automated system could not. This is often the problem with automated technology: It struggles to deal with change and uncertainty. Autonomous vehicles are still far from widespread use because they aren't yet able to handle all the chaos of the everyday world.

The Berkeley team decided to build a new neural network that analyzed the robot's mistakes and learned how much precision it was losing with each passing day. "It learns how the robot's joints evolve over time," said Brijen Thananjeyan, a doctoral student on the team. Once the automated system could account for this change, the robot could grab and move the plastics rings, matching the performance of human operators.

Other labs are trying different approaches. Researchers at the Worcester Polytechnic Institute are developing ways for machines to carefully guide surgeons' hands as they perform particular tasks, like inserting a needle for a cancer biopsy or burning into the brain to remove a tumor.

"It is like a car where the lane-following is autonomous but you still control the gas and the brake," said Greg Fischer, one of the Worcester researchers.

Many obstacles lie ahead, scientists note. Moving plastic pegs is one thing; cutting, moving and suturing flesh is another. "What happens when the camera angle changes?" said Ann Majewicz Fey, an associate professor at the University of Texas, Austin. "What happens when smoke gets in the way?"

For the foreseeable future, automation will be something that works alongside surgeons rather

than replaces them. But even that could have profound effects, Dr. Fer said. For instance, 手術室から遠く離れたところで医師が手術を行うことができるかもしれない(オ)—from miles or more away, perhaps, helping wounded soldiers on distant battlefields.

（出典　Cade Metz, "The Robot Surgeon Will See You Now: Real Scalpels, Artificial Intelligence—What Could Go Wrong?" *The New York Times*, April 30, 2021, 一部改変）

Notes

mimicked < mimic: to imitate (someone or their activities or words).
surgeon: a doctor who does operations in a hospital.
peg: a short pin or bolt that is used for hanging things on.
gingerly: in a careful or cautious manner.
dexterity: skill in performing tasks, especially with the hands.
underpin: to give strength or support to something and to help it succeed.
accelerate: to increase in amount or extent.
load: the amount of work to be done by a person or machine.
incision: a sharp cut made in something, particularly during a medical operation.
neural network: a computer system which is designed to work in a similar way to human brain.
procedure: a series of actions conducted in a certain order or manner.

（1）　下線部 (ア) のようなことをした目的について，本文に即して日本語で具体的に説明しなさい。

（2）　医療以外の分野における自動運転(操作)の実例を本文から３つ英語で抜き出しなさい。

（3）　下線部 (イ) を和訳しなさい。

（4）　下線部 (ウ) の手術中の用途を１つ，手術後の用途を２つ，それぞれ本文に即して日本語で簡潔に説明しなさい。

（5）　下線部 (エ) のようなことが起きた原因を，本文に即して日本語で簡潔に述べなさい。

（6）　下線部 (オ) を英訳しなさい。