2024年度
大学院理工学研究科【生命理学専攻】
博士後期課程　一般選抜試験(第Ⅱ期)問題

英　　語

開始時刻　午前10時00分
終了時刻　午前11時00分

【注意事項】
１．解答用紙には受験番号、氏名を必ず記入してください。
２．試験終了後、答案用紙は必ず提出してください（問題用紙は提出しなくてよい）。
３．問題番号が明記された答案用紙を使用し、解答してください。

問題 1　次の文章を読んで、以下の問いに答えなさい。

It comes as no surprise to anyone who sweated through it: 2023 was the hottest year in human history. Average surface temperatures rose nearly 0.2°C above the previous record, set in 2016, to 1.48°C over preindustrial levels, the European Union's Copernicus Climate Change Service reported today. Only Australia was spared record-setting heat. The extreme conditions are a "dramatic testimony of how far we now are from the climate in which our civilization developed," said Carlo Buontempo, Copernicus's director, in a statement.

Yet 2023's record temperatures—likely to be confirmed later this week by analyses from NASA, the U.S. National Oceanic and Atmospheric Administration, the United Kingdom's Met Office, and Berkeley Earth—come with a mystery. Humanity's unabated burning of fossil fuels is the dominant driver of the long-term trend, but it is insufficient to explain 2023's sudden spike, says Michael Diamond, an atmospheric scientist at Florida State University.

(問1)One exacerbating factor was the end of a La Niña climate pattern, which from 2020 to 2022 stirred up an increased amount of deep cold water in the eastern Pacific Ocean that absorbed heat and suppressed global temperatures. In 2023, the pattern flipped into an El Niño event, which blanketed the equatorial Pacific with warm waters and began to boost global temperatures.

But the flip is not enough to explain 2023's record, Gavin Schmidt, director of NASA's Goddard Institute for Space Studies, wrote in a blog post last week. (問2)Typically, El Niño plays a larger role in global temperatures the year after it starts—in this case, this year. And in 2023, heat surged far from El Niño's influence, Schmidt noted, above the northern Atlantic and Pacific oceans.

(問3)Perhaps the best explanation for the extra warming is the continued drop in light-blocking pollution as society shifts to cleaner sources of energy, says Tianle Yuan, an atmospheric physicist at NASA's Goddard Space Flight Center. In 2022, satellites began to detect this decrease from space. In 2020, new regulations from the International Maritime Organization added to the effect when ships began to cut sulfur pollution and inadvertently curbed the light-reflecting clouds that the sulfur particles help create. A preprint on Research Square suggests the loss of these clouds alone can explain half of the increase in the warming rate seen so far this decade, says Yuan, who led the work. "It would not account for all the warming we see this year, but it would represent a significant additional warming."

In a November 2023 paper, famed climate scientist James Hansen suggested [(問4)　　　　　　　　　]. But the acceleration has yet to show up in records of heat in the ocean depths, which resist the short-term fluctuations of the atmosphere and offer a truer sense of long-term trends.

The mystery of the past year leaves projections for this year less certain than usual. El Niño may inflate temperatures further, pushing the world briefly past the arbitrary 1.5°C "limit" settled on by policymakers in 2015's Paris agreement to protect small island nations from extreme sea-level rise. But extreme heat will again have to develop over the northern oceans for the world to breach the threshold—hardly a sure bet.

Regardless, the long-term warming pattern is certain to continue, as it has for decades—until fossil fuel burning ends.

(注) La Niña climate：ラニーニャ気候　El Niño event：エルニーニョ現象

問 1: 下線の部分を日本語に訳しなさい。

問 2: なぜ不十分か、下線に書かれている理由を日本語で説明しなさい。

問 3: この部分に書かれていることを日本語で要約しなさい。

問 4: この部分に対応する以下の文を英訳して、この部分を完成させなさい。
「汚染の抑制により、1970 年から 2010 年の間に、温暖化は 10 年あたり 0.18 ℃ から 10 年あたり 0.27 ℃まで加速した。」

問 5: この記事に対して英語で題名をつけなさい。

問 6: この記事に書かれている内容を英語で要約しなさい。記事の文章をそのまま使わずに、3 から 4 文程度で、自分で書いた文章で要約しなさい。

問題２　次の記事を読んで、問１～６に答えなさい。
Read the following article and answer the questions 1 - 6 below.

Researchers have made eggs from the cells of male mice — and showed that, once fertilized and implanted into female mice, the eggs can develop into seemingly healthy, fertile offspring. The approach is a long way from being used in humans. But it is an early proof-of-concept for a technique that raises the possibility of a way to treat some causes of infertility — or even allow for single-parent embryos. "This is a significant advance with significant potential applications,"_says Keith Latham, a developmental biologist at Michigan State University in East Lansing.

Researchers have been working towards this feat for years. In 2018, one team reported using embryonic stem cells made from sperm or eggs to generate pups with either two fathers or two mothers. The pups with two mothers survived to adulthood and were fertile; those with two fathers lived for only a few days. In 2020, a team led by developmental biologist Katsuhiko Hayashi, now at Osaka University in Japan, described the genetic changes necessary for cells to mature into eggs in a lab dish. And in 2021, the same researchers demonstrated that they could reconstruct the environment of mouse ovaries to grow eggs that produce healthy offspring.

With these tools in hand, Hayashi and his colleagues embarked on (a)<u>a project to create eggs using cells taken from an adult male mouse.</u> They reprogrammed these to create stem-cell-like induced pluripotent stem cells. The team grew these cells in culture until some of them had spontaneously lost their Y chromosomes. They then treated the cells with a compound called reversine, which can promote errors in how chromosomes are distributed during cell division, and looked for cells that were chromosomally female, with two copies of the X chromosome. From there, the team provided the induced pluripotent stem cells with the genetic signals needed to form immature eggs. They then fertilized the eggs using mouse sperm and transferred the resulting embryos into the uterus of a female mouse. The survival rate was low. Out of 630 transferred embryos, only 7 developed into pups. But the pups grew normally and were fertile as adults, Hayashi said at the meeting.

(b)<u>The technique is a long way from any kind of medical application.</u> "There are big differences between a mouse and the human," Hayashi said. Such differences often complicate efforts to translate discoveries in reproductive and stem-cell biology from mice to the clinic. In particular, Hayashi says that his team will need to carefully characterize the pups from the experiment, to look for any ways in which they differ from those bred using conventional methods. It will also be interesting to look at whether the 'epigenetic' chemical modifications to DNA that can influence gene activity are preserved properly in the eggs derived from male cells, says Fan Guo, a reproductive epigeneticist at the Chinese Academy of Sciences Institute of Zoology in Beijing, who calls Hayashi's results "illuminating". Epigenetic marks on DNA can influence development in the offspring well beyond the embryo stage. Another concern is that performing the same technique with human cells might require researchers to grow the egg cells in the laboratory for longer than was necessary with mouse cells, says Mitinori Saitou, a developmental biologist at Kyoto University in Japan who collaborated with Hayashi on the work. "If the culture period becomes longer, then both genetic and epigenetic abnormalities can accumulate," he told the conference. "The shorter the better." Latham says that even if the approach is feasible in humans, researchers will need to make it more efficient and practical by increasing the proportion of embryos that yield offspring. "If you're going to apply this in humans, you really want to err on the side of safety, caution and efficiency," he says. But if these hurdles are crossed, Hayashi's chromosomal-engineering approach could one day provide a treatment for some forms of infertility caused by sex-chromosomal conditions such as Turner's syndrome, in which women lack part or all of one of their X chromosomes.

The ramifications of Hayashi's work could also take human reproduction into (c)new territory, says bioethicist Tetsuya Ishii at Hokkaido University in Sapporo, Japan. If applied to humans, such research might help male couples to have biological children together, with the aid of surrogate mothers, he says. "It also suggests that a single man could have a biological child," he says, "in the far future." Such applications will require more than technical refinement of a biological method, said Hayashi, but also a broader societal discussion about the ethics and implications of implementing them: "(d)______________"

Modified from *Nature* **615**, 379-380 (2023)

問１．下線部(a)で示された project の具体的な内容を日本語で説明しなさい。

問２．下線部(b)が書かれたすべての理由を日本語で説明しなさい。

問３．下線部(c)が指しているすべてのことを日本語で簡潔に説明しなさい。

問４．次の「　」内の日本文を英訳して下線部(d)に入る英文を完成させなさい。
「このようなテクノロジーが人間社会に本当に適応できるかどうかは分からない。」

問５．この記事に書かれた内容の学術的意義と重要性を、英語でそれぞれ簡潔に（３〜４文程度で）説明しなさい。

問６．この記事に英語のタイトルをつけなさい。