I　次の英文を読んで，以下の設問に答えよ。(80 点)

Human-robot interaction researchers study relationships between robots and humans, often by running psychological experiments in which they observe human reactions to unconventional robot behaviors. One present-day study measures empathy and moral standing between adults and robots. Children are introduced to an apparently autonomous mobile robot, and together they play a children's game called "I Spy." In the midst of game-playing, lab technicians come in and tell the person and robot that it's time for the robot to go to the closet. The robot complains, saying the timing is unfair and that they are in the midst of a nice game. The technician is firm, and in spite of constant complaints pushes the robot into a closet, turns it off, and shuts the door as the robot ineffectually says, "I'm scared of being in the closet. It's dark in there, and I'll be all by myself. Please don't put me in the closet."

In another human-robot interaction study, researchers wanted to measure the level of destructiveness people can unleash upon seemingly intelligent robots. Student volunteers are introduced to a toy robot that follows the beam of a flashlight and are encouraged to spend some time playing with it. They are told that their job is to test the robot to verify that its genes are worth replicating. The researcher lets the student play with the robot for some time, then announces that this robot is substandard[*1] and must be destroyed, giving the student a hammer and literally asking him to "kill the robot now." Researchers then measure the level of destructiveness by counting the number of total hammer hits and the final number of fragments of crushed robot.

There are early, and very eerie, projects dedicated to understanding how we think of robots, and where we place seemingly autonomous robots in our system of ethics, empathy, and action. In science fiction, the problem is reversed. In Philip K. Dick's novel *Do Androids Dream of Electric Sheep?* (1968) and the movie adaptation of his work, *Blade Runner* (1982), bounty hunters try to find

and destroy renegade replicants — engineered beings with android brains. But replicant engineering has advanced to the point that these creatures are nearly indistinguishable from humans, yet they are enslaved in a system whose moral justifications are failing. Dick invented the *Voigt-Kampff* machine as the key tool for discriminating humans from replicants in this world. The machine works by detecting physiological responses to carefully worded questions during an interrogation, measuring the empathic response of the subject. So in fiction, the one solitary gap that remains between humans and androids is emotional: empathy. Of course, the story is powerful because it breaks down even this one (1) final distinction, leaving us to question the extent of our human rights and liberties.

But the irony is that, in our present-day nonfiction world, researchers are still busy trying to ascertain our human emotional response to robots. We do not even understand human empathy in the mixed-species world of humans and robots yet, let alone the emotional qualities of robots themselves. What makes this form of robo-ignorance even worse is that we do not fast-forward to the *Blade Runner* world overnight — rather, we will spend decades in intermediate stages, where the early robots out of the "womb" will be inferior to people in numerous ways, yet they will be social, interactive, and incorporated throughout society because they are useful enough to turn a profit for someone.

How will we treat these pioneering robots, which will doubtless have characteristics we can easily take advantage of if we so choose? We can extrapolate from examples of truly autonomous robots that have been introduced to the public in the past decade.

One experience that has always remained with me involves my undergraduate research robot, Vagabond, exploring the sandstone arcades of the central quadrangle*2 at Stanford University. Our goal was to create a navigation program that would enable Vagabond to travel anywhere in the quad, and we had (2) gone so far as to measure and map, by hand, the complete layout of the area —

the position of every hallway, curb, and pillar down to the nearest centimeter. Navigation software enabled Vagabond to measure distances to walls and columns using sonar, estimate its position in the handmade map, then navigate the walkways to a goal destination. Along the way, Vagabond used the same sonar sensors to detect people in its path, stopping or patiently attempting to navigate around them while continuing to track its position.

Normally, we communicated with Vagabond from a desktop computer on a wheeled cart. We had very long extension cords connecting the cart to our offices, on the second floor, and were nearly always in the same long walkway as the robot. Many tourists would walk by this picturesque location, and so we became very good at compactly describing our research dozens of times a day.

On one occasion, we were pushing Vagabond's navigation to the limit, having told it of a destination several buildings away. Our cart was situated near its starting point, and the robot was already out of sight. After a chat with Ben Dugan, my colleague on the project, I decided to check on the robot and went around the corner. I saw the robot — a two-foot-high black cylinder with a Powerbook 150 laptop latched on top — at the far end of the corridor, with two people standing next to it: a tall man in cowboy boots and a woman. I was 25 meters away and as I walked toward Vagabond I realized what they were doing. The woman was blocking the robot's path, keeping it still, and the man was kicking the robot on the side, hard. Hard enough that the robot was tipping and righting itself on every kick.

I started running, and as I neared them they began walking away and the man said, "I'm still smarter." In all our programming, in all our obstacle-detection logic built into the LISP[*3] code, we had never accounted for this particular possibility — man kicking robot to show off to girlfriend. (3)それは，ロボットのせいで人間が実に驚くべき行動をとってしまうということを私が悟るうえで，ひとつの転換点だった。

My second personal experience stems from Chips, an autonomous tour-guide

robot our research group installed at the Carnegie Museum of Natural History. Chips provided multimedia tours of Dinosaur Hall from 1998 to 2003, playing videos of paleontologists*4 and dig sites while also traveling around the massive Tyrannosaurus type specimen at the museum, pointing out details concerning the bones and additional exhibits on the walls. Chips was tall and heavy — more than 2 meters high and 300 pounds, so it was critical that this robot play it safe in a space full of children and strollers. (4)その操縦システムは，進路に何らかの障害物があればロボットがすぐさま完全に停止するよう設計されていた, as it said "Excuse me" through its speakers.

But during the first few months of deployment, we found Chips facing the same pathological condition time and time again. Children would be following the robot as if it were a pied piper, attending to its videos and enjoying the spectacle of a massive mobile robot with a cartoon face. Adults would step in front of the robot, watch it suddenly halt and say "Excuse me," and then wait there, smiling. And wait. And wait. Those following the robot on tour would eventually be fed up with the delays and leave for greener pastures.

Once again we had been naïve, assuming that "excuse me" would mean, to people, "Please step out of my way." Experimentally, when a robot tells a human "Excuse me," the person often interprets the statement to mean "Hey human, look at you, you have the power to stop me. How cool is that! Play with me."

The solution to Chips's abuse problem, obvious in hindsight, was a simple phrasing change from "Excuse me" to "Excuse us. You're blocking my path, and I am giving a tour to the people behind me. Please let us continue." (5)What a difference. People would block the robot, listen to its response, look at the people behind the robot embarrassingly, and move right out of the way.

I never really discovered a way to make people treat the robot with more respect. I simply brought the people following the robot into the social equation, and manipulated the human obstacle into behaving more politely for the sake of their human cousins.

So there is a chance that even slow robots will be treated well by people when they are wrapped into a human social context. But the story may be woefully different when robots are out and about on their own, apparently autonomous and disconnected from the social fabric of real people.

*1 substandard: below the usual or average standard

*2 quadrangle: a square open space that is surrounded by buildings, especially at a school or college; also called a "quad"

*3 LISP: a high-level programming language

*4 paleontologists: people who study past life forms as represented in fossils

[Adapted from Illah Reza Nourbakhsh, *Robot Futures*. Cambridge, Massachusetts: MIT Press, 2013, 54－59.]

I -1. 下線部(1)を日本語に訳せ。

I -2. 下線部(2)を日本語に訳せ。

I -3. 下線部(3)を英語に訳せ。

I -4. 下線部(4)を英語に訳せ。

I -5. 下線部(5) "What a difference." は具体的には何を意味するか。どうすることにより，どのような結果が生じたのかがわかるように，70 字以内の日本語で説明せよ。

I -6. 以下の(1)から(3)の答としてもっとも適切なものをＡからＥの中から選び，記号で答えよ。

(1) Select the sentence that best describes a purpose for studies of human-robot interactions mentioned in the text.

A. Researchers want to create friendly robots that can manage and direct the flow of people in crowded situations.

B. Researchers want to design sturdy robots that will not break upon collision with unpredictable objects like humans.

C. Researchers want to investigate people's emotional and ethical responses when they are in contact with robots.

D. Researchers want to measure human standards of morality by observing them with various kinds of robots.

E. Researchers want to predict human behaviors towards robots using artificial intelligence and big data.

(2) Select the sentence that best describes pioneering robots in intermediate stages, according to the text.

A. Pioneering robots are likely to be cherished as if they were immature creatures, just out of the womb.

B. Pioneering robots are likely to be invested in by entrepreneurs even if they do not make a profit from sales.

C. Pioneering robots are likely to be used by malicious people to gain dominance over a wide range of domains.

D. Pioneering robots are likely to conduct experiments on behalf of scientists in areas difficult for humans to reach.

E. Pioneering robots are likely to participate in social exchanges even though they may do so awkwardly.

(3) Which of the following do most people find it difficult to do in relation to robots, according to the text?

A. Most people find it difficult to accept that they are inferior to robots when it comes to navigating a route.

B. Most people find it difficult to avoid ending up quarreling with relatively primitive robots.

C. Most people find it difficult to ignore robots even when they are not functioning as programmed.

D. Most people find it difficult to offer the same degree of respect to robots as to humans.

E. Most people find it difficult to refrain from making fun of robots that have a limited linguistic repertoire.

I-7. 次の1から10の文から，本文の内容に一致するものを3つ選び，番号で答えよ。

1. After playing with a toy robot, student volunteers came to the conclusion that the genes of the robot were not worth replicating.
2. In his science fiction novel published in 1968, Philip K. Dick describes a reversed world in which humans are discriminated against by intelligent robots.
3. In the mixed-species world of humans and robots, it would be difficult to understand human responses to robots if the emotions of robots themselves were studied in isolation.
4. By perceiving sound waves reflected off walls and pillars, the research robot named Vagabond was able to estimate its position in the quadrangle of Stanford University.
5. Many people who were interested in robotics visited Stanford University in order to observe the experiment with Vagabond that was carried out in the quadrangle.
6. When the author first saw a couple at a distance down the corridor, he did not anticipate that the man was bullying Vagabond to demonstrate he was cleverer than the robot.
7. Chips's roles in the museum included showing visitors around Dinosaur Hall, digging up artifacts, and providing detailed commentaries on some exhibits.
8. Researchers found that children were more cautious in the presence of a robot like Chips than adults were in spite of its exciting and appealing features.
9. The results of the Chips experiment show that people are more likely to alter their behavior willingly for their blood relatives than for inanimate robots.
10. It is possible that people will not abuse a slow robot if it is properly incorporated into human social settings.

Ⅱ　次の英文を読んで，以下の設問に答えよ。(70 点)

When people are asked to choose from a list the best description of how they feel when doing whatever they enjoy doing most — reading, climbing mountains, playing chess, whatever — the answer most frequently chosen is "designing or discovering something new." At first, it seems strange that dancers, rock climbers, and composers all agree that their most enjoyable experiences resemble a process of discovery. But when we think about it some more, it seems perfectly reasonable that at least some people should enjoy discovering and creating above all else.

[①], try a simple thought experiment(a). Suppose that you want to build an organism, an artificial life form, that will have the best chance of surviving in a complex and unpredictable environment, such as that on Earth. You want to build into this organism some mechanism that will prepare it to confront as many of the sudden dangers and to take advantage of as many of the opportunities that arise as possible. How would you go about doing this? Certainly you would want to design an organism that is basically conservative, one that learns the best solutions from the past and keeps repeating them, trying to save energy, to be cautious and go with the tried-and-true patterns of behavior.

But the best solution would also include a relay system in a few organisms that would give a positive reinforcement every time they discovered something new or came up with a novel idea or behavior, whether or not it was immediately useful. It is especially important to make sure that the organism was not rewarded only for useful discoveries, otherwise it would be severely handicapped in meeting the future. For no earthly builder(1) could anticipate the kind of situations the species of new organisms might encounter tomorrow, next year, or in the next decade. So the best program is one that makes the organism feel good whenever something new is discovered, regardless of its present usefulness. And this is what seems to have happened with our race through evolution.

By random mutations, some individuals must have developed a nervous system in which the discovery of novelty stimulates the pleasure centers in the brain. Just as some individuals derive a keener pleasure from sex and others from food, so some must have been born who derived a keener pleasure from learning something new. (2) It is possible that children who were more curious ran more risks and so were more likely to die early than their more passive companions. But it is also probable that those human groups that learned to appreciate the curious children among them, and helped to protect and reward them so that they could grow to maturity and have children of their own, were more successful than groups that ignored the potentially creative in their midst.

[②], we are the descendants of ancestors who recognized the importance of novelty, protected those individuals who enjoyed being creative, and learned from them. Because they had among them individuals who enjoyed exploring and inventing, (3) 彼らにはその生存を脅かすような予測できない状況に立ち向かうための，よりよい用意があった. So we too share this propensity for enjoying whatever we do, provided we can do it in a new way, provided we can discover or design something new in doing it. This is why creativity, no matter in what domain it takes place, is so enjoyable. This is why Brenda Milner, among many others, said: "I would say that I am impartial about what is important or great, because every new little discovery, even a tiny one, is exciting at the moment of discovery."

But this is only part of the story. Another force motivates us, and it is more primitive and more powerful than the urge to create: (b) the force of entropy. This too is a survival mechanism built into our genes by evolution. It gives us pleasure when we are comfortable, when we relax, when we can get away with feeling good without expending energy. If we didn't have this built-in regulator, we could easily kill ourselves by running ragged and then not having enough reserves of strength, body fat, or nervous energy to face the unexpected.

This is the reason why the urge to relax, to curl up comfortably on the sofa

whenever we can get away with it, is so strong. Because this conservative urge is so powerful, for most people "free time" means a chance to wind down, to park the mind in neutral. When there are no external demands, entropy kicks in, and unless we understand what is happening, it takes over our body and our mind. We are generally torn between two opposite sets of instructions programmed into the brain: the least-effort imperative on one side, and the claims of creativity on the other.

In most individuals entropy seems to be stronger, and they enjoy comfort more than the challenge of discovery. A few are more responsive to the rewards of discovery. But we all respond to both of these rewards; the tendencies toward conserving energy as well as using it constructively are simultaneously part of our inheritance. Which one wins depends not only on our genetic makeup but also probably on our early experiences.(4) However, unless enough people are motivated by the enjoyment that comes from confronting challenges, by discovering new ways of being and doing, there is no evolution of culture, no progress in thought or feeling. It is important, therefore, to understand better what enjoyment consists of and how creativity can produce it.

[Adapted from Mihaly Csikszentmihalyi, *Creativity: Flow and the Psychology of Discovery and Invention*. New York: Harper Collins, 1996, 108－110.]

Ⅱ-1. 下線部(1)は本文においてはどのような人間のことを言っているか。15字以上25字以内の日本語で説明せよ。

Ⅱ-2. 下線部(2)を日本語に訳せ。

Ⅱ-3. 下線部(3)を英語に訳せ。

Ⅱ-4. 下線部(4)を日本語に訳せ。

Ⅱ-5. 文中の空欄[①]および[②]に入れるのにもっとも適切なものをAからEの中から選び，記号で答えよ。

① A. Apart from that
B. As a matter of fact
C. For this reason
D. In a moment
E. To see the logic of this

② A. As a result
B. By the way
C. If this is true
D. To make matters worse
E. Unless there is any change

Ⅱ-6. 以下の(1)および(2)の答としてもっとも適切なものをＡからＥの中から選び，記号で答えよ。

(1) Look at the underlined part (a). Which of the following does the "simple thought experiment" lead to?

A. building an organism that tackles problems regardless of whether it receives positive reinforcement for its actions

B. constructing a system that rewards a few of the organisms for both their beneficial findings and those that appear to be of no immediate use

C. designing a series of programs that support and enhance the creature's existence, discoveries, and creativity

D. installing a self-regulating integrated device within the artificial life form that diminishes the tendency to conserve energy

E. making an organism that conserves energy and follows traditional repetitive patterns without concern for rewards

(2) Look at the underlined part (b). Which of the following does the author discuss to illustrate the "force of entropy"?

A. Human genes are structured such that humans feel enjoyment when discovering and exploring novelty in their free time.

B. Humans tend to consciously save their energy to prepare for emergency situations.

C. The genetic makeup of the human body enables us to be creative, whether or not we have slept sufficiently.

D. The human body instinctively knows when to stop and rest to restore strength.

E. The survival mechanism is built into the human body in such a way that people spend less time on work and more time on rest.

Ⅱ-7. 次の1から8の文から，本文の内容に一致するものを2つ選び，番号で答えよ。

1. In building an artificial life form, learning the existing patterns of behavior and repeating them is of greatest importance when your primary concern is the life form's survival.
2. In the face of changing environmental conditions, the human brain instructs us to proceed cautiously to protect ourselves.
3. Our ancestors encouraged individuals to explore new ideas, preparing them for unexpected conditions, but they failed to facilitate communal learning.
4. Our creativity and desire for innovation and invention are stimulated by exterior factors such as rewards, encouragement, and pressure.
5. So-called cultural evolution is not necessarily dependent on the availability of sufficient reserves of energy for the enjoyment of novelty.
6. The fact that some of us use our creativity to overcome difficult situations has been a key factor in the development of human culture.
7. The organism with the best chance of survival is creative in principle, but conservative when it is exposed to competition with other individuals in the process of evolution.
8. While human beings are programmed to enjoy both comfort and creative activity, on the whole we are more inclined to conserve energy.