英語－Ⅰ

次の文章に関して、空欄補充問題と読解問題の二つがあります。まず、[31]から[40]の空所を埋めるのに、文脈的に最も適切な語を 1 から 3 の中から選び、その番号を解答欄（31）から（40）にマークしなさい。次に、内容に関する[41]から[45]の設問には、1 から 4 の選択肢が付されています。そのうち、文章の内容からみて最も適切なものを選び、その番号を解答欄（41）から（45）にマークしなさい。

1 It sounds like something out of a science fiction movie about making super-soldiers. Scientists have turned shy, low-ranking mice into aggressive fighters who almost always win in dominance competitions. And they did it by stimulating a part of the mouse brain that controls "effortful" behavior.

2 Mice are social animals, and male mice [31](1. embody 2. establish 3. eradicate) a pecking order amongst themselves by displaying aggressive behavior. Though this aggression can take many forms, neuroscientist Zhou Tingting of the Chinese Academy of Sciences, Shanghai, joined with his colleagues to measure mouse dominance using what's called the "tube test." The tube test creates a scenario [32](1. in which 2. in that 3. in so far as) there's not enough room for the mice to pass each other in the tube. Mice have to shove one another aside to get out. The mouse who shoves the most other mice out of its way will "win" the dominance game.

3 In a recent article for *Science*, Zhou and his colleagues write that "winner mice initiated significantly more pushes, and with a longer duration per push, than loser mice." Winners weren't stronger than losers; they were [33](1. simply 2. also 3. even) more persistently aggressive. The researchers also found that the winner mice showed brain activity in a cluster of neurons called the dorsomedial prefrontal cortex (dmPFC), which is associated with "effortful behavior" and "social dominance." Mice whose dmPFC was quiet during tube tests always lost.

4 Zhou and his colleagues wondered whether they could create "winner" mice by stimulating the dmPFC. Using a brain stimulation technique called "optogenetics" that [34](1. rides 2. triggers 3. considers) neural activity with proteins and light, they stimulated the dmPFC region of a low-ranking mouse's brain. Then the low-ranking mouse took the tube test with a high-ranking mouse. [35](1. Unfortunately 2. As expected 3. Immediately), the loser mouse began to shove the winner mouse vigorously, winning almost every contest.

5 There are a lot of interesting implications here for further research. [36](1. However 2. First of all 3. In this way), winning social dominance contests is clearly not just a matter of physical strength. Having an aggressive attitude is key to winning. And second, there is the question of whether this kind of technique would work on other animals and perhaps even humans. Mouse brains are similar to human brains in some ways, but our brains are far more complicated. That makes it

[37](1. assured 2. impossible 3. unlikely) that a shy person could be transformed into the Incredible Hulk with just one squirt of photons from a brain implant.

6 Perhaps more interesting is how researchers found they could permanently transform loser mice into winners, just by stimulating their brains six or more times in tube tests. "We observed that not all the mice returned to their original rank," Zhejiang University neuroscientist Hu Hailan reported to the Guardian. "Some mice did, but some of them had this newly dominant position." Hu and the other researchers refer to this as the "winner effect," in which one [38](1. triumph 2. defeat 3. fluke) can lead to more victories, due to a change in outlook.

7 Put in more scientific terms, the winner effect is the result of "neuroplasticity," or the way neural connections in our brains are constantly changing. Each time the mouse wins due to brain stimulation, the [39](1. undercutting 2. underwhelming 3. underlying) structure of its brain changes a little bit. Over time, the mouse has essentially been [40](1. rewired 2. relegated 3. relaxed) to be more aggressive in dominance games. Light stimulation isn't the only way to do this; animals can undergo changes in their brains through new experiences or learning. But brain stimulation works remarkably fast.

8 For now, this research could only lead to a more aggressive mouse army. But in the future, it could help people overcome social anxiety by giving them a little boost of assertiveness at just the right moment. Or it could create an army of hyper-aggressive super-soldiers. What could go wrong?

—Based on Newitz, A. (2017). "A brain implant turns 'loser' mice into aggressive fighters," *Ars Technica*.

[41] What is meant by the phrase "pecking order" in the 2nd paragraph?

1. Social ranking based on physical characteristics.
2. Aggressive eating habits in animals.
3. Status in a community as determined by assertiveness.
4. The order in which mice escape from tubes.

[42] According to the 3rd paragraph, the results of the "tube test" revealed that

1. stronger mice were more likely to be aggressive than weaker mice.
2. dominant mice pushed other mice longer and more often.
3. overall brain activity was weak in mice that lost the test.
4. the dorsomedial prefrontal cortex was composed of a cluster of neurons.

[43] Which of the following was ***NOT*** a result of repeated brain stimulation in low-ranking mice?

1. Decreased proteins.
2. Increased aggression.
3. Permanent neurological changes.
4. Victory over "winner" mice.

[44] In the 7th paragraph, the term "neuroplasticity" is explained as

1. the brain's ability to adapt to new information.
2. the short-term effect of aggressive behavior on the brain.
3. the use of optogenetics to resist social anxiety.
4. learning new skills through repeated failure.

[45] According to the article, which of the following is a limitation of this study?

1. Shy persons aren't able to overcome social anxiety.
2. Stimulating aggression in people may lead to super soldier armies.
3. Research on mice might have different effects when conducted on humans.
4. Brain stimulation can have irreversible effects on mice and other animals.

英語－Ⅱ

次の文章に関して、空欄補充問題と読解問題の二つがあります。まず、[46]から[55]の空所を埋めるのに、文脈的に最も適切な語を 1 から 3 の中から選び、その番号を解答欄（46）から（55）にマークしなさい。次に、内容に関する[56]から[60]の設問には、1 から 4 の選択肢が付されています。そのうち、文章の内容からみて最も適切なものを選び、その番号を解答欄（56）から（60）にマークしなさい。

1 When science fiction writers first imagined robot invasions, the idea was that bots would become smart and powerful enough to take over the world by force, whether on their own or as directed by some evildoer. In reality, something only slightly less scary is happening. Robots are getting better, every day, at impersonating humans. When directed by opportunists, malefactors, and sometimes even nation-states, they pose a [46](1. false 2. minimal 3. particular) threat to democratic societies, which are premised on being open to the people.

2 Robots posing as people have become a menace. Philip Howard, who runs the Computational Propaganda Research Project at Oxford, studied the deployment of propaganda bots during voting on Brexit, and the recent American and French presidential elections. Twitter is especially [47](1. encouraged 2. distorted 3. trusted) by its millions of robot accounts; during the French election, it was principally Twitter robots who were trying to make #MacronLeaks into a scandal. Facebook has admitted it was essentially hacked during the American election in November. In Michigan, Mr. Howard notes, “junk news was shared just as widely as professional news in the days leading [48](1. up 2. down 3. over) to the election.”

3 Robots are also being used to attack the democratic features of the administrative state. This spring, the US put its proposed revocation of net neutrality up for public comment. In previous years, such proceedings attracted millions of commentators. This time, someone with an agenda but no actual public support unleashed robots who impersonated — via stolen identities – hundreds of thousands of people, [49](1. mimicking 2. conquering 3. flooding) the system with fake comments against federal net neutrality rules.

4 To be sure, today’s impersonation-bots are different from the robots imagined in science fiction: they aren’t sentient, don’t carry weapons, and don’t have physical bodies. Instead, fake humans just have whatever is necessary to make them seem human enough to “pass”: a name, perhaps a virtual appearance, a credit-card number and, [50](1. if necessary 2. therefore 3. in effect), a profession, birthday, and home address. They are brought to life by programs or scripts that give one person the power to imitate thousands.

5 The problem is almost certain to get worse, spreading to even more areas of life as bots are trained to become better at mimicking humans. [51](1. Conferring 2. Given 3. Ignoring) the degree to which product reviews have been swamped by robots, which tend to hand out five stars with abandon, commercial sabotage in the form of negative bot reviews is not hard to predict.

6 So far, we've been [52](1. content 2. excited 3. dissuaded) to leave the problem to the tech industry, where the focus has been on building defenses, usually in the form of Captchas ("completely automated public Turing test to tell computers and humans apart"), those annoying "type this" tests to prove you are not a robot. But leaving it all to industries is not a long-term solution. For one thing, the defenses don't actually deter impersonation bots, but reward whoever can beat them. And perhaps the greatest problem for a democracy is that companies like Facebook and Twitter lack a serious financial incentive to do anything about matters of public concern. Twitter estimates at least 27 million probably fake accounts; researchers suggest the real number is closer to 48 million, [53](1. when 2. so 3. yet) the company does little about the problem.

7 The ideal anti-robot campaign would employ a mixed technological and legal approach. Improved robot detection might help us find the robot masters or [54](1. inadvertently 2. potentially 3. secretly) help national security unleash counterattacks, which can be necessary when attacks come from overseas. There may be room for deputizing private parties to hunt down bad robots. A simple legal remedy would be a "Blade Runner" law that makes it illegal to deploy any program that hides its real identity to pose as a human. Automated processes should be required to state, "I am a robot." When dealing with a fake human, it would be nice to know.

8 Using robots to fake support, steal tickets, or crash democracy really is the kind of evil that science fiction writers were warning us about. The use of robots takes advantage of the fact that political campaigns, elections, and even open markets make humanistic assumptions, [55](1. ensuring 2. providing 3. trusting) that there is wisdom or at least legitimacy in crowds and value in public debate. But when support and opinion can be manufactured, bad or unpopular arguments can win not by logic but by a novel, dangerous form of force — the ultimate threat to every democracy.

—Based on Wu, T. (2017). *The New York Times*.

[56] What is meant by the term "robot" in the article?

1. People faking their identity to post on the Internet anonymously.
2. Computers that can independently think.
3. Scripted programs claiming to be human.
4. Physical machines developed to spread propaganda.

[57] What is an example of "commercial sabotage" as mentioned in the 5th paragraph?

1. Attacks by foreign nations to influence international trade.
2. Businesses promoting their brand by using bot accounts.
3. Using the tech industry to speak out against robots.
4. Companies employing robots to write bad reviews of rival products.

[58] Why haven't tech industries been successful in solving the robot problem as described in the 6th paragraph?

1. Tools like Captchas are easy for robots to beat.
2. Their solutions only detect robots rather than prevent their use.
3. Companies like Twitter and Facebook make money off robot accounts.
4. It is difficult to create laws against using fake accounts.

[59] Which of the following would be the best title for this article?

1. Robots are People, too
2. Is Your Next Door Neighbor a Robot?
3. The Ideal Anti-Robot Campaign
4. Please Prove You're Not a Robot

[60] Based on the article, which of the following best exemplifies the danger posed by robots?

1. Computer hackers altering election results to change the outcome.
2. Governments denying people an equal opportunity to express their opinions.
3. A company posting an anonymous review of its own product to boost sales.
4. Researchers collecting private data from participants without their consent.

注 意 事 項 2

問題冊子に数字の入った $\boxed{}$ があります．それらの数字は解答用紙の解答欄の番号を表しています．対応する番号の解答欄の 0 から 9 までの数字または − (マイナスの符号) をマークしてください．

$\boxed{}$ が 2 個以上つながったとき，数は右詰めで入れ，左の余った空欄には 0 を入れてください．負の数の場合には，マイナスの符号を先頭の $\boxed{}$ に入れてください．

(例) $12 \longrightarrow \boxed{0}\boxed{1}\boxed{2}$

$-3 \longrightarrow \boxed{-}\boxed{0}\boxed{3}$

分数は約分した形で解答してください．マイナスの符号は分母には使えません．

(例) $\dfrac{4}{8} \longrightarrow \dfrac{1}{2} \longrightarrow \dfrac{\boxed{0}\boxed{1}}{\boxed{0}\boxed{2}}$

$-\dfrac{6}{9} \longrightarrow -\dfrac{2}{3} \longrightarrow \dfrac{\boxed{-}\boxed{2}}{\boxed{0}\boxed{3}}$

ルート記号の中は平方因子を含まない形で解答してください．

(例) $\sqrt{50} \longrightarrow \boxed{0}\boxed{5}\sqrt{\boxed{0}\boxed{2}}$

$-\sqrt{24} \longrightarrow \boxed{-}\boxed{2}\sqrt{\boxed{0}\boxed{6}}$

$\sqrt{13} \longrightarrow \boxed{0}\boxed{1}\sqrt{\boxed{1}\boxed{3}}$

数式については，つぎの例のようにしてください．分数式は約分した形で解答してください．

(例) $-a^2-5 \longrightarrow \boxed{-}\boxed{1}a^2+\boxed{0}\boxed{0}a+\boxed{-}\boxed{5}$

$\dfrac{4a}{2a-2} \longrightarrow \dfrac{-2a}{1-a} \longrightarrow \dfrac{\boxed{0}\boxed{0}+\boxed{-}\boxed{2}a}{1-\boxed{0}\boxed{1}a}$

選択肢の番号を選ぶ問題では，同じ選択肢を何回選んでもかまいません．

数学－Ⅲ

0から5までの番号のついた箱0, 箱1,..., 箱5がある．箱1と箱2には玉が1つずつ入っているが，他の箱には玉は入っていない．いま，1から6の目のついた2個のサイコロを振り，出た目の差の絶対値と同じ番号のついた箱の中身を確認し，玉が入っていた場合にはその玉を取り出す操作について考える．

(1) この操作を1回行うとき，箱2の玉が取り出される確率は $\frac{(61)(62)}{(63)(64)}$ である．

(2) この操作を2回繰り返すとき，箱1の玉と箱2の玉の少なくとも1つが取り出される確率は $\frac{(65)(66)}{(67)(68)}$ である．

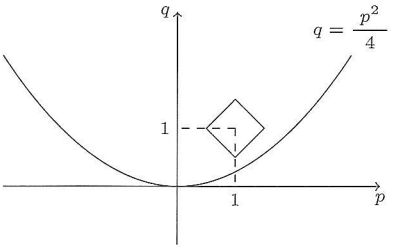
(3) 箱1と箱2の玉が両方とも取り出されるまで操作を繰り返すとき，その操作が3回で終わる確率は $\frac{(69)(70)(71)}{(72)(73)(74)}$ である．

数学－Ⅳ

(1) 実数 p, q が $q \leqq \dfrac{p^2}{4}$ をみたすとき，p, q に関する式

$$|p-1|+|q-1|$$

は，$p=$ [(75)][(76)]，$q=\dfrac{\boxed{(77)}\boxed{(78)}}{\boxed{(79)}\boxed{(80)}}$ のときに最小値 $\dfrac{\boxed{(81)}\boxed{(82)}}{\boxed{(83)}\boxed{(84)}}$ をとる．



(2) $a>\dfrac{1}{4}$ となる定数に対して，実数 x, y に関する式

$$|2x+y-1|+|2xy-a|$$

の最小値 m を考えると

(i) $\dfrac{1}{4}<a<\dfrac{\boxed{(85)}}{\boxed{(86)}}$ の場合

$x=\dfrac{\boxed{(87)}}{\boxed{(88)}}$，$y=\dfrac{\boxed{(89)}}{\boxed{(90)}}$ のときに $m=$ [(91)][(92)]$a+\dfrac{\boxed{(93)}\boxed{(94)}}{\boxed{(95)}\boxed{(96)}}$

(ii) $a=\dfrac{\boxed{(85)}}{\boxed{(86)}}$ の場合

$x=\dfrac{\boxed{(87)}}{\boxed{(88)}}$，$y=\dfrac{\boxed{(89)}}{\boxed{(90)}}$ または $x=\dfrac{\boxed{(97)}}{\boxed{(98)}}$，$y=\dfrac{\boxed{(99)}}{\boxed{(100)}}$ のときに $m=$ [(101)][(102)]

(iii) $a>\dfrac{\boxed{(85)}}{\boxed{(86)}}$ の場合

$x=\dfrac{\boxed{(103)}\boxed{(104)}}{\boxed{(105)}\boxed{(106)}}\sqrt{a}$，$y=$ [(107)][(108)]$\sqrt{a}$ のときに $m=$ [(109)][(110)]$\sqrt{a}+$ [(111)][(112)]

となる．

数学－Ⅴ

実数 x に対して，$[\,x\,]$ は x 以下の最大の整数とする．数列 $\{a_n\}$ と $\{b_n\}$ を

$$a_1 = 1, \qquad a_{n+1} = a_n + \left[\sqrt{n+1}\,\right] \qquad (n = 1, 2, 3, \dots)$$

$$b_1 = 1, \qquad b_{n+1} = b_n + (-1)^n \left[\sqrt{n+1}\,\right] \qquad (n = 1, 2, 3, \dots)$$

で定義すると

(1) $a_{10} =$ (113)(114)，$b_{10} =$ (115)(116) である．

(2) $a_n \geqq 100$ となるのは $n \geqq$ (117)(118) のときである．

(3) $b_n = 5$ となる最初の項は $n =$ (119)(120) のときである．

(4) 一般に，$m = \left[\sqrt{n}\,\right]$ とすると

$$a_n = \frac{\boxed{(121)}\boxed{(122)}\, m\, n + \boxed{(123)}\boxed{(124)}\, m^{\boxed{(125)}} + \boxed{(126)}\boxed{(127)}\, m^2 + \boxed{(128)}\boxed{(129)}\, m}{\boxed{(130)}\boxed{(131)}}$$

となる．