# 平成26年度　入学者選抜学力試験（前期）

# 数　　学

**注 意 事 項**

1. 試験開始の合図があるまで，この問題冊子と解答冊子を開かないでください.
2. 問題は必須問題と選択問題に分かれています.
3. 必須問題は3問あり，それらは1ページにあります．選択問題は問題範囲ごとにそれぞれ2問ずつあります．数学I・数学II・数学A・数学Bの問題は2ページに，数学III・数学Cの問題は3ページにあります.
4. 解答冊子は，必須問題用と選択問題用の2冊に分かれています．それぞれの解答冊子の表紙の所定欄に氏名と受験番号をはっきりと記入してください.
5. 選択問題は解答する問題範囲を選び，選択問題用解答冊子の表紙の解答問題欄の選択欄に○印を記入してください．○印を記入していない場合，または複数の選択欄に○印を記入した場合は，0点となります.
6. 計算用紙は，解答冊子の中に綴じてあります.
7. 試験中に問題冊子の印刷不明瞭，ページの落丁・乱丁および解答用紙の汚れ等に気がついた場合は，静かに手を上げて監督員に知らせてください.
8. 試験終了後，問題冊子は持ち帰ってください.
9. 解答時間は120分です.
10. 問題ごとに配点が記されています.

# 必須問題

**I** 次式で与えられる 2 つの放物線 $C_1, C_2$ について，以下の問いに答えよ．

$$C_1 : \ y = x^2, \qquad C_2 : \ y = ax^2 + 1$$

ただし，$a$ は 0 でない定数とする．（配点 60 点）

**問 1** $C_1$ と $C_2$ が 2 個の共有点をもつように，定数 $a$ のとりうる値の範囲を求めよ．さらに，そのときの共有点の座標をすべて求めよ．

**問 2** $a$ の値が問 1 で求めた範囲にあるとき，第 1 象限における $C_1$ と $C_2$ の共有点を P とする．点 P における $C_1$ と $C_2$ の接線をそれぞれ $\ell_1, \ell_2$ とする．また，$\ell_1$ と $\ell_2$ および $y$ 軸で囲まれた部分の面積を $S_1$，$C_1$ と $C_2$ で囲まれた部分の面積を $S_2$ とする．このとき，$\dfrac{S_2}{S_1}$ を求めよ．

**II** 次のように定められる 2 つの数列 $\{a_n\}, \{b_n\}$ について，以下の問いに答えよ．（配点 60 点）

$$a_{n+1} = \frac{2a_n}{1 + a_n}, \quad b_{n+1} = b_n + \frac{1}{a_n}, \quad b_1 = 1, \quad b_2 = 4$$

**問 1** 数列 $\{a_n\}$ の一般項を求めよ．

**問 2** 数列 $\{b_n\}$ の一般項を求めよ．

**III** 6 個のさいころを同時に投げるとする．以下の問いに答えよ．（配点 60 点）

**問 1** 出る目がすべて異なる確率を求めよ．

**問 2** 出る目のうち，奇数の目が 3 個となる確率を求めよ．

**問 3** 出る目の和が 9 となる確率を求めよ．

**必須問題は，このページで終りである．**

# 選択問題 (数学Ⅰ・数学Ⅱ・数学A・数学B)

**Ⅰ** $f(x) = |x^2 - 3x + 2|$ とする．曲線 $y = f(x)$ を $C$ とし，曲線 $C$ 上の点 $\mathrm{A}(a, f(a))$ における接線を $\ell$ とする．ただし，$1 < a < 2$ とする．以下の問いに答えよ．
（配点 60 点）

**問 1**　接線 $\ell$ の方程式を求めよ．

**問 2**　曲線 $C$ と接線 $\ell$ の共有点のうち，接点 A とは異なる 2 つの点の $x$ 座標を $\alpha, \beta$ $(\alpha < \beta)$ とするとき，$\beta - \alpha$ を $a$ で表せ．

**問 3**　曲線 $C$ と接線 $\ell$ で囲まれた部分の面積を $S$ とするとき，$S$ のとりうる値の範囲を求めよ．

**Ⅱ** 空間の点 O, A, B に対して，$\overrightarrow{\mathrm{OA}}$ と $\overrightarrow{\mathrm{OB}}$ のなす角を $\theta$ $\left(0 < \theta < \dfrac{\pi}{2}\right)$ とする．
以下の問いに答えよ．（配点 60 点）

**問 1**　$|\overrightarrow{\mathrm{OA}}| = 1$, $|\overrightarrow{\mathrm{OB}}| = \cos\theta$ であるとき，$\overrightarrow{\mathrm{OA}}$ と $\overrightarrow{\mathrm{AB}}$ のなす角を求めよ．さらに，△OAB の面積の最大値を求めよ．また，そのときの $\theta$ の値を求めよ．

**問 2**　$|\overrightarrow{\mathrm{OA}}| = 1$, $|\overrightarrow{\mathrm{OB}}| = \cos\theta + 2\sin\theta$ であるとき，△OAB の面積の最大値を求めよ．ただし，そのときの $\theta$ の値は求めなくてよい．

**問 3**　$|\overrightarrow{\mathrm{OA}}| = \cos\theta$, $|\overrightarrow{\mathrm{OB}}| = 1 - \cos\theta$ であるとき，$|\overrightarrow{\mathrm{OA}} + \overrightarrow{\mathrm{OB}}|^2$ の最小値を求めよ．ただし，そのときの $\theta$ の値は求めなくてよい．

**数学Ⅰ・数学Ⅱ・数学A・数学Bの問題は，**
**このページで終りである．**

# 選択問題 (数学 III・数学 C)

**I** 行列 $A = \begin{pmatrix} 3 & 2 \\ -2 & -1 \end{pmatrix}$, $E = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ について，以下の問いに答えよ．ただし，$n$ を正の整数，$A^1 = A$ とする．（配点 60 点）

**問 1**　等式 $A(A - E) = A - E$ が成り立つことを示せ.

**問 2**　$A^{n+1} - A^n$ を求めよ.

**問 3**　$A^n$ を求めよ.

**II**　$f(x) = \log x$, $g(x) = (\log x)^2$ とするとき，以下の問いに答えよ．（配点 60 点）

**問 1**　関数 $y = f(x)$ と関数 $y = g(x)$ のグラフを 1 つの座標平面上にかけ.

**問 2**　曲線 $y = f(x)$ と曲線 $y = g(x)$ で囲まれた部分の面積を求めよ.

**数学 III・数学 C の問題は，このページで終りである．**

# 2014 Entrance Exam
# 平成26年度　入学者選抜学力試験（前期）

## English
## 英 語

注意事項

1. 試験開始の合図があるまで, この問題冊子と解答冊子を開かないでください.
2. 問題は1～10ページにあります.
3. 解答冊子の表紙の所定欄に氏名と受験番号をはっきりと記入してください.
4. 試験中に問題冊子の印刷不明瞭, ページの落丁・乱丁および解答用紙の汚れ等に気づいた場合は, 静かに手を上げて監督員に知らせてください.
5. 試験終了後, 問題冊子は持ち帰ってください.
6. 解答時間は90分です.
7. 辞書を使用することができます.
8. Part ごとに配点が記されています.
9. Part 1 と Part 2 の読解問題の配点の合計は 120点です.
10. Part 3 と Part 4 の英作文問題の配点の合計は 80点です.

# Part 1　Reading Comprehension

Read the following article and answer questions (1) – (10).　( 配点70点 )

What is intelligence? On the face of it, intelligence seems to be a straightforward concept. My dictionary tells me that it is "an ability to acquire and apply knowledge and skills." Thought of like this, intelligence is just like many other abilities; some of us possess a lot of it, and others not so much. However, unlike other abilities, intelligence is a complex and controversial concept because, unfortunately, it is frequently used as a measure of people, groups and things, and consequently defines what kind of lives people lead.

One way to appreciate its complexity and tendency to ignite controversy is to think about ①our position in the hierarchy of ②animate and inanimate objects. It is generally accepted that humans are at the pinnacle and inanimate objects are at the bottom. Moreover, some people argue that our superior intelligence justifies, or at least explains, our dominance over and exploitation of Earth's resources. However, research into intelligence suggests that perhaps our superiority is less certain, and that therefore we should place more value on other human abilities and qualities.

Animals that are considered to be 'stupid' are often ill-treated by people. However, research shows that animals are more intelligent than many people realise. For example, ③Christine Nicol, professor of animal welfare at Bristol University, says that studies have demonstrated that chickens have very efficient sensory capacities and can draw inferences, apply logic, and plan ahead. Furthermore, they have better numeracy and spatial awareness skills than young children. Sheep are also far more intelligent than we assume them to be. It has been shown that they can remember the faces of 50 individual sheep, as well as human faces[1].

What about plants? Research has shown that some plants are able to do maths. At night, when there is no sunlight, they use this ability to control their starch reserves to ensure they last until the morning. Experiments by scientists at the John Innes Centre in the U.K. show that to regulate its starch consumption so precisely, a plant called *Arabidopsis* must be doing arithmetic division. However, Dr. Richard Buggs from the University of London suggests that this apparent ability to do maths does not necessarily mean that plants are intelligent. It simply shows that they have a mechanism to regulate their resources[2].

While it is the case that classifying plants as intelligent is open to debate, almost no one would claim that inanimate objects, things that are lifeless, are in any way intelligent. However, Watson, a computer designed by IBM, defeated humans in an American TV quiz show called *Jeopardy!* in 2011. One of the human contestants, Ken Jennings, is famous for having won the game against other humans 74 times in a row[3]. Watson is an example of the progress that researchers in Artificial Intelligence (A.I.) are making. Given that we tend to treat with respect things that we consider intelligent, ④in the future we may also treat machines with more respect.

How should things that are more intelligent than us treat us? In his book, *Eating Animals*, Jonathan Safran Foer poses this thought experiment[4]. Imagine that some aliens have come to Earth. They are more intelligent than us to the same degree that we are more intelligent than pigs. They are also hungry. How do we persuade them not to eat us? In order to persuade them, we would need to consider attributes other than intelligence to justify our continued existence and value as non-food.

References

[1] E. Saner (2013, June. 19). "*Animals Know More Than You Think*". The Guardian [Online]. Available: http://www.theguardian.com/science/shortcuts/2013/jun/19/animals-know-more-than-you-think. [Accessed: Aug. 7, 2013].

[2] H. Briggs (2013, June. 23) "*Plants 'Do Maths' to Control Overnight Food Supplies*". BBC News [Online]. Available: http://www.bbc.co.uk/news/health-22991838. [Accessed: Aug. 7, 2013]

[3] J. Markoff. (2011, Feb. 16) "*Computer Wins on 'Jeopardy!': Trivial, It's Not*". The New York Times [Online]. Available: http://www.nytimes.com/2011/02/17/science/17jeopardy-watson.html. [Accessed: Aug. 7, 2013]

[4] J. S. Foer, *Eating Animals*. New York, NY: Little, Brown and Company, 2009.

(1) **本文によると，知性はどのような点で他の多くの能力に似ているか．以下の選択肢の中から最も適切なものを一つ選び，記号で答えよ．**

(ア) It is something that we all possess to some degree.
(イ) It is measured by the way we live.
(ウ) It is an ability that animals do not have.
(エ) It has been created by IBM.

(2) **下線部①の** ‘our position’ **は，何または誰の** position **を指すか．以下の選択肢の中から最も適切なものを一つ選び，記号で答えよ．**

(ア) intelligence
(イ) scientists
(ウ) the author
(エ) humans

(3) **下線部②の** ‘animate’ **はどのような意味で用いられているか．以下の選択肢の中から最も適切なものを一つ選び，記号で答えよ．**

(ア) full of excitement
(イ) alive
(ウ) to bring to life
(エ) to make a cartoon

(4) **下線部③の** Christine Nicol **はどのような人か．以下の選択肢の中から最も適切なものを一つ選び，記号で答えよ．**

(ア) a journalist
(イ) an English teacher
(ウ) a scientist
(エ) a pet shop owner

(5) **本文中ではニワトリについてどのように述べられているか．以下の選択肢の中から最も適切なものを一つ選び，記号で答えよ．**

(ア) Chickens have a much better awareness of space than adults.
(イ) Chickens are better at some things than young humans.
(ウ) Chickens are artists.
(エ) Chickens are better at organizing themselves than high school students.

(6) **本文中ではヒツジについてどのように述べられているか．以下の選択肢の中から最も適切なものを一つ選び，記号で答えよ．**

(ア) Sheep are good at maths.
(イ) Most people think that sheep are as clever as young children.
(ウ) Most people are aware how smart sheep can be.
(エ) Sheep can tell the difference between the faces of 50 different sheep.

(7) **The John Innes Centre で行われた実験に関して，Dr. Buggs はどのように考えているか．以下の選択肢の中から最も適切なものを一つ選び，記号で答えよ．**

(ア) He thinks that an appearance of doing maths is not the same as really doing maths.
(イ) He believes that they show plants like *Arabidopsis* are able to do maths better than young children.
(ウ) He argues that the ability of *Arabidopsis* to perform automatic calculations surpasses that of humans.
(エ) He suggests that *Arabidopsis* can do maths with a purpose in mind.

(8) **本文中の Watson の説明として最も適切なものを，以下の選択肢の中から一つ選び，記号で答えよ．**

(ア) a person who won a quiz show 74 times
(イ) a researcher at IBM who designed an intelligent computer
(ウ) a machine that beat some humans in a quiz show
(エ) a contestant in a quiz show who lost to someone called Ken Jennings

(9) **下線部④で著者はなぜ，**‘in the future we may also treat machines with more respect’**と述べているのか．以下の選択肢の中から最も適切な理由を一つ選び，記号で答えよ．**

(ア) We are always respectful of our human superiors.
(イ) We now consider all machines to be our superiors.
(ウ) A.I. research will soon produce computers able to beat humans in quiz shows.
(エ) Humans tend to respect things they consider smart.

(10) **著者は知性についてどのように考えているか．以下の選択肢の中から最も適切なものを一つ選び，記号で答えよ．**

(ア) We must judge people primarily according to how intelligent they are.
(イ) He thinks that some plants may be as smart as humans.
(ウ) We should be careful about placing too much importance on intelligence.
(エ) He believes that intelligence is a skill that can be improved.

# Part 2　Questions about a Japanese Text

Read the following article and answer questions (1) – (3). （配点50点）

**著作権保護のため問題文は省略してあります**

**T.フォルジャー，日経サイエンス編集部訳.「知能は伸び続けるか」(「日経サイエンス」2012 年 12 月号，96 -100 頁，日経サイエンス社，2012 年） より引用**

(1) Based on the article, mark each of the following statements True (◯) or False (×).

(ア) Since the beginning of the 20th century, IQ scores steadily increased by 0.3 points a year until the rate turned negative about ten years ago.
(イ) Improvement of IQ scores has been most notable in the kind of knowledge learned in school such as arithmetic and vocabulary.
(ウ) Recognizing a similarity beyond two objects' physical characteristics requires some sort of abstract thinking.
(エ) It is predicted that the trend of increasing IQ scores will stop in the next ten years.
(オ) School children have been getting better at identifying the relationships between geometric figures.
(カ) The Flynn effect seems to reflect the nature of the modern society where understanding abstract categories and logical thinking has become useful and necessary.

(2) According to the article, which one of the following is true as referred to in the underlined part marked ①? Choose the best answer from below.

(ア) The overall quality of intelligence has improved compared to that of previous generations.
(イ) Human intelligence has adapted to the new demands required by our more advanced society.
(ウ) Improved intelligence has enabled people to perform arithmetic calculations more quickly and accurately.
(エ) There is a new type of human intelligence that no existing IQ tests are able to measure.

(3) What does the underlined part marked ② refer to? Choose the best answer from below.

(ア) It refers to the relationship between the knowledge we learn in school and the knowledge we use in the real world. Researchers have found that the former enhances the latter.

(イ) It refers to the directionality of the evolving human brain. Because the human brain can only get bigger, researchers assume that the younger generation will always be more intelligent than their parents.

(ウ) It refers to the cyclic positive interaction between human abilities and society. Our abilities change to meet the demands of a highly technological world that we created. This leads to the creation of an even more advanced world.

(エ) It refers to the paradox of the Flynn effect. Even though more and more people receive an education, higher performances are observed on the parts of IQ tests that are not necessarily taught at school.

# Part 3　Opinions

Write one paragraph (about 100 words) in English explaining why you think your English ability should or should not be evaluated.（**配点** 40 **点**）

# Part 4　Explanatory Skills

Imagine that some aliens have come to Earth. They are extremely intelligent, carnivorous and hungry. They may want to eat you. In one paragraph (about 100 words), explain in English how you would survive.（**配点** 40 **点**）