

平成28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、静かに手を挙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 箱の中に 1 から 10 までの自然数が 1 つずつ書かれた 10 枚のカードが入っている。この箱の中からカードを同時に 3 枚取り出し、取り出されたカードの数字を小さいものから順に X, Y, Z とする。以下の問いに答えよ。（配点 40 点）

問 1 X が 4 以下である確率を求めよ。

問 2 Y が 4 以下である確率を求めよ。

II 関数 $f(x) = 1 - |ax(1-x) - 1|$ について、以下の問いに答えよ。ただし、 a は正の実数とする。（配点 80 点）

問 1 $ax(1-x) - 1$ が常に負になるための a の条件を求めよ。

問 2 $a = 6$ のとき、 $y = f(x)$ のグラフを描け。

問 3 関数 $f(x)$ の最大値を $M(a)$ とする。 a がすべての正の実数値をとって変化するとき、点 $(a, M(a))$ を座標平面上に図示せよ。

問 4 直線 $y = x$ と $y = f(x)$ のグラフが 3 つの共有点をもつときの a の値を求めよ。

III a, b を実数とする。関数 $f(x) = x^3 - 3a^2x + 2b$ について、以下の問いに答えよ。（配点 60 点）

問 1 $f(x)$ が単調に増加するとき、 a についての条件を求めよ。

問 2 $y = f(x)$ のグラフが x 軸と異なる 3 点で交わるための条件を a と b を用いて表せ。

問 3 a, b が問 2 で求めた条件をみたすとき、点 (a, b) が存在する領域を座標平面上に図示せよ。

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 数列 $\{a_n\}$ が以下の漸化式をみたすとする.

$$a_1 = -4, \quad a_{n+1} = \frac{1}{2}a_n + \frac{3}{2} \quad (n = 1, 2, 3, \dots)$$

また, 実数 x の多項式 $P_n(x)$ を

$$P_n(x) = a_1x + \dots + a_nx^n$$

で定める. このとき, 以下の問いに答えよ. (配点 60 点)

問 1 $\{a_n\}$ の一般項を求めよ.

問 2 $P_n(x)$ を $x - 1$ で割ったときの余りを求めよ.

問 3 $P_n(x)$ を $x - 4$ で割ったときの余りが -24 になるように, n の値を定めよ.

II n を自然数とする. 以下の問いに答えよ. (配点 60 点)

問 1 三角関数の加法定理を用いて次の等式を示せ.

$$2 \cos \alpha \sin \beta = \sin(\alpha + \beta) - \sin(\alpha - \beta)$$

問 2 数学的帰納法によって, 次の等式を証明せよ.

$$2 \sin \frac{\theta}{2} \sum_{l=1}^n \cos l\theta = \sin \left(n + \frac{1}{2} \right) \theta - \sin \frac{\theta}{2}$$

問 3 m を整数とする. $\theta \neq 2m\pi$ のとき, 次の不等式が成り立つことを証明せよ.
ただし, 等号が成立する条件は調べなくてよい.

$$\left| \sum_{l=1}^n \cos l\theta \right| \leq \frac{1}{2} \left(1 + \left| \sin \frac{\theta}{2} \right|^{-1} \right)$$

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)

I 関数 $y = e^{-x}$ で表される曲線を C とする. また, t は $0 < t < 2$ をみたす実数とし, $x = t$ における曲線 C の接線を l とする. 以下の問いに答えよ. (配点 60 点)

問 1 接線 l の方程式を求めよ.

問 2 y 軸, 曲線 C および接線 l で囲まれた部分の面積を $S_1(t)$, x 軸, 直線 $x = 3$, 曲線 C および接線 l で囲まれた部分の面積を $S_2(t)$ とする. $S_1(t) + S_2(t)$ を求めよ.

問 3 問 2 で求めた $S_1(t) + S_2(t)$ の最小値を求めよ.

II a を 1 以上の実数, b を実数, i を虚数単位とし, 複素数 z を $z = a + bi$ とする. また, 複素数 w を $w = \frac{1}{z}$ とする. 以下の問いに答えよ. (配点 60 点)

問 1 複素数 z が存在する領域を複素数平面上に図示せよ. また, iz が存在する領域を複素数平面上に図示せよ.

問 2 x, y を実数とし, $w = x + yi$ とおくとき, a を x および y を用いて表せ.

問 3 w が存在する領域を複素数平面上に図示せよ.

数学 III の問題は, このページで終りである.

2016 Entrance Exam
平成28年度 入学者選抜学力試験(前期)

外国語(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1~12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、静かに手を挙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 (配点 80 点)

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

The Future of the Office: From Technology-Driven to Design-Driven Change

With the decline of traditional manufacturing industries and the rise of knowledge and service-based economies, more people are working in offices. Therefore, it is important for the well-being of office workers that their workplaces are comfortable and stimulating. There are two significant factors that have the potential to improve the office environment; technology and design. So far, technology alone does not appear to have had the expected impact on the office environment. For example, despite the introduction of computers and other digital technology, the layout of and interactions within many office spaces have essentially remained unchanged for one hundred years. On the other hand, in the near future important changes in the office environment will be driven by design, and supported by recent technological innovations.

In the past, many people incorrectly predicted that technology would drive improvements in office environments. In 1945, in an influential essay titled ‘As We May Think’, Vannevar Bush looked forward to a future in which technology would assist people to process effectively the large amount of information that was available to them (Bush, 1945). Bush described a hypothetical machine called the ‘Memex’, which is considered to be a precursor of the Internet; a technology that has had a huge impact on how we get information, but has neither changed the dynamics of the office nor how we interact with machines.

The paperless office is another prediction that failed to become a reality. In 1975, George Pake, who was the head of Xerox Corporation's Palo Alto Research Center, believed that the revolutionary technology being created by his company would “change the office like the jet plane revolutionized travel and the way that TV has altered family life” (Business Week, 1975). In the same article, Vincent E. Giuliano predicted that the use of paper in the office would have declined by 1980, “and by 1990, most record-handling will be electronic.” However, digital technologies have made it easy to print anything from trivial emails to multiple one-hundred-page reports. Another reason why the paperless office is not yet the norm is that paper has attributes that cannot, as yet, be replaced by technology (Sellen & Harper, 2002).

Another technology-driven prediction that has failed to become commonplace is telecommuting. The assumption was that as communication technologies improved, many people would work from home. However, most people’s work requires their physical presence in an office where they can meet both colleagues and clients. This reality has been highlighted by Marissa Mayer, the CEO of Yahoo, who in 2013 ended Yahoo’s work-from-home policy. She explained that workers are “more collaborative and innovative when they’re together” (Tkaczyk, 2013).

Technology has therefore facilitated people to do old things in new ways, but has not radically changed the nature of office work. However, there are two reasons why the future office is likely to be quite different from its present form. First, technology has now matured to the point that the paperless office and telecommuting will soon be possible. Advances in 'digital paper' are reducing the perceived disadvantages of going paperless. Also, people's habits are changing. For example, younger people are printing less (The Economist, 2008). As for telecommuting, breakthroughs in communication technology will soon make it possible for people to be virtually present in their office while actually being elsewhere.

The second and more important reason why the nature of the office will change is due to an increasing awareness of how certain designs can foster collaboration (Waber, Magnolfi, & Lindsay, 2014). Thus, technology's role is to support design; machines and gadgets will facilitate interactions between colleagues and between office workers and their customers. However, it will be the design of offices that will have the biggest impact on the way most people spend their working lives.

References

- Bush, V. (1945). As we may think. *The Atlantic*, 176, 101-108.
- Business Week. (1975). The office of the future, *Business Week*, 2387, 48-70.
- The Economist. (2008, October 9). Not dead, just resting. *The Economist*. Retrieved from <http://www.economist.com/node/12381449>.
- Sellen, A. J., & Harper, R. H. R. (2002). *The Myth of the Paperless Office*. Cambridge, MA: MIT Press.
- Tkaczyk, C. (2013, April 19). Marissa Mayer breaks her silence on Yahoo's telecommuting policy. *Fortune*. Retrieved from <http://fortune.com/2013/04/19/marissa-mayer-breaks-her-silence-on-yahoos-telecommuting-policy>.
- Waber, B., Magnolfi, J., & Lindsay, G. (2014, October 1). Workspaces that move people. *Harvard Business Review*. Retrieved from <https://hbr.org/2014/10/workspaces-that-move-people>.

(1)

本文では、オフィスが **comfortable** で **stimulating** であるべきだと述べている。その理由は何か。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) because the environment is getting worse and worse
- (イ) because technology has had a big impact on the office
- (ウ) because so many people spend their working lives in an office
- (エ) because the modern office is no different from offices of one hundred years ago

(2)

本文では、現代のオフィスが 100 年前のオフィスとどのように異なると述べているか。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) The introduction of technology has had a significant impact on office life.
- (イ) Modern offices have electronic computers.
- (ウ) The layout and interactions within modern offices have changed dramatically.
- (エ) Offices of one hundred years ago had very different designs.

(3)

本文では、**Vannevar Bush** について何と述べているか。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 invented the Internet.
- (イ) He wrote a blog called 'As We May Think'.
- (ウ) He changed the way the office functions.
- (エ) He published an important essay in 1945.

(4)

本文では、**Memex** について何と述べているか。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 was never actually made.
- (イ) Vannevar Bush made it in 1945.
- (ウ) It changed the way office workers interact with machines.
- (エ) It was the first machine to be able to access the Internet.

- (5) 本文によると、なぜオフィスがペーパーレスになるだろうと人々は信じていたのか。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) because they thought that digital devices would replace paper
- (イ) because they believed that revolutions would change everything
- (ウ) because they thought that TV would change office life as it had done family life
- (エ) because they argued that by 1990 everyone would be using email

- (6) 本文によると、なぜオフィスでいまでも紙が広く使われているのか。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) because Xerox failed to make revolutionary machines
- (イ) because many people still use typewriters
- (ウ) because printing is easy and paper is useful
- (エ) because people declined to use Xerox's technologies and their habits changed

- (7) 本文によると、telecommuting がいまだに普及していない理由の一つは何か。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) The CEO of Yahoo has prevented everyone from working from home.
- (イ) Technological breakthroughs made it possible for people to work from home.
- (ウ) Collaboration is only possible via telecommuting.
- (エ) Most office workers need to be able to physically meet each other face-to-face.

- (8) 本文によると、Yahoo の CEO は telecommuting についてどのように考えたのか。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) She thought that it was good for her company.
- (イ) She thought it was bad for Yahoo.
- (ウ) She thought that it promoted collaboration and innovation.
- (エ) She thought that digital technologies would make it a reality.

(9)

本文の著者は, technology の役割とはどのようなものだと考えているか. 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) The author thinks it will be the most important factor in how offices are organized.
- (イ) The author believes that it has had no impact on how things are done in the office.
- (ウ) The author believes that it will have a negative impact on how people work.
- (エ) The author thinks that its role will be less important than office design.

(10)

本文の著者は, オフィスの未来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) The author believes that it will be the same as it was one hundred years ago.
- (イ) The author thinks that technology will have the biggest impact on the future office.
- (ウ) The author thinks that design will have the greatest influence on the future office.
- (エ) The author believes that it will become even harder for people to work from home.

(このページは白紙である)

Part 2 Reading Comprehension (配点 40 点)

Section 1:

Read the following article and answer questions (1) and (2).

著作権保護のため問題文は省略してあります

出典

OECD 東京センター・ニューズルーム, 「幼少期の男女格差が将来のキャリア選択と雇用機会に影響」
2015年3月5日,
<http://www.oecd.org/tokyo/newsroom/early-gender-gaps-drive-career-choices-and-employment-opportunities-says-oecd-japanese-version.htm> (アクセス: 2015年5月25日).

注) *, **, []は出題者による.

*OECD(経済協力開発機構)は, 1961年に設立された経済や(貿易, 環境, 農業, 教育など)社会の諸分野について調査・分析・議論を行う国際機関である. 平成23年1月現在, 日本のほか, 欧米諸国など先進34カ国が加盟している.

参考文献

外務省, 経済協力開発機構室(編), 国内広報室(発行)「経済協力開発機構と日本」,
<http://www.mofa.go.jp/mofaj/files/000030487.pdf> (アクセス: 2015年5月25日).

**PISA(国際学習到達度調査)は, OECDが3年ごとに世界各国の15歳の生徒を対象に行う学習達成度調査である. 数学的リテラシー, 読解力, 科学的リテラシーの3つの分野に加え, 学習への態度や生徒の社会的背景など, 生徒の学びに関わる幅広いデータを集めている.

参考文献

国立教育政策研究所, OECD生徒の学習到達度調査(PISA),
<http://www.nier.go.jp/kokusai/pisa/>(アクセス: 2015年5月25日).

(1) The following is a short summary of the article.

This article addresses two gender-related issues in education and students' (a)_____ choices. First, girls are about (b)_____ times less likely to pursue a career in STEM fields than boys. New OECD findings suggest that (c)_____, teachers and employers are partly to blame for this gender difference. For instance, in Chile, Hungary and Portugal less than (d)_____ percent of parents expect their daughters to work in STEM fields, whereas about (e)_____ percent of parents do so for their sons. The second issue is that (f)_____ struggle with their school studies. Six out of ten students who got (g)_____ scores in reading, math, and (h)_____ in OECD PISA surveys were boys.

From the list below, choose the words that best fit into the blanks, and write their corresponding katakana characters (ア) to (チ).

- (ア) average (イ) boys (ウ) career (エ) customers (オ) economy
(カ) fifty (キ) five (ク) four (ケ) girls (コ) high
(サ) low (シ) parents (ス) science (セ) students (ソ) thirty
(タ) three (チ) twenty

(2) Choose the two statements from below that are consistent with the content of the article.

- (ア) Playing video games in moderation enhances girls' digital reading skills.
(イ) Parents should read to their children in order to develop their reading habits.
(ウ) Girls have less confidence in math and science than boys do.
(エ) Stefan Kapferer emphasized the need for financial support to encourage girls to pursue STEM careers.
(オ) Teachers could do more in order to help both boys and girls improve their math performance.

Section 2:

Based on the information shown in Figure 1, mark the statements (ア) to (エ) as True or False.

- (ア) Parents in all of the countries and regions investigated are more likely to expect their sons than their daughters to go into STEM careers.
- (イ) Smaller gender gaps in Hong Kong, Korea and Macao indicate that parents in those countries and regions are more likely to expect their daughters to choose STEM careers than parents in other countries.
- (ウ) Parents of girls in Portugal and Croatia are more likely than parents of boys in Korea and Macao to expect their children to work in STEM fields.
- (エ) For both boys and girls, the percentage of students whose parents expect them to work in STEM fields is the highest in Hungary.

著作権保護のため図は省略してあります

Source: OECD (2015), *The ABC of Gender Equality in Education: Aptitude, Behaviour, Confidence*, PISA, OECD Publishing. Retrieved from <http://dx.doi.org/10.1787/9789264229945-en>. [Accessed: September 16, 2015].

Part 3 Writing (配点 50 点)

Write one paragraph (about 100 words) in English describing a technology or design that has had an impact on the way you live.

Part 4 Writing (配点 30 点)

Write one paragraph (about 100 words) in English explaining why you think it is either important **or** not important for university students in Japan to study science, technology, engineering, and/or mathematics (STEM subjects).