# 令和６年度　一般選抜（前期日程）個別学力検査

# 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２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ページから３ページに，数学Ⅲの問題は４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，解答冊子の中にとじてあります.
7. 試験中に問題冊子や解答冊子の印刷不鮮明，ページの落丁・乱丁，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** △OAB において，$\overrightarrow{\mathrm{OA}}$ と $\overrightarrow{\mathrm{OB}}$ のなす角を $\theta\left(0<\theta<\dfrac{\pi}{2}\right)$ とする．実数 $s,t$ は $0 \leqq s \leqq 1,\ 0 \leqq t \leqq 1,\ 0 \leqq s+\dfrac{1}{2}t \leqq 1$ を満たし，点 P を $\overrightarrow{\mathrm{OP}}=s\overrightarrow{\mathrm{OA}}+t\overrightarrow{\mathrm{OB}}$ と定める．以下の問いに答えよ．（配点 75 点）

**問 1**　解答用紙の △OAB に対し，点 P の存在範囲を図示せよ．

**問 2**　$|\overrightarrow{\mathrm{OA}}|=\sin\theta+2\cos\theta,\ |\overrightarrow{\mathrm{OB}}|=4$ とする．点 P の存在範囲の面積を $2\theta$ の関数で表せ．

**問 3**　問 2 で求めた面積の最大値を求めよ．ただし，そのときの $\theta$ の値を求める必要はない．

**II** 関数 $f(x)=x^2(x+1)$ と $g(x)=ax^2+bx+c$ は $f(-1)=g(-1),\ f(1)=g(1)$, および $f(k)=g(k)$ を満たす．ただし，$-1<k<1$ とし，さらに $a$, $b$, および $c$ は実数とする．以下の問いに答えよ．（配点 75 点）

**問 1**　$f(x)-g(x)$ を $k$ を用いて表せ．

**問 2**　$y=f(x)-g(x)$ のグラフを座標平面上にかけ．

**問 3**　$\displaystyle\int_{-1}^{1}|f(x)-g(x)|dx$ が最小になる $k$ の値と $g(x)$ をそれぞれ求めよ．

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** 座標平面上で，中心が点 A$(1, 1)$ で半径 1 の円を $C$ とする．また，原点を通り円 $C$ と異なる 2 点で交わる直線を $\ell$ とする．ただし，円 $C$ と直線 $\ell$ の 2 つの交点における $C$ の 2 本の接線は直交し，その交点を B とする．以下の問いに答えよ．
（配点 75 点）

**問 1**　円 $C$ の中心と直線 $\ell$ の距離を求めよ．

**問 2**　直線 $\ell$ の傾きを求めよ．

**問 3**　線分 AB の中点は直線 $\ell$ 上にあることを示せ．

**問 4**　交点 B の座標を求めよ．

**II** 自然数 $n$ に対して，数列 $\{r_n\}$, $\{\theta_n\}$ は，以下の漸化式を満たす．

$$\begin{aligned} r_{n+1}\cos\theta_{n+1} &= r_n \sin\theta_n \\ r_{n+1}\sin\theta_{n+1} &= \sqrt{2} r_n \cos\left(\theta_n - \frac{\pi}{4}\right) \end{aligned}$$

ただし，$r_1 = \sqrt{2}$, $\theta_1 = \dfrac{\pi}{4}$ とし，すべての $n$ に対して，$r_n > 0$, $0 \leqq \theta_n < 2\pi$ とする．この数列 $\{r_n\}$, $\{\theta_n\}$ を用いて，数列 $\{a_n\}$, $\{b_n\}$ を以下のように定める．

$$\begin{aligned} a_n &= r_n \cos\theta_n \\ b_n &= r_n \sin\theta_n \end{aligned}$$

以下の問いに答えよ．（配点 75 点）

**問 1** $a_{n+1}$ および $b_{n+1}$ を $a_n$ および $b_n$ を用いてそれぞれ表せ．

**問 2** $c_n = a_{n+1} - \dfrac{1+\sqrt{5}}{2} a_n$, $d_n = a_{n+1} - \dfrac{1-\sqrt{5}}{2} a_n$ とおく．数列 $\{c_n\}$ および $\{d_n\}$ の一般項をそれぞれ求めよ．

**問 3** 数列 $\{a_n\}$ および $\{b_n\}$ の一般項をそれぞれ求めよ．

**問 4** $r_n$ を $a_{2n+1}$ を用いて表せ．

**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** $x \geqq 0$ で定義された関数を $f(x) = e^{-2x}\sin^2 x$ とする．さらに，$n$ を 0 以上の整数とし，定積分 $S_n$ を

$$S_n = \int_{n\pi}^{(n+1)\pi} f(x)dx$$

と定める．以下の問いに答えよ． （配点 75 点）

**問 1** $y = f(x)$ のグラフの概形を座標平面上にかけ．ただし，変曲点を求める必要はない．

**問 2** $S_n$ を求めよ．

**問 3** $N$ を 0 以上の整数とする．

$$\lim_{N\to\infty} \sum_{n=0}^{N} S_n$$

の値を求めよ．

**II** 関数 $f(x)$ は，微分可能で $f(x) > 0$ とする．また，実数 $x, y$ に対して，$f(x+y) = 2f(x)f(y)$ が成り立つ．さらに，関数 $g(x)$ を $g(x) = \log(f(x))$ と定める．以下の問いに答えよ．（配点 75 点）

**問 1** $f(-x) = \dfrac{1}{4f(x)}$ を示せ．

**問 2** $g(x)$ は微分可能でその導関数を $g'(x)$ とおく．$g'(0) = 2$ とするとき，$g'(x)$ を求めよ．

**問 3** 問 2 で求めた $g'(x)$ に対し，実数 $a, b$ を用いて $g(x) = ax + b$ とおくとき，$a$ および $b$ の値をそれぞれ求めよ．さらに，$f(x)$ を求めよ．

**数学 III の問題は，このページで終りである．**

令和６年度　一般選抜（前期日程）個別学力検査

# 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ページから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. 下書き用紙は，解答冊子の中にとじてあります．
5. 試験中に問題冊子や解答冊子の印刷不鮮明，ページの落丁・乱丁，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．
6. 試験終了後，問題冊子は持ち帰ってください．
7. 解答時間は90分です．
8. Partごとに配点が記されています．
9. 英語辞書を使用することができます．

# Part 1: Reading Comprehension I （配点 80 点）

Use the information in the article to answer questions (1) – (8). For each question, choose one answer (A, B, C or D).

## Robotics tested at rice paddies with eye on full automation

NOBEOKA, Miyazaki Prefecture -- The backbreaking work of sowing and harvesting rice by hand could soon fall exclusively to drones and robots under an ambitious agricultural program taking shape here.

As part of its efforts to alleviate a farmer shortage, the Nobeoka city government already signed an agreement with Kyoto-based robot manufacturer Tmsuk Co. to take on the task of tending to vacant rice paddies.

Once rice seeds have been planted by a drone, a succession of robotic technologies still to be developed would deal with weeding and reaping.

"This initiative is in line with our course of action to support (farming)," said a farm ministry representative. "We welcome the entry from different industries with wide perspectives."

A trial run on April 15 saw a drone take off with a quiet whir, its movements controlled with a joystick like one used for video games. The craft flew over a 1000-square-meter rice paddy, scattering seeds treated beforehand with powdered iron to ensure a smooth drop from the air.

The seeding process took just 10 minutes.

"It was done in almost an instant," said a gobsmacked Nobeoka Mayor Yoji Yomiyama who was watching. "This method is revolutionary. It will dramatically reduce the burden on farmers."

In Yomiyama's view, the municipal government was "clutching at straws" when it tied up with Yoichi Takamoto, the chairman of Tmsuk.

Takamoto was working on plans to robotize agricultural procedures based on communications technology at the time. He also happened to be a longtime friend of Yomiyama's deputy, Hiroshi Nakama. It turned out that Nakama once worked at the Ministry of Internal Affairs and Communications where he was responsible for telecommunications policies.

Takamoto harbored bitter memories of abandoning farmland he had inherited in Gunma Prefecture because he could find no one to work the land on his behalf.

Alarmed by the prospect of Japan's agriculture vanishing, Takamoto decided to join hands with Nobeoka city as it, too, is struggling with a rapidly growing number of fields left vacant by increasingly elderly farmers.

"We do not have the farmers to take over paddies," said Yomiyama. "The challenge now is how to lighten the heavy workload in farming."

Growing seedlings takes up a considerable part of the labor process in rice farming. With this in mind, Tmsuk adopted an aerial seed spraying method to sidestep the process of creating beds for seedlings.

"Our style is just the same as that in the United States, where seeds are directly scattered from aircraft," said Takamoto.

Nobeoka city provided three paddies totaling 3000 square meters for the experiment. Setting up its base in the municipality, Tmsuk will develop and test various robots during the program's three-year trial period.

One such envisioned model is a duck-based robot that will go into operation by the end of May. The machine, which sort of resembles a bird, will stir water in the paddies to prevent weeds from popping up. Around 15 units are projected to be introduced.

Fertilizer will be sprayed with a drone, while a rice-harvesting robot will be tested for reaping as the successor to the robotic duck.

All farming processes from seeding to harvesting will be automated as much as possible.

The objective is to establish a business model where part-time farmers can care for their fields while working at offices or from home for their companies, given that Tmsuk's robots can be operated remotely with PCs and smartphones.

[…]

**Abridged from:**
*The Asahi Shimbun.* Asia & Japan Watch , May 10, 2023（承認番号 24-0882）

(1) According to the article, why are drones and robots being developed by Tmsuk?

(A) Farmers want to increase their profits.
(B) The Ministry of Internal Affairs and Communications requested their development.
(C) There are not enough farmers.
(D) Farmers from the United States recommended their development.

(2) According to the article, what technology has Tmsuk already tested?

(A) a robot to deal with weeding
(B) a drone to plant seeds
(C) an automated machine to harvest rice
(D) an aircraft to fertilize paddies

(3) According to the article, what did Yoji Yomiyama think about the trial run on April 15?

(A) it would cause farmers to be concerned about their jobs
(B) it would lead to a reduction of the workload on farmers
(C) it would reduce the financial burden on farmers
(D) it would be of interest to farmers in the U.S.

(4) According to the article, who is Hiroshi Nakama?

(A) the mayor of Nobeoka
(B) the developer of the drone
(C) the chairman of Tmsuk
(D) a friend of Yoichi Takamoto

(5) According to the article, why is Yoichi Takamoto interested in automating the rice-growing process?

(A) He thinks that young people should eat more rice.
(B) He wants to grow rice in Gunma Prefecture.
(C) He is concerned that Japan will no longer grow food.
(D) He was inspired by what he saw in the United States.

(6) According to the article, for how long will Tmsuk experiment with robots in Nobeoka city?

(A) three years
(B) fifteen years
(C) until a business model is developed
(D) until the end of May

(7) According to the article, what is one of the things that Tmsuk will do?

(A) program robotic ducks to harvest rice
(B) test the effectiveness of scattering seeds from airplanes
(C) experiment with technology to grow rice seedlings in beds
(D) develop a robot to prevent weeds from growing in rice paddies

(8) According to the article, which of the following is an objective of Tmsuk?

(A) to make Nobeoka city Japan's leading rice producer
(B) to sell farm-related robotics throughout Japan
(C) to have Japan produce all of its food
(D) to allow part-time farmers to take care of their fields remotely

## Part 2: Writing I （配点 50 点）

If you could build a robot to help people, what would you design it to do and how would it help people? Write about 100 words in English.

（このページは白紙である）

## Part 3: Reading Comprehension II （配点 40 点）

Use the information in the article to answer questions (1) – (4). For each question, choose one answer (A, B, C or D).

### Academics Nurture Personnel for Sustaining Life in Space

Universities are educating so-called space personnel in anticipation of an era when people will be living on other planets and the moon.

Professions include doctors and nutritionists who manage astronauts' health in outer space and AI experts who lead exploration activities.

The government is also supporting the development of specialists in various fields to keep pace as countries around the world ramp up space-related activities.

Kyoto University, in collaboration with other universities, has been promoting since October an educational project to foster human resources in "astromedicine." Students attend lectures, conduct experiments and visit research facilities in the space field. In February, students conducted a medical experiment at Jikei University School of Medicine in Tokyo using a device that reproduces a microgravity environment.

"It's essential to have personnel with a medical perspective in the special environment of microgravity and strong radiation in space," said Kyoto University Program-Specific Associate **A**, who is in charge of the program.

The U.S.-led Artemis lunar exploration program, in which Japan participates, plans to send astronauts to the moon in 2025. The exploration of lunar resources and the construction of facilities will begin.

Businesses such as space travel corporations are also emerging. Some estimates predict the global market for space travel will reach $13 billion (¥1.8 trillion) by 2033.

However, there is a shortage of human resources. According to the Economy, Trade and Industry Ministry, about 11,000 people in Japan are working in the space industry, less than one-tenth the number in the United States, where more than 150,000 are involved in the field.

The Education, Culture, Sports, Science and Technology Ministry has allocated ¥500 million this fiscal year for projects such as the development of human resources in the space field.

Kanazawa University and other institutions are participating in the project, and they have begun teaching students from high school to graduate school how to use AI in the space industry.

Tokushima University established in April a space nutrition course at its graduate school, teaching the diets and exercise necessary to stay healthy in space. The school, in cooperation with related academic societies, is considering granting new qualifications such as a "space dietician" to students who complete the course.

"I hope students will develop food that can be eaten in space," Tokushima University **B** said.

**Source:**

Academics nurture personnel for sustaining life in space. 2023 年 5 月 19 日 *The Japan News*.より抜粋。Retrieved from https://japannews.yomiuri.co.jp/society/general-news/20230519-110247/

※問題文について，出題時から個人情報に該当する部分を一部改変しております。

(1) According to the article, in what fields are specialists being trained for the space industry?

(A) soil science, nutritional science, AI
(B) medicine, aeronautics, food science
(C) psychology, astronomy, agriculture
(D) AI, medicine, nutrition

(2) According to the article, at which university can students learn about “astromedicine”?

(A) The University of Tokyo
(B) Tokushima University
(C) Kanazawa University
(D) Kyoto University

(3) According to the article, which of the following best describes a “space dietician”?

(A) a specialist who can help people to maintain their health in space
(B) an academic who specializes in “astromedicine”
(C) a scientist who studies how AI can be used to grow food in space
(D) a student who is learning about the science of exercise

(4) What is the main idea of the article?

(A) Japanese astronauts are being trained to live on the moon.
(B) Universities need to improve their health and nutrition related courses.
(C) Japan is preparing for a time when people will live on other planets.
(D) There are not enough academics in Japan to teach “astromedicine”.

## Part 4: Writing II （配点 30 点）

Do you want to live in space? Explain your answer in about 60 words in English.