

2nd Kyu

Section 2: Application Test

数学検定

PROFICIENCY TEST IN PRACTICAL MATHEMATICS

Test Time : 90 minutes

Test Instructions

1. Make sure that you have the correct level (Kyu) test.
2. Do not open the booklet until you are told to do so.
3. Write your name and examinee number on this page.
4. Write your name, examinee number and other necessary information on the answer sheets.
5. Write your answers on the answer sheets (No. 1, No. 2 and No. 3). Write the steps leading to your answer. However if there are specific instructions for a problem, follow the instructions.
6. Problems 1 to 5 are selective problems.
Choose three problems from the selective problems and fill in ○ to indicate which problems you chose. Then write your answers. Note that all of your answers will not be marked if you answered more than three problems from the selective problems. Problems 6 and 7 are required problems.
7. You may use a calculator.
8. Turn off your cell phone and do not use it during the test.
9. Ask an examination supervisor if your problem sheets have inconsistent page numbering or missing pages.
10. It is prohibited to disclose the problems to the general public, such as on the Internet, without permission.

Please submit this test upon agreeing to the following "handling of personal information".

Information regarding the handling of all personal information attached to this form

1. Name of Organization : The Mathematics Certification Institute of Japan
2. Title, Affiliation and Contact Information of Personal Information Protection Administrator :
Title : Personal Information Protection Administrator
Department: Secretariat Contact Information : 03-5812-8340
3. Purpose for Use of Personal Information : Management of examinee information, marking, and for the purpose of identifying candidates
4. Provision of Personal Information to Third Parties : In cases where an application is made through the organization's office, registration information, names, test level and test results for the purpose of informing certification results via the Internet, fax, mail or electronic mail attachment, etc. will be provided to the applicant.
5. Outsourcing of Personal Information Handling : Personal information only for the purposes described in the preceding section, "purpose for using personal information", may be outsourced.
6. Requests for Disclosure of Personal Information : Examinees may submit inquiries to customer information concerning the disclosure of personal information concerning themselves. In this case, the Organization shall confirm the customer's identity and respond within a reasonable period. [Customer Information]
The Mathematics Certification Institute of Japan, Certification Inquiry Desk
Bunshodo Building 6F, 5-1-1 Ueno, Taito Ward, Tokyo, 110-0005
Tel : 03-5660-4804 (Monday to Friday 9:30-17:00 not including national holidays, New Year's holidays and organization holidays)
7. Voluntariness of the Provision of Personal Information : Whether to provide personal information to the Organization is entirely up to the examinee. However, if the Organization does not receive accurate information, it may not be possible to provide certain services in an appropriate manner.

Name

Examinee
Number

—



公益財団法人

日本数学検定協会

The Mathematics Certification Institute of Japan

[2nd Kyu] Section 2: Application Test**1** (Selective)

a is a constant. Find the range of values of a such that there is only one integer x that satisfies the inequality $x^2 + (a^2 + a + 1)x + a^2 + a < 0$.

2 (Selective)

A die numbered 1 to 6 is rolled 6 times successively. Let a, b, c, d, e and f be the numbers facing up for the 1st, 2nd, 3rd up to the 6th roll, respectively. What is the probability that $(a - b)(b - c)(c - d)(d - e)(e - f) = 0$?

3 (Selective)

The fourth power of a complex number $z = a + i$ is a real number r , where a is a real number and i is the imaginary unit. Find all pairs of a and r .

4 (Selective)

Consider the two vectors, \vec{a} and \vec{b} with

$$|\vec{a}| = |\vec{b}| = 2 \quad \text{and} \quad \vec{a} \cdot \vec{b} = 1 - \sqrt{5}.$$

Note that if your answer contains double radical signs, express the answer without them.

(1) Find $|\vec{a} - \vec{b}|$.

(2) Find all real numbers t that satisfy $|\vec{a} + t\vec{b}| = |\vec{a} - \vec{b}|$.

5 (Selective)

The figure in Figure 1 contains four triangles in total. We paint each of the six sides one of three colors such that the following three conditions are satisfied.

(Condition 1) Every color is used at least once.

(Condition 2) Do not make triangles whose three sides have the same color.

(Condition 3) Do not make triangles whose three sides have all different colors.

First, we paint one side a color that is represented by a wavy line as shown in Figure 2. **We paint the rest of the five sides using the other two colors** that are represented by bold lines and dotted lines. Sketch all possible drawings using bold lines and dotted lines such that the three conditions are satisfied. You don't need to write the steps leading to your answer. Sketch only your answer. *(Organizing skill)*

Figure 1

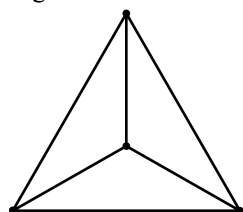
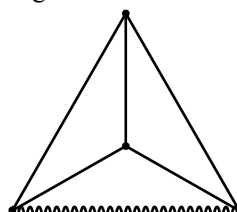


Figure 2



Bold line 

Dotted line 

6 (Required)

Consider $\triangle ABC$ with area S , $BC = a$, $CA = b$ and $AB = c$. Express

$$\frac{1}{S} \left(\frac{\sin A}{a} + \frac{\sin B}{b} + \frac{\sin C}{c} \right)$$

in terms of a , b and c .

(Expression skill)

7 (Required)

Point $A(2, -3)$ lies on the parabola $y = x^2 - 5x + 3$. Line ℓ is the tangent line to the parabola at A .

(1) Find the equation of line ℓ .

(2) Find the area S bounded by the parabola, the y -axis and line ℓ .

(Measurement skill)