

# 1st Kyu

## Section 1: Calculation Test

# 数学検定

## PROFICIENCY TEST IN PRACTICAL MATHEMATICS

Test Time : 60 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 only answers on the answer sheets provided.
6. You may not use a calculator, ruler or compass.
7. Turn off your cell phone and do not use it during the test.
8. Ask an examination supervisor if your problem sheets have inconsistent page numbering or missing pages.
9. 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
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[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

## [1st Kyu] Section 1: Calculation Test

1 Solve for the following equation for  $x$ .

$$x^4 - 4x^3 + x^2 - 3 = 0$$

2 For a point  $z$  in the complex plane, let A, B and C be the points represented by  $z$ ,  $2z$  and  $z^2$ , respectively.

- ① Find the area of  $\triangle ABC$  if  $\triangle ABC$  is a right-angled isosceles triangle with  $\angle C = 90^\circ$ .
- ② If  $z \neq 0$ , the locus of the point A such that  $AC = 2BC$  is a circle. Find the radius of the circle.

3 In the  $xyz$ -space, the equation of the locus of points P that are equidistant from the point  $(0, 0, 1)$  and the plane  $x + y + z - 1 = 0$  is given (using vectors and a matrix) by

$$(x \ y \ z \ 1)A \begin{pmatrix} x \\ y \\ z \\ 1 \end{pmatrix} = 0,$$

where  $A$  is a  $4 \times 4$  symmetric matrix. Find the matrix  $A$  supposing that the  $(1, 1)$  element of  $A$ , i.e. the element at the first row and the first column of  $A$ , is 2.

- 4** Find the eigenvalues of the following matrix.

$$\begin{pmatrix} 1 & 2 & 3 & 4 \\ 2 & 4 & 1 & 3 \\ 3 & 1 & 4 & 2 \\ 4 & 3 & 2 & 1 \end{pmatrix}$$

- 5** Consider the following probability density function defined for all real numbers

$$f(x) = \begin{cases} a(x-x^3) & (0 \leq x \leq 1) \\ 0 & (x < 0, 1 < x), \end{cases}$$

where  $a$  is a constant.

- ① Find the value of  $a$ .
  
- ② Find the variance of the probability distribution defined by  $f(x)$ .

- 6** Evaluate the following sum of the series. Note that " $n!$ " represents the factorial of a positive integer  $n$ .

$$\sum_{n=1}^{\infty} \frac{n^2}{n!}$$

- 7** Evaluate the following iterated integral. Note that  $e$  represents the base of the natural logarithm.

$$\int_0^3 dy \int_0^{\sqrt{y}} \log_e(x^3 - 3x + 3) dx$$