

# 3<sup>rd</sup> Kyu

## Section 2: Application 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 sheet.
5. Write your answers on the answer sheets provided. Follow any instructions given when solving the problems.
6. If your answer contains a fraction, write the fraction in simplest form by reducing it to lowest terms.
7. If your answer contains a radical, write your answer in simplest radical form. For example,  $\sqrt{12}$  must be expressed as  $2\sqrt{3}$ .
8. You may use a calculator.
9. Turn off your cell phone and do not use it during the test.
10. Ask an examination supervisor if your problem sheets have inconsistent page numbering or missing pages.
11. 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

## [3rd Kyu] Section 2: Application Test

1

Consider the following six numbers.

$$5, \quad \frac{1}{4}, \quad -2, \quad -2.7, \quad -\frac{10}{3}, \quad 0$$

- (1) Find the least number.
- (2) Find all numbers that become negative numbers when  $-2$  is subtracted from the number.
- (3) Find all numbers that become negative numbers when they are cubed.

2

Kate recorded the height of her vertical jump 10 times. The following data shows each height. *(Statistical skill)*

Height (cm)	43	45	47	43	43	46	42	45	44	44
-------------	----	----	----	----	----	----	----	----	----	----

- (4) Find the median, in cm.
- (5) Let  $a$  cm,  $b$  cm and  $c$  cm be the mean, median and mode, respectively. Which of the following statements is true? Choose one and write the corresponding number.

- ①  $a < b < c$       ②  $a < c < b$       ③  $b < a < c$       ④  $b < c < a$   
 ⑤  $c < a < b$       ⑥  $c < b < a$       ⑦  $a = b = c$

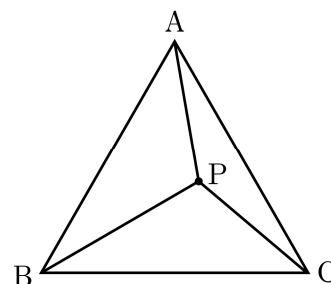
3

The denominator of a fraction is 5 greater than its numerator. Let  $x$  and  $y$  be the numerator and denominator, respectively.

- (6) Write the relationship between  $x$  and  $y$  as an equation. *(Expression skill)*
- (7) If the numerator is increased by 2 and the denominator is decreased by 7, the new fraction equals 2. Find the original fraction.

4

In the figure on the right, point P lies within equilateral triangle ABC such that  $\angle ABP = \angle CBP$ . Point P and vertices A, B and C are connected.



- (8) Which conditions are required to prove that  $\triangle ABP$  and  $\triangle CBP$  are congruent in the simplest way? Choose three conditions from the following and write the corresponding numbers.

- ①  $AB = CB$                       ②  $BP = BP$                       ③  $PA = PC$   
 ④  $\angle ABP = \angle CBP$             ⑤  $\angle BPA = \angle BPC$             ⑥  $\angle PAB = \angle PCB$

- (9) Explain in words the condition for proving that  $\triangle ABP$  and  $\triangle CBP$  are congruent using your three conditions in (8).

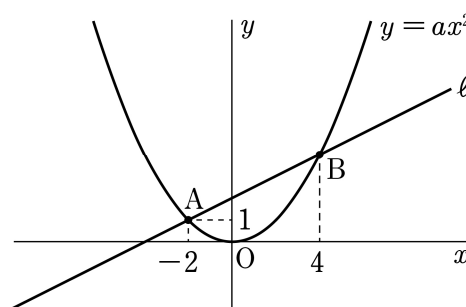
5

Answer the following when three coins are flipped.

- (10) Find the probability that three coins show heads.  
 (11) Find the probability that two coins show heads and one coin shows tails.

6

In the figure on the right, the graph of the function  $y = ax^2$  (\*) and line  $\ell$  cross at two points A and B. The coordinates of point A is  $(-2, 1)$  and the  $x$ -coordinate of point B is 4.

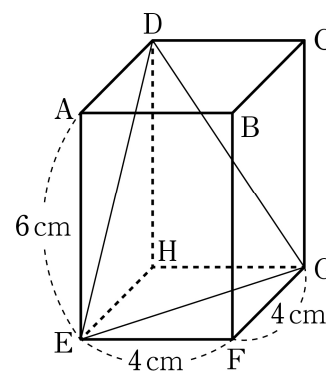


- (12) Find the value of  $a$ .  
 (13) Find the equation of line  $\ell$ .  
 (14) For the function (\*), find the range of  $y$  for the interval  $-2 \leq x \leq 4$ .

7

The figure on the right shows rectangular prism ABCD-EFGH with  $AE = 6\text{ cm}$  and  $EF = FG = 4\text{ cm}$ . Include units in your answer. (*Measurement skill*)

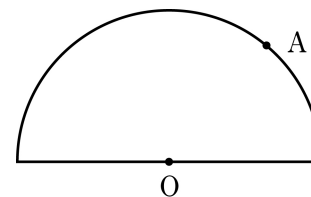
- (15) Find the length, in cm, of line segment EG.
- (16) Find the length, in cm, of line segment DG. Write the steps leading to your answer.
- (17) Find the area, in  $\text{cm}^2$ , of  $\triangle DEG$ .



8

In the figure on the right, point A lies on the arc of a semicircle with its center at O.

- (18) Construct the tangent line of the arc passing through point A. Follow the <Notes> below. You may also explain the procedure in words instead of actually constructing it. (*Construction skill*)



<Notes>

1. Use a compass and ruler for your construction. However, only use the ruler to draw straight lines.
2. Draw precisely how the compass arcs were drawn. Place a dot ( $\bullet$ ) to clearly indicate the position of the compass point.
3. Do not use a protractor.
4. Do not erase lines and/or arcs that are used for the construction and assign numbers ①, ②, ③, ... to show the order in which they were drawn.

9

A tourist walks to a hotel from a temple along the streets according to the following rule.

The route from the temple to the hotel is to be as long as possible within the given area without visiting the same intersection twice.

Figure 1, for example, shows a map where the line segments and the crossing points represent streets and intersections, respectively. Point A represents the temple and point B represents the hotel. Within this area, one of the routes that satisfies the condition above is shown in Figure 2. If we call "one block" the length from one intersection to the next intersection, the tourist walks eight blocks in total in Figure 2. Note that every block has the same distance. *(Organizing skill)*

Figure 1

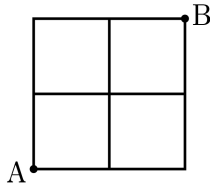


Figure 2

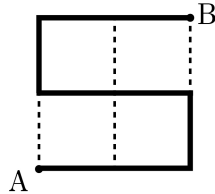


Figure 3

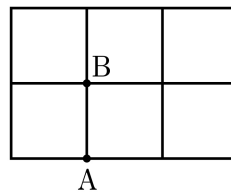
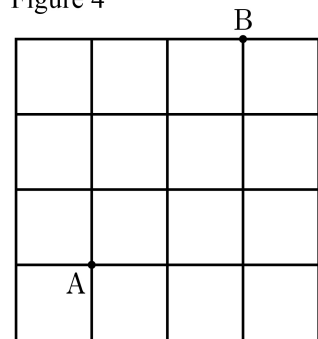


Figure 4



- (19) Within the area in Figure 3, how many blocks does the tourist walk from the temple (point A) to the hotel (point B) according to the rule?
- (20) Within the area in Figure 4, how many blocks does the tourist walk from the temple (point A) to the hotel (point B) according to the rule?