

**[2nd Kyu]      Section 1: Calculation Test**

- 1** Expand and simplify the following expression.

$$(x + 3y)(x^2 - 3xy + 9y^2)$$

- 2** Factor the following expression.

$$x^3 - 3x^2y + 3xy^2 - y^3$$

- 3** Simplify the following expression.

$$\sqrt{5 - 2\sqrt{6}}$$

- 4** Find the value of  $\cos \theta$  when  $\tan \theta = -3$  for  $90^\circ < \theta < 180^\circ$ .

- 5** Six students are divided into 2 rooms, A and B, containing 3 students each. How many different ways can the students be divided?

- 6** For two sets,  $A = \{1, 4, 7, 10\}$  and  $B = \{1, 3, 5, 7, 9\}$ , find the elements of set  $A \cap B$  and list them using set notation.
- 7** For the parabola  $y = 2x^2 + 4kx + 5k + 3$ , where  $k$  is a constant, find the range of  $k$  such that the parabola crosses the  $x$ -axis at two distinct points.
- 8** Find the value of  $a$  such that the polynomial  $x^3 + 3x^2 + ax + 4$  is divisible by  $x - 2$ .
- 9** When  $\alpha$  and  $\beta$  are the complex solutions of the quadratic equation  $3x^2 + 2x + 1 = 0$  find the value of  $\alpha^2 + \beta^2$ .
- 10** Find the values of  $a$  and  $b$  satisfying the following equality. Note that  $i$  represents the imaginary unit.

$$\frac{3+i}{2-i} = a + bi$$

**11** Simplify the following expression.

$$(\log_3 2 + \log_3 8) \cdot \log_4 3$$

**12** Find the shortest distance between point  $(0, 1)$  and the straight line  $x - 3y - 7 = 0$ .

**13** Evaluate the following definite integral.

$$\int_0^2 (x^2 - 1) dx$$

**14** For a geometric sequence whose first term is 6 and the 4th term is 48, answer the following. Note that the common ratio is a real number.

① Find the common ratio of the geometric sequence.

② Find the 6th term of the geometric sequence.

**15** For two vectors,  $\vec{a}$  and  $\vec{b}$ , answer the following when  $|\vec{a}| = 2$ ,  $|\vec{b}| = 3$  and the angle between them is  $120^\circ$ .

① Find the dot product of  $\vec{a}$  and  $\vec{b}$ .

② Find  $|\vec{a} + 2\vec{b}|$ .