Pre **2**nd Kyu

Section 2：Application Test

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 provided. Write the steps leading to your answer. However if the problem says "Write only your answer", you do not need to write your steps.

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.

| Name	
Examinee Number	―

[Pre-2nd Kyu]　　Section 2: Application Test

1　The figure on the right shows pentagon ABCDE. All sides of the pentagon have an equal length of 10 cm, but this is not a regular pentagon. Diagonal BE satisfies

$$BE \parallel CD \quad \text{and} \quad BE = 16 \text{ cm}.$$

The perpendicular line to CD from vertex A intersects BE and CD at P and Q, respectively, where P is the midpoint of BE and Q is the midpoint of CD. (*Measurement skill*)
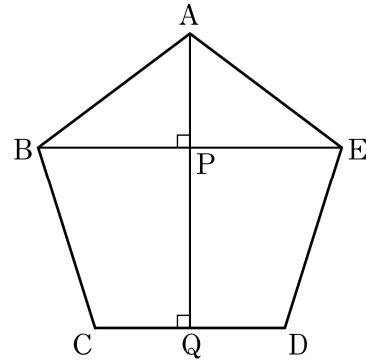
(1)　Find the length of line segment AP. Write only your answer.

(2)　Find the length of line segment PQ.

2　There is an equilateral triangle of sides a cm whose area is given by $\dfrac{\sqrt{3}}{4}a^2$ cm^2 (you don't need to prove this).

(3)　A larger equilateral triangle is made by extending each side of the equilateral triangle by 2 cm. How much larger is the area of the larger equilateral triangle than the original equilateral triangle? Express the difference in terms of a. (*Expression skill*)

3 Answer the following.

(4) n is a positive integer. Find all values of n such that $\sqrt{\dfrac{260}{n}}$ is an integer. Write only your answer.

4 Consider the quadratic function $y = -x^2 + 2ax + a$, where a is a constant.

(5) Find the coordinates of the vertex of the graph of the function. Write only your answer.

(6) Find the range of values of a such that the quadratic function always has negative values.

5 Answer the following.

(7) Find all possible values of x for $\triangle ABC$ with

$$AB = 13, \qquad BC = x, \qquad CA = 14, \qquad \sin A = \frac{12}{13}.$$

(*Measurement skill*)

6 A die numbered 1 to 6 is rolled 4 times successively. Let a, b, c and d be the numbers facing up for the 1st, 2nd, 3rd and 4th rolls, respectively.

(8) How many different combinations of the four numbers satisfy $(a-b)(b-c)(c-d) \neq 0$? Write only the answer.

(9) What is the probability that $(a-b)(b-c)(c-d) = 0$?

7 Answer the following.

(10) 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 one example of the drawings such that the three conditions are satisfied. Only sketch your answer. (*Organizing skill*)
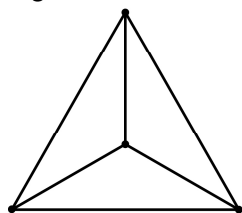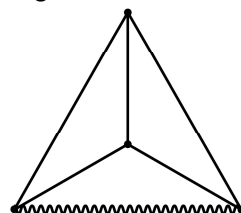
Figure 1   Figure 2

Bold line ———
Dotted line ▪ ▪ ▪ ▪