

[3rd Kyu] Section 2: Application Test

1

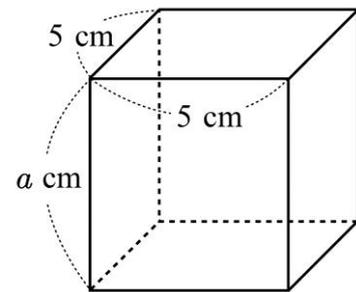
The table below contains information on the highest and lowest temperatures for each day from July 20th to July 24th in Osaka city. The numbers show the difference in temperature between $30\text{ }^{\circ}\text{C}$ and the actual temperature. Positive numbers indicate temperatures higher than $30\text{ }^{\circ}\text{C}$. Negative numbers indicate temperatures lower than $30\text{ }^{\circ}\text{C}$.

July	20th	21st	22nd	23rd	24th
Highest (difference between $30\text{ }^{\circ}\text{C}$)	+3.9	+4.2	+5.3	+6.0	+5.6
Lowest (difference between $30\text{ }^{\circ}\text{C}$)	-3.6	-3.8	-3.8	-2.5	-2.7

- (1) Find the actual lowest temperature on the 20th. Include units in your answer.
- (2) Which day has the greatest difference between the highest and lowest temperatures?

2

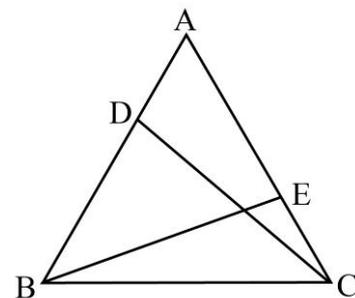
The diagram on the right shows a rectangular prism of length 5 cm, width 5 cm and height a cm. Include units in your answer.



- (3) Find the volume, in cm^3 , of the rectangular prism.
- (4) Find the surface area, in cm^2 , of the rectangular prism.

3

The diagram on the right shows equilateral triangle ABC. Points D and E lie on side AB and AC, respectively such that $AD=CE$. $\angle ACD=\angle CBE$ will be proven in the simplest way using congruent triangles.



- (5) Which two triangles should be shown to be congruent?
- (6) Which conditions are required to prove that the two triangles in your answer for (5) are congruent? Choose three conditions from the following and write the corresponding letters.

(a) $AD=CE$	(b) $AC=CB$	(c) $CD=BE$
(d) $\angle ADC=\angle CEB$	(e) $\angle ACD=\angle CBE$	(f) $\angle CAD=\angle BCE$
- (7) Explain in words the condition for congruent triangles in your answer for (5).

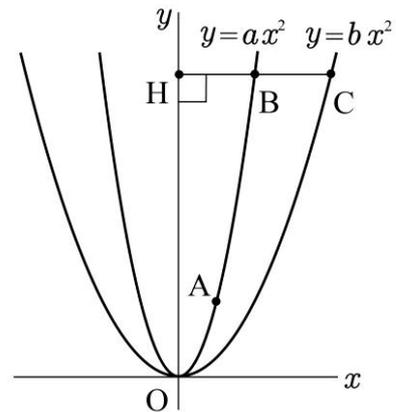
4

There are two numbers, x and y . The sum of x and y is 30. The sum of 7 times x and 2 times y is 95.

- (8) Write a system of equations using x and y . (Expression skill)
- (9) Find the values of x and y .

5

In the graph shown on the right, the parabola $y = ax^2$ has its vertex at O and passes through point A(1, 2). Point B lies on $y = ax^2$ and its x -coordinate is 2. Point H lies on the y -axis and line BH is perpendicular to the y -axis. Point C lies on line BH such that $HB = BC$. The parabola $y = bx^2$ has its vertex at O and passes through point C.



- (10) Find the value of a .
- (11) Find the y -coordinate of point B.
- (12) Find the value of b . Write the steps leading to your answer.

6

Researchers made a guideline for physical activities using two measurements. The metabolic equivalent of task (MET) is used as a unit expressing the intensity of physical activities as multiples of resting metabolic rate. The exercise (Ex) is used as a unit expressing the quantities of physical activities. The relationship between MET and Ex is

$$1 \text{ Ex} = 1 \text{ MET} \times 1 \text{ hour} .$$

Doing physical activities with 23 Exs or more in a week is thought to be good for health. For example, if you do physical activities of 4 METs for 2 hours, the Exs you consume is calculated by

$$4 \text{ METs} \times 2 \text{ hour} = 8 \text{ Exs} .$$

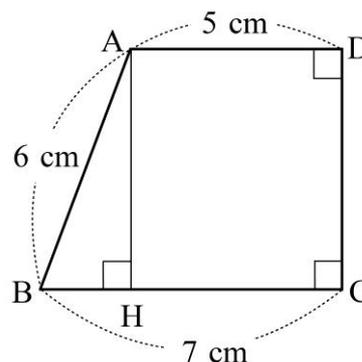
The table on the right shows the relationship between various physical activities and the corresponding physical intensity (MET). Physical activities are divided into two parts, sports and life activities.

METs	Physical activities	
	Sports	Life activities
3	Bowling	Walking
4	Ping-pong	Cycling
5	Baseball	Playing with animals (running)
6	Basketball	Moving furniture
7	Tennis	
8	Swimming	Going up stairs

- (13) How many Exs do you consume when you move furniture for 2 hours?
- (14) Linda swims for 1 hour and plays basketball for 5 hours in a week. Find the total amount, in Exs, of physical activities she consumes in a week from the 2 activities.
- (15) Becky planned to consume 23 Exs in a week by playing tennis and ping-pong. If she plays tennis for 1 hour in a week, at least how many hours does she have to play ping-pong for in a week? Include units in your answer.

7

The figure on the right shows trapezoid ABCD with $AD \parallel BC$ and $AD \perp DC$. Point H lies on side BC and line AH is perpendicular to side BC. Answer the following when $AB=6$ cm, $BC=7$ cm and $AD=5$ cm.



- (16) Find the length, in cm, of AH.
- (17) Find the area, in cm^2 , of trapezoid ABCD.

8

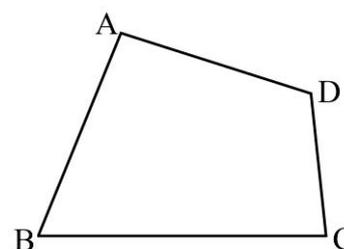
In the diagram on the right, each number from 1 to 16 is assigned to each of the 16 squares so that the sum of the 4 numbers in any row, column or diagonal is the same. (This kind of square is called a magic square) Seven numbers are already assigned. (*Organizing skill*)

a	14	15	b
12	c	6	d
e	f	10	g
h	i	3	16

- (18) Find the sum of four numbers in a row, column or diagonal.
- (19) Find the numbers for a and h .

9

The figure on the right shows quadrilateral ABCD.



- (20) Construct point P that lies on diagonal AC so that it is equidistant from sides AB and BC. 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.