Grade 6 Mathematics

Problem Set A

2016 Japanese Achievement Test

Original can be found at

http://www.nier.go.jp/16chousa/pdf/16mondai_shou_sansuu_a.pdf

Translated by Tad Watanabe

[1] Answer the following questions

(1) We are going to think about the size of the quotient for ☐ ÷ 0.8. A non-zero number will go into the ☐.

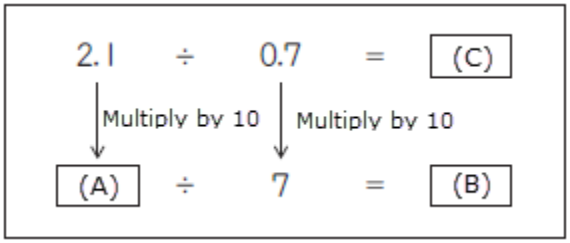
Select the correct statement from **1** through **3** below and write the number.

1 The quotient for ☐ ÷ 0.8 will be greater than ☐.

2 The quotient for ☐ ÷ 0.8 will be less than ☐.

3 The quotient for ☐ ÷ 0.8 will be equal to ☐.

(2) We are going to calculate 2.1 ÷ 0.7 using the property of division, "When both the dividend and the divisor are multiplied by the same number, the quotient will not change," as shown below.



Write the numbers that will go into (A), (B) and (C).

(3) We calculated that the answer for 48.1 ÷ 1.3 is 37.

We are going to check if this answer is correct as shown below.

Calculate [(D)] × [(E)] to see if we get [(F)].

The numbers 48.1, 1.3 and 3.7 will go into (D), (E) and (F) above.

Write the numbers that will go into (D), (E) and (F).

[2] Calculate the followings.

(1) 905 – 8

(2) 4.65 + 0.3

(3) 18 ÷ 0.9

(4) $\frac{2}{9} \times 3$ (If the answer can be simplified, simplify until it cannot be simplified any more.)

[3] Answer the following questions.

(1) For ① and ② below, compare the two numbers in each and write the appropriate inequality symbol in the on the ☐ **answer sheet**.

① 75 ☐ 25

② 104 ☐ 112

(2) Write the least and the greatest numbers of the 3 numbers shown below.

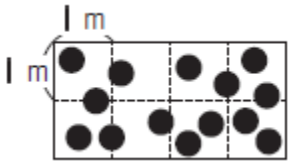
7.1	7	7.01

[4]

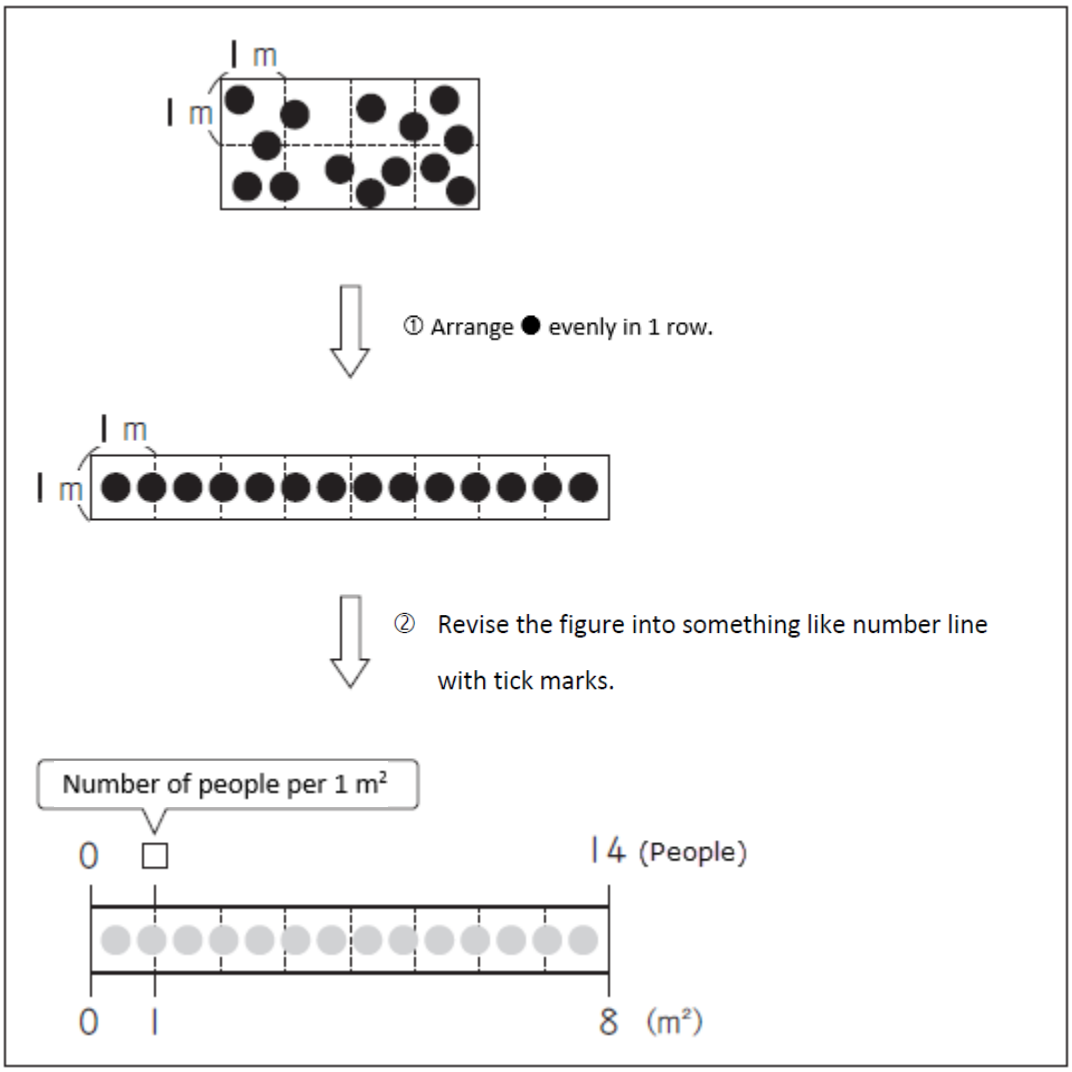
We are going to figure out the number of people per 1 m2 on a picnic sheet.

The area of this picnic sheet is 8 m2, and there are 14 people sitting on the sheet.

The figure below shows how people are seated on this sheet. Each ● indicate one person.



In order to think about the calculation to determine the number of people per 1 m2 on this picnic sheet, we re-arranged the figure showing how people are seated on this sheet as shown below.



Write the expression to calculate the number of people per 1 m2.

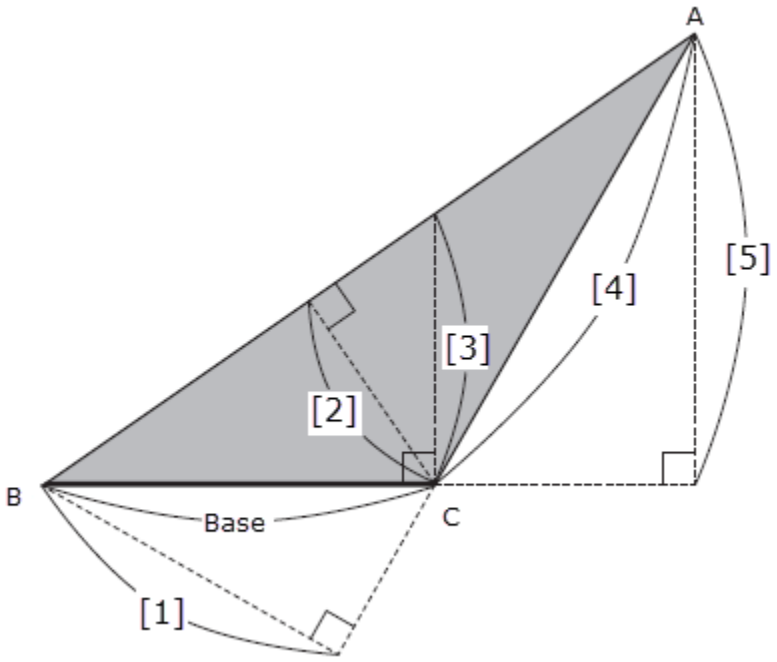
You do not have to write the answer for the calculation.

[5]

We are going to think about the way to calculate the area of the triangle ABC shown below.

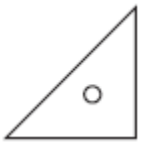
If we consider side BC as the base, where can we measure the height of the triangle?

Select from [1] through [5] below and write the number.

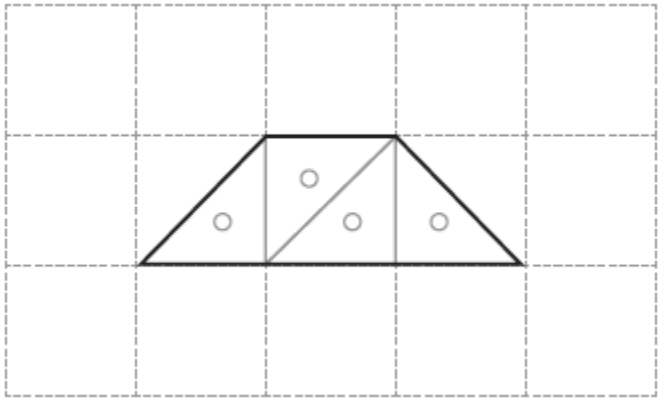


[6]

There is a set square in the shape of an isosceles right triangle as shown below.

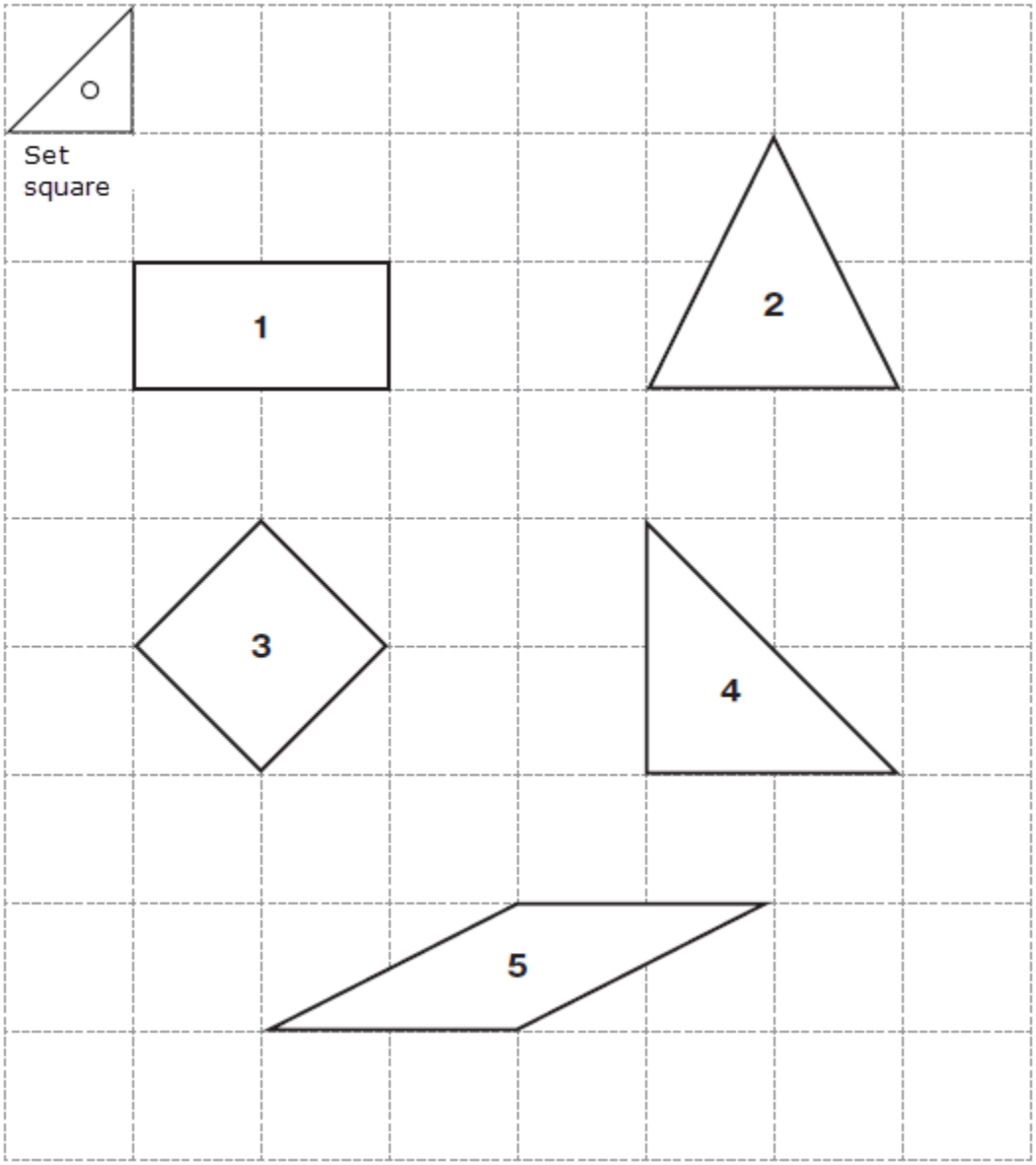


If we use 4 of this set squares, we can make a trapezoid as shown below.



If we use 4 of this set squares, what other figures can we make?

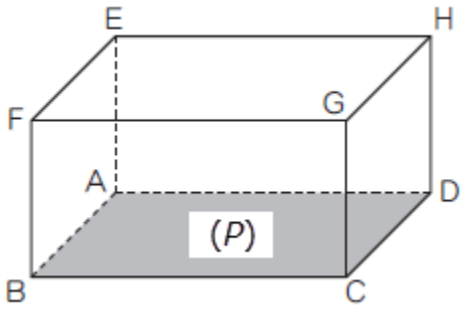
Select 3 from **1** through **5** below and write the numbers.



[7]

In a rectangular prism, there are 6 faces.

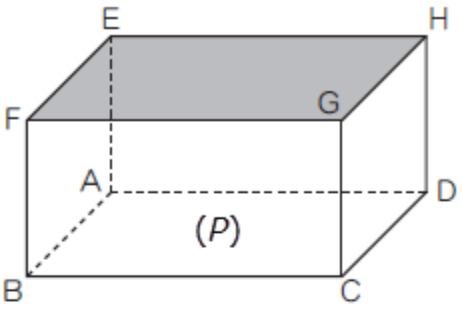
Face (P) in the figure below will be called face ABCD. Other faces will be named in the same way.



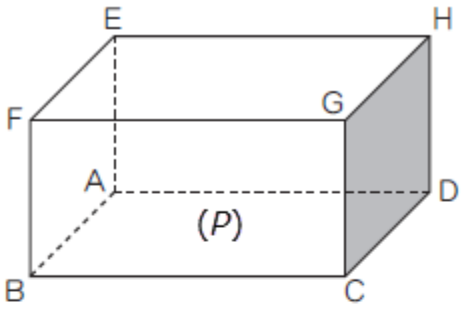
Which faces are perpendicular to face (P)?

Select all that are perpendicular to face (*P*) from **1** through **5** below and write the numbers.

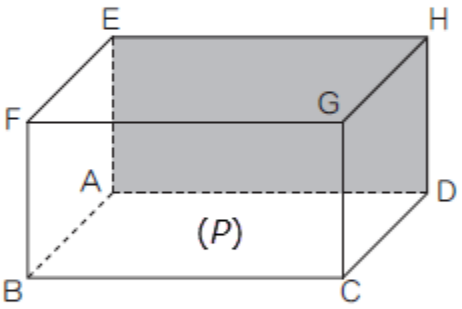
1 Face EFGH



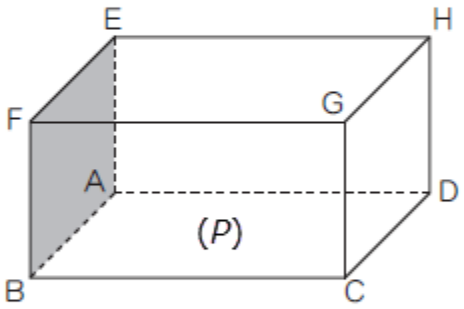
2 Face GCDH



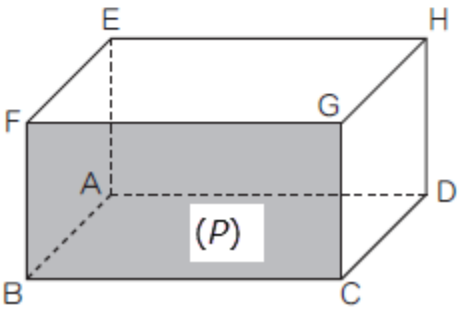
3 Face EADH



4 Face FBAE



5 Face FBCG



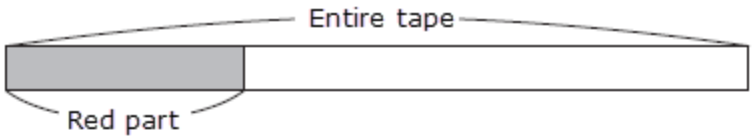
[8]

As shown below, there are 4 pieces of tape each of which is partially red.

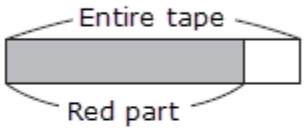
If we consider the length of the entire tape as the base of comparison, which tape has the largest ratio for the length of the red part?

Select one from **1** through **4** below and write the number.

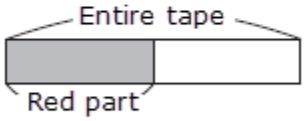
1



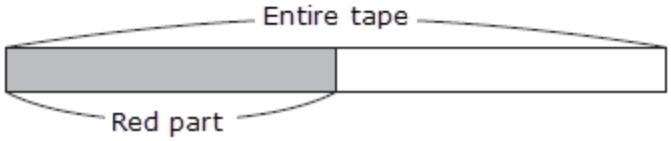
2



3



4



[9]

Answer the following questions.

(1) People waiting for a bus is lined up in a single file at a bus stop.

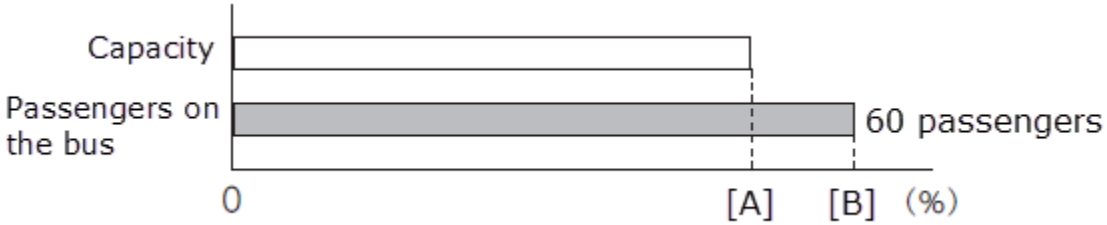
There are 10 people in front of Sayuri, and there are 19 people behind her.

How many people are waiting in the line for a bus at the bus stop?

Write the answer and the equation(s) to calculate the answer.

(2) There are 60 passengers on the bus. The number of passengers on the bus is 20% more than the capacity of the bus.

We are going to represent the number of passengers on the bus, the capacity of the bus, and the percent of the passenger on the bus compared to the capacity of the bus in a diagram shown below.



One of the 4 numbers below will go in to each of [A] and [B] in the diagram.

Write the numbers that will go into [A] and [B].

20	80	100	120

Grade 6 Mathematics

Problem Set B

2016 Japanese Achievement Test

Original can be found at

http://www.nier.go.jp/16chousa/pdf/16mondai_shou_sansuu_b.pdf

Translated by Tad Watanabe

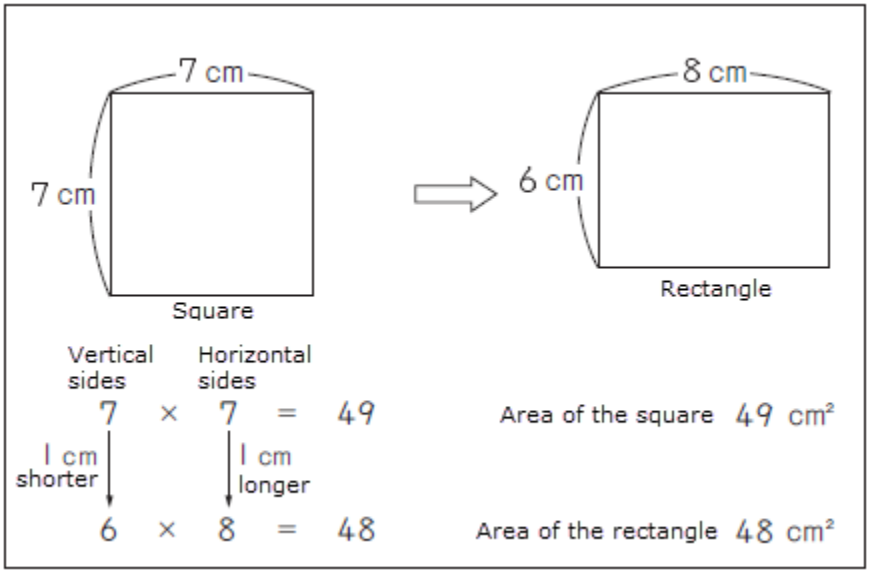
[1]

A teacher and his students are talking about a square whose sides are 7 cm long.

Teacher

What happens to the area if we shorten the vertical sides of the square by 1 cm and lengthen the horizontal sides by 1cm?

Yoshiko did the following calculations.



Yoshiko

The area of the new rectangle will be 1 cm^2 smaller than the area of the original square.

(1) Yoshiko investigated if the area will become 1 cm^2 smaller when the vertical sides are shortened by 1 cm and the horizontal sides are lengthened by 1cm for 8 cm square and 9 cm square as well. Her investigation is shown below.

Write the numbers that will go into (A), (B) and (C).

8 cm square

$8 \times 8 = 64$ Area of the square 64 cm^2

$7 \times 9 = 63$ Area of the rectangle 63 cm^2

9 cm square

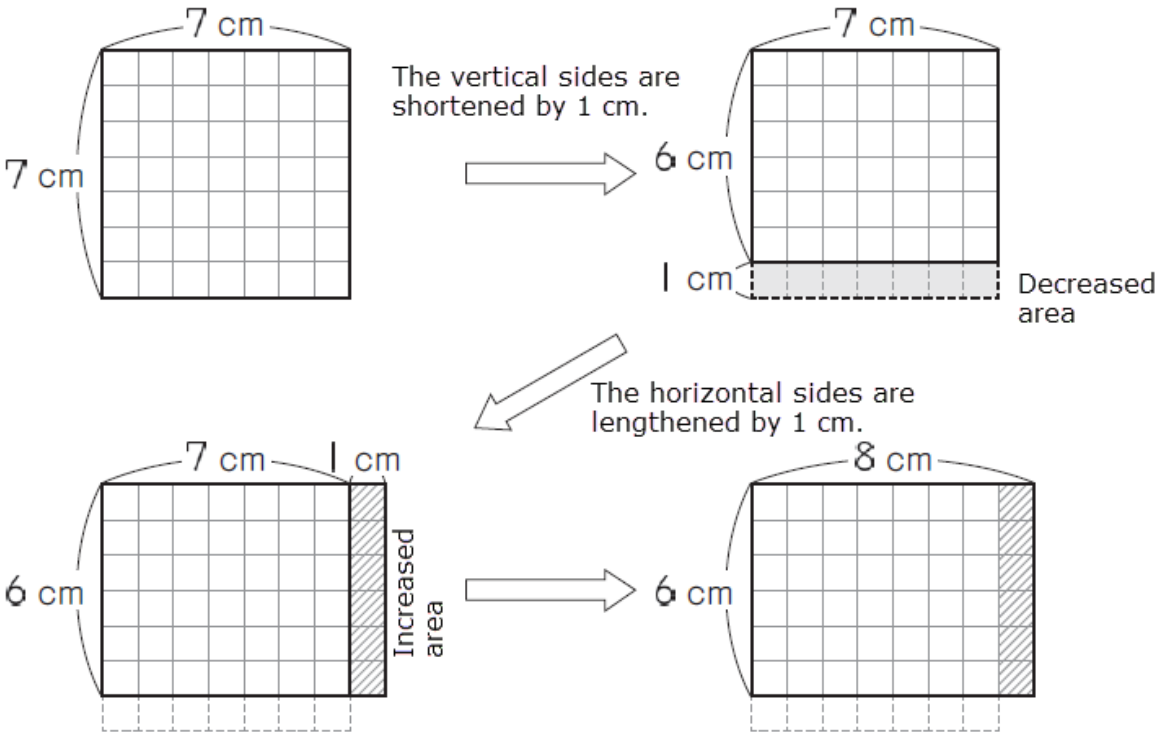
$9 \times 9 = 81$ Area of the square 81 cm^2

(A) × (B) = (C) Area of the rectangle (C) cm^2

Yoshiko

Even with 8 cm and 9 cm squares, the area of rectangle is 1 cm^2 smaller than the area of the original square as it was the case with the 7 cm square.

Yoshiko thought about why the area of the rectangle obtained by shortening the vertical sides of a square by 1 cm and lengthening the horizontal sides by 1 cm in the case of a 7 cm square as follows.



She then explained her reasoning as follows.

[Yoshiko's Explanation]

If the vertical sides of a square is shortened by 1 cm,

the area of the decreased part is $1 \times 7 = 7$, or 7 cm^2.

Then, if we lengthen the horizontal sides by 1 cm,

the area of the increased part is $6 \times 1 = 6$, or 6 cm^2.

If we compare the areas of the decreased part and the increased part,

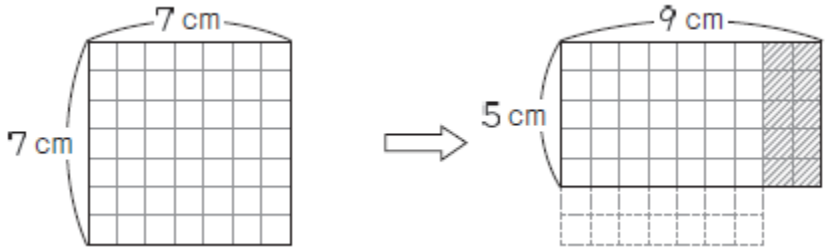
it will be $7 - 6 = 1$, or the area of increased part is 1 cm^2 less than the area of the increased part.

Therefore, the area of the rectangle will be 1 cm^2 smaller than the area of the original square.

(2) Next, we are going to think about what happens to the area when the vertical sides of a square is shortened by 2 cm and the horizontal sides are lengthened by 2 cm. We will use a 7 cm square to investigate.


Takashi

If we use Yoshiko's reasoning, we can tell that the area will get 4 cm^2 smaller than the original square.



We are to explain why the area will become 4 cm^2 smaller based on **[Yoshiko's Explanation]**.

Fill in (D), (E) and (F) with words and equations and complete the explanation.

[Explanation]

If we shorten the vertical sides of the square by 2 cm,

(D)

Next, if we lengthen the horizontal sides by 2 cm,

(E)

If we compare the decreased part and the increased part,

(F)

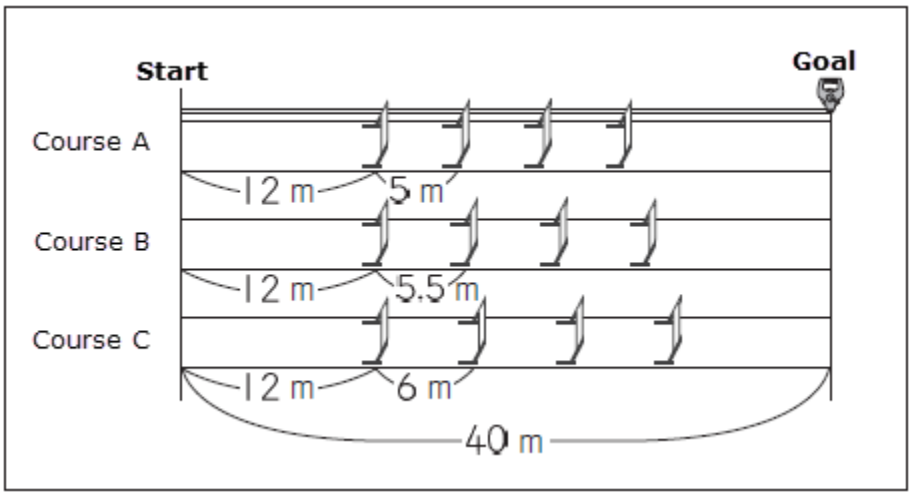
Therefore, the area of the rectangle will be 4 cm^2 smaller than the area of the original square.

[2]

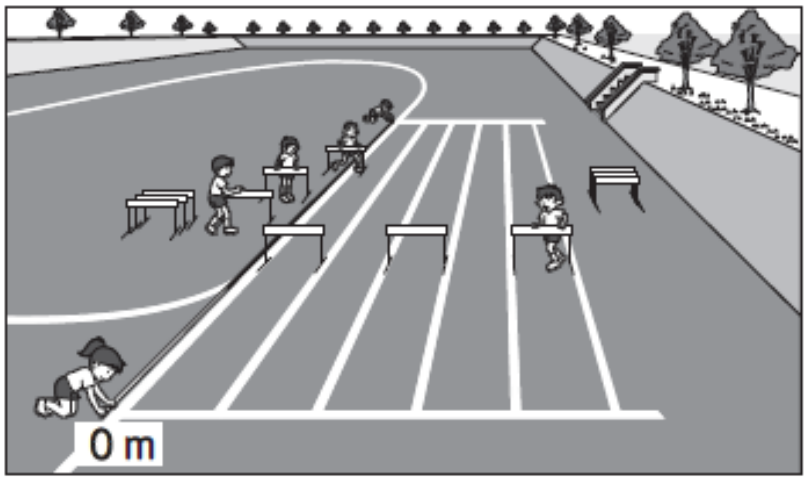
During a Physical Education class, we are going to run a 40 m hurdles race.

As shown in the diagram below, there are 3 courses, A, B, and C, with 4 hurdles in each. The distance between the hurdles are 5 m, 5.5 m, and 6 m in each.

Diagram showing the placement of hurdles in 40 m courses



Koji is placing the 4th hurdles from the start line on Course A where the distance between hurdles is 5 m.



(1) In Course A, the distance from the start line and the first hurdle is 12 m, and the distance between hurdles is 5 m.

If we place the “0 m” tick mark of a measuring tape at the start line, at how many meter mark on the measuring tape will the 4^{th} hurdle be placed?

Write the answer and the equation(s) to calculate the answer.

Next, based on the record of 40 m dash, we are going to set the target time for the 40 m hurdles race.

We are going to determine the target time based on the following formula.

Formula to determine the target time for 40 m hurdles race

Time for 40 m dash + 0.4 (sec.) × Number of hurdles = Target time for 40 m hurdles race

Manami

In this formula, the underlined (_____) part is the increased time in the 40 m hurdles race, isn't it?

(2) Manami's time for the 40 m dash was 8.1 seconds. If the number of hurdles is 4, what will be Manami's target time?

Write the target time and the equation to calculate the target time.

Manami was able to meet the target time. She told the teacher that she was able to meet the target.


Teacher

If you were able to meet the target time, let's modify the f**ormula to determine the target time for 40 m hurdles rac**e.

Without changing the time for your 40 m dash or the number of hurdles, we can change the number, 0.4, in the formula to something else, like 0.3.

Original Formula Time for 40 m dash + 0.4 (sec.) × Number of hurdles = Target time

↓

Modified Formula Time for 40 m dash + 0.3 (sec.) × Number of hurdles = Target time


Manami

We are changing the number, 0.4, into 0.3, aren't we?

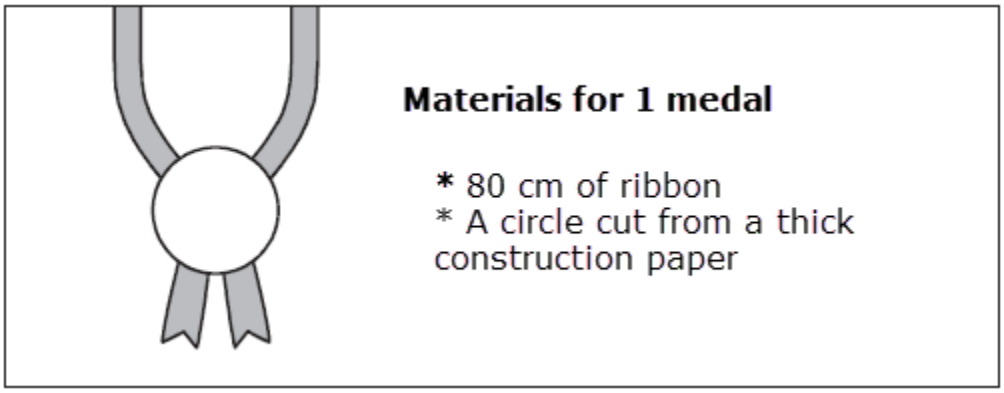
I wonder what 0.4 and 0.3 in these formulas are representing.

(3) What are the numbers [0.4] and [0.3] in the formulas representing? Write your answer using words and numbers.

[3]

At Tomomi's school, they hold a special performance for preschool children in the area. 24 preschool children are expected to attend. At the event, they are planning to give each child a commemorative medal that students are making.

The amount of materials needed for each medal is as shown below.



Teachers have prepared 2000 cm of ribbon and a 39 cm by 54 cm thick construction paper. Tomomi, Haruo and Akane are trying to figure out if they have enough ribbon and construction paper.

(1) The 3 students are figuring out whether or not the 2000 cm of ribbon is enough for 24 children coming to the performance. Each student's reasoning is shown in the equation below.

Tomomi

$80 \times 24 = 1920$

Haruo

$2000 \div 80 = 25$

Akane

$2000 \div 24 = 83.3 \cdots$

Tomomi

Haruo

Akane

We have enough ribbon.

What is each equation determining?

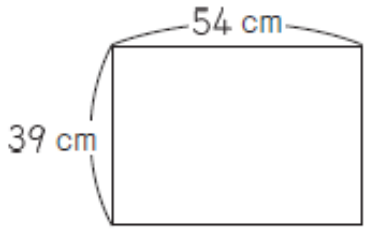
Select 1 for each equation from **1** through **3** below and write the number.

1 How many segments needed for 1 medal can be taken from the total length of ribbon.

2 With the total length of ribbon, how many cm of ribbon can be allocated to each child.

3 How many cm of ribbon will be needed to make medals for all of the children.

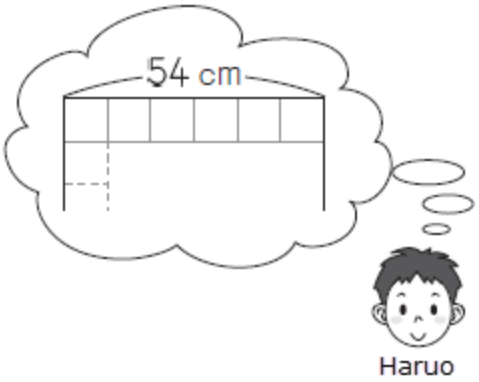
(2) Haruo noticed that he can cut out 24 9-cm squares from 1 sheet of 39 cm by 54 cm thick construction paper.



Haruo is trying to explain how he knew 24 9-cm squares can be cut out from the thick construction paper by using its dimensions.

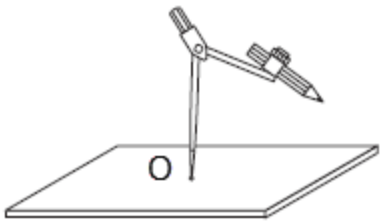
Haruo's explanation

The horizontal dimension is 54 cm. Since each side of a square is 9 cm, 54 ÷ 9 = 6 We can draw 6 squares in each row.



Complete Haruo's explanation to show that 24 9-cm squares can be cut out from this construction paper using words and expression(s)/equation(s).

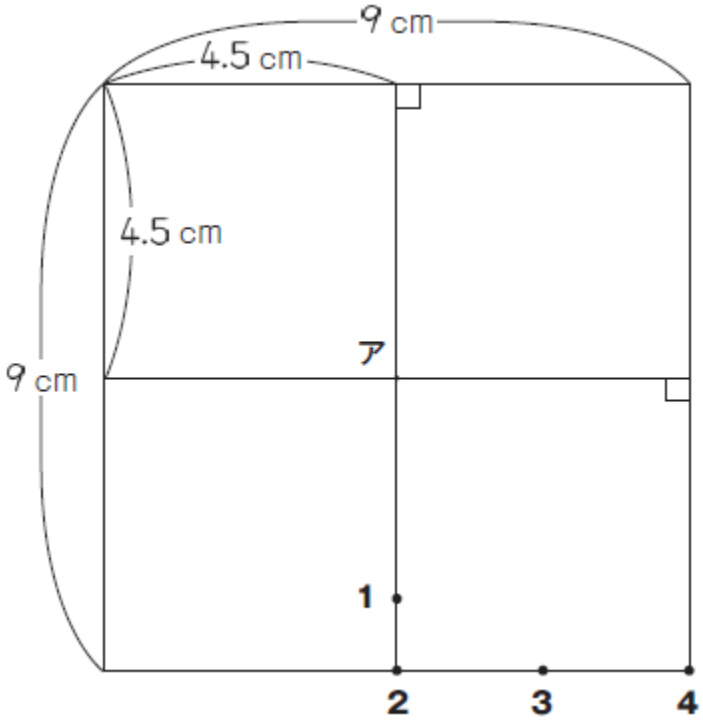
(3) On a 9-cm square cut out of the thick construction paper, we are going to draw the largest circle possible and cut it out.



On the **Diagram of the construction paper** shown below, we are going to place the needle of a compass at point O. Which of the points **1** through **4** in the diagram should we put the pencil on the compass?

Select the point (•) where we should place the pencil on the compass from **1** through **4** below and write the number.

Diagram of the construction paper



[4]

The Library Committees of A Elementary School and B Elementary School are putting their efforts together to encourage more students to read.


A Elementary School


B Elementary School

The tables below summarize the number and types of books that were checked out at each school in the 4 month period between April and July.

Records of books checked out at each school's library: April through July

Table 1 Number of checked out books each month (volumes)

	April	May	June	July	TOTAL
A Elementary	986	2918	3414	2420	9738
B Elementary	849	2523	2938	2095	8405

Table 2 Types of checked out books at A Elementary School

Novels	Sciences	History	Biography	Others	TOTAL
3800	1977	1496	989	1476	9738

The students in the Library Committee at A Elementary School are discussing the data in Table 1 that are marked by ☐ as shown below.


Kenta

Students at which school are checking out more books?


Makoto

Based on **the total number of checked out books at each school**, there are more books checked out at A Elementary School. So, I think students at A Elementary School are checking out more books.

Asako

In order to decide students at which school are checking out more books, I would like to compare **the number of checked out books per student at each school**.

To figure out the number of checked out books per student, in addition **to the total number of checked out books at each school**, what additional information do we need?

(1) In order to find **the number of checked out books per student at each school** as Asako suggests, in addition to **the total number of checked out books at each school** shown in the section indicated by  in **Table 1**, what additional information is needed?

Select 1 from **1** through **4** below and write the number.

1 The number of students who used the library at each school.

2 The number of students at each school.

3 The number of books in the library at each school.

4 The number of checked out books for each type of books at each school.

(2) The members of the Library Committee from A Elementary School made the following statements about the number of checked out books during the 4 month period between April and July.

In the statements **1** through **4** below, select 1 statement for which **Tables 1** and **2** are not enough to justify the underlined conclusion and write the number.

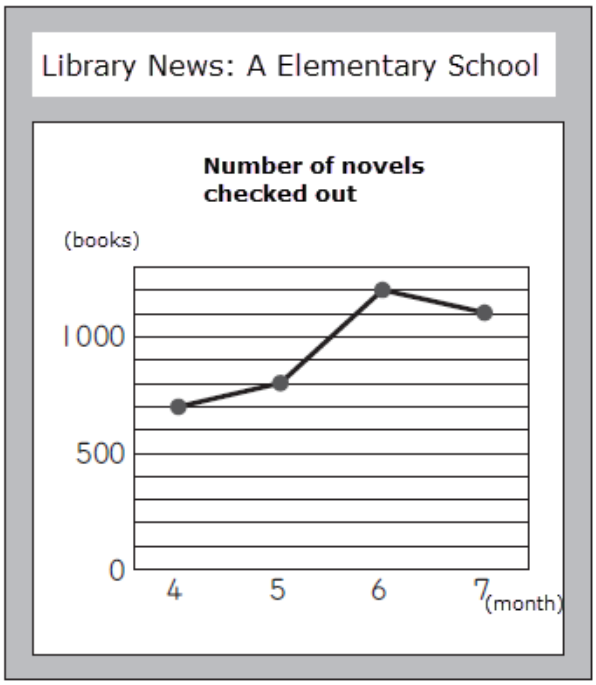
1 <u>At both schools, the number of checked out books is the greatest in June</u>. It is probably due to the Library Week. We should hold a Library Week in fall, too.

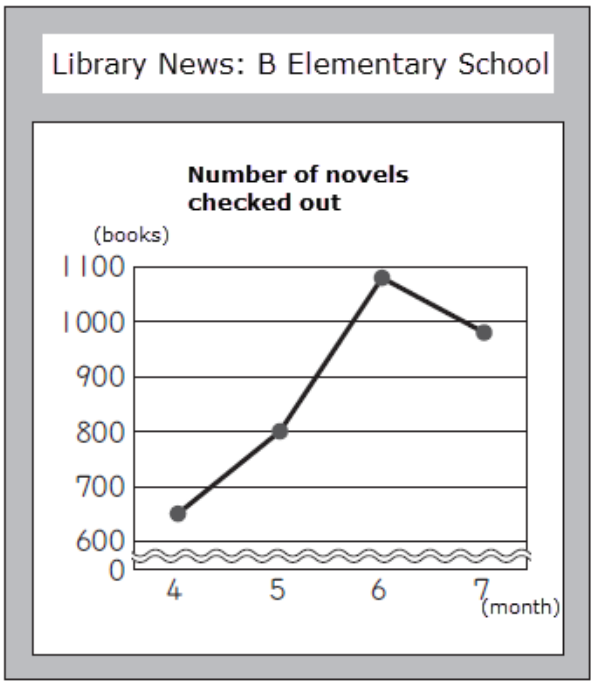
2 <u>At A Elementary School, novels are the most checked out books</u>. Let's have students write a brief essay recommending the books they enjoyed.

3 <u>The number of biographies checked out in May is small</u>. Let's make a poster encouraging students to read biographies.

4 <u>The total number of checked out books at A Elementary School was 9738 volumes</u>. Let's aim for 10,000 volumes of more in the next 4 months.

(3) In order to show the effects of various efforts to encourage reading more books, the Library Committee at each school summarized the data on the number of novels checked out in the broken line graphs below.





Kenta made the following statement after looking at the 2 graphs above and comparing the changes in the number of novels checked out from May to June.


Kenta

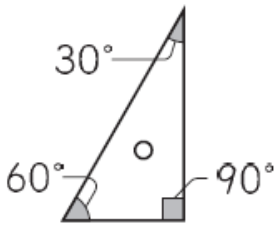
> The incline from May to June at B Elementary School is steeper than that of A Elementary School.
>
> Therefore, the increase in the number of novels checked out from May to June is greater at B Elementary School than at A Elementary School.

The underlined (=====) section of Kenta's statement is incorrect.

Using words and numbers, write the reason why his statement is incorrect based on the number of checked out books from the graphs.

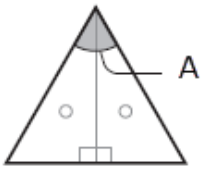
[5]

There is a set square (a triangular ruler) with 30°, 60° and 90° angles as shown on the right.



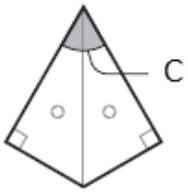
We made the following 3 geometric figures using 2 of this set square, by putting together the sides that are the same length.

(1) Equilateral triangle



(2) Isosceles Triangle

(3) Quadrilateral



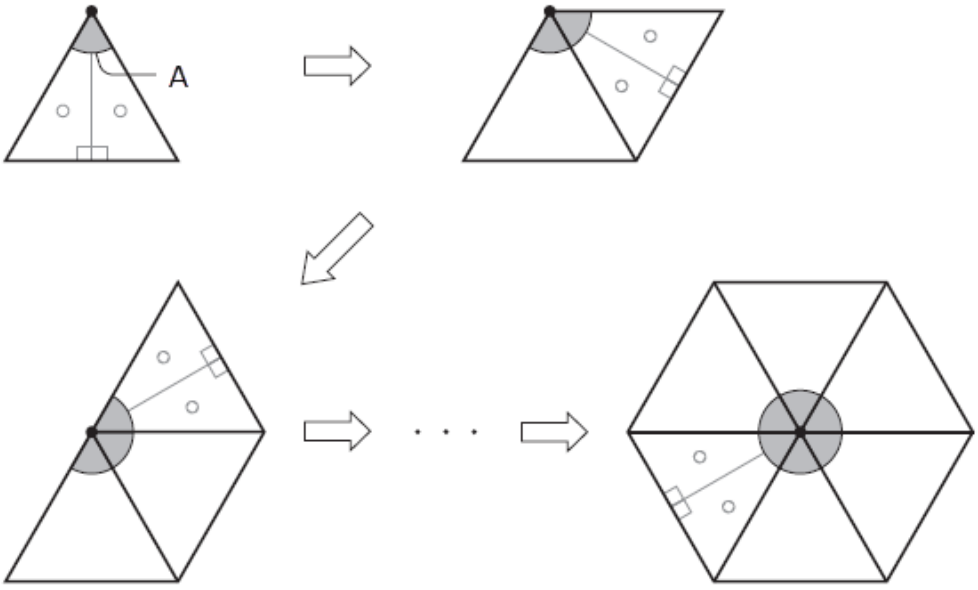
Teacher

By using one of these 3 figures, we are going to make new figures.

If we put together several copies of the selected figure so that angle A, B or C will be around the same point, what kind of figure do we make?

Yuta

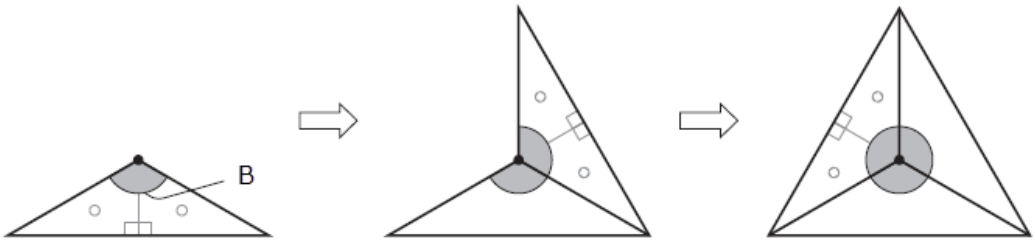
If we put together the **equilateral triangles**, (1), so that angle A will be around the same point, we get a regular hexagon using 6 of them.



(1) Next, we are going to use the **isosceles triangles**, (2), to make new figures.

Kanae

If we put together the **isosceles triangles**, (2), so that angle B will be around the same point, we get a regular hexagon using 3 of them.



Teacher

Why will 3 of the isosceles triangles fit together exactly to make the equilateral triangle?

Kanae

360 ÷ 120 = 3. Because the quotient is 3, 120 divides 360 evenly.

Teacher

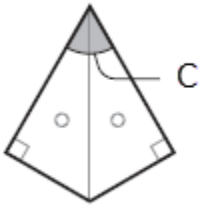
That's right.

What does the answer for 360 ÷ 120 represent? Please explain.

What does the answer for 360 ÷ 120 represent?

Use words and numbers to explain. Write your answer so that what "360" and "120" represent are clearly understandable.

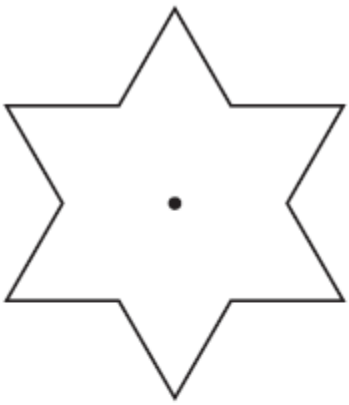
(2) Next, we are going to use the **quadrilateral**, (3), to make new figures.



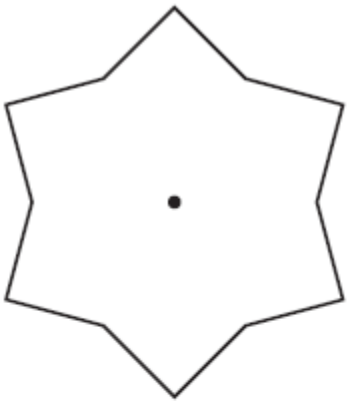
If we put together the **quadrilaterals**, (3), so that angle C will be around the same point, we get a certain figure using 6 of them.

Select the figure you make from **1** through **4** below and write the number.

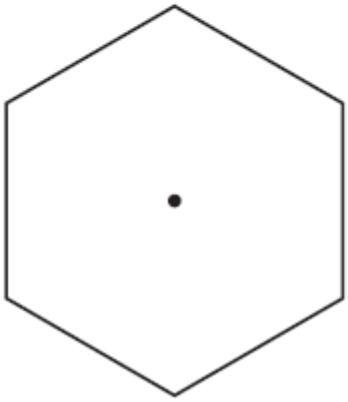
1



2



3



4