



NAME \_\_\_\_\_

CLASS \_\_\_\_\_

Points: \_\_\_\_\_ Kangaroo leap: \_\_\_\_\_ ID Code (teacher fills): \_\_\_\_\_

Separate this answer sheet from the test. Write your answer under each problem number.

A right answer gives 3, 4 or 5 points. Every problem has exactly one right answer.

For each wrong answer,  $\frac{1}{4}$  of the points of the problem will be deducted, for example for a 4-point problem -1 point. If you leave the answer empty, no deduction will be made.

There are two goals: to score as many points as possible or to have as many consecutive right answers as possible (Kangaroo leap).

**3 points**

PROBLEM	1	2	3	4	5	6	7	8
ANSWER								

**4 points**

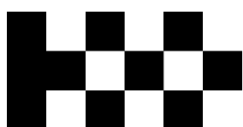
PROBLEM	9	10	11	12	13	14	15	16
ANSWER								

**5 points**

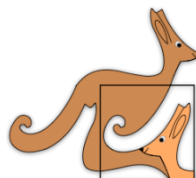
PROBLEM	17	18	19	20	21	22	23	24
ANSWER								

Contest not to be held before 25th of March 2019.

Logon design by Samin Ahmed.



Teknologiateollisuuden  
100-vuotissäätiö



**3 points**

1.

A digital clock looks like this:



What does the clock look like the next time it shows the digits 2, 0, 1, and 9 in some order?



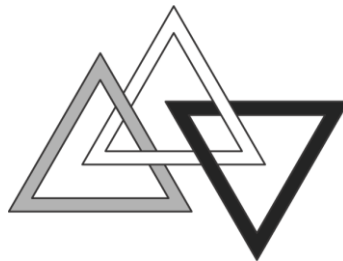
2.

For a toy train, it takes 1 min 11 s to finish one lap. How long does it take to finish 6 laps?

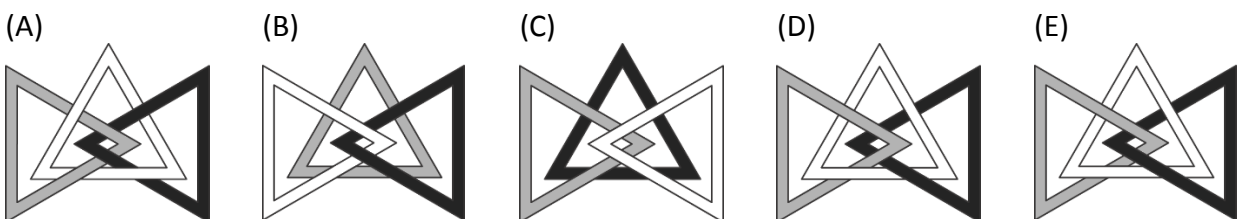
- (A) 6 min 56 s      (B) 7 min 6 s      (C) 7 min 16 s      (D) 7 min 26 s      (E) 7 min 36 s

3.

Three triangles are linked as shown.



Which of the following pictures shows these three triangles linked in the same way?



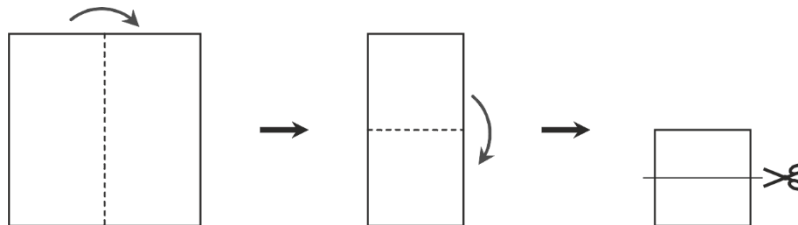
4.

Three ordinary dice are thrown, and the results are added up. How many different outcomes are possible?

- (A) 14      (B) 15      (C) 16      (D) 17      (E) 18

5.

As seen in the figure, a paper is folded twice and cut along a line. In how many pieces is the paper after cutting?



(A) 2

(B) 3

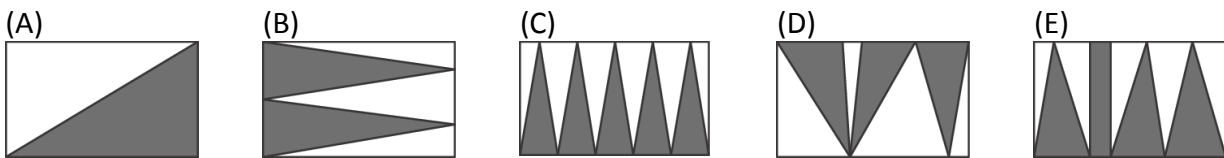
(C) 4

(D) 5

(E) 6

6.

Five identical rectangles have been coloured in different ways. Which rectangle has the most grey?



7.

A pyramid has 23 triangular faces. How many edges does the pyramid have?

(A) 23

(B) 24

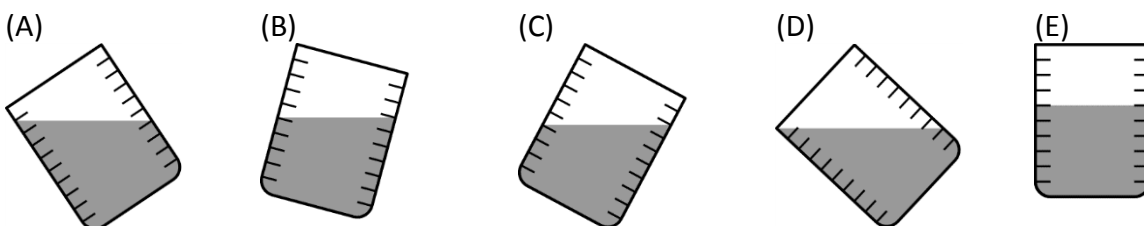
(C) 46

(D) 48

(E) 69

8.

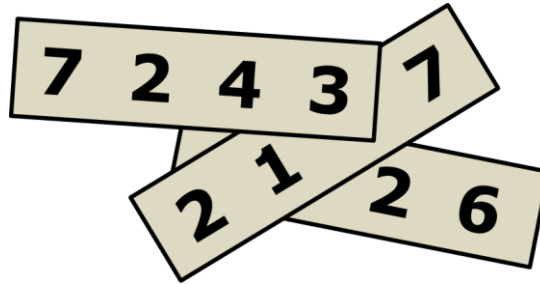
Five identical glasses with circular bases and straight sides are filled with juice. Four of them contain the same amount of juice. Which one contains a different amount?



4 points

9.

Three 4-digit numbers are written on three pieces of paper as shown. The sum of the three numbers is 11 126. Three of the digits are covered. What are the covered digits?



- (A) 1, 4 and 7      (B) 1, 5 and 7      (C) 3, 3 and 3      (D) 4, 5 and 6      (E) 4, 5 and 7

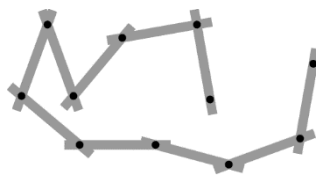
10.

Ada is looking for the smallest number that has 2019 as the sum of its digits. What is the first (the leftmost) digit of this number?

- (A) 2      (B) 3      (C) 4      (D) 5      (E) 6

11.

A little kangaroo is playing with a ruler that is formed of ten hinged parts.



Which of the following patterns can the kangaroo **not** form?

- (A)      (B)      (C)      (D)      (E)

12.

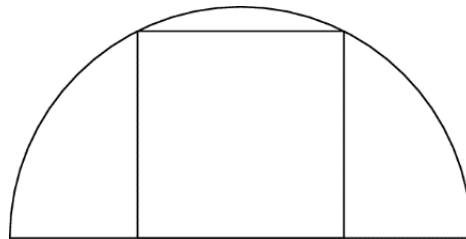
What is the highest power of 3 that the number  $7! + 8! + 9!$  is divisible by?

(The factorial  $n!$  stands for the product of  $n$  and of all the positive integers smaller than  $n$ ; for example,  $7! = 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1$ .)

- (A)  $3^2$                       (B)  $3^4$                       (C)  $3^5$                       (D)  $3^6$                       (E) Some higher power of 3

13.

Two vertices of a square lie on the arc of a semicircle and two lie on its diameter as shown.

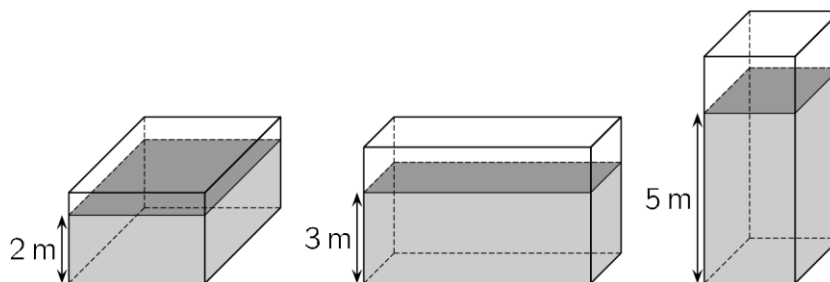


The radius of the semicircle is 1 cm. What is the area of the square?

- (A)  $\frac{4}{5} \text{ cm}^2$                       (B)  $\frac{\pi}{4} \text{ cm}^2$                       (C)  $1 \text{ cm}^2$                       (D)  $\frac{4}{3} \text{ cm}^2$                       (E)  $\frac{2}{\sqrt{3}} \text{ cm}^2$

14.

A container in the shape of a rectangular box is partially filled with  $120 \text{ m}^3$  of water. The depth of the water depends on which side of the box is on the ground, as shown (not to scale). What is the volume of the container?



- (A)  $160 \text{ m}^3$                       (B)  $180 \text{ m}^3$                       (C)  $200 \text{ m}^3$                       (D)  $220 \text{ m}^3$                       (E)  $240 \text{ m}^3$

15.

What is the integer part of the number

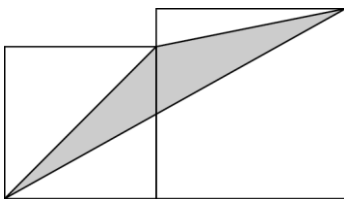
$$\sqrt{20 + \sqrt{20 + \sqrt{20 + \sqrt{20 + \sqrt{20}}}}} ?$$

(Integer part means the number obtained by removing the decimals of a number.)

- (A) 4                      (B) 5                      (C) 6                      (D) 20                      (E) 25

16.

Two adjacent squares with side lengths  $a$  and  $b$  ( $a < b$ ) are shown. What is the area of the shaded triangle?

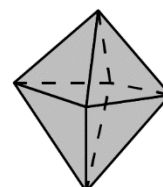
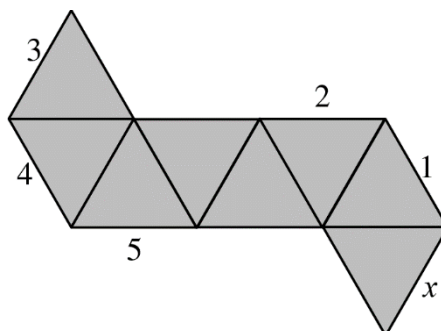


- (A)  $\frac{1}{2}a^2$                       (B)  $\frac{1}{2}b^2$                       (C)  $\sqrt{ab}$                       (D)  $\frac{1}{4}(a^2 + b^2)$                       (E)  $\frac{1}{2}(a^2 + b^2)$

5 points

17.

The diagram shows a net of an octahedron. When the net is folded to form the octahedron, which of the labelled line segments will coincide with the line segment marked with the  $x$ ?



- (A) Side 1                      (B) Side 2                      (C) Side 3                      (D) Side 4                      (E) Side 5



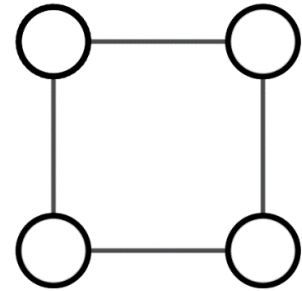
18.

How many different planes pass through at least three vertices of a given cube?

- (A) 6                      (B) 8                      (C) 12                      (D) 16                      (E) 20

19.

On each vertex of a square, one positive integer is placed. For any two numbers joined by an edge of the square, one is a multiple of the other. However, for any two diagonally opposite numbers, neither is a multiple of the other. What is the smallest possible sum of the four numbers?



- (A) 12                      (B) 24                      (C) 30                      (D) 35                      (E) 60

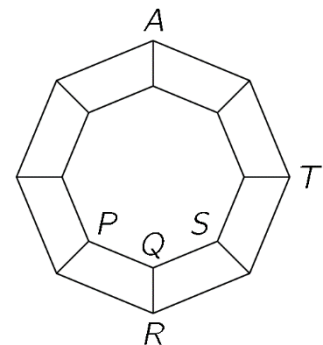
20.

For how many integers  $n$  is the number  $|n^2 - 2n - 3|$  a prime number?

- (A) one                      (B) two                      (C) three                      (D) four                      (E) infinitely many

21.

A spider web is formed of 16 vertices and strings connecting them as seen in the figure. A spider sets out from vertex A and runs around the web from vertex to vertex passing 2019 strings in total. Which of the vertices P, Q, R, S, T are possible locations of the spider to end its journey?



- (A) only P, R and S, not Q or T  
(B) only P, R, S and Q, not T  
(C) only Q  
(D) only T  
(E) all of them: P, Q, R, S and T.



22.

The first member of the sequence  $a_1, a_2, a_3, \dots$  is  $a_1 = 49$ . When  $n \geq 2$ , the number  $a_n$  is obtained by counting the sum of the digits of  $a_{n-1}$ , adding one, and squaring the result. For example,  $a_2 = (4 + 9 + 1)^2 = 196$ . What is  $a_{2019}$  ?

- (A) 25                      (B) 49                      (C) 64                      (D) 121                      (E) 400

23.

The equation

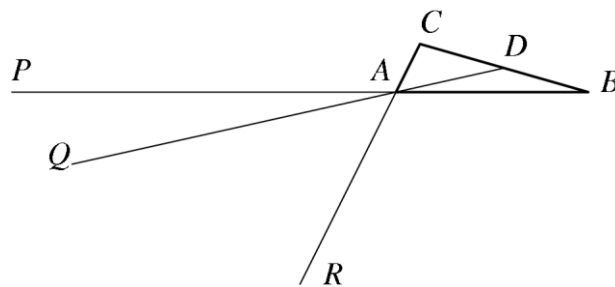
$$2 - |x| = ax$$

has exactly two solutions. What can be said of the parameter  $a$ ?

- (A)  $a \leq -1$               (B)  $-1 < a < 1$               (C)  $a \geq 1$               (D)  $a = 0$               (E)  $a = 1$  or  $a = -1$

24.

Consider a triangle  $ABC$  with point  $D$  as the midpoint of  $BC$ . As shown in the figure, the points  $P$ ,  $Q$  and  $R$  are chosen on rays  $BA$ ,  $DA$  and  $CA$  respectively so that  $AP = 2AB$ ,  $AQ = 3AD$ , and  $AR = 4AC$ . The area of the triangle  $ABC$  is  $S$ . What is the area of the triangle  $PQR$  ?



- (A)  $S$                       (B)  $2S$                       (C)  $3S$                       (D)  $\frac{1}{2}S$                       (E) 0, i.e.  $P$ ,  $Q$  and  $R$  are collinear