



Kangaroo 2016 Student
upper secondary (lukio)

NAME _____

GROUP _____

Points: _____ Kangaroo leap: _____

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

From 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.

PROBLEM	1	2	3	4	5	6	7	8	9	10
ANSWER										

PROBLEM	11	12	13	14	15	16	17	18	19	20
ANSWER										

PROBLEM	21	22	23	24	25	26	27	28	29	30
ANSWER										

Contest not to be held before March 17th 2016.

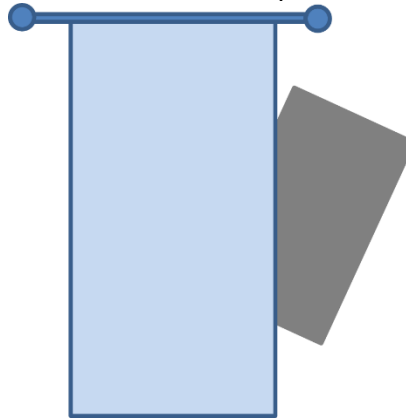
Logo design by Jenna Tuupanen.



3 points

1.

A rectangle is partly hidden behind a curtain. What shape is the hidden part?



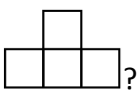
- (A) A triangle (B) A square (C) A hexagon (D) A circle (E) A rectangle

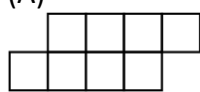
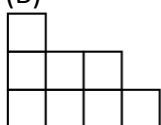
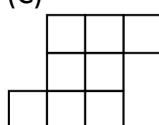
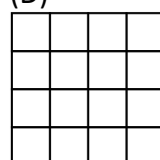
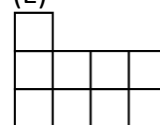
2.

Which of the following is equal to $\frac{1}{10} + \frac{1}{100} + \frac{1}{1000}$?

- (A) $\frac{3}{111}$ (B) $\frac{111}{1110}$ (C) $\frac{111}{1000}$ (D) $\frac{3}{1000}$ (E) $\frac{3}{1110}$

3.

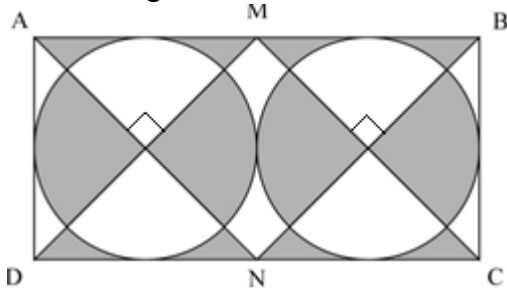
Which of the shapes below is **impossible** to build using only blocks like this:  ?

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



4.

The rectangle $ABCD$ has an area of 200. How large is the area coloured in grey?



- (A) 50 (B) 80 (C) 100 (D) 120 (E) 150

5.






Four of the coordinates below form the vertices of a square. Which point is not one of the vertices?

- (A) (-1, 3) (B) (0, -4) (C) (-2, -1) (D) (1, 1) (E) (3, -2)

6.








Which pattern cannot be obtained by glueing two identical squares of cardboard together?

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

7.

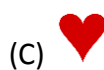
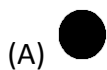
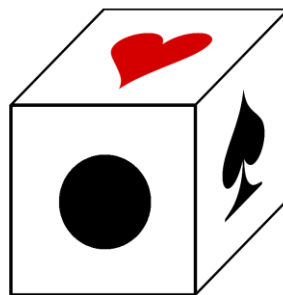
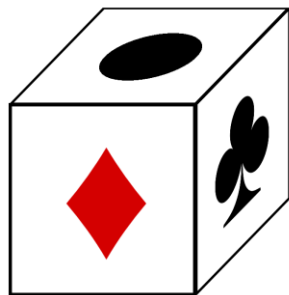
Five rivers are presented in the figures below. Four of them have constant width (so from any point on the shore the shortest distance to the opposing shore is the same). Which of the rivers does not have constant width?

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



8.

A die has the following symbols: ♠, ♥, ♣, ♦, ● and ■, one at each face. In the pictures below you see the die from two different directions. Which symbol is on the opposite side of ■?



9.

Which of the following is closest to $\frac{17 \cdot 0.3 \cdot 2016}{999}$?

(A) 0,01

(B) 0,1

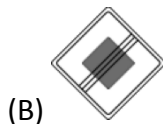
(C) 1

(D) 10

(E) 100

10.

Which of the following traffic signs has the largest number of axes of symmetry? (An axis of symmetry is a line dividing the figure into two mirror images.)

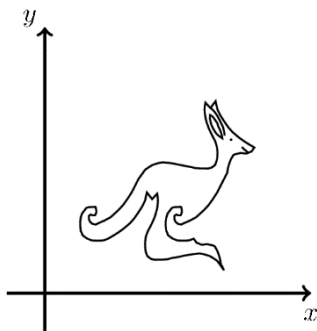




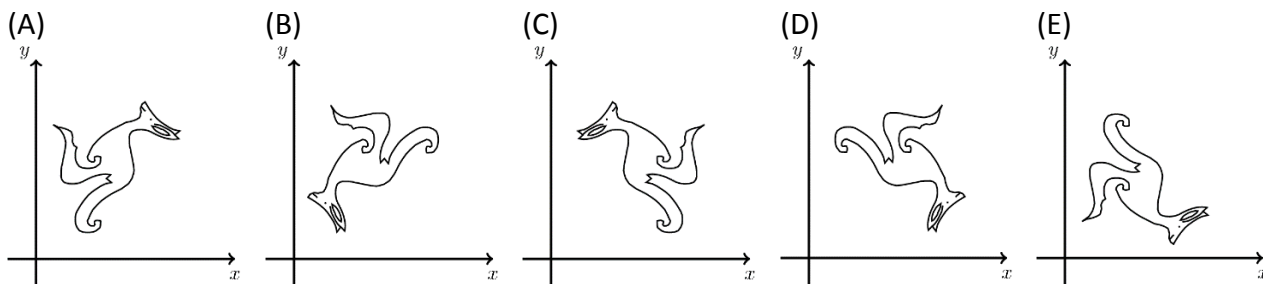
4 points

11.

A set of points forms a picture of a kangaroo in the xy -plane as shown.

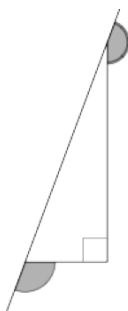


For each point the x and y coordinates are swapped. What is the result?



12.

What is the sum of the shaded angles in the figure?



(A) 150°

(B) 180°

(C) 270°

(D) 320°

(E) 360°



13.

What is the smallest number of planes that are needed to enclose a bounded part in three-dimensional space?

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

14.

As a child Lucas developed his own style of marking negative numbers. In descending order, he wrote

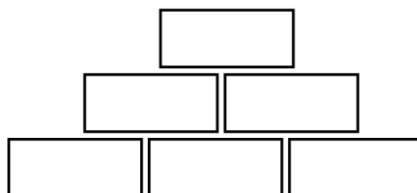
3, 2, 1, 0, 00, 000, 0000, ...

What is the result of the calculation $000 + 0000$ in his system?

- (A) 1 (B) 00000 (C) 000000 (D) 0000000 (E) 00000000

15.

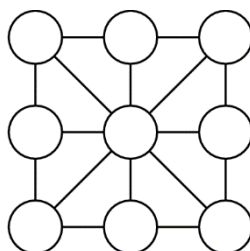
In this pyramid of numbers each upper field is the product of the two fields directly underneath. Which of the following numbers **cannot** appear in the top field, if the three bottom fields only contain natural numbers bigger than 1?



- (A) 36 (B) 42 (C) 56 (D) 90 (E) 220

16.

Diana wants to write nine integers into the circles on the diagram so that, for the small triangles whose vertices are joined by segments, the sums of the numbers in their vertices are identical. What is the largest number of different integers she can use?



- (A) 1 (B) 2 (C) 3 (D) 5 (E) 8



17.

For positive integers a, b, c, d it holds

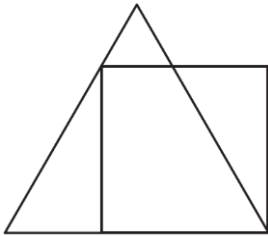
$$a + 2 = b - 2 = c \cdot 2 = d : 2.$$

Which of a, b, c, d is the greatest?

- (A) a (B) b (C) c (D) d (E) not enough information

18.

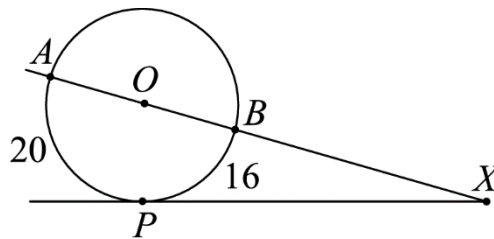
The perimeter of the square in the figure equals 4. What is the perimeter of the equilateral triangle?



- (A) 4 (B) $3 + \sqrt{3}$ (C) 3 (D) $3 + \sqrt{2}$ (E) $4 + \sqrt{3}$

19.

The arcs AP and BP have lengths 20 and 16 as in the figure. How large is the angle AXP ?



- (A) 30° (B) 24° (C) 18° (D) 15° (E) 10°

20.

On the Island of Knights and Knaves every citizen is either a Knight (who always speaks the truth) or a Knave (who always lies). During your travels on the island you meet 7 people sitting around a bonfire. They all tell you "I'm sitting between two Knaves!" How many Knaves are there?

- (A) 3 (B) 4 (C) 5 (D) 6 (E) not enough information



26.

A cube is dissected into six pyramids by connecting a given point in the interior of the cube with each vertex of the cube. The volumes of five of these pyramids are 2, 5, 10, 11 and 14. What is the volume of the sixth pyramid?

- (A) 1 (B) 4 (C) 6 (D) 9 (E) 12

27.

A quadrilateral contains an inscribed circle (i.e. a circle tangent to the four sides of the quadrilateral). The ratio of the perimeter of the quadrilateral to that of the circle equals 4:3. Then the ratio of the area of the quadrilateral to that of the circle equals

- (A) $4 : \pi$ (B) $3\sqrt{2} : \pi$ (C) $16 : 9$ (D) $\pi : 3$ (E) $4 : 3$

28.

At a conference, the 2016 participants are registered from P1 to P2016. Each participant from P1 to P2015 shook hands with exactly the same number of participants as their registration number. How many hands did P2016 shake?

- (A) 1 (B) 504 (C) 678 (D) 1008 (E) 2015

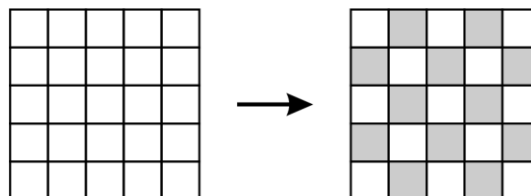
29.

The positive integer N has exactly six distinct (positive) divisors including 1 and N . The product of five of these is 648. Which one of the following is the sixth divisor of N ?

- (A) 4 (B) 8 (C) 9 (D) 12 (E) 24

30.

Consider a square divided into 25 cells. Initially all its cells are white. In each move it is allowed to change the colour of any three consecutive cells in a row or in a column to the opposite colour (i.e. white cells become black and black ones become white). What is the smallest possible number of moves needed to obtain the chessboard colouring shown in the figure?



- (A) less than 10 (B) 10 (C) 12 (D) over 12 (E) it is impossible to do