

## WereldWijde WiskundeWedstrijd

WWW.W4KANGOEROE.NL

# W4Kangoeroe



Good luck and most of  
all have fun !

© Stichting Wiskunde Kangoeroe



calculators are not  
allowed



you may use  
75 minutes



only a pencil, an  
eraser and scribbling  
paper are allowed



results and prizes will  
arrive at school at  
the end of May



answers will be posted  
on the website about  
March 29<sup>th</sup>

wizEXPERT  
WO students  
HBO students

zwijse n

Breng leren tot leven  
www.zwijsen.nl



www.e-nemo.nl



www.education.ti.com



www.smart.be



www.schoolsupport.nl

ID Premiums Relatiegeschenken b.v.  
Relatiegeschenken & Promotieartikelen  
www.idpremiums.nl



www.mathplay.eu



www.ru.nl

platform  
wiskunde nederland  
www.platformwiskunde.nl



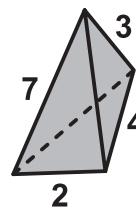
www.museumboerhaave.nl



10. With which digit does the product  $(5^5 + 1)(5^{10} + 1)(5^{15} + 1)$  end?

- A. 0                      B. 1                      C. 3                      D. 5                      E. 6

11. A triangular pyramid has six edges.  
The lengths of the edges are integers.  
The lengths of four of these edges are given in the figure alongside.



What is the sum of the lengths of the remaining two edges?

- A. 9                      B. 10                      C. 11                      D. 12                      E. 13

12. For any positive integer  $n$ ,  $n!$  is the product of the integers 1 up to  $n$ .  
For example  $4! = 4 \cdot 3 \cdot 2 \cdot 1 = 24$ . Of the number  $g$ , we know that  $g! = 6! \cdot 7!$ .

What is the sum of the digits of the number  $g$ ?

- A. 1                      B. 2                      C. 4                      D. 8                      E. 9

13. A point  $A$  lies for every possible value of  $a$  on the graph of  $y = x^3 + 3x^2 + ax + 2a + 4$ .

What is the sum of the coordinates of point  $A$ ?

- A. 2                      B. 4                      C. 6                      D. 8                      E. 10

14. Given are five numbers  $a_1, a_2, a_3, a_4$  and  $a_5$ .  
The sum of these numbers is  $S$ .  
They are related by the formula  $a_k = k + S$  for  $k = 1, 2, 3, 4, 5$ .

What is the value of  $S$ ?

- A. -15                      B.  $-\frac{15}{4}$                       C.  $\frac{15}{4}$                       D. 15                      E. you can not know

15. How many pairs of integers  $m, n$  satisfy the inequality  $|2m - 2023| + |2n - m| \leq 1$ ?

- A. 0                      B. 1                      C. 2                      D. 3                      E. 4

16. There are 23 animals in a row.  
Each animal is either a kangaroo or a beaver.  
Each animal has at least one kangaroo as a neighbor.

What is the maximum number of beavers in this row?

- A. 7                      B. 8                      C. 10                      D. 11                      E. 12

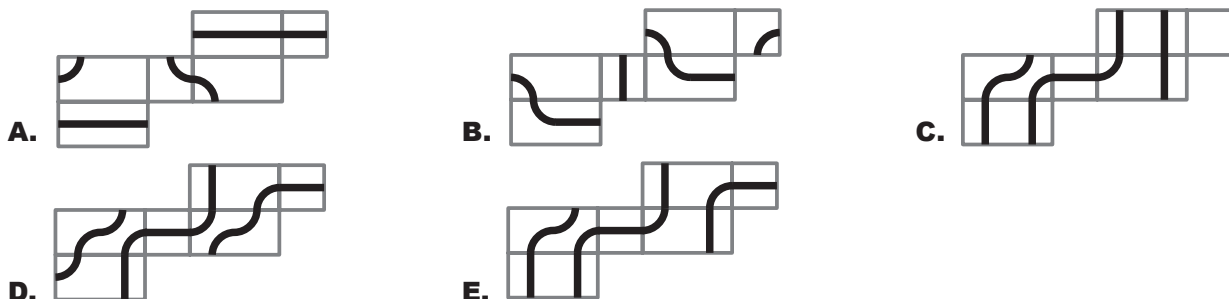
17. We can write  $5^{5^6}$  as  $n^n$  for a certain number  $n$ .

Which number is  $n$ ?

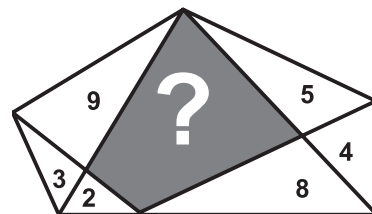
- A. 11                      B. 30                      C.  $5^5$                       D.  $5^6$                       E.  $5^{30}$

18. *Leon* has drawn some curves on the net of a rectangular beam.

Which net can he fold so that there is one closed curve on the beam?



19. A pentagon is divided into smaller parts as shown on the right. Their area is written in the triangles. Their area is written in the triangles.



What is the area of the grey area with the question mark?

- A. 15      B.  $\frac{31}{2}$       C. 16      D. 17      E. you can not know

20. How many numbers are divisors of  $2^{20}3^{23}$  but not of  $2^{10}3^{20}$ ?

- A. 13      B. 30      C. 273      D. 460      E. you can not know

21. Two functions  $f$  and  $g$  on  $\mathbb{R}$  satisfy the system of equations  $f(x) + 2g(1 - x) = x^2$  and  $f(1 - x) - g(x) = x^2$ .

Which function is  $f$ ?

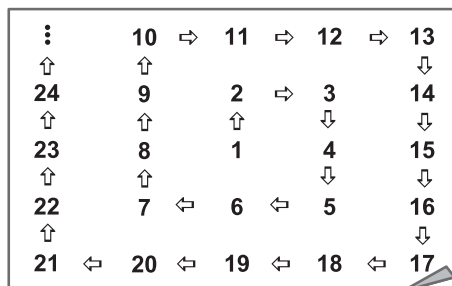
- A.  $f(x) = x^2 - \frac{4}{3}x + \frac{2}{3}$       B.  $f(x) = x^2 + \frac{4}{3}x + \frac{2}{3}$       C.  $f(x) = -x^2 + \frac{4}{3}x + \frac{2}{3}$   
 D.  $f(x) = x^2 - 4x + 5$       E. there is no such function

22. In a climbing tournament, 13 climbers compete in three categories. The score of each competitor is the product of their rankings in the three categories. So if someone finishes 4<sup>th</sup>, 3<sup>rd</sup> and 6<sup>th</sup> the score is  $4 \cdot 3 \cdot 6 = 72$ . Hannah becomes 1<sup>st</sup> in two categories.

At most, how many climbers can have a lower score than Hannah?

- A. 1      B. 2      C. 3      D. 4      E. 5

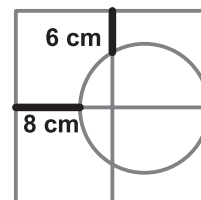
23. Consecutive numbers are written down in a spiral as below, starting with 1.



If we continue the pattern, in what shape will the numbers 625, 626 and 627 appear?

- A. 625      B. 625 ⇒ 626 ⇒ 627      C. 625 ⇒ 626 ⇒ 627  
 D. 625 ⇒ 626      E. 627

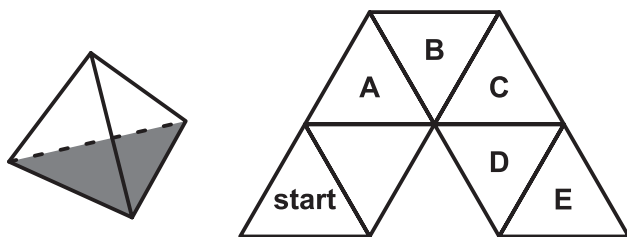
24. The large square is divided into four smaller squares. The circle touches the right side of the large square at its midpoint.



How many cm is the side length of the large square?

- A. 18      B. 20      C. 24      D. 28      E. 30

25. In the regular tetrahedron below, one face is coloured grey. The tetrahedron is placed with the grey face on the board to the right on the triangle with START. The tetrahedron is rolled over the board by rotating the tetrahedron over an edge



On which triangle will the tetrahedron stand for the first time again on its grey face?

- A. A      B. B      C. C      D. D      E. E

26. Because of an ink blot, part of the 5<sup>th</sup>-degree polynomial cannot be seen.

$$x^5 - 11x^4 + \text{[ink blot]} - 7$$

It is known that all the roots of this polynomial are integers.

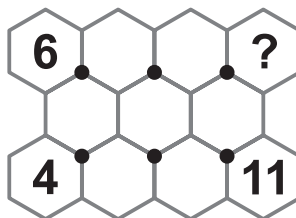
What is the highest power of  $x - 1$  that divides the polynomial?

- A.  $(x - 1)^1$       B.  $(x - 1)^2$       C.  $(x - 1)^3$       D.  $(x - 1)^4$       E.  $(x - 1)^5$

27. What is the greatest common divisor of all numbers of the form  $n^3(n + 1)^3(n + 2)^3(n + 3)^3(n + 4)^3$ , where  $n$  is a positive integer?

- A.  $2^93^3$       B.  $2^63^35^3$       C.  $2^83^25^3$       D.  $2^83^35^3$       E.  $2^93^35^3$

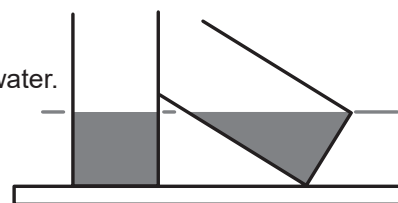
28. In the hexagons, fill in all the numbers 1 to 11. Around each black point the sum of the numbers should be the same. Three numbers are already written.



Which number will be written in the hexagon with the question mark?

- A. 1      B. 3      C. 5      D. 7      E. 9

29. Two identical cylinders contain the same amount of water. One of the cylinders is standing straight, the other is leaning against it. The bottom of the right cylinder is just barely completely covered with water. The water level is the same in both cylinders, as shown here. The bottom of both cylinders has an area of  $3\pi$  m<sup>2</sup>.



How many m<sup>3</sup> of water does each of the cylinders contain?

- A.  $\frac{3\pi}{4}$       B.  $3\sqrt{3}\pi$       C.  $6\pi$       D.  $9\pi$       E. you can not know

30. The product of six consecutive numbers is a 12-digit number of the form

$$abbcdcdabb$$

where the digits  $a$ ,  $b$ ,  $c$  and  $d$  are themselves consecutive in some order.

Which digit is  $d$ ?

- A. 1      B. 2      C. 3      D. 4      E. 5