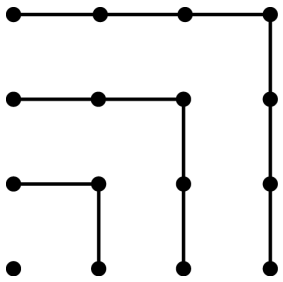
MATHEMATICS

LEVEL: 11 – 12
(Β΄ - Γ΄ Λυκείου)

10:00 – 11:00 , 20 March 2010

3 points



1. Using the picture to the right we can observe that
1+3+5+7 = 4 x 4.
What is the value of 1 + 3 + 5 + 7 + 9 + 11 + 13 + 15 + 17?

A) 14 x 14 B) 9 x 9 C) 4 x 4 x 4 D) 16 x 16 E) 7 x 9

2. If both rows have the same sum, what is the value of * ?

1	2	3	4	5	6	7	8	9	10	2010
11	12	13	14	15	16	17	18	19	20	*

A) 1010 B) 1020 C) 1910 D) 1990 E) 2000

3. Two empty cubes have base areas of 1 dm^2 and 4 dm^2 respectively. We want to fill the bigger cube with spring water which we fetch using the smaller cube. How many times do we have to go to the spring?

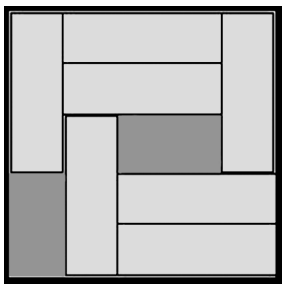
A) 2 times B) 4 times C) 6 times D) 8 times E) 16 times

4. How many four-digit numbers exist with only odd digits are divisible by five?

A) 900 B) 625 C) 250 D) 125 E) 100

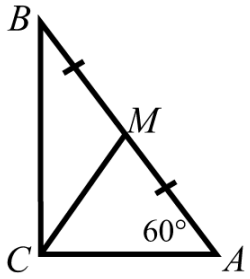
5. The director of a company said: *"Each of our employees is at least 25 years old."* Later, it turned out, that he was not right. It means, that

A) all employees in the company are exactly 25 years old
B) all employees in the company are more than 26 years old
C) none of the employees in the company is 25 years old yet
D) some employee in the company is less than 25 years old
E) some employee in the company is exactly 26 years old



6. There are seven 3×1 bars in the box of size 5cm x 5cm as shown in the figure. We wish to slide some bars in the box so there will be room for one more bar. At least how many bars must be moved in order to achieve this?

A) 2 B) 3 C) 4 D) 5 E) It is impossible



7. The triangle ABC is right-angled, M is the midpoint of the hypotenuse AB and $\angle A = 60°$. What is the measure of $\angle BMC = ?$

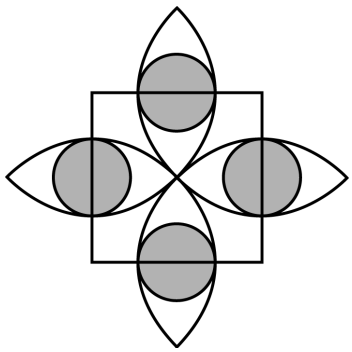
A) 105° B) 108° C) 110° D) 120° E) 125°

8. Choose a number which could be equal to a number of edges of some prism.

A) 100 B) 200 C) 2008 D) 2009 E) 2010

9. How many 2-digit numbers xy have digits x and y with the property $(x-3)^2 + (y-2)^2 = 0$?

A) 1 B) 2 C) 6 D) 32 E) none



10. In the picture, the side of the square has length 2, the semicircles go through the center of the square and have centers on the vertices of the square. The shaded circles have centers on the sides of the square and are tangent to the semicircles. What is the area of the shaded region?

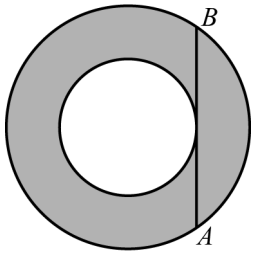
A) $4(3-2\sqrt{2})\pi$ B) $\sqrt{2}\,\pi$ C) $\frac{\sqrt{3}}{4}\pi$ D) π E) $\frac{1}{4}\pi$

4 points

11. The three numbers $\sqrt{7}$, $\sqrt[3]{7}$, $\sqrt[6]{7}$ are consecutive terms of a geometric progression. The next term of the progression is

A) $\sqrt[9]{7}$ B) $\sqrt[12]{7}$ C) $\sqrt[5]{7}$ D) $\sqrt[10]{7}$ E) 1

12. The chord AB is tangent to the smaller of the concentric circles. If $AB = 16$, what is the area of the shaded region?

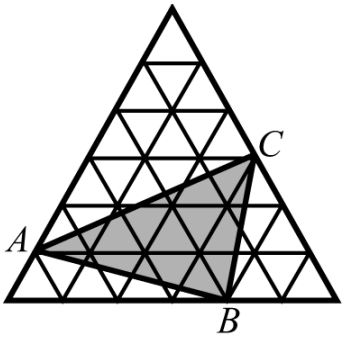


A) 32π B) 63π C) 64π D) $32\pi^2$ E) it depends on radii of the circles.

13. The integer numbers x and y satisfy $2x = 5y$. Only one of the following can be $x + y$. Which is it?

A) 2011 B) 2010 C) 2009 D) 2008 E) 2007

14. The big equilateral triangle consists of 36 smaller equilateral triangles with area 1 cm^2 each. Find the area of ΔABC.



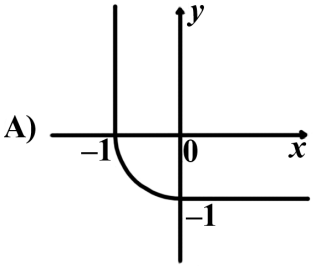
A) 11 cm^2 B) 12 cm^2 C) 13 cm^2 D) 14 cm^2 E) 15 cm^2

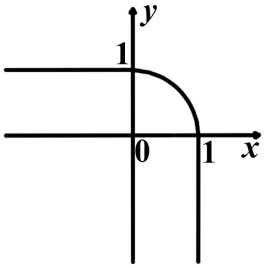
15. There are balls of three colours in a bag: blue, green and red (there is at least one from each colour). We know that in case we are blindfolded and draw five balls randomly, there will definitely be at least two red ones and at least three will be of the same colour. How many blue balls are there in the bag?

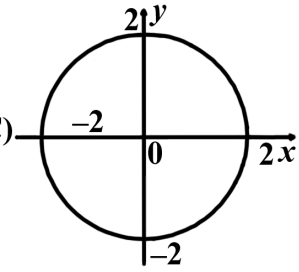
A) 1 B) 2 C) 3 D) 4

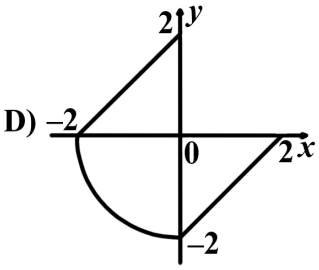
E) It is impossible to find out without more detailed information

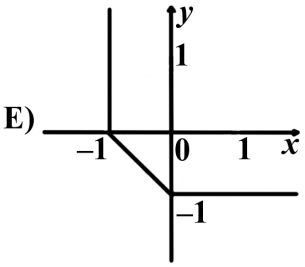
16. Which of these graphs corresponds to the set of all the solutions of the equation $(x - |x|)^2 + (y - |y|)^2 = 4$?

A) 

B) 

C) 

D) 

E) 

17. How many right-angled triangles can be formed by joining three vertices of a given regular 14-gon?

A) 42 B) 84 C) 88 D) 98 E) 168

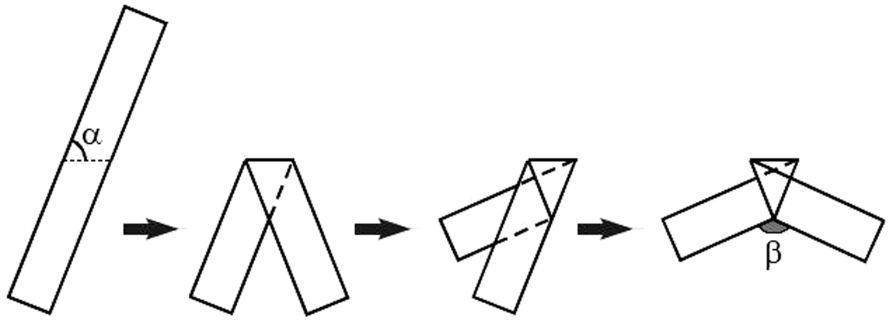
18. Here are seven numbers: –9 ; 0 ; –5 ; 5 ; –4 ; –1 ; –3. We arranged six of them in groups of two so that the sum in each group is the same. Which number remains?

A) 5 B) 0 C) -3 D) -4 E) -5

19. The lengths of the sides of a triangle in centimeters are the natural numbers 13, x and y. Find the perimeter if $xy = 105$.

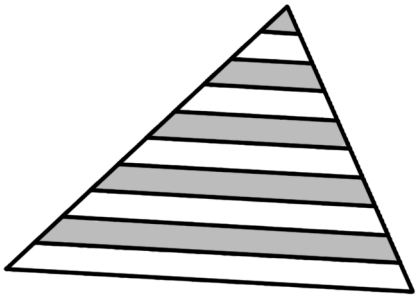
A) 35 B) 39 C) 51 D) 69 E) 119

20. The paper ribbon is folded three times as shown. Find β if $\alpha = 70^\circ$.



A) 140º B) 130º C) 120º D) 110º E) 100º

5 points



21. Lines parallel to the base divide each of the other two sides of the triangle shown into 10 equal segments.
What percentage of the triangle is the grey area?

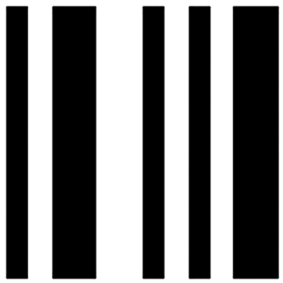
A) 42,5% B) 45% C) 46% D) 47,5% E) 50%

22. 100 people took part in a race, no two of which arrived at the same time. Each one was asked, in which place they had finished and everybody answered with a number from 1 to 100. The sum of all answers equals to 4000. What is the smallest number of false answers the runners could have given?

A) 9 B) 10 C) 11 D) 12 E) 13

23. We throw a dice three times. If the number obtained on the third throw is equal to the sum of the numbers we obtained on the first two, what is the probability that a 2 appeared at least once?

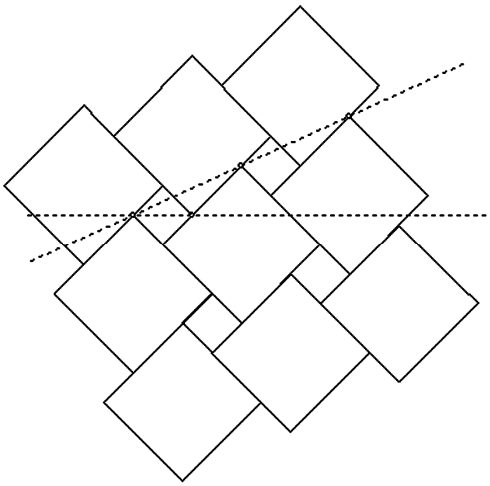
A) 1/6 B) 91/216 C) 1/2 D) 8/15 E) 7/12



24. A bar-code of the type shown is composed of alternate strips of black and white, always beginning and ending with a black strip. Each strip (of either colour) has the width 1 or 2, and the total width of the bar code is 12. How many different codes are possible, always reading from left to right?

A) 24 B) 132 C) 66 D) 12 E) 116

25. A wall is tiled with two sizes of square tile as shown. The larger tile has sides of length a, and the smaller of length b. The dashed lines (horizontal and slanted) form an angle of 30°. Determine the ratio a:b.



A) $(2 \cdot \sqrt{3}) : 1$ B) $(2 + \sqrt{3}) : 1$ C) $(3 + \sqrt{2}) : 1$ D) $(3 \cdot \sqrt{2}) : 1$ E) 2 : 1

26. The natural numbers from 1 to 10 are each written on the blackboard 10 times. The students in the class then play the following game: a student deletes 2 of the numbers and instead of them writes down on the blackboard their sum decreased by 1; after that another student deletes 2 of the numbers and instead of them writes down on the blackboard their sum decreased by 1; and so on. The game continues until only one number remains on the blackboard. The remaining number is:

A) less than 440 B) 451 C) 460 D) 488 E) more than 500

27. The value of the expression $\dfrac{(2+3)\left(2^2+3^2\right)\ldots\left(2^{1024}+3^{1024}\right)\left(2^{2048}+3^{2048}\right)+2^{4096}}{3^{2048}}$ equals:

A) 2^{2048} B) 2^{4096} C) 3^{2048} D) 3^{4096} E) $3^{2048} + 2^{2048}$

28. The square root $\sqrt{0,\underbrace{44\ldots4}_{100\ times}}$ is written as an infinite decimal. What is the 100^{th} digit after the decimal point?

A) 1 B) 2 C) 3 D) 4 E) 6

29. $f : R_+^{\neg} \to R,\ \forall x > 0 \ :\ 2f(x) + 3f\left(\dfrac{2010}{x}\right) = 5x$

$f(6) = \ldots$

A) 993 B) 1 C) 2009 D) 1013 E) 923

30. Points P and Q are chosen, one on each leg of a right-angled triangle. The length of the sides are a and b respectible. Let K and H be the feet of P and Q respectively on the hypotenuse. Find the least possible value of the sum $KP+PQ+QH$.

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