Regional winter Tournament “Saint Nicholas Thaumaturge” - Bourgas

Area: Mathematics and Information Technologies
Style of the Competition:

- Test exam with multiple-choice and free answers and a problem for Math and test exam with multiple-choice answers and practice work (with Microsoft Office) for IT;
- Individual and Team Competition.
- Financial conditions: fully-charged.
- The competition has a restricted time limit (4 hours) for solving the tasks.
- Presence needed (attendance of the participants at the appointed time and place).
- Method of evaluation: grading system, offered by the author of the theme.
- The Competition Jury consists of three members in each age group. One of them is the author of the theme for this age group. He is chosen by the Organizing committee one month before the Tournament and receives instructions about the form and the level of difficulty. The Jury is chosen by the teachers in Math and IT in the area, who do not teach in this age group.
- The Organizing committee consists of 8-10 members, who choose the date of the tournament (before December 6) every year, the members of the Jury in every age group and the authors of the themes. It organizes and holds the tournament, prepares the certificates for all participants and awards those who win on December, 6-th – the feast of the town in the aula of The Free University of Bourgas.
- The competition is announced in regional newspapers, websites and invitations are sent to all the schools in the area and Regional inspectorates of education in near areas.
- The results of the tournament are announced at the day, at which the prizes are given (December 6) and, after that, are published in the Internet. Every school receives a verification of its’ students’ performance. During 2005 a book of mathematical and IT problems, which comprises all the themes and their solutions, is issued.
- Math: 10 age groups: 3-12 classes, IT: 4 age groups: 5-6 class, 7-8 class, 9-10 class, 11-12 class.
- Team and individual awards.
- All participants are given a certificate, the winners – a diploma.
- The awards given consist of a diploma and money. The teams awarded receive flags. There is a 100-Euro prize for the most original solution, which is awarded be the Jury.

Target Group: The tournament is regional and is opened for all students from 3 to 12 classes from area of Bourgas and near areas.
Age of Participants: from 9 to 19 years
School level of Participants: Primary**,** Secondary schools, High schools.
Number of Participants and number of the editions of the competition during the last 3 years: 940**,** 980, 1010 participants in 3 editions
History of Competition: It was firstly organized in 1999 by the Union of the Bulgarian Mathematicians (UBM) and Regional Inspectorate of education in Bourgas. UBM is the principal organizer also of the subsequent editions of the event.
Financial Basis of the competition: Union of the Bulgarian Mathematicians supports the event financially.
Competition Problems:

The test for 6th grade, 2006

1. The difference of the smallest and the largest of the numbers: 0,53; 0,509; 0,39; 0,4 and 0.3999 is:
   a) -0,109 b) -0,119 c) -0,14 d) 0,11

2. How many different factors are there in the product of 2.2.2.3.3
a) 10 b) 12 c) 14 d) 16

3. The sum of the numerator and the dominator of the simplest form of a fraction, equal to 87,5% is:
a) 8 b) 10 c) 19 d) 17

4. If 7% of 12 equals of a, then a equals:
a) 22 b) 20 c) 19 d) 21

5. The value of the expression A = |x-y+z|, when x=3, y=-2 and z=-6, is
a) 1 b) -1 c) 5 d)11

6. In the sequence of numbers 2,71; 2,8; 2,88; 2,95; 3,01; ……….. determine the number which has to be added to 2.71 to get the seventh number in this sequence.
a) 0,39 b) 3,9 c) 0,42 d) 4,2

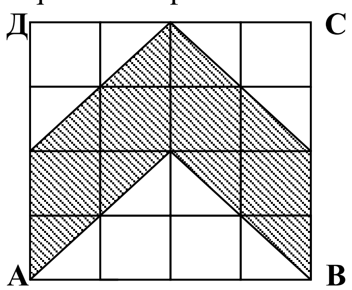
7. The smallest positive integer n, for which it is true that $\frac{2}{5} < \frac{n-5}{35} < \frac{6}{7}$, is:

a) 9 b) 20 c) 8 d) 15

8. The solution x of the equation 10,8 – 6,8 (x + 5, 4) = 8 is:

9. The reciprocal of the expression: $A = \left(1-\frac{1}{10}\right)\left(1-\frac{1}{11}\right)\left(1-\frac{1}{12}\right)..........\left(1-\frac{1}{27}\right)$ is:

10. Looking at the figure, the square ABCD is divided into 16 congruent squares. The area of the shaded figure is 128 sq. cm. The perimeter of the square ABCD in centimeters is:



11. The value of the expression $\dfrac{10}{4-\dfrac{2}{1+\dfrac{1}{3}}}$ is:

a) 3 b) $\frac{1}{2}$ C) 8 D) 4

12. The distance between the images of the numbers x and y, whose values equal to the values of the expression $x = \left(1\frac{1}{4}-2\right)+\left(-3-|-1|\right)$ and $y = \dfrac{2+\left(-2+\dfrac{9}{4}\right)}{|-9|}$ is:

a) $-4\frac{1}{2}$ b) -5 c) 5 d) $4\frac{1}{2}$

13. If the number ab4 is divisible by 3, the number $\overline{4ab}$ is divisible by 4, and the number $\overline{b4a}$ is divisible by 5, then b equals:
a) 3 b) 5 c) 9 d) 6

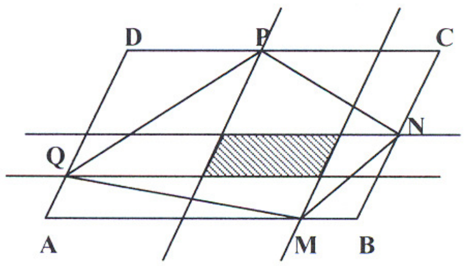
14. The smallest three-digit number, coded with ЛЕД, which is a solution of the rebus ЛЕД + ЛЕД = РЕКА is:

15. A motor boat travels the distance of 30 km between two harbours three times faster downstream than the time it takes to travel upstream. How many hours will it take for the raft to arrive from one of the harbours to the other, if the velocity of the motor boat in still water is 15 km/h?

16. If we increase the numerator of a fraction by 12%, and decrease the denominator by 30%, then the fraction will be greater by:
a) 18% b) 60% c) 42% d) 50%

17. Five brothers received an inheritance. At the partition, the first one got 100 gold pieces and one-sixth of the remainder. The second one got 200 gold pieces and one sixth of the remainder. The third one got 300 gold pieces and one-sixth of the remainder. The fourth one got 400 gold pieces and one-sixth of the remainder. The fifth one got the 500 gold pieces that were left. How many gold pieces altogether were there that the brothers inherited?
a) 2 500 b) 1 800 c) 1 250 d) 2 350

18. On the sides of the parallelogram ABCD with an area of 60 sq. cm. there are points M, N, P, and Q. Straight lines are constructed through the points, parallel to the sides of the parallelogram, as shown in the figure. What is the area of the quadrilateral MNPQ in square centimeters, if the shaded area is 20 sq. cm.?



a) b) 35 c) 40 d) 45

19. For Nick's birthday, his mother made cups with a mixture of peanuts and almonds. Nick hurried to grab some of the peanuts which he loved. To his mother's complaints, he answered, "Don't worry—60% of all the nuts are peanuts, I eat only peanuts and when I finish, the peanuts will be 50% of all the nuts." What portion of all the nuts will Nick eat?
a) $\frac{1}{10}$ b) $\frac{1}{5}$ c) $\frac{1}{4}$ d) $\frac{1}{3}$

20. This year on his birthday, Mr. Petrov noticed that the number representing his age has interesting properties: if you divide this number by 3, you get a remainder of 2, if you divide it by 5, you get a remainder of 3, and if you divide it by 7, you get a remainder of 5. How old is

Mr. Petrov's grandson, if the product of both of their ages is an exact second power of a natural number?

PROBLEM: A parallelogram ABCD is given. Point M is on the side CD, so that CM = $\frac{2}{3}$CD, also the point P is in the middle of the line segment AM.

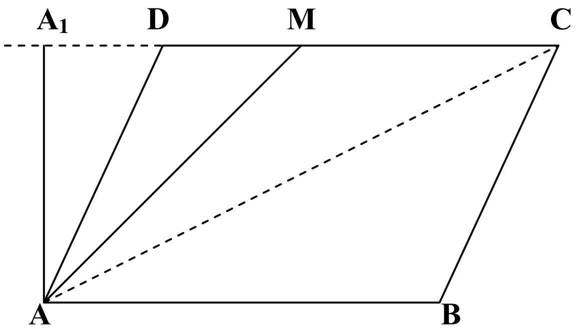
a) Prove that $S_{AMD} = \frac{1}{6} S_{ABCD}$

b) What part of the area of the parallelogram is the area of the triangle BCP?

TEST ANSWER KEY

1. C	**2. B**	**3. C**	**4. D**	**5. A**	**6. A**	**7. B**	**8. $(-2\frac{34}{35})$**	**9. 3**	**10. 64**
11. D	**12. C**	**13. D**	**14. 627**	**15. 4**	**16. B**	**17. A**	**18. C**	**19. B**	**20. 17**

Solution to the problem



a) We construct a diagonal AC

$$\Rightarrow S_{\triangle ABC} = S_{\triangle ACD} = \frac{1}{2} S_{\triangle ABCD}$$

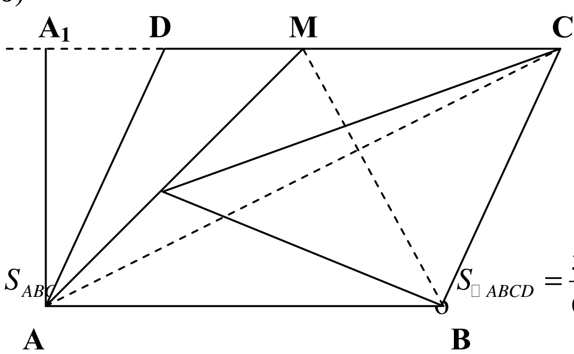
We construct AA_1 as an altitude $\triangle ACD$

$$S_{\triangle ACD} = \frac{CD.AA_1}{2} \quad \text{and} \quad S_{\triangle AMD} = \frac{DM.AA_1}{2}$$

but $DM = DC - MC = DC - \frac{2}{3}DC = \frac{1}{3}DC$

$$\Rightarrow S_{\triangle AMD} = \frac{\frac{1}{3}DC.AA_1}{2} = \frac{1}{3}.\frac{DC.AA_1}{2} = \frac{1}{3}S_{\triangle ACD} = \frac{1}{3}.\frac{1}{2}S_{\triangle ABCD} = \frac{1}{6}S_{\triangle ABCD}$$

б)



S_{AB} $S_{\triangle ABCD} = \frac{5}{6} S_{\triangle ABCD}$

$$S_{\triangle BCP} = S_{ABCM} - \left(S_{\triangle ABP} + S_{\triangle CMP}\right)$$

$$S_{\triangle AMC} = \frac{CM.AA_1}{2} = \frac{\frac{2}{3}DC.AA_1}{2} = \frac{2}{3}.\frac{DC.AA_1}{2} = \frac{2}{3}S_{\triangle ACD} = \frac{2}{3}.\frac{1}{2}S_{\triangle ABCD} = \frac{1}{3}S_{\triangle ABCD}$$

But point P is the midpoint of AM $\Rightarrow S_{\triangle PMC} = \frac{1}{2}.S_{\triangle AMC} = \frac{1}{2}.\frac{1}{3}S_{\triangle ABCD} = \frac{1}{6}S_{\triangle ABCD}$

Let us label the altitude to the side AB in the parallelogram with ***h*** $\Rightarrow S_{\triangle ABM} = \frac{AB.h}{2} = \frac{1}{2}.S_{\triangle ABCD}$

Again from the fact that P is the midpoint of $AM \Rightarrow S_{\triangle ABP} = \frac{1}{2}.S_{\triangle ABM} = \frac{1}{2}.\frac{1}{2}S_{\triangle ABCD} = \frac{1}{4}S_{\triangle ABCD}$

$$\Rightarrow S_{\triangle BCP} = \frac{5}{6}S_{\triangle ABCD} - \left(\frac{1}{6}S_{\triangle ABCD} + \frac{1}{4}S_{\triangle ABCD}\right) = \frac{5}{12}S_{\triangle ABCD}$$

Contact Address of the Organizers: Kosta Papazov, 42, “Hristo Botev” Street, Bourgas, Bulgaria.
E-mail: kpapazov@abv.bg