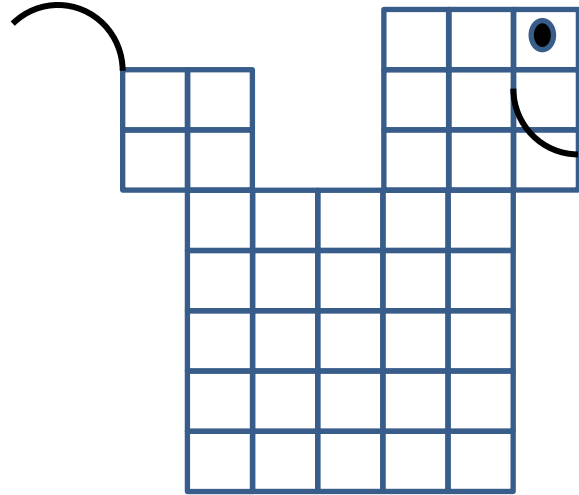


# ***The 38<sup>th</sup> Contest***



*Mathematics Educators of Greater St. Louis  
and St. Louis Community College  
at Florissant Valley present*

# **Excellence In Mathematics**

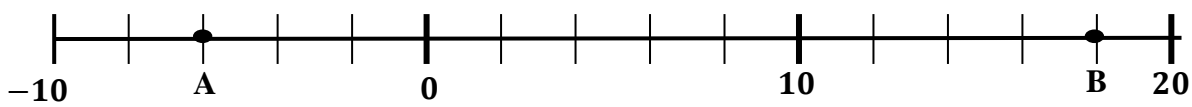
**Eighth Grade Test**  
***Thirty-Eighth Annual Mathematics Contest***  
**March 19, 2016**

- I. Do not open the test booklet or begin work until instructed to do so by your proctor.**
- II. You have 75 minutes to take this test.**
- III. Listen carefully as the proctor explains where to write your name, the name of your school, your grade level, and how to mark your answers.
- IV. You may use a calculator. You only need a four-function calculator, but you may use any calculator approved for the SAT test, which includes most graphing calculators except the TI-92 and TI-Voyager. If you are unsure whether your calculator is allowed, check with your proctor
- V. Your score will be the number of questions you answer correctly. In the event of ties, Problem #40 will be used as a tie-breaker. If ties still remain, Problem #39 will be used as a tie-breaker and so on until all ties are broken.

*Eighth Grade Test - Excellence in Mathematics Contest – 2016*

- The perimeter of a rectangle is 36 cm. If the length of one side of the rectangle is 12 cm, what is the area of the rectangle?  
A.  $30 \text{ cm}^2$     B.  $36 \text{ cm}^2$     C.  $48 \text{ cm}^2$     D.  $72 \text{ cm}^2$     E.  $144 \text{ cm}^2$
- Which one of the following five numbers can be written as the sum of three distinct non-zero square numbers?  
A. 34    B. 38    C. 44    D. 47    E. 55
- Consider a pizza to be a cylinder of height **a** and radius **z**. What is the volume of this pizza?  
A.  $2 \cdot \text{Pi} \cdot z \cdot a$     B.  $\text{Pi} \cdot a^2 \cdot z$     C.  $4 \cdot \text{Pi} \cdot z^2 \cdot a$   
D.  $\text{Pi} \cdot z \cdot a \cdot z \cdot z$     E.  $\text{Pi} \cdot z \cdot z \cdot a$
- Determine the smallest positive difference between any pair of these numbers.  
**0.9            0.79            1.12            1.043            0.9714**  
A. 0.11    B. 0.071    C. 0.077    D. 0.0714    E. 0.0716
- On January 13, 2016, the NFL gave Stan Kroenke permission to move the St. Louis Rams to Inglewood, California, about 1860 miles away. Starting at 8 AM on January 13, St. Louis Rams fans ran Stan Kroenke out of town at an average rate of 9 miles per hour, 12 hours a day – from 8 AM to 8 PM. ☺  
Using this data, on what day did Stan Kroenke arrive in Inglewood?  
A. Jan. 29    B. Jan. 30    C. Jan. 31    D. Feb. 1    E. Feb. 2
- In the regular hexagon ABCDEF, what is the measure of angle BAC?  
A.  $30^\circ$     B.  $45^\circ$     C.  $60^\circ$     D.  $90^\circ$     E.  $150^\circ$
- What is the sum of all of the numbers in both of these finite arithmetic sequences?  
**2; 12; 22;.....; 92; 102    and    8; 18; 28;.....; 98; 108**  
A. 1100    B. 1120    C. 1210    D. 1220    E. 1320
- With \$5.25 in nickels and quarters, you have twice as many nickels as quarters.  
What is the number of coins that you have?  
A. 15    B. 30    C. 36    D. 45    E. 48
- In a 48-minute basketball game, the Lakers had the ball  $\frac{5}{8}$  of the time. When the Lakers had the ball, their point-guard Kobe had the ball  $\frac{1}{3}$  of the time. For what per cent of the game did Kobe have the ball?  
Round to the nearest per cent.  
A. 17%    B. 20%    C. 21%    D. 25%    E. 33%

*Eighth Grade Test - Excellence in Mathematics Contest – 2016*

10. The Kansas City Federal Reserve Money Museum Bank has a display of 40 million dollars in stacks of \$100 bills. It costs the US Mint 6.2 cents to make one bill of any US denomination. How much did it cost to make the bills in this display of 40 million dollars?
- A. \$248      B. \$2,480      C. \$24,800      D. \$248,000      E. \$2,480,000
11. What is the area of a triangle with side lengths of 15 cm, 20 cm, and 25 cm?
- A.  $60 \text{ cm}^2$       B.  $150 \text{ cm}^2$       C.  $187.5 \text{ cm}^2$   
D.  $250 \text{ cm}^2$       E. Cannot be determined from the given information
12. For whole numbers A and B,  $3^A + 5^B = 74,674$ . What is the sum  $A + B$ ?
- A. 12      B. 13      C. 14      D. 15      E. 16
13. ABC is an equilateral triangle of side-length 8 cm. An irregular hexagon is formed by cutting equilateral triangles of side-length 1 cm from vertex A, of side-length 2 cm from vertex B, and of side-length 3 cm from vertex C. What is the perimeter of the hexagon?
- A. 12 cm      B. 15 cm      C. 18 cm      D. 21 cm      E. 24 cm
14. Horse races are measured in furlongs. A furlong is  $\frac{1}{8}$  of a mile. How much longer is a 1.5 mile horse race than a 7 furlong race?
- A.  $\frac{1}{2}$  mile      B.  $\frac{1}{8}$  mile      C.  $\frac{3}{8}$  mile      D.  $\frac{5}{8}$  mile      E.  $\frac{1}{4}$  mile
15. This number line from  $-10$  to  $20$  has been divided into equal parts. What is the sum  $A + B$ ?
- 
- A. 8      B. 10      C. 12      D. 13      E. 24
16. One of the unplanned effects of China's one-child policy was that in 2015 there were 33 million more males than females in China. With a 2015 population of China of 1.375 billion, what per cent of Chinese were male? Round to the nearest tenth of a per cent.
- A. 50.0%      B. 50.8%      C. 51.2%      D. 51.6%      E. 52.4%
17. While visiting grandma and grandpa for Christmas in the Upper Peninsula, grandma would call her husband, son, daughter-in-law, and granddaughter for dinner by calling her husband first or last and call the other three in any sequence. She called: her husband *Hon* or *Don*; her son *Rick*, *Rich*, or *Richard*; her daughter-in-law *Fran* or *Francine*; and her granddaughter *Suzanne* or *Zan*. In how many different ways could grandma call the four of them to dinner?
- A. 96      B. 144      C. 192      D. 288      E. 576
18. Marathon runner Ryan Hall retired in 2015. In 2011, Ryan ran the Boston Marathon in 2 hours, 4 minutes, and 58 seconds, the fastest marathon time ever for an American. A marathon is 26.22 miles long. What was Ryan's average time per mile? Round to the nearest second.
- A. 4 minutes, 41 seconds      B. 4 minutes, 45 seconds      C. 4 minutes, 46 seconds  
D. 4 minutes, 50 seconds      E. 4 minutes, 53 seconds

***Eighth Grade Test - Excellence in Mathematics Contest – 2016***

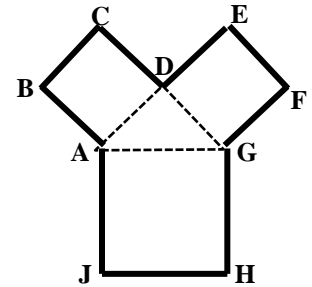
19. A three-dimensional shape is formed by placing a pyramid ABCDP on top of a cube on face ABCD. What is the total number of faces, edges, and vertices of this shape?

- A. 34      B. 35      C. 36      D. 40      E. 44

20. Rick’s family trip in April 2015 to Sarawak, Malaysia, was his first return since 1974. On this trip, the government mandated gasoline price was 1.95 Malaysian Ringgit per liter. If one US dollar equals 4.425 Ringgit and 1 liter equals 1.06 quarts, what was the price of gasoline in dollars per gallon? Round to the nearest cent.

- A. \$0.42      B. \$1.66      C. \$1.87      D. \$2.04      E. \$8.14

21. As shown, squares are mounted on the three sides of an isosceles right triangle. The area of square ABCD is 15 square centimeters. What is the area of the polygon ABCDEFGHJ? Round to the nearest tenth of a square centimeter.



- A. 52.5 cm<sup>2</sup>      B. 58.7 cm<sup>2</sup>      C. 62.3 cm<sup>2</sup>      D. 67.5 cm<sup>2</sup>      E. 75.0 cm<sup>2</sup>

22. X and Y are integers such that  $-4 \leq X \leq -2$  and  $2 \leq Y \leq 4$ . There is an ordered pair (X, Y) which maximizes the value of  $\frac{X+Y}{X-Y}$ . What is that value?

- A.  $-\frac{1}{3}$       B.  $\frac{1}{2}$       C.  $\frac{1}{7}$       D.  $\frac{1}{3}$       E.  $\frac{1}{5}$

23. The distance from the center of a clock to the tip of its minute hand is 8 cm. From 8:45 AM to 6:30 PM of the same day, how many centimeters does the tip of the minute hand move? Round to the nearest centimeter.

- A. 40 cm      B. 41 cm      C. 475 cm      D. 480 cm      E. 490 cm

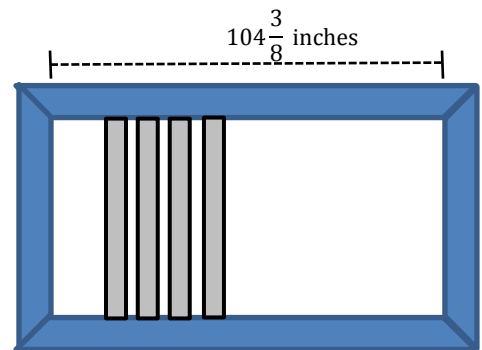
24. In 2016, the two digits in Wil’s age are the same as the two digits in Ruth’s age, but in reverse order. In 2023, Wil will be twice as old as Ruth will be in 2023. In 2016, what is the sum of the digits in Wil’s age?

- A. 7      B. 8      C. 9      D. 10      E. 11

25. If  $x = -5$ , what is the value of  $x^3 - x^2$ ?

- A. -150      B. -100      C. -5      D. 100      E. 150

26. Earl will attach narrow (grey) slats for the lower shelf of a table. As shown, the interior length between the boards that form the frame is  $104\frac{3}{8}$  inches. Each slat is  $1\frac{3}{4}$  inches wide and there is a gap of  $\frac{3}{8}$  inches between slats. The distance between the last slat and the frame at each end will be equal and be less than  $\frac{3}{4}$  inch.

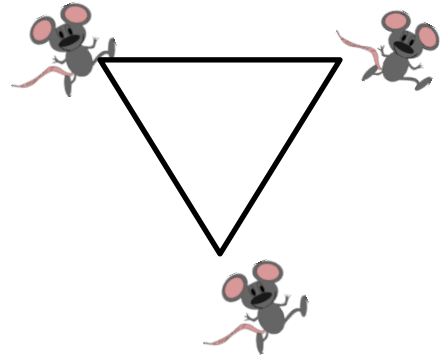


At each end, what is the distance in inches between the last slat and the frame?

- A. 1/8      B. 3/16      C. 1/4      D. 5/16      E. 7/16

*Eighth Grade Test - Excellence in Mathematics Contest – 2016*

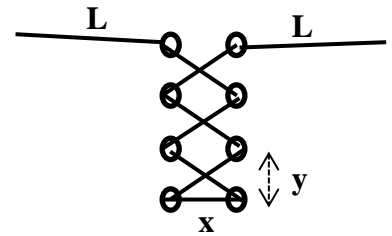
27. Three mice are at the three vertices of an equilateral triangle. At the same time, each mouse runs to an adjacent vertex. To determine which vertex to run to, each mouse flips a fair coin:
- If Heads, that mouse runs clockwise
  - If Tails, that mouse runs counter-clockwise.



After they do this once, what is the probability that there are NOT two mice at any one vertex?

- A. 1/8      B. 1/4      C. 1/2      D. 3/4      E. 1

28. The diagram depicts a *shoe-lace pattern* for a shoe with four pairs of eyelets.  $x$  and  $y$  are the horizontal and vertical distances between eyelets, as shown. The same amount  $L$  of lace is left at each end for tying.



Austin uses the same pattern for his shoes with six pairs of eyelets. When the lace is tightened,  $x = 3$  cm and  $y = 2$  cm. If Austin buys a shoelace of length 60 cm, calculate  $L$ , the length of each end left for tying. Round to the nearest tenth of a centimeter.

- A. 6.9 cm      B. 10.5 cm      C. 13.1 cm      D. 16.5 cm      E. 18.5 cm

29.  $4^{2016} + 8^{2016} = 2^M (1 + 2^N)$  What is the sum  $M + N$ ?

- A. 2016      B. 4032      C. 6048      D. 8064      E. 12,096

30. Among the 400 athletes in a college, every 3 months 100 of them are randomly selected for testing for illegal drugs. Therefore, in one year, any one athlete could be tested 0, 1, 2, 3, or 4 times. In one year, what is the probability that their track star Breanna is tested at least once? Round to the nearest per cent.

- A. 59%      B. 68%      C. 75%      D. 84%      E. 100%

31. On triangle ABC, points D and E are on sides AB and AC respectively such that DE is parallel to BC. The area of triangle ADE is twice the area of trapezoid BCED. In triangle ADE, the length of the altitude perpendicular to DE is 12 cm. In triangle ABC, what is the length of the altitude perpendicular to BC?

Round to the nearest tenth of a centimeter.

- A. 14.7 cm      B. 14.9 cm      C. 15.2 cm      D. 16.0 cm      E. 17.0 cm

*Eighth Grade Test - Excellence in Mathematics Contest – 2016*

32. In this multiplication problem, each letter represents a digit 0 through 9.  
Neither **A** nor **E** represent 0. Two different letters may represent the same digit.  
What does the sum  $A + B + C + D + E$  equal?

$$\begin{array}{r}
 \mathbf{A\ B\ C\ D\ E} \\
 \phantom{\mathbf{A\ B\ C\ D\ E}} \times \mathbf{4} \\
 \hline
 \mathbf{E\ D\ C\ B\ A}
 \end{array}$$

- A. 22      B. 23      C. 25      D. 27      E. 29
33. The length of each side of a right triangle is a whole number of meters. The lengths (in meters) of two of the three sides are consecutive whole numbers. If the perimeter equals 5700 m, what is its area?
- A. 98,820 m<sup>2</sup>    B. 99,500 m<sup>2</sup>    C. 102,850 m<sup>2</sup>    D. 104,200 m<sup>2</sup>    E. 105,450 m<sup>2</sup>

34. B and C are digits, possibly the same digit, in the 7-digit number: **1,68B,53C** .

For how many ordered pairs (B, C) is **1,68B,53C** a multiple of 15?

- A. 3      B. 4      C. 5      D. 6      E. 7

35. 2 3 4 5 6 9

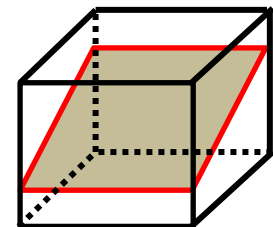
Each of these six cards has a Whole Number written on both sides. Aristotle claims,

*“If the number on either side of a card is even then the number on the other side of that card is a square number.”*

What is the minimum number of cards that you would need to turn over to verify whether Aristotle’s claim is true?

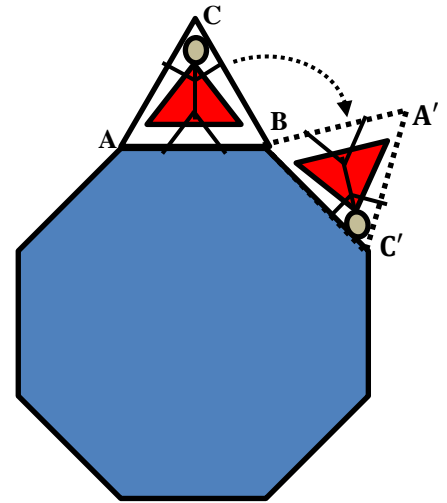
- A. 2      B. 3      C. 4      D. 5      E. 6

36. A solid cube of wood is cut by a plane. One possible cut is shown in the diagram.  
The intersection of a cube and a plane could NOT be:



- A. An equilateral triangle  
B. A regular hexagon  
C. A rhombus which is not a square  
D. A trapezoid [Note: A *trapezoid* is a quadrilateral with exactly one pair of parallel sides.]  
E. All four of the above intersections are possible

37. Supergirl is trapped motionless in an equilateral triangle as it revolves clockwise around a regular octagon of the same side length. The first “step” is shown. As the triangle pivots at point B: Vertex C rotates to C' and vertex A rotates to A'. After 8 “steps”, the triangle is again on top of the octagon.



As the triangle revolves, how many  $360^\circ$  rotations has Supergirl experienced?

- A.  $2\frac{1}{3}$       B.  $2\frac{2}{3}$       C.  $3\frac{1}{3}$   
 D.  $3\frac{2}{3}$       E. 4
38. For the 9 students taking the AIME exam, their math teacher seats them as shown so that no two students are sitting in the same row, column, or diagonal. When the teacher briefly leaves the room, exactly 3 students move to seats adjacent (horizontally, vertically, or diagonally) to their assigned seats. Since again no two students are sitting in the same row, column, or diagonal, the teacher doesn't notice that anyone has moved.

		<b>C</b>						
				<b>E</b>				
							<b>H</b>	
	<b>B</b>							
								<b>I</b>
					<b>F</b>			
<b>A</b>								
						<b>G</b>		
			<b>D</b>					

If D was one of the students who moved, who were the other two students who moved?

- A. A and C      B. C and G      C. E and G  
 D. E and I      E. F and G
39. From a regular octagon, a triangle is formed by connecting three randomly selected (distinct) vertices of the octagon. What is the probability that the triangle does not include any of the sides of the octagon?
- A.  $\frac{2}{7}$       B.  $\frac{3}{7}$       C.  $\frac{1}{8}$       D.  $\frac{1}{4}$       E.  $\frac{1}{2}$

40. See the next page for Problem #40.

*Eighth Grade Test - Excellence in Mathematics Contest – 2016*

40. A **completed** 5x5 Numbrix Puzzle is shown to the right. Notice that the numbers 1 through 25 are positioned so that it is possible to draw a continuous path from 1 to 25. All segments of the path must connect squares horizontally or vertically, not diagonally.

<b>3</b>	2	<b>23</b>	22	<b>21</b>
4	1 ●	24	25 ●	20
<b>5</b>	6	7	18	<b>19</b>
10	9	8	17	16
<b>11</b>	12	<b>13</b>	14	<b>15</b>

Complete this Numbrix Puzzle so that the 49 cells contain the numbers 1 through 49 and so that it is possible to draw one continuous path from 1 to 49 which connect squares horizontally or vertically, not diagonally.

When finished, what is the sum of the numbers in the four cells marked A, B, C, and D?

- A. 104      B. 108      C. 112      D. 114      E. 116

<b>A</b>						
	<b>11</b>	<b>16</b>	<b>B</b>	<b>20</b>	<b>27</b>	
	<b>10</b>				<b>28</b>	
	<b>6</b>				<b>32</b>	
	<b>43</b>	<b>44</b>	<b>C</b>	<b>48</b>	<b>49</b>	
						<b>D</b>