



Rocket City Math League Discovery Test

**2005-2006
Round 2**

Answers must be written inside the adjacent answer boxes. All answers must be written in exact, reduced, simplified, and rationalized form. All decimals and mixed numbers must be written as improper fractions. **No calculators, books, or other aids may be used.**

1. Let $x * y = x^2 - 2y^2$, where x and y are positive integers. If $7 * a = 17$, what is the value of a ? (1 point)	
2. A 25 feet ladder is placed against the vertical wall of a house and is resting on a horizontal ground. The foot of the ladder is 15 feet from the bottom of the house. If the top of the ladder slips down 13 feet, how many feet will the foot of the ladder slide? (1 point)	
3. What is the sum of the coefficients of the quadratic equation whose graph passes through (0,1), (3,4) and (2,7)? (1 point)	
4. Anakin and R2-D2 decide to play a game of chance. Anakin draws one card, and if he draws either an ace or a spade from a standard 52-card deck then he wins. What is the probability that Anakin will win? (1 point)	
5. Given that $\log 2 \approx 0.301$, how many digits are in the number 2^{2005} ? (2 points)	
6. C-3PO is tired of working one day and decides to draw an equilateral triangle with sides of 12 inches inscribed in a square WXYZ. One vertex of the triangle is at W, one vertex is on XY and the last one is on YZ. After completing his masterpiece, C-3PO wants to know the area of the square. Write the area in simplest form. (2 points)	
7. The slant and vertical asymptotes of the graph of $y = \frac{x^3 - 5x^2 - 17x + 21}{3x^2 + 36x + 81}$ can be written in the form $x + Ny = S$ and $x = A$, where N , S , and A are rational, real numbers. Find $N \cdot A \cdot S \cdot A$. (2 points)	
8. Suppose $p(x) = 11x^3 - 4x^2 + D$. If the three real roots of $p(x)$ form an arithmetic sequence then what is the value of D ? (2 points)	
9. Mr. Zryphokas assigns his alien class to do certain math problems of a 100 question worksheet. On Monday, he assigns all problem numbers that divide evenly by 5. On Tuesday, he assigns all problems that evenly divide by 4. On Wednesday, he assigns all problem numbers that divide evenly by 3. On Thursday, he assigns all problems evenly divisible by 2. Finally, on Friday, he assigns all the problems which his class has not already done. How many problems did Mr. Zryphokas assigns on Friday? (Note: Each day Mr. Zryphokas excludes the problems which his class has already done on a previous day.) (3 points)	
10. The newly discovered radioactive element Grissomite decays exponentially. If the half-life of Grissomite is 10 days, then how many grams of a 100 gram sample of Grissomite are left after 25 days? (3 points)	
11. Quadrilateral MSFC is inscribed in the circle shown. If $\cos(\angle M)$ is expressed as a ratio of relatively prime positive integers A/B , find $B-A$. (3 points)	
12. John is driving in a 4 block by 4 block section (each line is a street and each square is a block) of downtown Huntsville, the Rocket City. The streets are all one way; he can only go down on the vertically drawn streets and right on the horizontally drawn ones. Due to repaving, certain streets are closed as represented by the dotted lines. Define X as the number of routes from A to B when all the streets are open (including the ones represented by the dotted lines) before construction started and define Y as the number of routes from A to B when the streets represented by the dotted line are closed during construction. Find $X - Y$. (4 points)	

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