

Name \_\_\_\_\_



## Rocket City Math League Discovery Test

**2017-2018  
Round 1**

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 aides may be used.**

**Time Limit: 45 minutes**

1. Find the equation(s) of the vertical asymptote(s) of the graph: $f(x) = \frac{x^3+3x^2+4}{x^2-x-6}$ . <span style="float: right;">(3 points)</span>	
2. On the planet Glurg, currency is measured in Glaks, Glogs, Gloobs, and Glorks. 10 Glaks is equal to 1 Glog, 2 Glogs is equal to 1 Gloob, and 5 Gloobs is equal to 3 Glorks. If Gleek buys dinner that costs 4 Gloobs and 1 Glog, and she pays with 3 Glorks, how much change will she receive in Glaks? <span style="float: right;">(3 points)</span>	
3. A satellite is orbiting planet Glop's moon in a perfectly circular orbit. Every 20 minutes it completes one full orbit. Every 25 minutes the satellite takes a photograph of the equator of the moon. Every photograph captures a third of the moon's equator that faces the satellite. How long will it take (in minutes) for the satellite to take at least one photograph of every point on the entire equator of the moon? Time starts as soon as the first photograph is taken. Assume planet Glop's moon doesn't rotate. <span style="float: right;">(3 points)</span>	
4. Given $A = \begin{bmatrix} 2 & 4 \\ 1 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} 3 & 1 \\ 5 & 2 \end{bmatrix}$ , find $A^{-1} \cdot B$ , where $A^{-1}$ is the inverse of matrix $A$ . <span style="float: right;">(3 points)</span>	
5. In triangle ABC, if $\cos A = -\frac{5}{7}$ , what is the rationalized form of $\frac{2}{21 \sin A - 4}$ ? <span style="float: right;">(4 points)</span>	
6. An astronaut crashes onto an alien world. He is taken prisoner and is forced to play a game to determine if he will be set free or remain a prisoner. Nine aliens and the astronaut form a circle and every participant is given a teleportation ray. Going around the circle, each participant teleports the player three spaces around the circle clockwise from himself back to a prison cell. This is continued until only one player remains, who is set free. If the participants are numbered from 1 to 10 clockwise, and the participants take turns in increasing number order starting with 1, in which position in the circle should the astronaut stand to ensure he will be set free? <span style="float: right;">(4 points)</span>	
7. Commander Cool has a pink square spaceship that has a side length of 6,521,493 meters. Commander Starlight has a blue square spaceship that has a side length of 6,521,483 meters. If 1 Bloop is equal to 20 m <sup>2</sup> , how much more area does Commander Cool's spaceship have measured in Bloops? <span style="float: right;">(4 points)</span>	
8. If $a^2 - a \cdot \cos\left(\frac{\pi}{3}\right) + 3a - 3 \cdot \sin\left(\frac{\pi}{6}\right) = 0$ , solve for all possible values of $a$ . <span style="float: right;">(5 points)</span>	
9. If $f(x) = 8x^4 - 33x^3 + 42x^2 - 33x + 34$ , find the sum of the $x$ -values of the coordinates where this polynomial crosses the $x$ -axis. <span style="float: right;">(5 points)</span>	
10. Given that $\sin A = \frac{3}{5}$ and $0 \leq A \leq \frac{\pi}{2}$ , what is $\cos 3A$ ? <span style="float: right;">(6 points)</span>	

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