

Name: \_\_\_\_\_

School: \_\_\_\_\_

**2016 Math Field Day Analytic Geometry (12th Grade)**

State the exact answer for each problem. Do **NOT** use decimal approximations for  $\pi$ ,  $\sqrt{2}$ ,  $\sqrt{3}$ , for example. Radicals must be in simplest radical form and fractions in simplest form, or lowest terms. If there are multiple solutions, separate them by a comma. If there is no solution, write 'NONE'.

1. \_\_\_\_\_ Find the maximum value of the function  $f(x) = 1 - 2x - 3x^2$ .
  
2. \_\_\_\_\_ Find the distance between  $(2, -3)$  and the leftmost vertex of the hyperbola  $\frac{(x - 1)^2}{9} - \frac{(y + 5)^2}{8} = 1$ .
  
3. \_\_\_\_\_ Find the equation of the line perpendicular to the line  $2x + 3y = 6$  that passes through the point  $(-2, 1)$ .
  
4. \_\_\_\_\_ Find the equations of the asymptotes of the rational function  $\frac{3x^2 - 6x + 3}{2x^3 - 2x}$ .
  
5. \_\_\_\_\_ The points  $(4, -7)$ ,  $(-2, 0)$ ,  $(k, -3)$  are collinear. Find the value of  $k$ .
  
6. \_\_\_\_\_ Determine the foci of the ellipse  $(x + 1)^2 + \frac{(y - 3)^2}{4} = 1$ .
  
7. \_\_\_\_\_ Find a polynomial function  $P(x)$  of degree 3 that contains the point  $(0, -4)$  and has zeros 2 and  $-1$  where 2 is double zero.
  
8. \_\_\_\_\_ Determine the  $y$ -coordinates of the points of intersection of the circle  $x^2 + y^2 = 3$  and the hyperbola  $\frac{x^2}{2} - y^2 = 1$ .
  
9. \_\_\_\_\_ Determine the area of the region enclosed by the graph  $2x^2 + 2y^2 - 8x + 4y - 6 = 0$ .