# Algebra Placement Exam
# Harris School of Public Policy
# September 21, 2009

You have ninety minutes for this exam. No books, notes, calculators, or other aids are allowed. Please answer in the blue books provided, and please make sure to include your name and UCID number on all work submitted.

1. **Linear Equations.** (20 points, 5 each)

   Consider the point $P = (-2, -3)$ and the two lines:

   $$\begin{array}{ll} \text{Line 1:} & x + 4y - 5 = 0 \\ \text{Line 2:} & 3x + 8y - 6 = 0 \end{array}$$

   (a) Find the equation of the line through $P$ that is parallel to Line 1.

   (b) Find the equation of the line through $P$ that is perpendicular to Line 2.

   (c) Find the point of intersection of Line 1 and Line 2.

   (d) Find the distance from $P$ to the point of intersection from part (c).

2. **Rectilinear Figures.** (20 points, 10 each)

   Consider the following three points $A = (-6, -1)$, $B = (1, 8)$, and $C = (18, 5)$.

   (a) Find a point $D$ so that $A$, $B$, $C$, and $D$ are the vertices of a parallelogram.

   (b) Find the area of your parallelogram.

3. **Quadratic Equations.** (24 points, 8 each) Consider the parabola defined by the equation

   $$y = 5x^2 - 16x - 21.$$

   (a) Use the technique of completing the square to put the parabola in Vertex Form.

   (b) Find the $x$-intercepts of the parabola.

   (c) Graph the parabola.

4. **Absolute Value.** (20 points, 10 each)

   Find the solution sets for each of the following equation and inequalities:

   (a) Solve the inequality $|2x + 4| \geq 10$.

   (b) Graph the equations $y = |2x + 4|$ and $y = 10$ on the same set of axes, and indicate how the graph corresponds to your answer to part (a).

**5. Two Inequalities.** (20 points, 10 each)

(a) Solve the inequality $4 - \dfrac{2}{x-3} < 2$.

(b) Solve the inequality $x - \dfrac{2}{x-3} < 2$.

**6. Exponentials and Logarithms.** (21 points, 7 each)

(a) Find the value of $k$ such that $2^k = \sqrt[4]{8} \cdot \dfrac{16^{3/2} \cdot 2^{-4}}{\sqrt{32}}$

(b) Assuming that $\ln 2 = 0.693$ and $\ln 3 = 1.099$ (accurate to the thousandths), determine an approximate value (also accurate to the thousandths) for $\ln \sqrt[3]{36}$.

(c) Graph the function $y = 10^{-x}$ on a reasonable set of axes.

**7. Algebraic Expressions.** (19 points, 5/7/7)

Consider the following algebraic expression in two variables: $a^3 + a^2b + ab^2 + b^3$.

(a) Evaluate the expression when $a = 2$ and $b = \frac{1}{2}$.

(b) Factor the expression as completely as possible (using real coefficients).

(c) Multiply the expression by $(a - b)$ and simplify as much as possible.