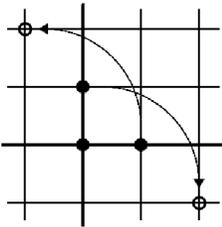November 2008

⋆ NATIONAL LEVEL ⋆

The 𝕄andelbrot ℂompetition

Round One Test

Time Limit: 40 minutes

Name: _____

1. Which of the following graphs contains at least three distinct points that all lie on a single line? (Simply write A, B, or C for your answer.)

   A. $y = 2\sin x$ B. $y = \ln(x-1)$ C. $y = x^2 + 4$

① 1

2. One creates a hexagon sum by placing the numbers 1, 2, 3, 4, 5 and 6 in any order at the vertices of a hexagon. Next multiply the numbers at the endpoints of each segment, then add up all six products. What is the smallest possible hexagon sum?
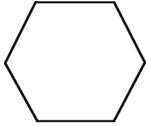
① 1

3. Find a pair of positive integers m and n such that $\dfrac{m - 2n}{3m - 4n} = 5.$

② 2

4. Troy must put a black, maroon, or white car into each of twelve spots in a small parking lot. He prefers to park them so that no two adjacent cars, either horizontally or vertically, are the same color. (Diagonally is OK.) With these restrictions, in how many ways could he choose the colors of the cars in each spot?
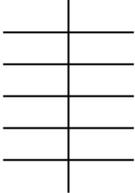
② 2

5. What fraction of the form $\dfrac{A}{x+3}$ can be added to $\dfrac{6x}{x^2 + 2x - 3}$ so that the result reduces to a fraction of the form $\dfrac{B}{x-1}$? Here A and B are real numbers. Give the value of A as your answer.

② 2

6. Sydney places three markers at the points $(0,0)$, $(1,0)$, and $(0,1)$ on a sheet of graph paper. She then repeatedly "jumps two of the markers over each other," meaning that the old and new positions are located at four evenly spaced points along a line, as shown. After a while two of the markers are located at $(63, -2)$ and $(-108, 16)$. Where is the third?

③ 3

7. Find an angle θ for which $\cos\theta = \sin 60° + \cos 42° - \sin 12° - \cos 6°.$

③ 3

SCORE: