# MASSACHUSETTS MATHEMATICS LEAGUE
# CONTEST 2 - NOVEMBER 2015 SOLUTION KEY

## Round 1

A) Since $i^3 = -i$ and $i^4 = 1$, it follows that $i^3 = i^7 = i^{11} = ... = -i$
The prime we seek is 3 more than a multiple of 4.
The first value we check is 103.
To verify primeness, we test for divisibility by 2, 3, 5 and 7.
Any composite number $N$ must have a factor which is less than or equal to $\sqrt{N}$ .
All four possible factors fail and **<u>103</u>** is prime.

B) The 6 values of $k$ are the multiples of 4, namely 4,8,12,16,20 and 24.
The 6 real numbers are $-4, 16, -64, 256, -1024,$ and $4096$, which produce a sum of **<u>3276</u>**.

C) $x^4 = 16 \Leftrightarrow x^4 - 16 = \left(x^2 - 4\right)\left(x^2 + 4\right) = 0$
The four 4th roots of 16 are $\pm 2, \pm 2i$ ; so their sum will be 0.
$(0 + 9i)^3 = 729i^3 = -729i$. Therefore, $\left(a, b\right) = \underline{\left(\mathbf{0, -729}\right)}$.