Date Completed: _____
Mentor Initials: _____

Complex Numbers (Advanced)

1. Given that $i^2 = -1$ and that k is a positive odd integer, which of the following is a possible value of i^{6k} ?

A. $-i$
B. -1
C. 0
D. i
E. 1

2. Given that $i^n = -i$, which of the following statements about n must be true?
(Note: $i^2 = -1$)

A. When n is divided by 4, the remainder is 0
B. When n is divided by 4, the remainder is 1
C. When n is divided by 4, the remainder is 2
D. When n is divided by 4, the remainder is 3
E. Cannot be determined from the given information.

3. For the complex number i and an even integer x, what is a possible value of i^x ?

A. -1
B. $-i$
C. 0
D. i
E. $\sqrt{2}$

4. Which of the following equations is equivalent to $16x^2 + 49$?

A. $(4x + 7)^2$
B. $(4x + 7i)^2$
C. $(4xi + 7)^2$
D. $(4x + 7)(4x - 7)$
E. $(4x + 7i)(4x - 7i)$

5. What are the solutions to $x^2 - 2x + 82 = 0$?

A. 2 and 41
B. $1 \pm 2\sqrt{41}i$
C. $1 \pm 9i$
D. $1 \pm 18i$
E. $2 \pm 9i$

6.

$$y = x^2$$
$$px + qy = z$$

In the system of equations above, where p, q, and z are integers, for which of the following will there be two non-real solutions to the system?

A. $p^2 - 4qz < 0$
B. $q^2 - 4pz < 0$
C. $p^2 + 4qz > 0$
D. $q^2 + 4qz > 0$
E. $p^2 + 4qz < 0$

7. Which of the following quadratic equations has the complex number $-1 + 2i$ as a solution?

A. $x^2 + 2 = 0$
B. $x^2 + x + 2 = 0$
C. $x^2 - x + 2 = 0$
D. $x^2 + 2x + 5 = 0$
E. $x^2 - 2x + 5 = 0$

8. Which of the following equations given in factored form has roots at $\frac{2}{3}$, $\frac{4}{3}$, i, and $-i$?

A. $(3x - 2)(3x - 4)(x^2 + 1) = 0$
B. $(3x - 2)(3x - 4)(x^2 - 1) = 0$
C. $(3x + 2)(3x - 4)(x^2 + 1) = 0$
D. $(3x + 2)(3x - 4)(x^2 - 1) = 0$
E. $(3x + 2)(3x + 4)(x^2 + 1) = 0$

9.

$$i^4 + i^5 + i^6 + i^7$$

The complex number expression above can be rewritten in the form $c + di$, where c and d are real numbers. What is the value of $|c| + |d|$?

A. -4
B. -1
C. 0
D. 1
E. 4

10. In the complex number system, what is the value of the expression $20i^4 - 5i^2 + 2$?

A. 17
B. $17i$
C. 0
D. 27
E. $27i$

11. $x^4 - 32x^2 - 144 = 0$

What is the solution set of the above equation?

A. $\{-12,\ 12\}$
B. $\{-12,\ 6,\ 2\}$
C. $\{-4, -3, 12\}$
D. $\{-2, 2,\ -6i,\ 6i\}$
E. $\{-6, 6,\ -2i,\ 2i\}$

12. For all real number x and the imaginary number i, which of the following expressions is equivalent to $(x - 2i)^3$?

A. $x^3 - 12x^2i - 36x - 8i$
B. $x^3 + 12x^2i - 36x + 8i$
C. $x^3 + 6x^2i - 12x - 8i$
D. $x^3 - 6x^2i - 12x + 8i$
E. $x^3 + 8i$