

## 2015 Qualifying Test Round Two

1. What is the ones (units) digit of  $2^{57,885,161} - 1$ ? \_\_\_\_\_
2. A fair coin is tossed three times (and whether it lands heads or tails each time is noted). The same coin is then tossed three more times. What is the probability that the first sequence of tosses matches the second sequence? \_\_\_\_\_
3. Which of the following is largest?  
a.  $\cos\left(\cos\frac{\pi}{6}\right)$    b.  $\cos\left(\sin\frac{\pi}{6}\right)$    c.  $\sin\left(\cos\frac{\pi}{6}\right)$    d.  $\sin\left(\sin\frac{\pi}{6}\right)$  (circle one)
4. What is the coefficient of the  $x^2$  term in  $(3x + 2)^5 - (2x + 3)^3$ ? \_\_\_\_\_
5. Three of the vertices of a square in  $\mathbf{R}^3$  are  $(1, 2, 3)$ ,  $(10, 14, 23)$ , and  $(22, 30, 8)$ . What is the sum of the coordinates of the fourth vertex? \_\_\_\_\_
6. An  $n$ -term arithmetic sequence ( $n > 1$ ) with common difference  $d$  starts with 4 and ends with 2014. Write  $d$  as a function of  $n$ .      $d =$  \_\_\_\_\_
7. A right triangle has legs of length 7 and 24. What is the length of the altitude that extends from the vertex at the right angle to the hypotenuse? \_\_\_\_\_
8. A set of numbers in which the leading digit,  $D$ , occurs with probability  $\log_{10}(1 + 1/D)$  obeys a law named after (circle one):  
a. Frank Benford   b. Pafnuty Chebyshev   c. Andrei Markov   d. John von Neumann
9. How many quadratic functions with leading coefficient 2 have two distinct integer roots and a graph with a  $y$ -intercept of 72? \_\_\_\_\_
10. For which value of  $n$  below is a regular  $n$ -sided polygon **not** constructible?  
a. 255     b. 256     c. 257     d. 258     (circle one)