

## 2020 Who Wants to Be a Mathematician Round One Qualifying Test

### KEY

- What is the perimeter (in inches) of a square that has area 9 square inches?  
a. 8                      b. 10                      c. 12                      d. 16                      **c.**
- The graph of which of the following is perpendicular to the line  $y + 3x = 7$ ?  
a.  $y - 3x = 7$                       b.  $x - 3y = 7$                       c.  $3x - y = 7$                       d.  $x + 3y = 7$                       **b.**
- Let  $T = \sin(\cos(\pi/2))$  (where  $\pi/2$  is measured in radians). Then  
a.  $T = 0$                       b.  $0 < T \leq 1/2$                       c.  $1/2 < T < 1$                       d.  $T = 1$                       **a.**
- Sue rolls two fair six-sided dice (with faces numbered 1-6) and computes their sum, while Diane rolls a single fair dodecahedral die (with faces numbered 1-12). Which of the following numbers has the property that Sue and Diane are equally likely to roll that number?  
a. 8                      b. 9                      c. 10                      d. 11                      **c.**
- A positive integer is called *square-free* if it is not divisible by any perfect square greater than 1. Suppose  $m$  and  $n$  are square-free integers greater than 1, with  $m \neq n$ . Which of the following is not possible?  
a.  $mn$  is square-free and composite    b.  $m/n$  is prime    c.  $m/n$  is square-free and composite  
d.  $\sqrt{mn}$  is rational                      **d.**
- Let  $f(x) = 5x^3(2x + 3)^4$  and  $g(x) = 50x^5(8x - 4)^2$ . Which of the following is closest to  $f(10^6) \div g(10^6)$ ?  
a. 0.025                      b. 0.25                      c. 2.5                      d. 25                      **a.**
- The graph of the equation  $(x + 2)^2 + (y - 3)^2 = 12$  contains points in all quadrants except quadrant  
a. I                      b. II                      c. III                      d. IV                      **d.**
- A, B, C, D, E, F, G, and H represent eight different digits selected from  $\{1, 2, \dots, 9\}$ . If  $(A + B)/(C + D) + (E + F)/(G + H)$  is as large as possible, which digit is not used?  
a. 1    b. 2    c. 4    d. 5                      **d.**
- Suppose  $x$  is an integer satisfying  $\log_3(9x) + \log_9(3x) = 7$ . What is the ones digit of  $x$ ?  
a. 3                      b. 5                      c. 7                      d. 9                      **c.**
- How many ordered pairs of positive integers  $(m, n)$  are there such that  $m^2n^5 = 20^{20}$ ?  
a. 15                      b. 20                      c. 30                      d. 40                      **a.**