

**2017 John O'Bryan Mathematical Competition  
Freshman-Sophomore Individual Test**

**Directions:** Please answer all questions on the answer sheet provided.

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2. The points  $(7,a)$  and  $(b,6)$  lie on a line with the equation  $x - 3y + 25 = 0$ . Find  $3a + b$
  
3. Let  $A$  be a positive two-digit integer. The integer  $B$  is the same as  $A$  when its digits are reversed. What is the largest value of  $A$  such that  $A = 3B - 2$ ?
  
4. The ratio of two supplementary angles is 1:8. Find the degree measure of the smaller of the two angles.
  
5. In the diagram at the right,  $\overline{MA} \parallel \overline{TH}$ ,  $MA = 4x$ ,  $AC = 5x + 2$ ,  $MC = 3x + 4$ ,  $CT = x + 3$  and  $TH = x + 2$ . Find the length of  $\overline{CH}$ .
  
6.  $\overline{AB}$  is a chord in circle  $O$  such that the degree measure of minor arc  $\widehat{AB}$  is one-quarter the degree measure of major arc  $\widehat{AB}$ . Find the degree measure of  $\angle OAB$ .
  
7. The average of three values is  $3x + 2y$ . If two of the values are  $4x + 2y$  and  $3x - y$ , find the third value. Give your answer as an expression in terms of  $x$  and/or  $y$ .

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8. When eight coins are flipped, find the probability that tails occurs exactly three times. Write your answer as

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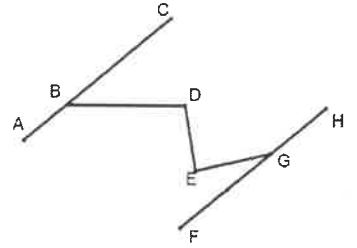
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13. The sum of the smallest and largest of three consecutive even integers is 52. The integer  $k$  is 10 less than the median of the three consecutive even integers. If  $p^2 = k$  where  $p$  is a positive integer, find the value of  $p$ .

14. In the diagram to the right,  $\overline{AC} \parallel \overline{HF}$ ,  $\angle CBD \cong \angle GED$ , the measure of  $\angle E$  is  $18^\circ$  less than  $\angle D$ , and the measure of  $\angle FGE$  is  $44^\circ$ . Find the degree measure of  $\angle D$ .

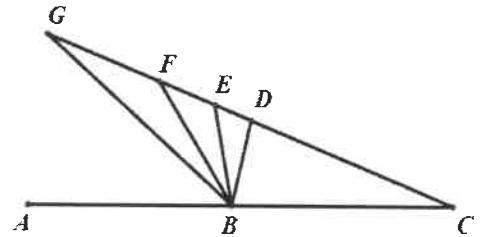


15. A circle with area  $81\pi$  is inscribed in an equilateral triangle. Find the area of the triangle, rounding your answer to the nearest integer.

16. If  $3x^2 + 8 = 56$ , find the smallest possible value of  $4x - 5$ .

17. If  $\begin{bmatrix} 3 & 2 \\ d & 4 \end{bmatrix} + 2\begin{bmatrix} 4 & 3 \\ e & 5 \end{bmatrix} = \begin{bmatrix} a & b \\ 4 & c \end{bmatrix}$ , find the value of the expression  $(a + b + c + 2d + 4e)$ .

18. In the diagram at the right, the measure of  $\angle CBF$  is  $73^\circ$  more than the measure of  $\angle ABG$ .  $\overline{BD}$  bisects  $\angle CBG$  and  $\overline{BE}$  and  $\overline{BF}$  trisect  $\angle DBG$ . Find the degree measure of  $\angle EBC$ .



19. One of the following statements is selected at random. Find the

A parallelogram is a rectangle.  
 A rectangle is a parallelogram.  
 A square is a rectangle.  
 A rectangle is a square.  
 A square is a parallelogram.  
 A parallelogram is a square.

parallelograms. Write your answer as a common fraction reduced to lowest terms.

