The Department of Mathematics at NDSU is happy to announce the second round of the annual North Dakota Mathematics Talent Search. The goals of the talent search are to locate high school students in North Dakota and surrounding areas with a talent for solving mathematical problems, to reward these students and their teachers for their efforts, and to encourage these students to attend NDSU and major in the mathematical sciences or engineering.

The Talent Search poses sets of challenging mathematical problems throughout the year which will be posted on our website at https://www.ndsu.edu/math/ongoing_events/nd_talent_search/

Interested students are strongly encouraged to send in solutions even if they only solve one problem in a set; finding a good solution to a problem is always an achievement. The problems do not require advanced mathematical knowledge – just creativity and a feeling or taste for problem solving.

The students who submit a significant number of mathematically sound solutions for each of the three rounds will be rewarded with various prizes.

Please upload and submit your solutions by January 31, 2020, using the form on the website. Alternatively, solutions may be sent by regular mail to:

Talent Search
c/o Maria Alfonseca
Mathematics NDSU Dept. # 2750
PO BOX 6050
Fargo, ND 58108-6050

Please do not forget to include your name, postal address, school, and e-mail address.

Here is the second set of problems:

1. Solve the system (here \(x, y, z\) are unknowns and \(a\) is a parameter)

\[
\begin{align*}
x + y + z &= a, \\
x^2 + y^2 + z^2 &= a^2, \\
x^3 + y^3 + z^3 &= a^3.
\end{align*}
\]

2. In how many parts is a regular \(n\)-gon divided by its diagonals if no three of them intersect at the same point?

3. There are 1500 people in a village. Show that at least two of them have the same initials.

4. Six people try to guess the number of tennis-balls in a box. Anne guesses 52 balls, Bill says 59, Charlie guesses 62, Dana guesses 65, Erika says 49 and Fran says 42. Nobody guessed the right number, some of them guessed too high and some too low. Their errors were of 1, 4, 6, 9, 11 and 12 balls (not necessarily in this order).

How many tennis-balls are in the box?
5. We define a new way to measure the distance between two points $x$ and $y$ on the real line $\mathbb{R}$: We will say that the “distance” between $x$ and $y$ is $\sqrt{|x - y|}$.

(a) Describe the set of all the points that are at “distance” 2 from the point 5.

(b) Describe the set of all the points that are at “distance” $r$ from the point $x$, where $x$ is a real number and $r$ is a positive real number.