The Department of Mathematics at NDSU is happy to announce our annual North Dakota Mathematics Talent Search.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/outreach/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 April 5, 2024, 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 **third set** of problems:

1. Is $46^{41} + 36^{41}$ a multiple of 41? Give a very simple explanation.

2. Let ABC be a triangle, with the smallest angle at the vertex A. Let P be a point on the circle circumscribing ABC, located on the arc joining BC that does not contain point A. On the line AP, we have the two points Q, R, such that Q is the point of intersection of AP with the mediatrix of side AB, and R is the point of intersection of AP with the mediatrix of side AC. Let S be the point of intersection of the lines BQ and CR. Show that $AP = SB + SC$.

3. We write all the irreducible fractions p/q, where p, q are positive and $q < 200$ in ascending order of value (for example, $4/9 = 0.444\ldots$ comes after $2/5 = 0.4$, not necessarily adjacent). Between which two fractions does $5/7$ stand?

4. The sum of a certain number of consecutive positive integers is 2000. Find all the possible such consecutive numbers.

5. To a person standing on the surface of Saturn, from what latitude will Saturn's rings appear to be widest?

   Explanation (see attached picture): We assume that Saturn is perfectly spherical with a radius of 60,000 km, and that the rings are perfectly circular. The distance from the center of Saturn to the inner ring is 70,000 km, and the distance from the center of Saturn to the outer ring is 140,000 km. The latitude is the angle φ above the equator, and the rings will appear widest when the angle α is biggest. This is a plane geometry question.