# Grade 7/8 Math Circles

October 27, 2021

Linear and Quadratic Sequences - Problem Set

1. For each sequence below, state if it is linear, quadratic, or neither. For sequences that are linear/quadratic, state the common first/second differences.

   (a) $\{1,\ 1,\ 1,\ 1,\ 1,\ ...\}$

   (b) $\{35,\ 27,\ 22,\ 20,\ 21,\ 25,\ ...\}$

   (c) $\{3,\ 6,\ 12,\ 24,\ 48,\ ...\}$

   (d) $\{-3,\ 8,\ 23,\ 42,\ 65\}$

   (e) $\{5,\ 0,\ 5,\ 0,\ 5,\ 0,\ ...\}$

2. What is the 6th term of the sequence defined by $t_n = \dfrac{1}{2}n^2 - 2n + 3$?

3. Find the sequence defined by $t_n = \dfrac{3}{2}n - \dfrac{1}{2}$, $1 \le n \le 6$. Is this a linear or quadratic sequence?

4. How many terms are in the sequence $\{3, 10, 17, 24, ..., 101\}$?

5. For each of the following sequences, compute the closed-form formula for the nth term.

   (a) $\{1,\ 3,\ 6,\ 10,\ 15,\ 21,\ ...\}$

   (b) $\left\{\dfrac{3}{2},\ 4,\ \dfrac{13}{2},\ 9,\ \dfrac{23}{2},\ ...\right\}$

   (c) $\{15,\ 13,\ 8,\ 0,\ -11,\ ...\}$

6. $3x + 1$, $5x - 3$, and $6x - 1$ are consecutive terms in a linear sequence. Find the value of x.

7. In the grids provided below, plot the following sequences using n as the x-axis and t_n as the y-axis, or $(n,\ t_n)$. For example, if the first term of the first sequence is 3, plot a point on the coordinate $(1,\ 3)$. Then, connect the points using a line. What do you notice?

   (a) The linear sequence $\{1,\ 5,\ 9,\ 13,\ 17\}$

   (b) The quadratic sequence $\{1,\ 2,\ 4,\ 7,\ 11,\ 16\}$
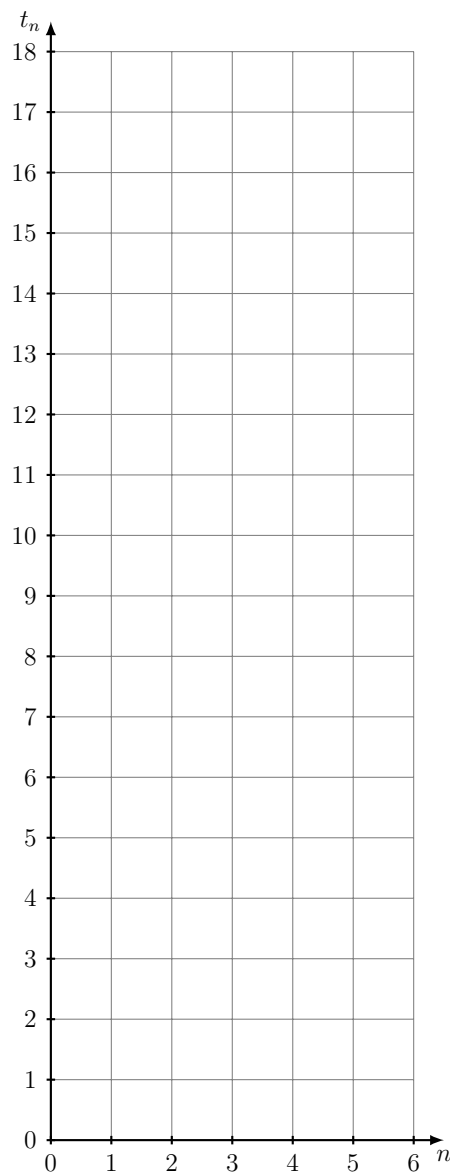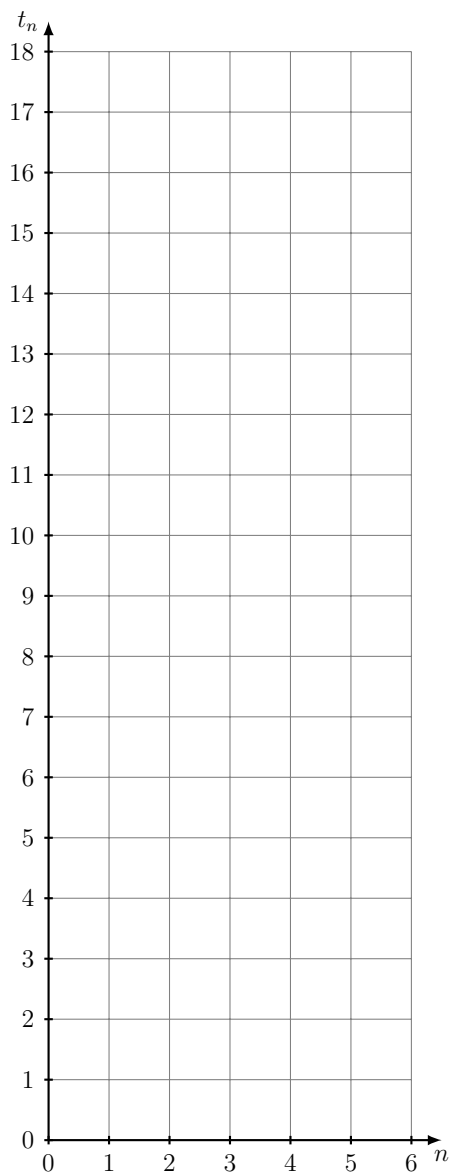
8. Here are some sequences that are not linear nor quadratic. Find the next 3 terms in each sequence by finding patterns.

    (a) {1, 3, 9, 27, 81, 243, ...}

    (b) {4, 5, 9, 14, 23, 37, ...}

    (c) {1, 8, 27, 64, 125, 216, ...}

    (d) {1, 7, 21, 46, 85, 141, ...}