



## Grade 6 Math Circles

October 14<sup>th</sup>, 2020

### ***Modular Arithmetic - Problem Set***

1. Reduce each expression modulo n

(a)  $8 \equiv \text{mod } 4$   
(b)  $8 \equiv \text{mod } 2$   
(c)  $45 \equiv \text{mod } 7$   
(d)  $62 \equiv \text{mod } 4$   
(e)  $124 \equiv \text{mod } 4$

2. I have 5 trays with 9 cookies each and I divide it evenly among 4 friends, and I ate the leftovers. How many cookies did each of my friends eat? How many cookies did I eat?
3. If Halloween is on Saturday October 31st this year (2020), what day of the week will Halloween be in 2 years (2022)?
4. Spiderman is initially facing Thanos. In order to dodge an attack from Thanos, Spiderman spins around  $772^\circ$  counter-clockwise. When he stops, how much must he rotate in order to face Thanos again? (Note: A circle has 360 degrees)
5. The following questions involves divisibility of 2.
  - (a) What are the possible remainders when you divide any number by 2?
  - (b) How can you tell by just looking at the number the remainder of any number when divided by 2?
  - (c) Using part a and part b, reduce the expression:

$$108 + 2534 + 3976 + 321539 \pmod{2}$$

6. Which of the following are equivalent to 3 modulo 4?

$$5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16$$

7. Find the day of the week of each person was born (don't look up the answers!):

- |    |               |              |
|----|---------------|--------------|
| a. | July 31, 1980 | Harry Potter |
| b. | Dec 21, 1995  | Elsa         |
| c. | Your Birthday |              |
| d. | Aug 10, 2001  | Spiderman    |

Note: The number of leap years that have occurred are 10, 6, ?, and 5 respectively.

8. Philippa counted the loonies in her pocket. When she put them in groups of 4, she had 2 loonies left over. When she put them in groups of 5, she had one loonie left over. If Philippa has more than 10 loonies, what is the smallest possible number of loonies she could have?
9. What's a math teacher's favorite kind of tree? The answer "DBLJBQOV" has been encrypted with a shift number of 23. Decrypt the answer using  $k = 23$ .