

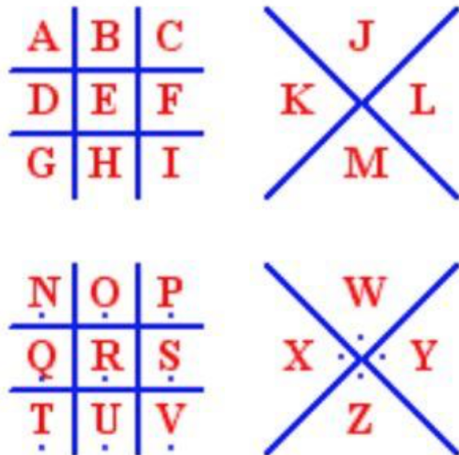
Math Circle 2015-2016 Review

May 22, 2016

We will be playing Math Dominoes at our last meeting, so we will be doing a review today of only **some** of the concepts we have learned throughout the year. Please note that **all** of what we have learned this year is fair game for the Math Dominoes game.

Ciphers

Recall the Pigpen Cipher.



1. Encode the message "MATH CIRCLE".

2. Encode the message "CHOCOLATE FOUNTAIN".

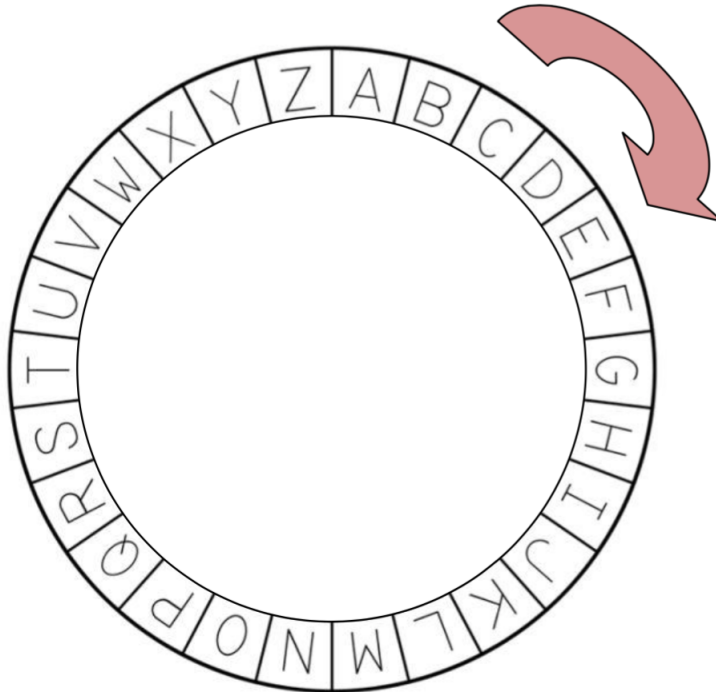
3. Decode the message

ט ל ג ט ט ט ט

4. Decode the message

ג א ט ט א

Recall the Caesar Cipher, or Shift Cipher. To encode a message in the Caesar Cipher, “shift” a letter clockwise by a given number of spots.



1. Encrypt the letter L with a shift of 5. What is the encrypted letter?
2. Let's shift by 7. Encrypt the following letters:
 - A
 - G

- X

3. Encrypt the word “MONKEY” with a shift of 5.

4. Encrypt the word “DONUT” with a shift of 4.

5. Decode the word “UEKGPEG” if we shifted by 3.

Splitting the Difference

1. Anna has 6 candies more than Ellen. How many candies does Anna need to give to Ellen in order for them to have the same number of candies?

2. Joe has 50 more quarters than Jasmine. How many quarters does Joe need to give Jasmine so they have the same amount of money?

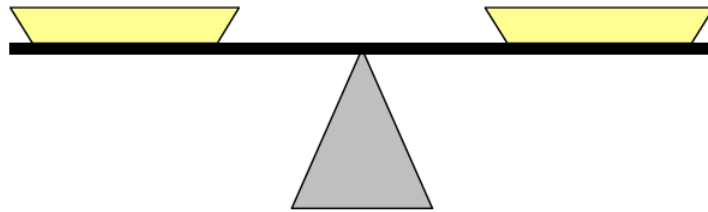
3. Jerry has 100 stamps, and Eric has 40 more than Jerry. How many stamps does Eric need to give Jerry so they have the same number of stamps? How many stamps do they have now?

4. Harry has 30 more pens than Sue, and Sue has 10 more pens than Josephina. How many pens does Harry need to give to Josephina so that Harry and Josephina have the same number of pens?

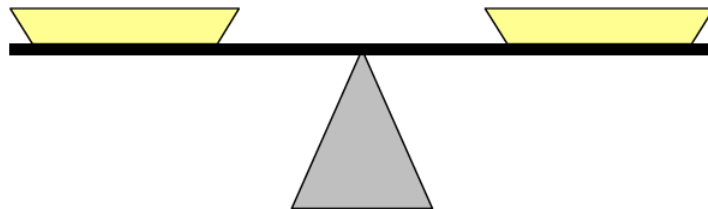
5. Sarah and Jerry have the same amount of soccer balls, and Justin has 30 more than Jerry. How many soccer balls does Justin need to give to Sarah and to Jerry so all three of them have the same number of soccer balls?

Balance Scale

1. We see 5 magic apples on one side of the scale, and a 50 pound weight on the other side of the scale. How heavy is each magic apple? Draw a picture.

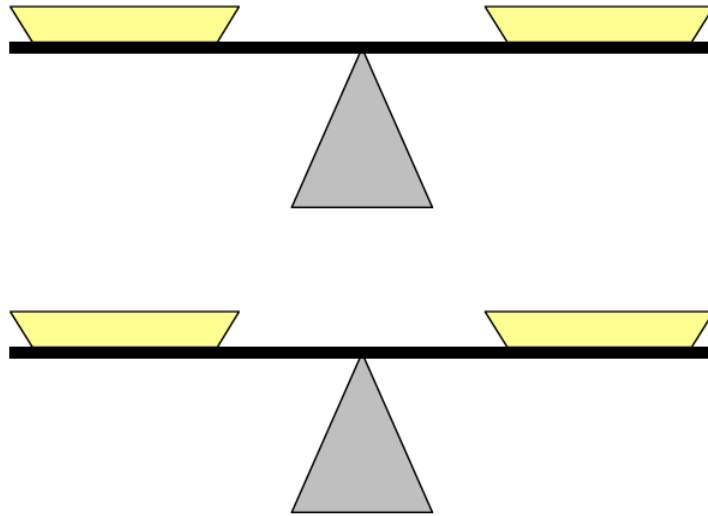


2. There are 3 magic blueberries on one side of the scale, and 2 magic blueberries and a 10-gram weight on the other side. How much does one magic blueberry weigh? Draw a picture.



3. We know that an eraser and a stapler weighs the same

as an apple plus 10 grams, and an apple equals an eraser plus 50 grams. How much does a stapler weigh? Draw a picture.



Binary

Recall that in binary, we use a series of standard weights to create numbers. We can only use 1's and 0's in binary. A "1" will represent us using that weight, and a "0" will represent us not using that weight.

1, **2**, **4**, **8**, **16**, **32**, ...

"Regular numbers" that we use normally are called "decimal" numbers.

1. Write the following decimal numbers in binary notation.

- $3 =$

- $28 =$

- $160 =$

2. Write the following in decimal notation.

- $100 =$

- $101 =$

- $1000 =$

- $10101 =$

Recall that we can add and subtract in binary. Here are some of the rules for addition.

$$\begin{array}{l}
 \boxed{0} + \boxed{0} = \boxed{0} \qquad \boxed{1} - \boxed{1} = \boxed{0} \\
 \boxed{0} + \boxed{1} = \boxed{1} \qquad \boxed{1} - \boxed{0} = \boxed{1} \\
 \boxed{0} + \boxed{1} = \boxed{1} \boxed{0} \qquad \boxed{1} \boxed{0} - \boxed{1} = \boxed{1}
 \end{array}$$

1. Add the following binary numbers using the binary addition rules from above.

$$\begin{array}{r}
 \boxed{1} \boxed{0} \boxed{1} \boxed{1} \\
 + \quad \boxed{1} \boxed{0} \boxed{0} \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 \boxed{1} \boxed{0} \boxed{1} \boxed{1} \\
 + \quad \boxed{1} \boxed{0} \boxed{1} \boxed{0} \\
 \hline
 \end{array}$$

2. Subtract the following binary numbers using the binary subtraction rules from above.

$$\begin{array}{r} \boxed{1} \boxed{0} \boxed{1} \boxed{1} \\ - \quad \quad \boxed{1} \boxed{1} \\ \hline \end{array}$$

$$\begin{array}{r} \boxed{1} \boxed{1} \boxed{0} \boxed{1} \\ - \quad \quad \boxed{1} \boxed{1} \\ \hline \end{array}$$

Roman Numerals

Recall the following information about Roman Numerals:

I	II	III	IV	V
1	2	3	4	5
VI	VII	VIII	IX	X
6	7	8	9	10

1. Write the following numbers in Roman Numerals

• 25 =

• 16 =

• 19 =

• 35 =

• 42 =

2. Move a stick to correct the following equations. If the equation is correct, write “no error”.

(a) VI + III = XI

(b) XIII + XI = XXII

(c) IV + IV = X

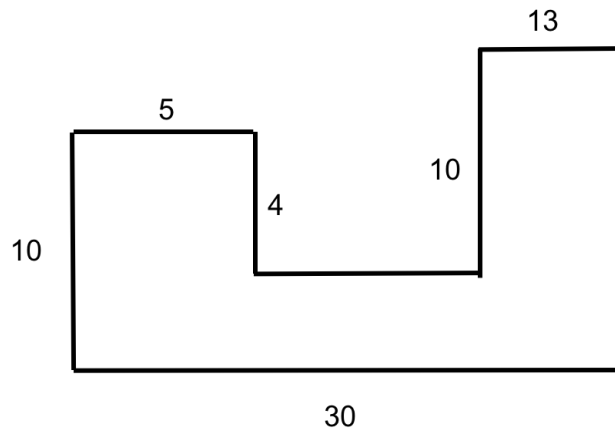
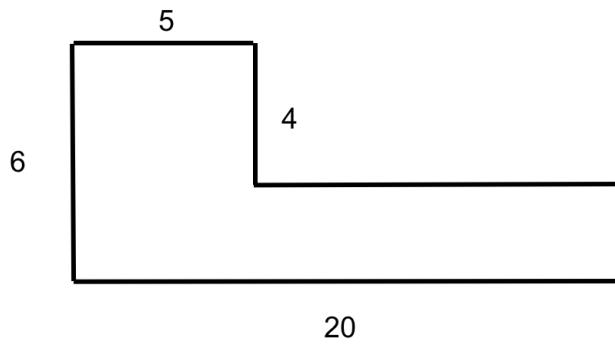
(d) XXV + XXIII = XLVIII

(e) LI-XXVII = XXII

(f) CIV-XCII = XII

Area and Perimeter

1. Find the area of the following figures. Note that the figures are not drawn to scale.



1. Consider a large rectangle that has side lengths of 20 cm x 16 cm.
 - What is the maximum number of squares with sides of 4 cm that would fit inside?

- What is the maximum number of squares with sides of 2 cm that could fit inside?

- What is the maximum number of squares with sides of 8 cm that could fit inside?