

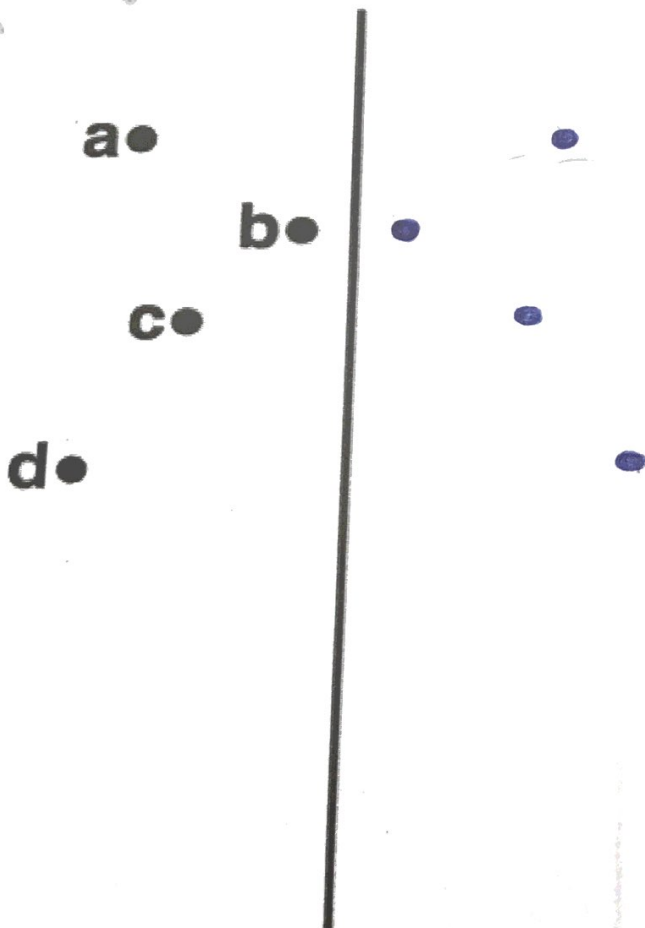
Math With Sticks
Math Circle Final Project
Chynna Swift

**Key*

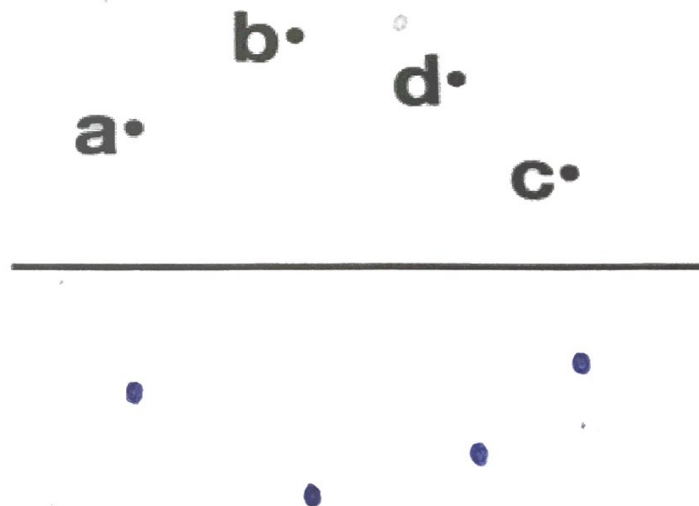
Warm-Up: Symmetry

1. Reflect the points across the line on each graph.

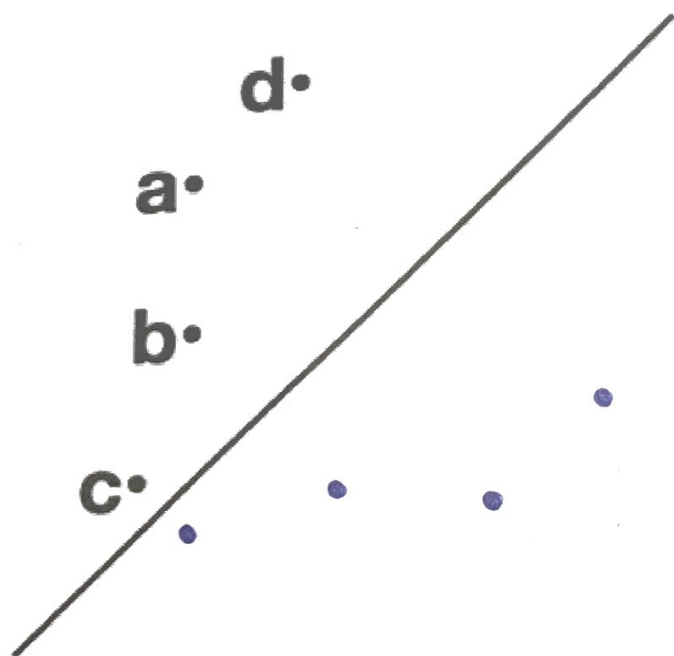
a)



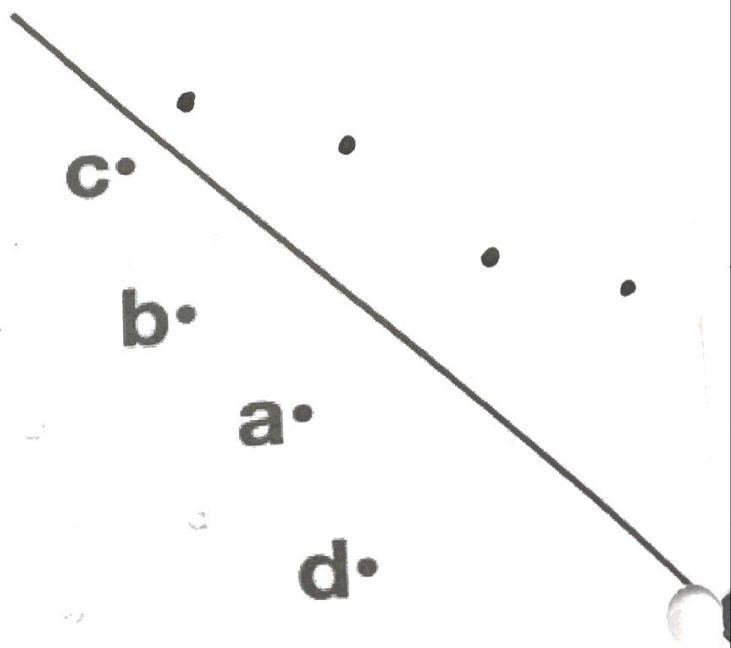
b)



c)

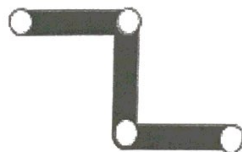


d)

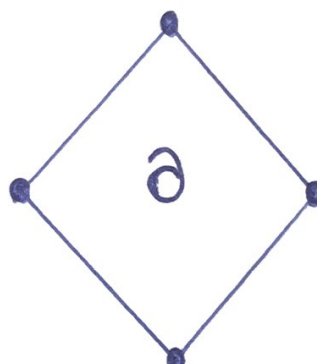
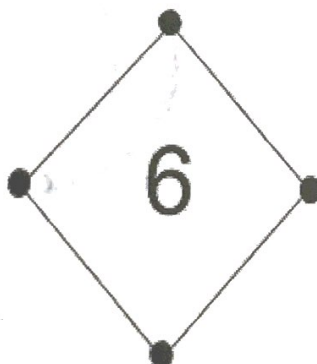


2. First, reflect the marked points. Then, draw a reflection of these shapes across the vertical line.

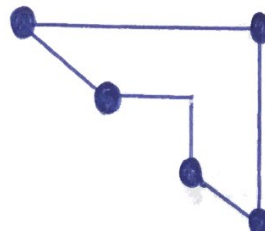
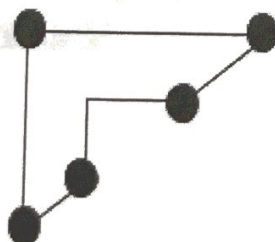
a)



b)

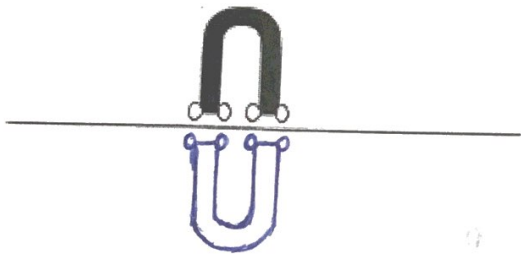


c)

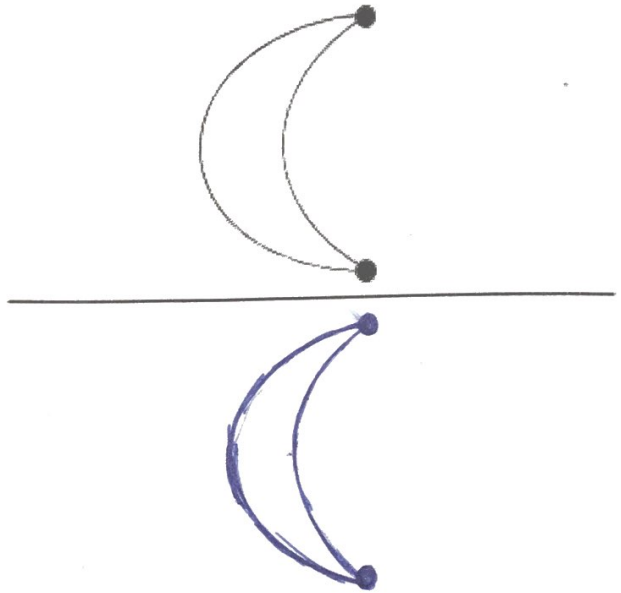


3. First, reflect the marked points. Then, draw a reflection of these shapes across the horizontal line.

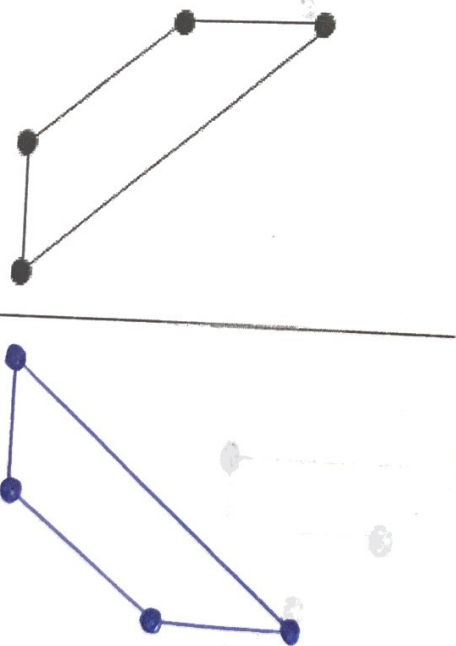
a)



b)

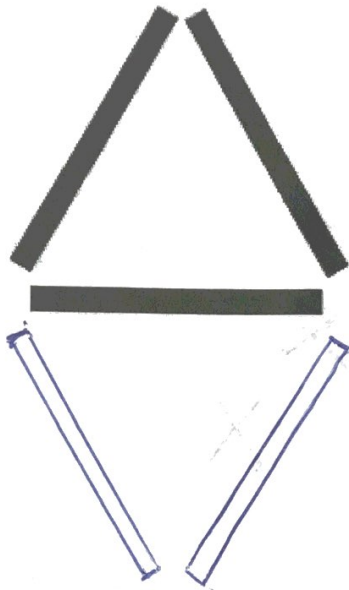


c)

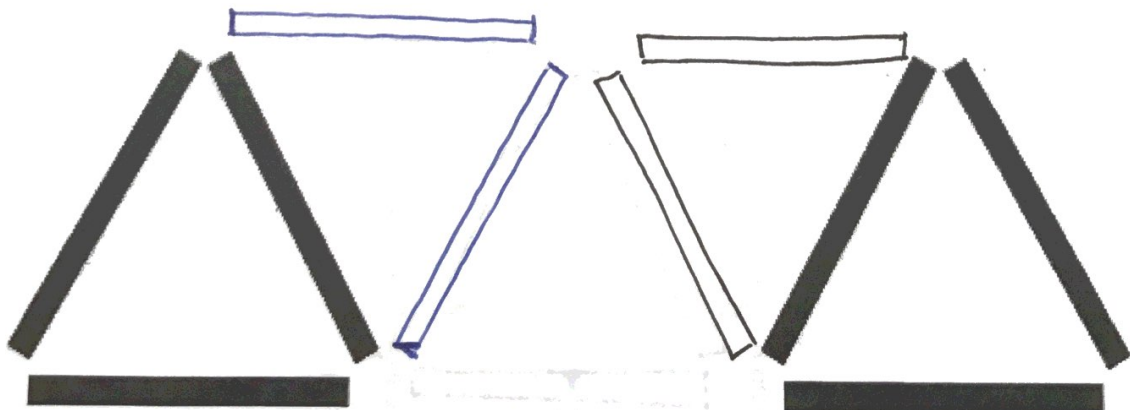


Part 1: Geometry With Toothpicks

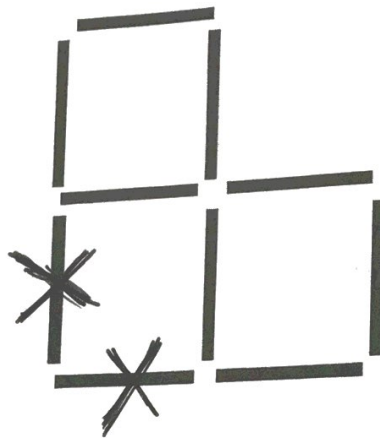
1. Add 2 sticks to make another triangle of the same size.
Draw where you added them.



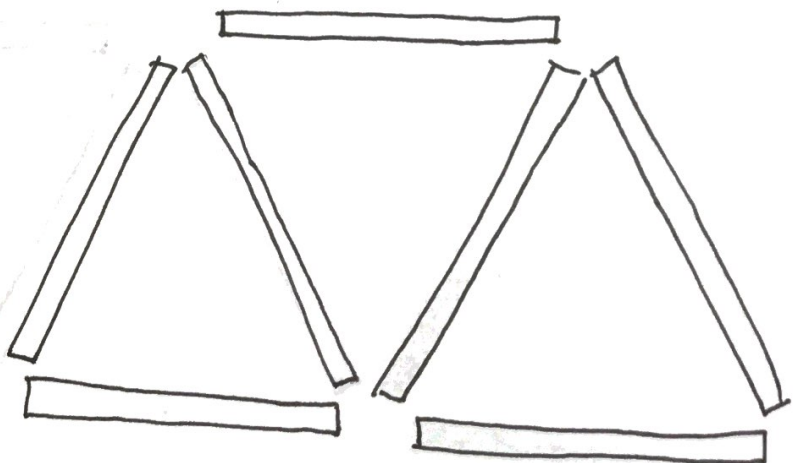
Find 2 more different ways to make another triangle of the same size and draw it below.



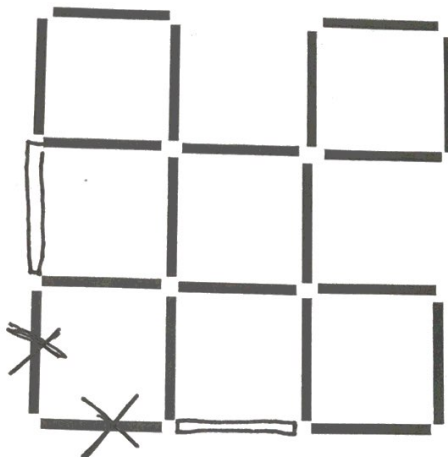
2. Remove 2 sticks so that only 2 squares (and nothing else) are left. Cross out the sticks which you removed.



3. Use 7 sticks to create 3 equal triangles. Make a picture below.



4. Move 2 sticks so that 6 squares (and nothing else) are left. Cross out the sticks you moved and draw where you moved them to.



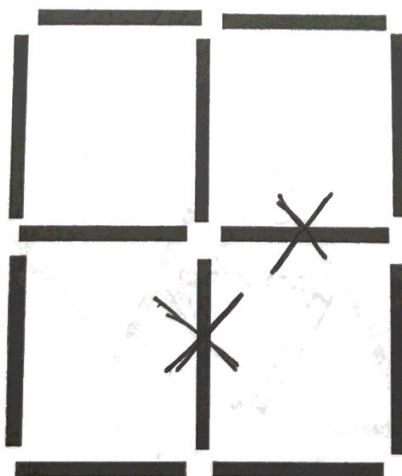
5. How many squares do you see in the picture below?

5

Are they all the same size?

NO

Remove 2 sticks so that 2 squares (and nothing else) are left. Cross out the sticks which you removed.



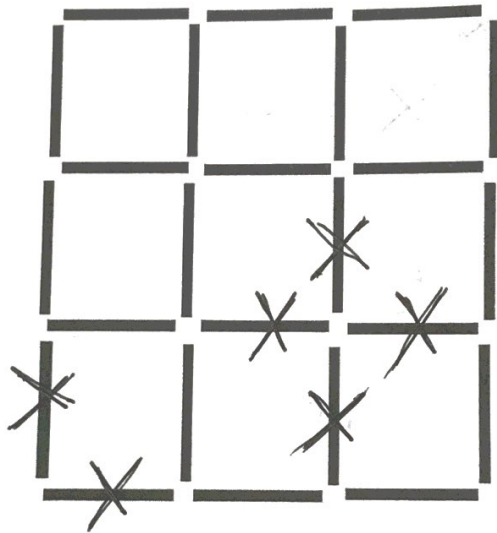
6. How many squares do you see in the picture below?

14

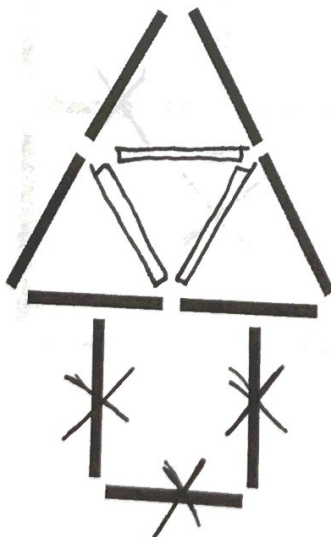
Are they all the same size?

NO

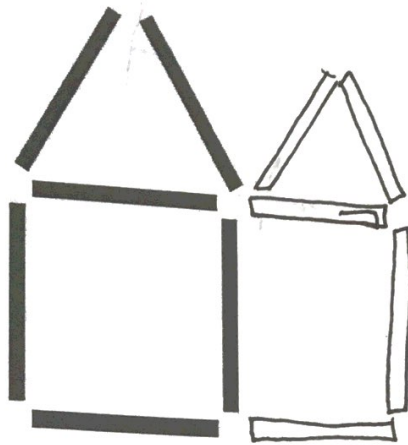
Remove 6 sticks so that 5 squares (and nothing else) are left.
Cross out the sticks which you removed.



7. Move 3 sticks to create 4 equal triangles. Cross out the sticks you moved and draw where you moved them to.



8. This is Jane's house. Jane loves spending time with Emily, so she builds Emily a house right next to hers. Make Emily's house using 5 sticks and draw where you placed the sticks.

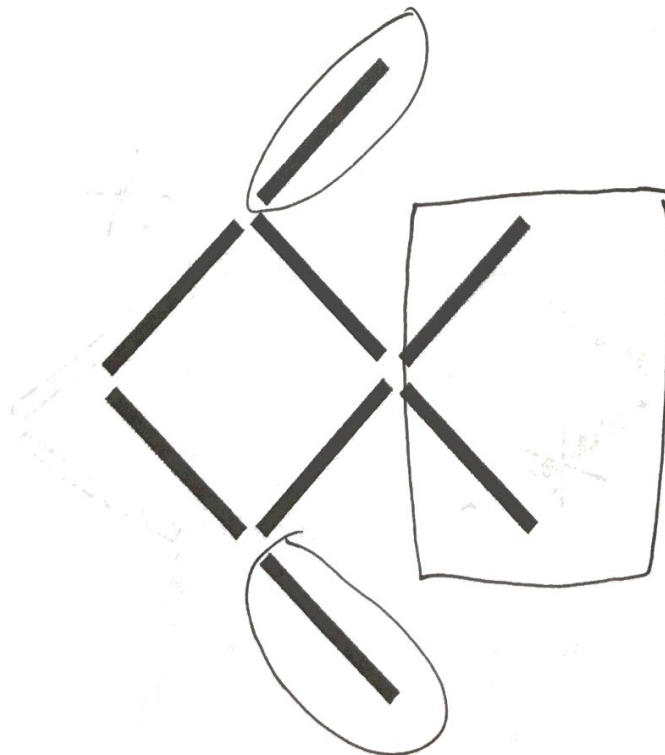


9. This is Frank the fish. Which way is he swimming?

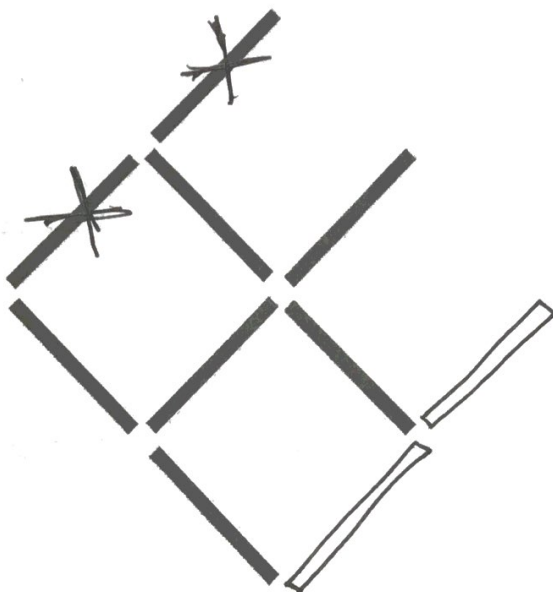
← left

Where are his fins? Draw a circle around them.

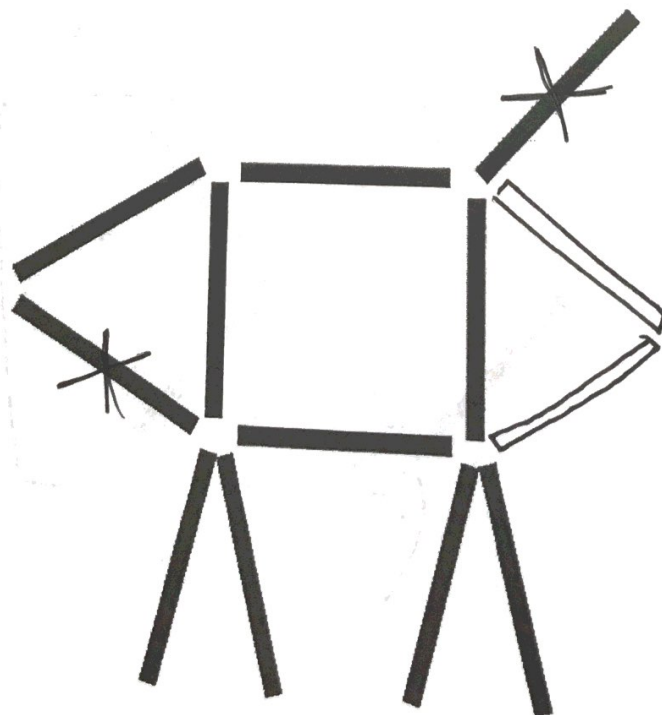
Where is his tail? Draw a box around it.



Frank wants to swim down to his reef to go to sleep. Make him swim downwards by moving 2 sticks. Cross out the sticks you moved and draw where you moved them to.



10. This is my dog, Spot. Spot sees a giant bear in front of him, so he gets scared and runs away. Move 2 sticks to make Spot run in the opposite direction. Cross out the sticks you moved and draw where you moved them to (this is a trick question!)



PART 2: Roman Numerals with Toothpicks

A student worked on some problems using Roman Numerals, but they are all incorrect.

1. Form these problems with sticks, then correct them by moving 1 stick.

*Note that + and - are NOT made out of sticks.

a. $IV + V = XI$ $\longrightarrow VI + V = XI$

b. $III + III = IV$ $\longrightarrow III + III = VI$

c. $XV + I = XIV$ $\longrightarrow XI + V = XVI$

d. $VIII + V = XI$ $\longrightarrow VII + V = XII$

e. $VII + XII = XXI$ $\longrightarrow VII + XII = XIX$

2. Form these problems with sticks, then correct them by moving 1 stick to change ONLY the plus or minus sign.
*Note that + and - are made out of sticks.

Example: $VI+IV=I$ \longrightarrow $VI-IV=II$

a. $X+IV=V$ \longrightarrow $X-IV=VI$

b. $VII-III=IX$ \longrightarrow $VII+II=IX$

c. $II-II=III$ \longrightarrow $II+I=III$

d. $VI-IV=IX$ \longrightarrow $VI+IV=X$

e. $XII+V=VI$ \longrightarrow $XII-V=VII$

Challenge Questions

Put a + or - into the boxes to make the problems correct.

Example: $7 \boxed{-} 6 \boxed{+} 5 = 9 \boxed{-} 4 \boxed{+} 1$

Now you try!

1. $5 \boxed{+} 3 \boxed{+} 2 = 8 \boxed{+} 5 \boxed{-} 3$

2. $3 \boxed{+} 2 \boxed{+} 1 = 10 \boxed{-} 3 \boxed{-} 1$

3. $9 \boxed{+} 8 \boxed{-} 3 = 10 \boxed{+} 7 \boxed{-} 3$

4. $12 \boxed{+} 7 \boxed{-} 4 = 7 \boxed{+} 6 \boxed{+} 2$