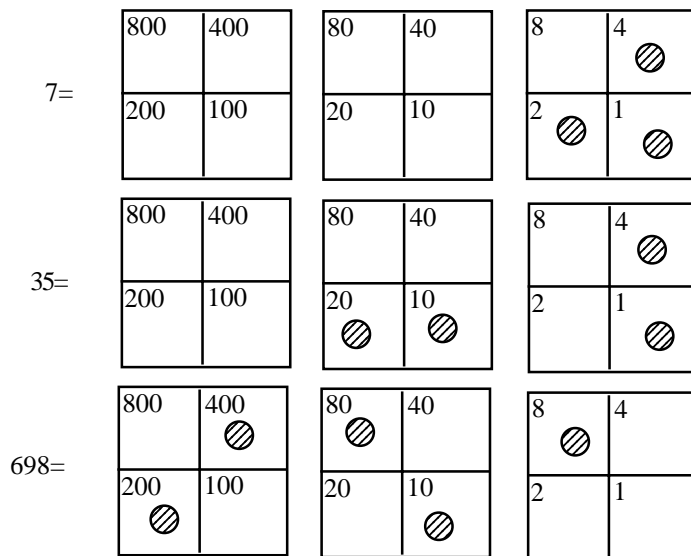


Papy's Computer

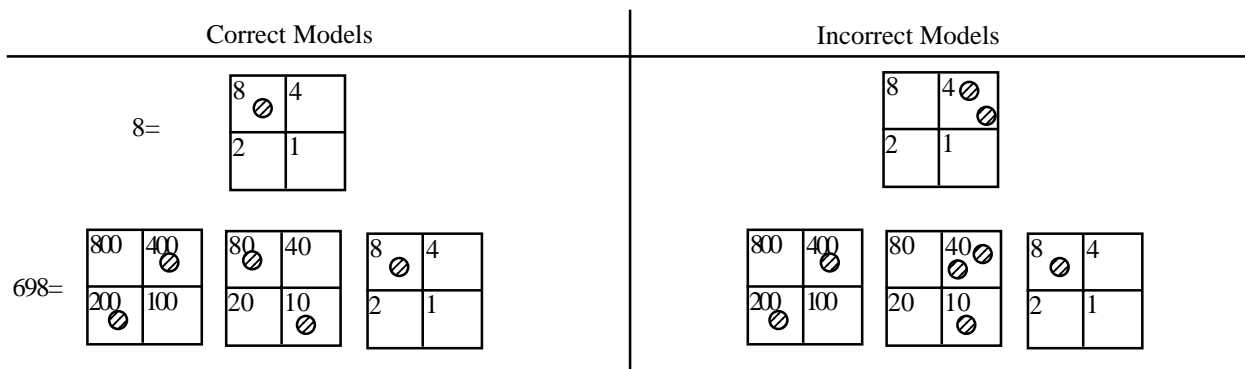
Practice modeling numbers in a variety of ways helps children develop number sense. Awareness of number relationships also strengthens estimation and computational skills.

In the early 1970's the students in Frederica Papy's fourth grade class in Belgium invented a type of two-dimensional abacus that has become known as Papy's Computer. Introduced into the United States through a National Council of Teachers of Mathematics annual meeting, Papy's Computer was originally created as an extension of work with Cuisenaire Rods. John Firkins of Gonzaga University shared Papy's Computer with teachers in North Carolina.

Use counters and Papy's Computer to build one, two, and three digit numbers. Here are several examples:



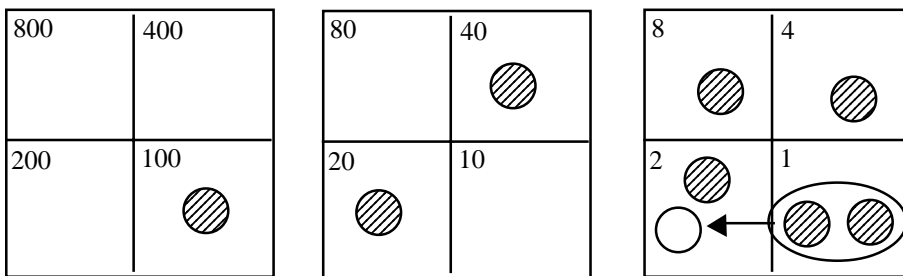
Notice that no square has more than one counter.



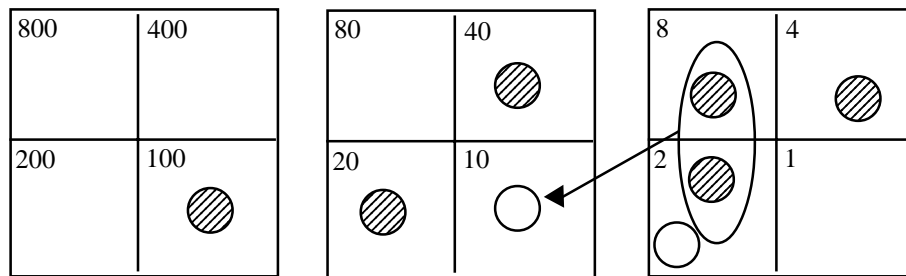
Give children opportunities to build numbers on the overhead so that all can see correct models and then allow them to work with a partner to practice building many numbers. Try modeling these numbers: 43,59, 137, 524, 691. You may wish to have students work with partners at their desks and take turns showing their models on the overhead.

Adding with Papy's Computer

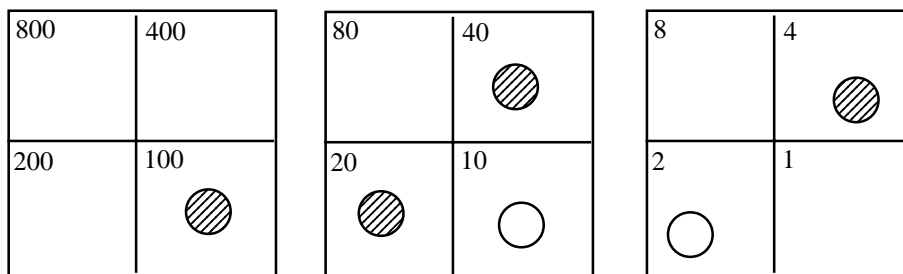
Addition of sums to 999 can be done on the boards. For example: If you are adding 129 to 47, you would first build 129 and then build 47 on the same boards. (You would put counters on the 100, 20, 8, 1 for the 129 and then the 40, 4, 2,1 for 47.) To do the addition, you must rearrange the counters on the boards so that each board has no more than one counter in each square. The two counters on the 1 are added together and exchanged for one on the 2.



Now there are two counters on the 2. One on the 2 should be added to the counter on the 8 and exchanged for one marker on the 10 rather than changing two 2's for one counter on the 4. This is to avoid having two counters in the same space. At this point there is only one marker on any square.



By adding the numbers on which there is a counter you have the answer to the addition problem.

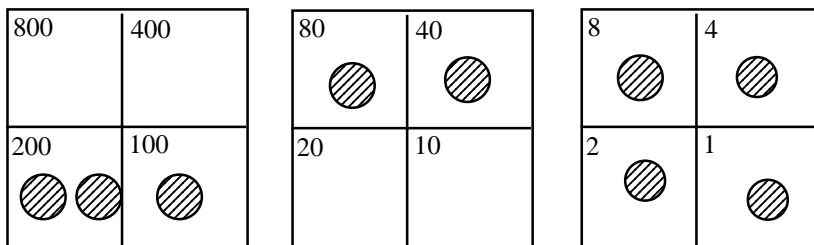


$$100 + 40 + 20 + 10 + 4 + 2 = 176$$

Try these examples: $56 + 29$, $234 + 217$, $603 + 28$ (You may wish to try them yourself before working with the students.)

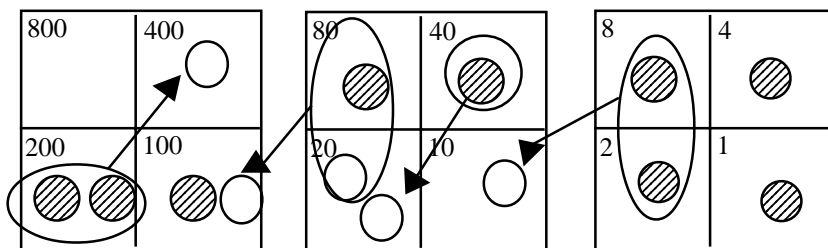
A more difficult problem involves several steps in trading:

a. Build both numbers.



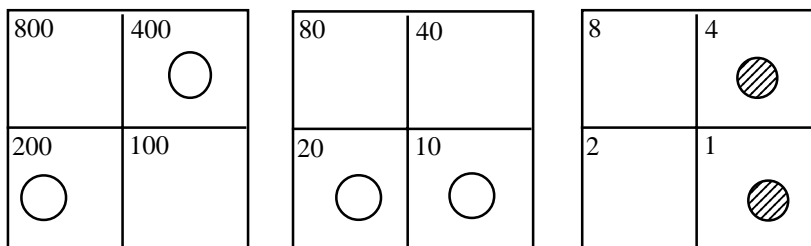
b. Combine 2 and 8 to make a 10.

c. Trade a 40 for two 20's and add 20 + 80 to make 100.



d. Combine two 200's to make a 400.



e. Combine two 100's to make a 200.

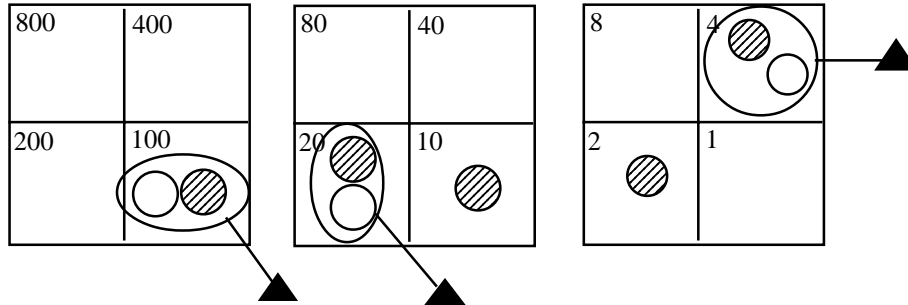


$$400 + 200 + 20 = 10 + 4 + 1 = 6356$$



Papy's Computer appeals to many students while others find it difficult to go beyond modeling of numbers and simple addition. Encourage children to work with partners to both assist and monitor each other.

The boards may be used for subtraction, but many third grade children will need a great deal of guidance. You may decide to use Papy's Computer for addition only.

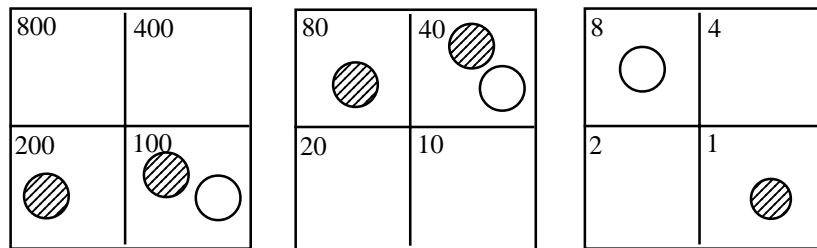
Here is one simple subtraction example. Two different colored counters are helpful. Use  counters to show 136 and  counters to model 124. Notice this is building a type of comparative model.



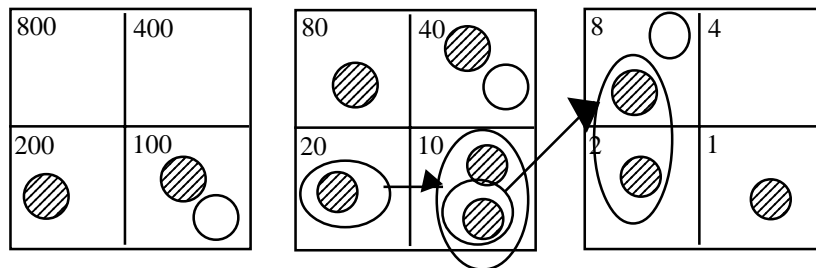
If there are equal counters of the two colors in a square, they cancel each other out and are removed from the board. The counters remaining on the board, when all of the white counters are removed, name the difference or the subtraction problem.

Below is a more complex model. It requires us to make a fair trade and exchange one counter of higher value for two others of an equal value. Use  to show 361 and  to show 148.

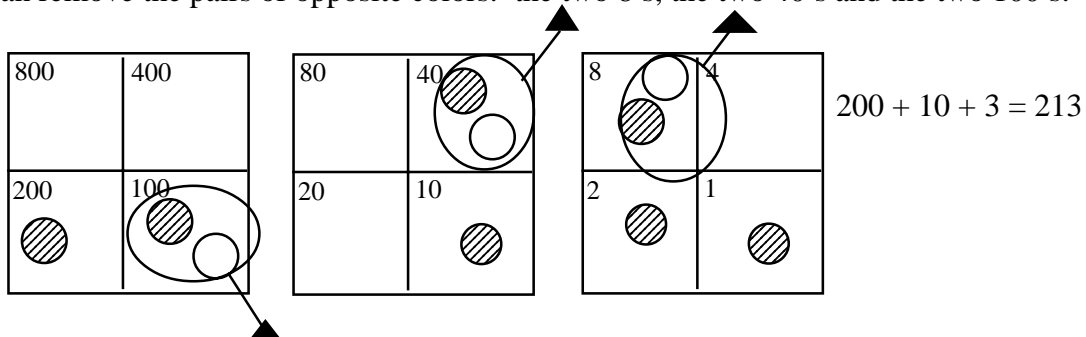
$$361 - 148 = 213$$



Because you need to remove both 148 in the lighter counters and 148 from the original set, you must trade to be able to remove the counter from the 8. Trade one 20 for two 10's. Then trade for an 8 and a 2.



Now you can remove the pairs of opposite colors: the two 8's, the two 40's and the two 100's.

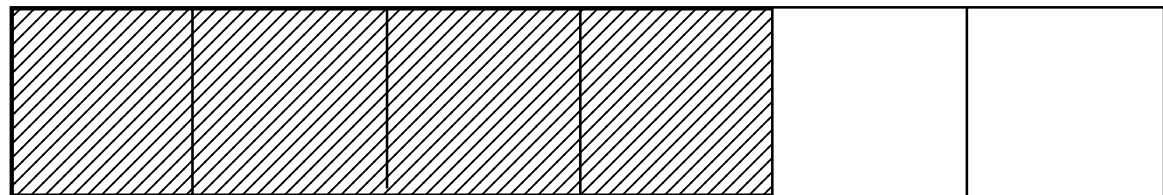
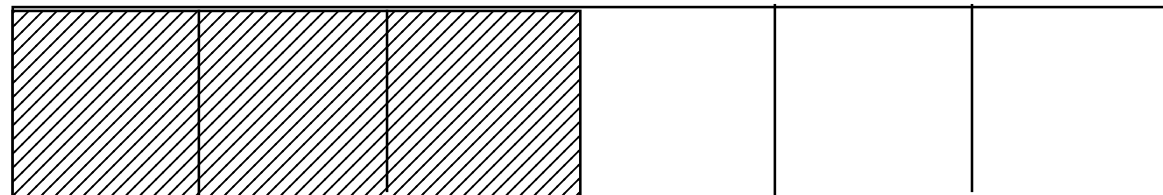
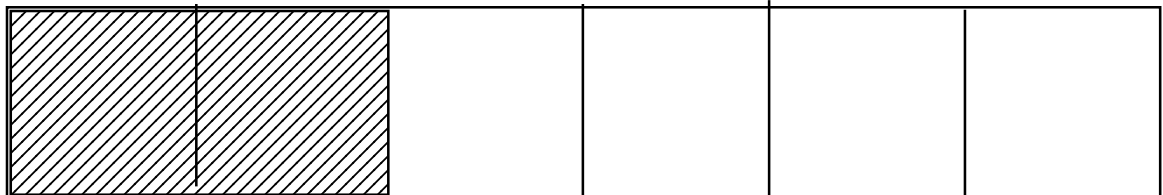
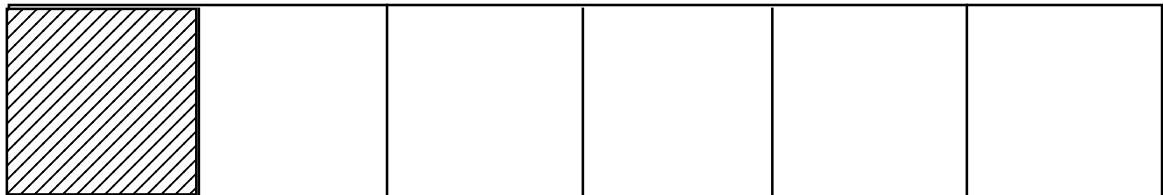
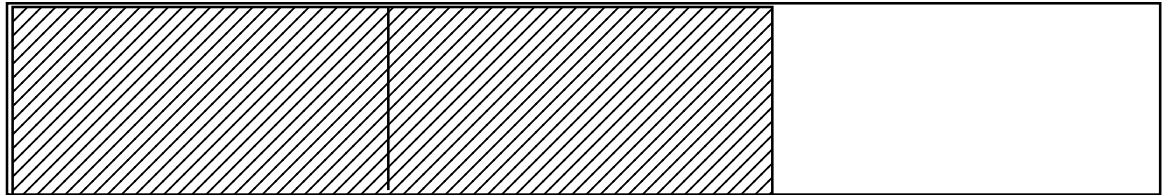
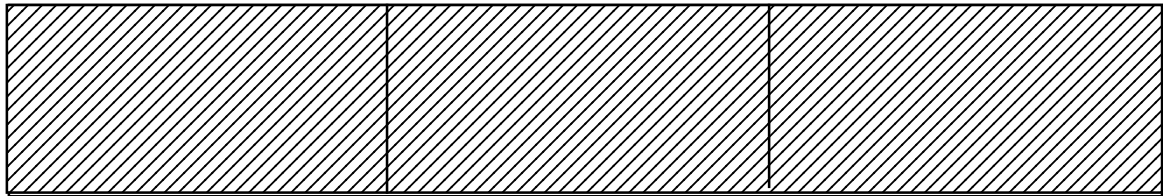


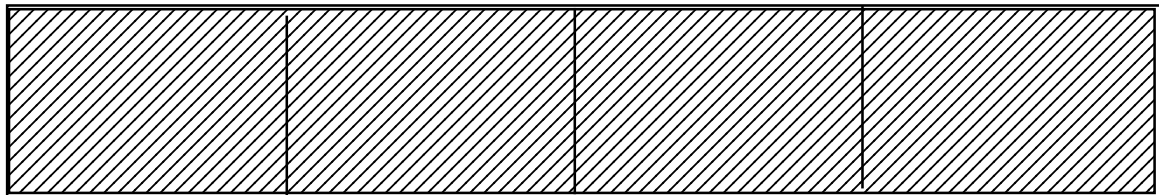
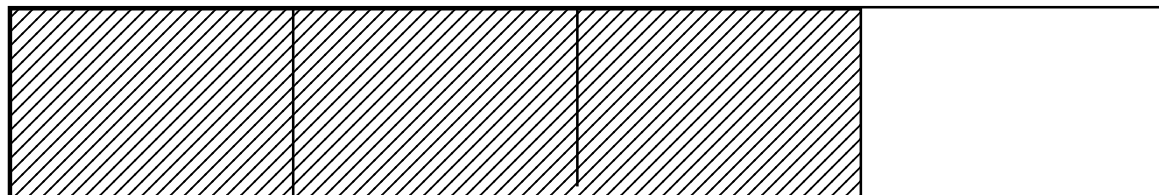
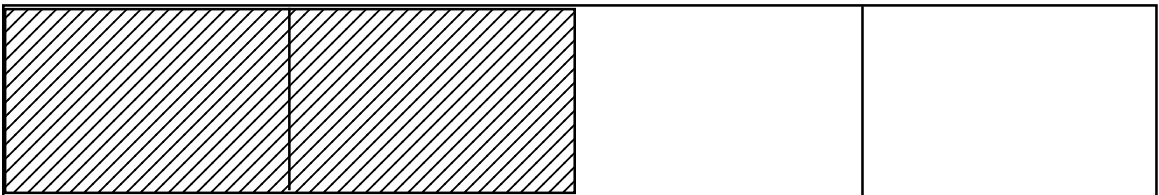
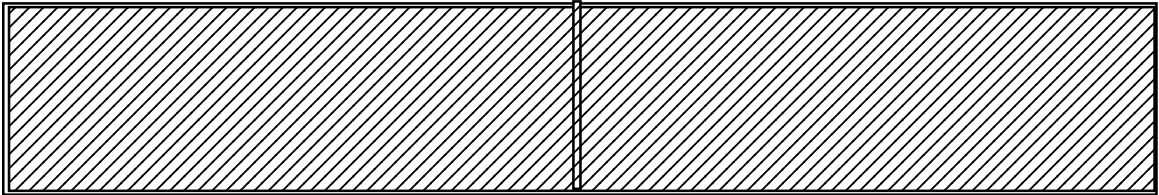
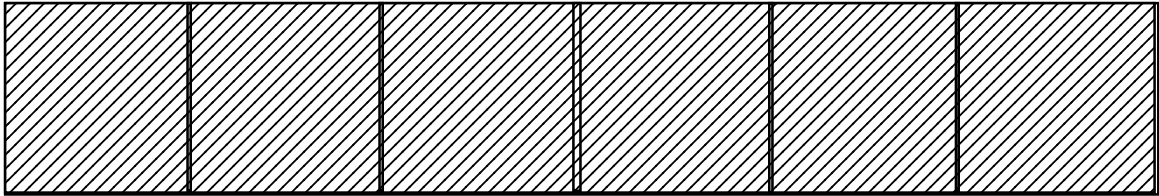
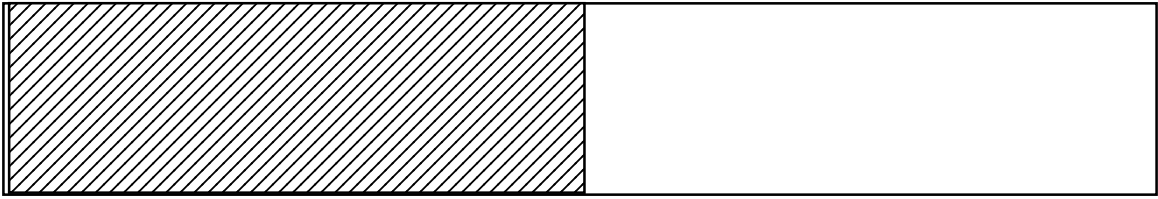
Papy's Computer

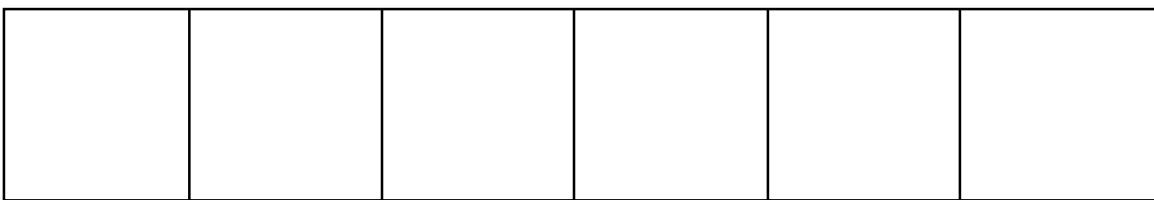
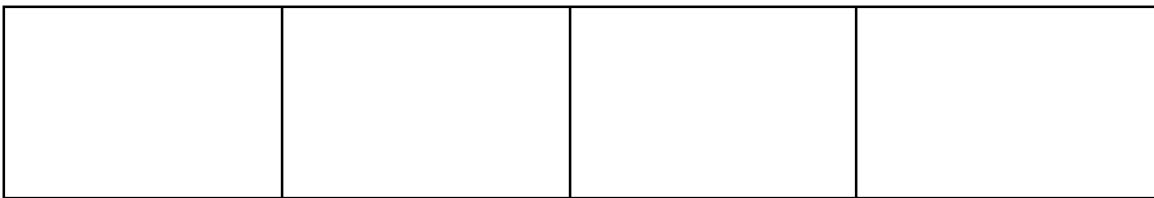
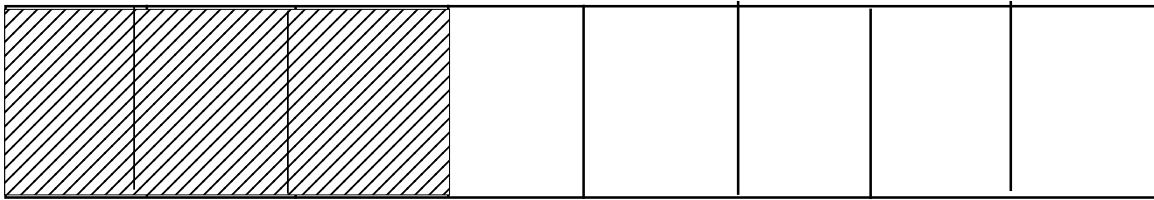
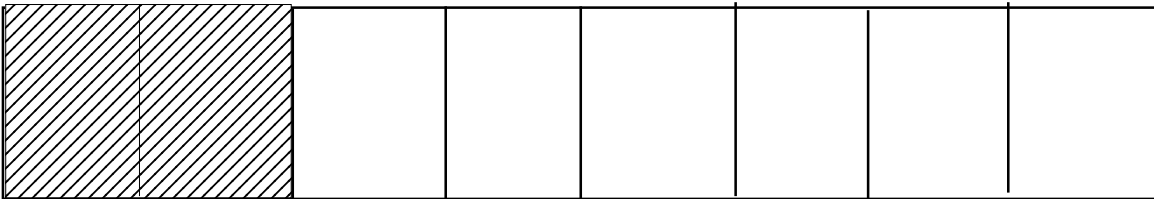
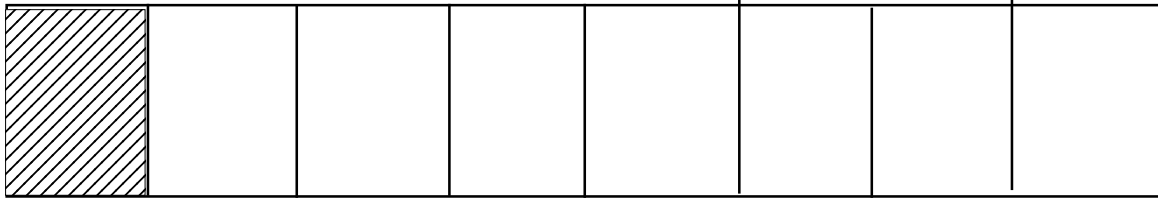
800	400
200	100

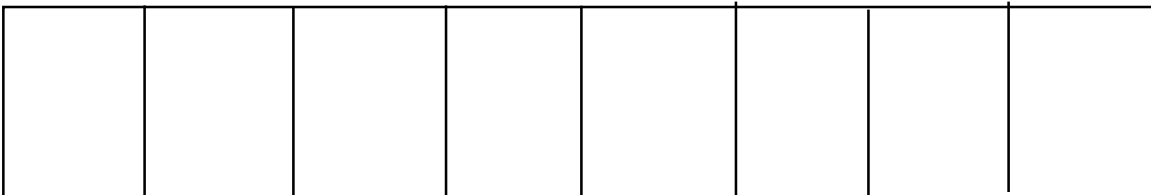
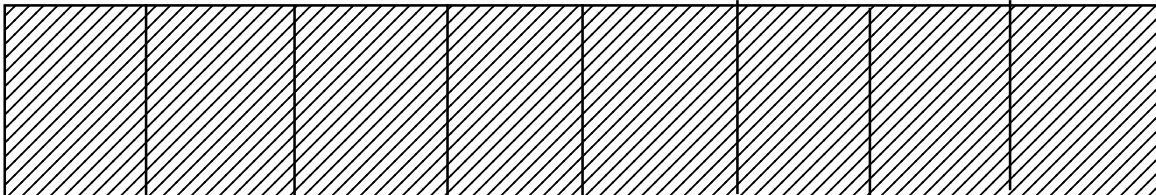
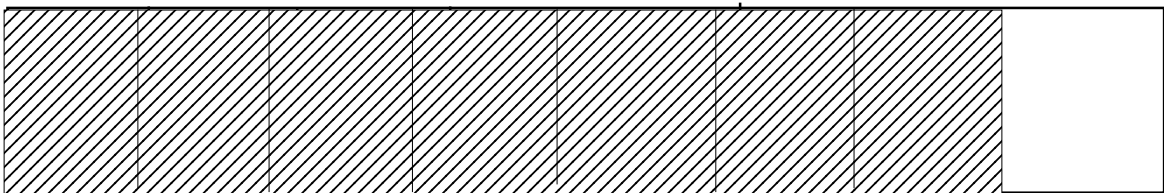
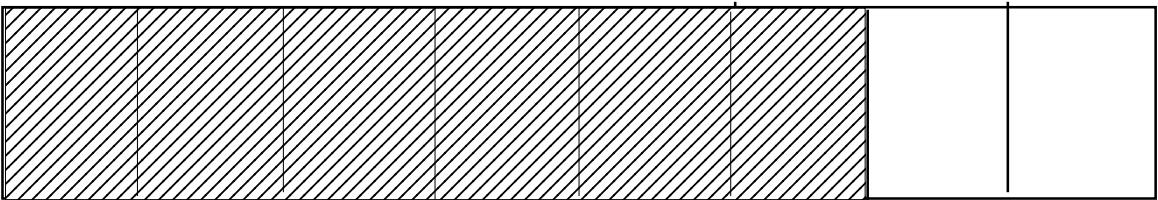
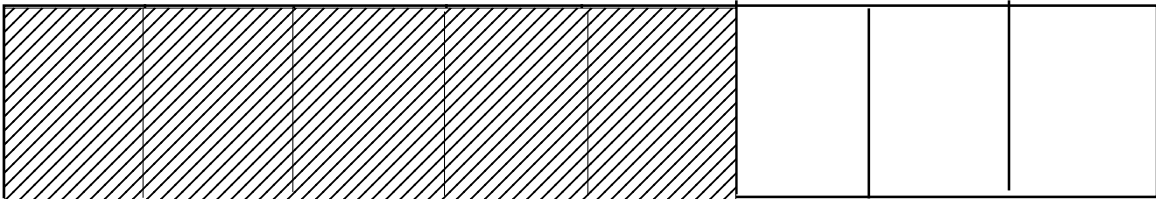
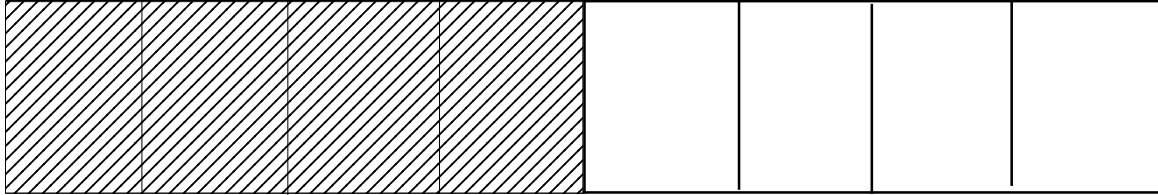
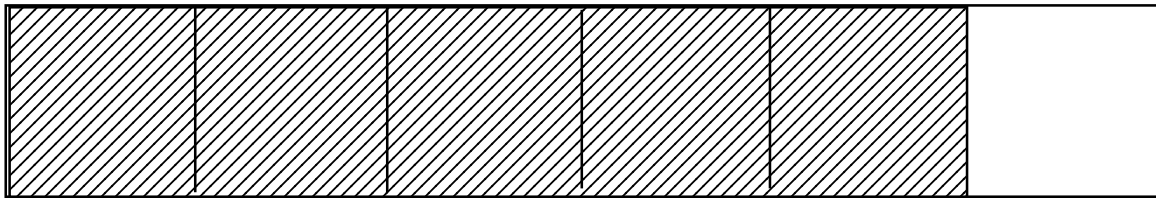
80	40
20	10

8	4
2	1









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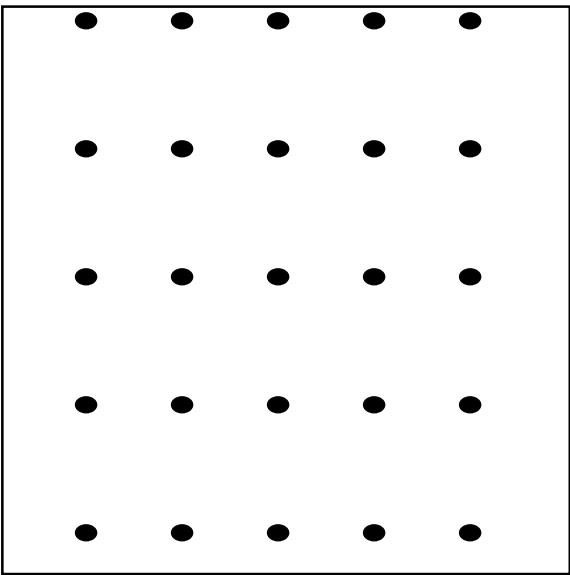
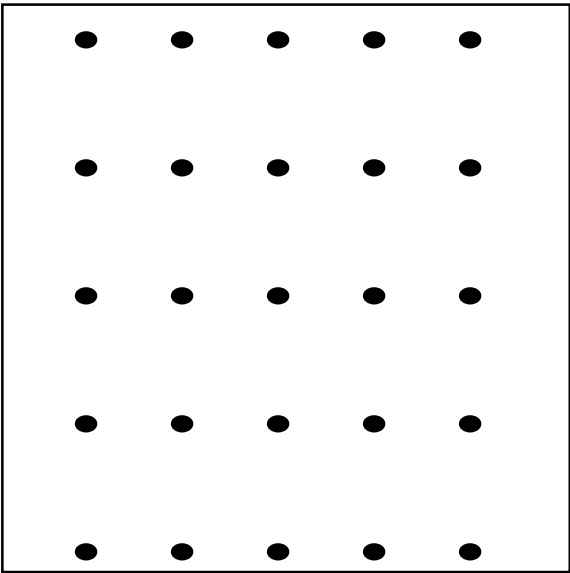
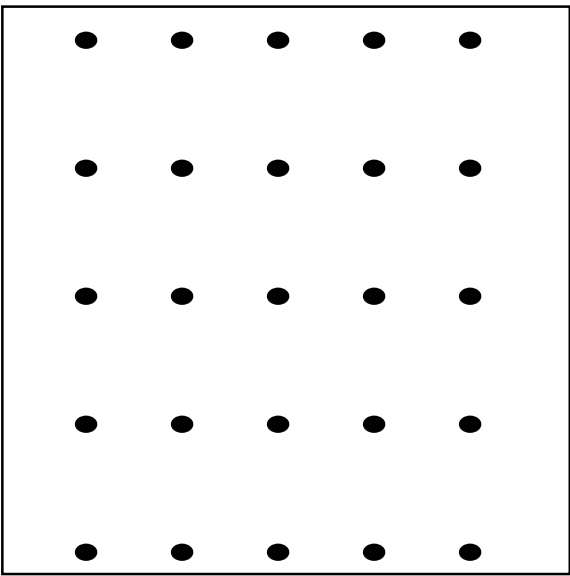
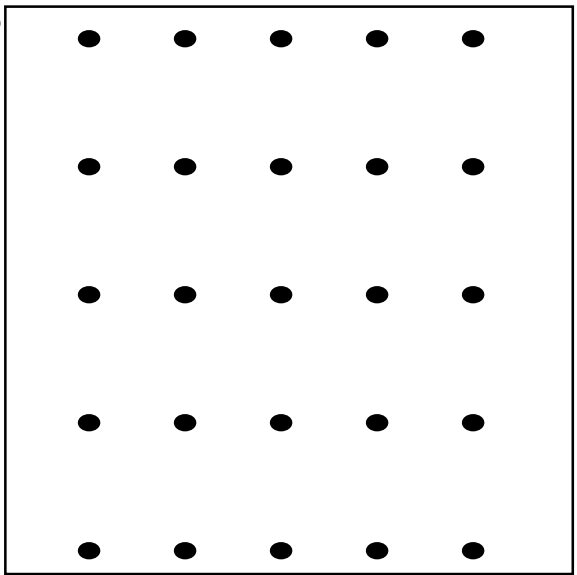
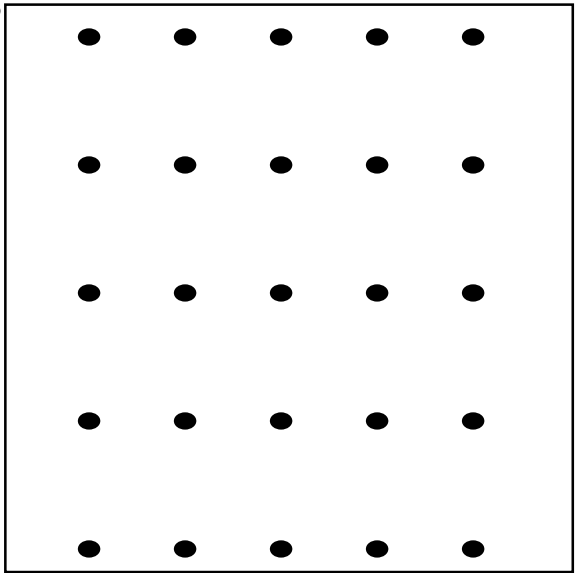
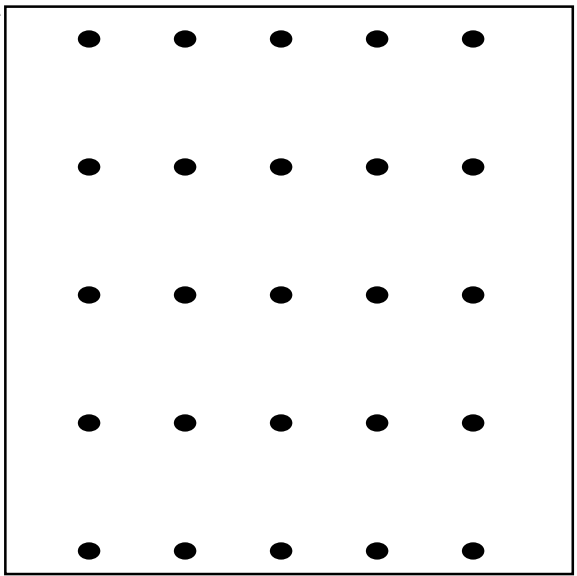
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$$\frac{1}{12}$$

$$\frac{1}{2}$$

$$\frac{1}{10}$$

$$\frac{1}{3}$$

$$\frac{5}{8}$$

$$\frac{1}{4}$$

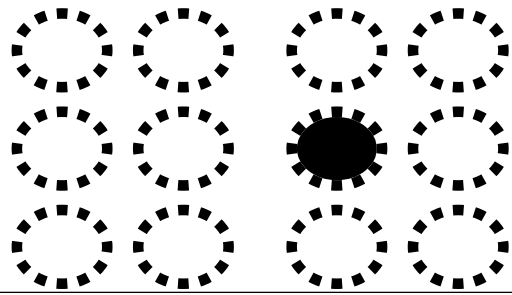
$$\frac{1}{8}$$

$$\frac{2}{3}$$

$$\frac{3}{4}$$

$$\frac{1}{5}$$

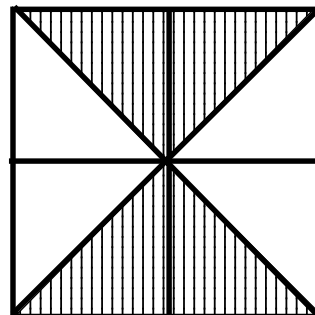
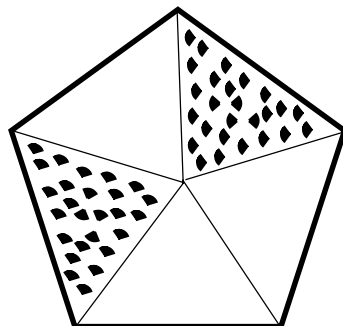
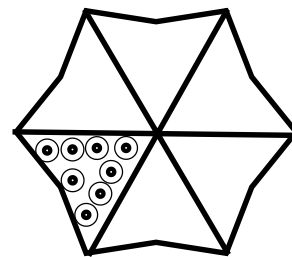
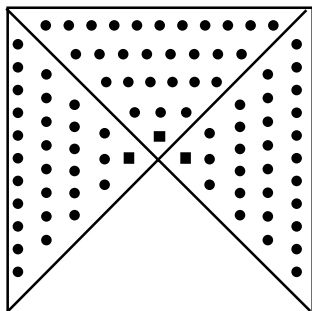
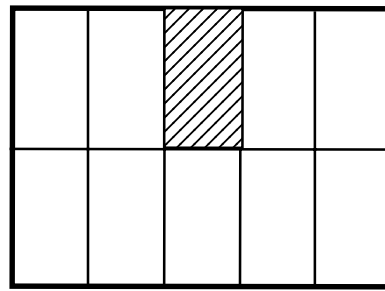
$$\frac{2}{5}$$

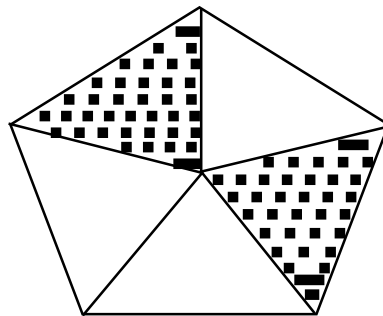
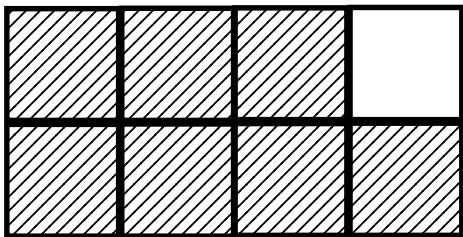
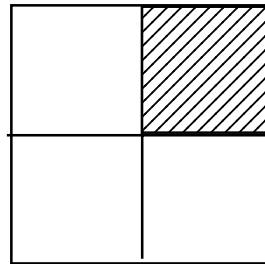
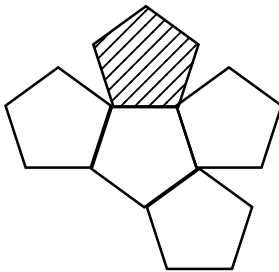
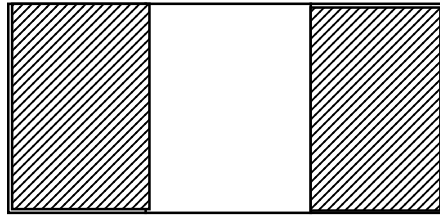
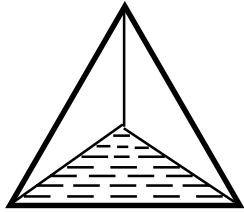


$$\frac{1}{6}$$



$$\frac{7}{8}$$





$$\frac{2}{16}$$

$$\frac{3}{24}$$

$$\frac{6}{8}$$

$$\frac{9}{12}$$

$$\frac{8}{12}$$

$$\frac{4}{6}$$

$$\frac{6}{12}$$

$$\frac{3}{12}$$

$$\frac{2}{8}$$

$$\frac{4}{20}$$

$$\frac{2}{10}$$

$$\frac{5}{10}$$

$$\frac{4}{12}$$

$$\frac{2}{6}$$

$$\frac{2}{24}$$

$$\frac{3}{36}$$

$$\frac{15}{24}$$

$$\frac{21}{24}$$

$$\frac{2}{12}$$

$$\frac{2}{20}$$

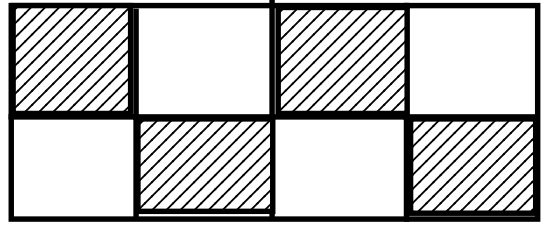
$$\frac{3}{30}$$

$$\frac{10}{16}$$

$$\frac{14}{16}$$

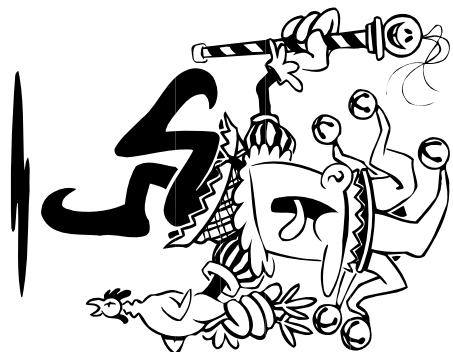
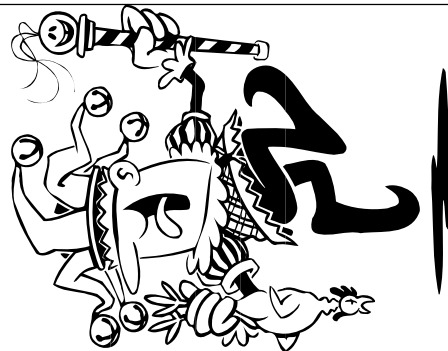
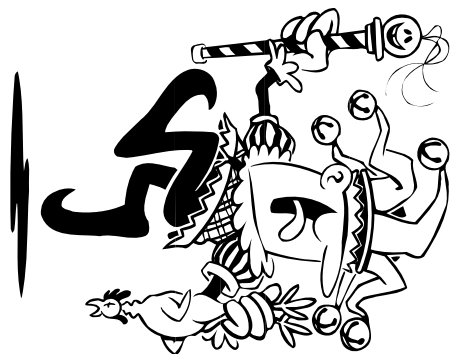
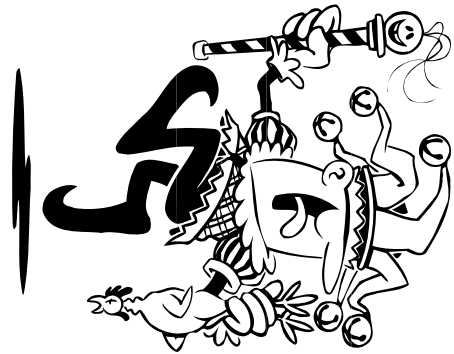
$$\frac{3}{18}$$

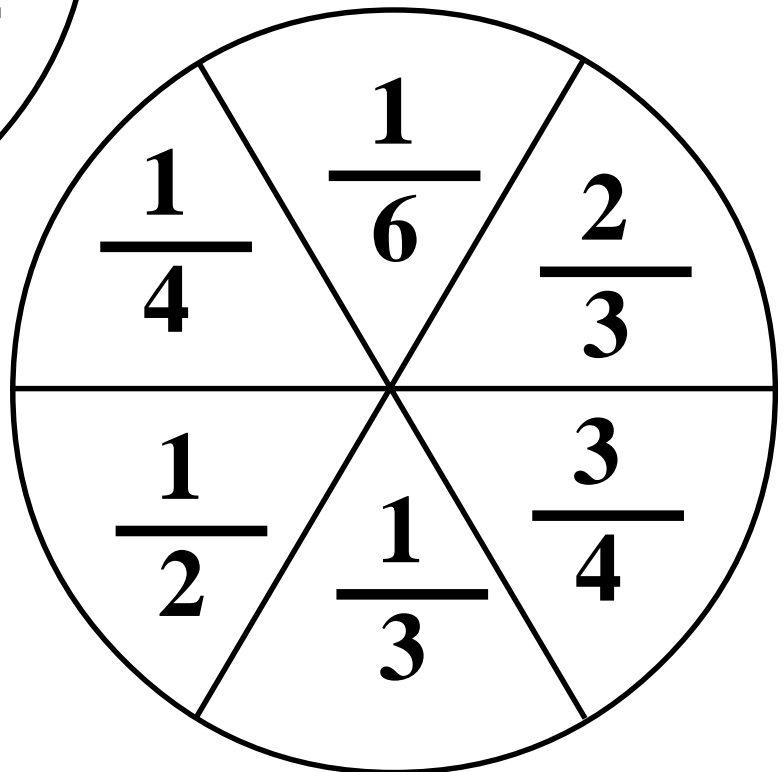
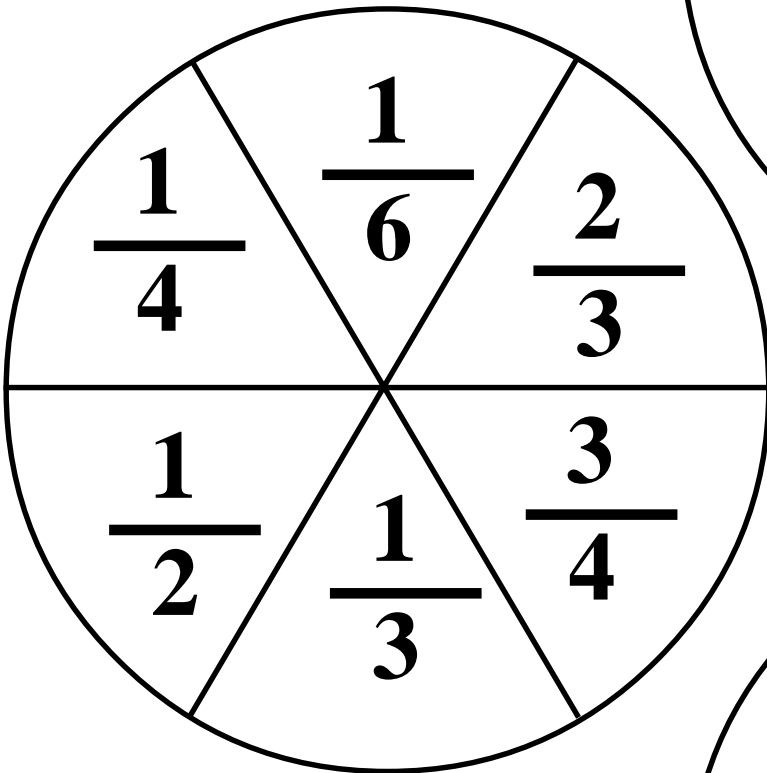
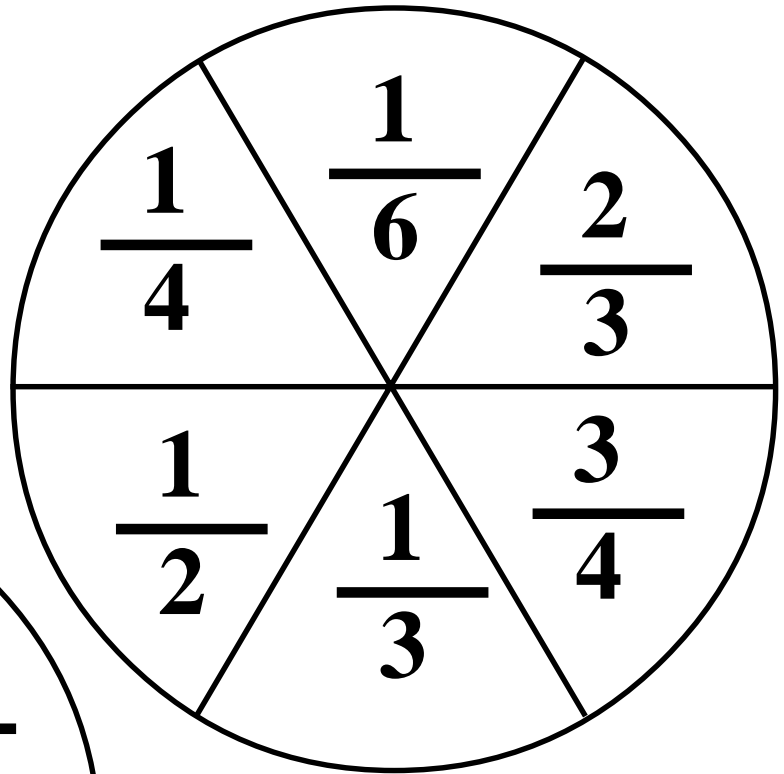
$$\frac{4}{8}$$

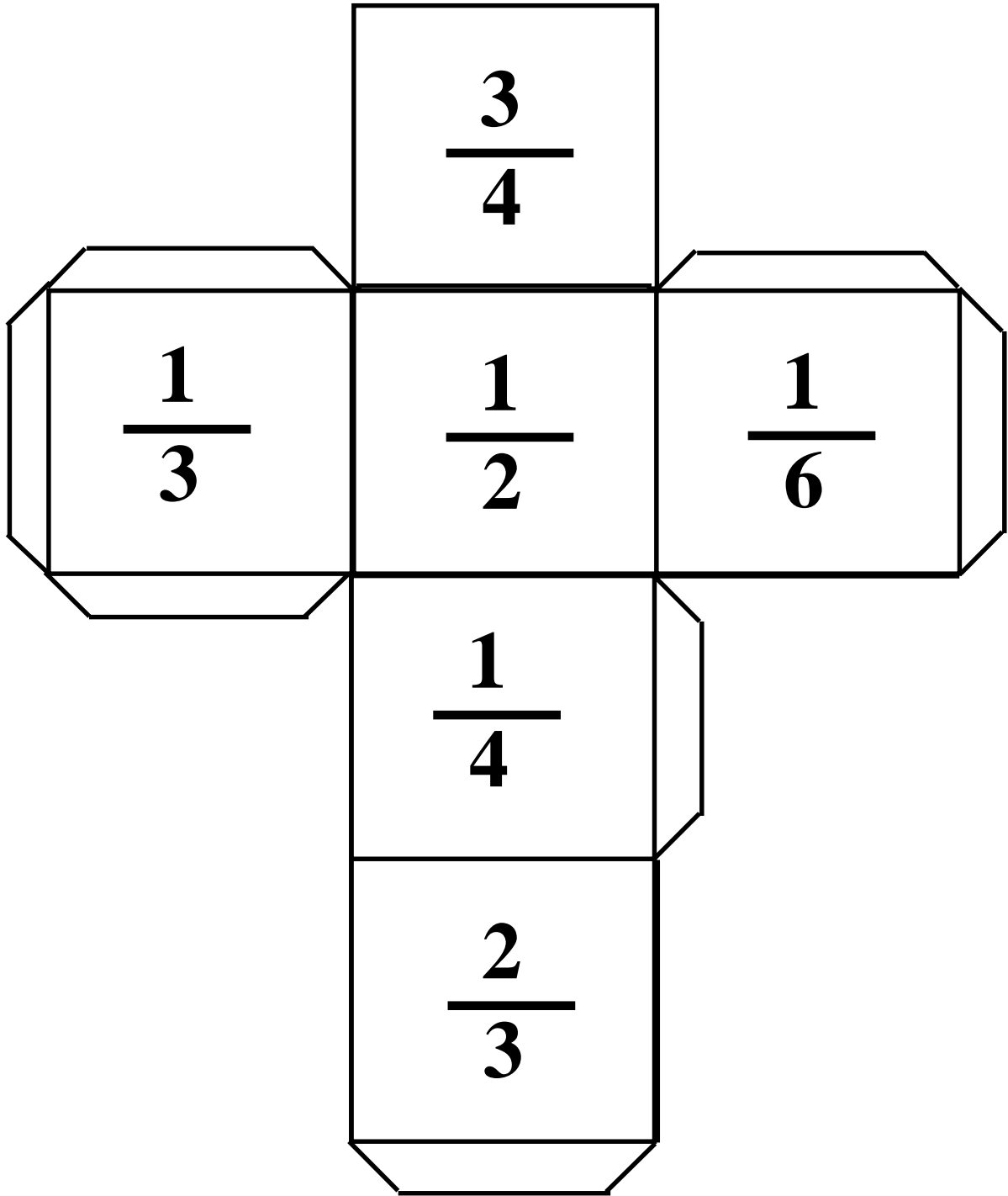


$$\frac{4}{10}$$

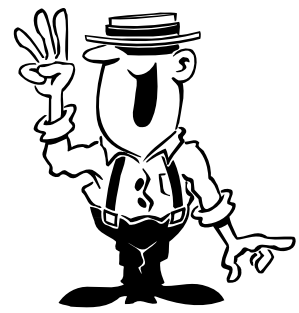
$$\frac{6}{15}$$







THREE-IN-A-ROW



Choose a Gameboard!

A.

$\frac{1}{6}$	$\frac{3}{4}$	$\frac{5}{6}$
$\frac{1}{2}$	$\frac{3}{3}$	$\frac{3}{8}$
$\frac{3}{5}$	$\frac{7}{8}$	$\frac{1}{4}$

B.

$\frac{5}{8}$	$\frac{2}{8}$	$\frac{1}{4}$
$\frac{3}{4}$	$\frac{2}{5}$	$\frac{2}{8}$
$\frac{3}{3}$	$\frac{1}{2}$	$\frac{5}{6}$

C.

$\frac{5}{8}$	$\frac{1}{2}$	$\frac{3}{6}$
$\frac{2}{3}$	$\frac{3}{8}$	$\frac{4}{4}$
$\frac{7}{8}$	$\frac{2}{5}$	$\frac{1}{3}$

D.

$\frac{4}{8}$	$\frac{5}{6}$	$\frac{1}{2}$
$\frac{1}{6}$	$\frac{3}{5}$	$\frac{2}{8}$
$\frac{2}{3}$	$\frac{6}{6}$	$\frac{1}{4}$

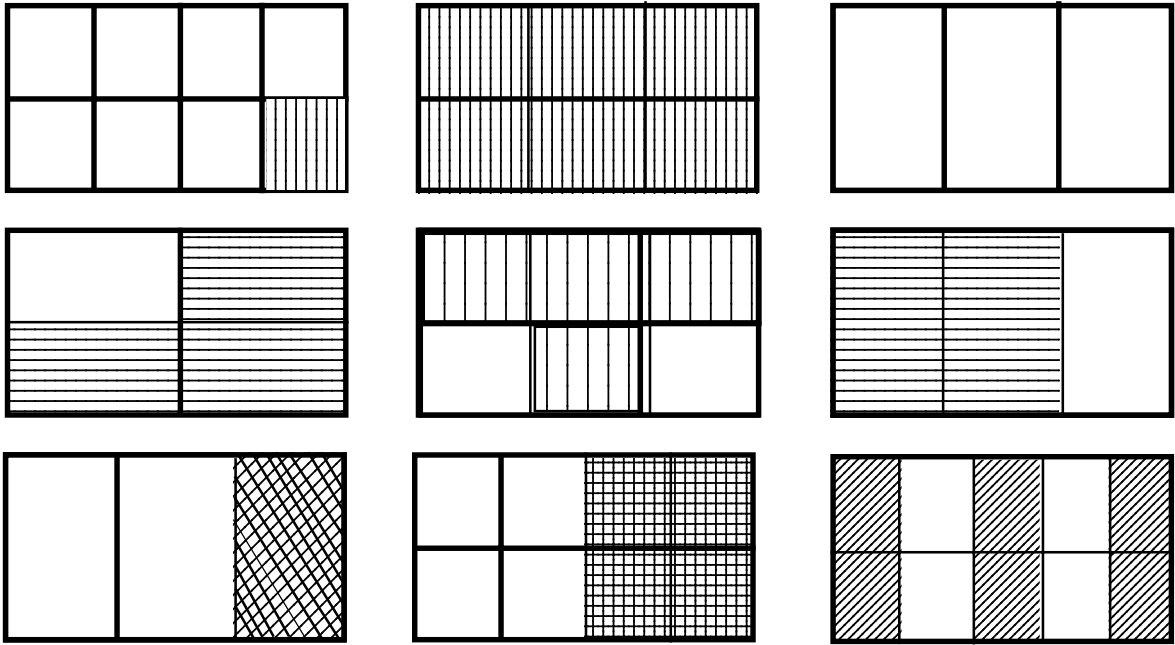
E.

$\frac{2}{8}$	$\frac{1}{3}$	$\frac{5}{6}$
$\frac{2}{5}$	$\frac{4}{4}$	$\frac{2}{3}$
$\frac{1}{2}$	$\frac{7}{8}$	$\frac{1}{4}$

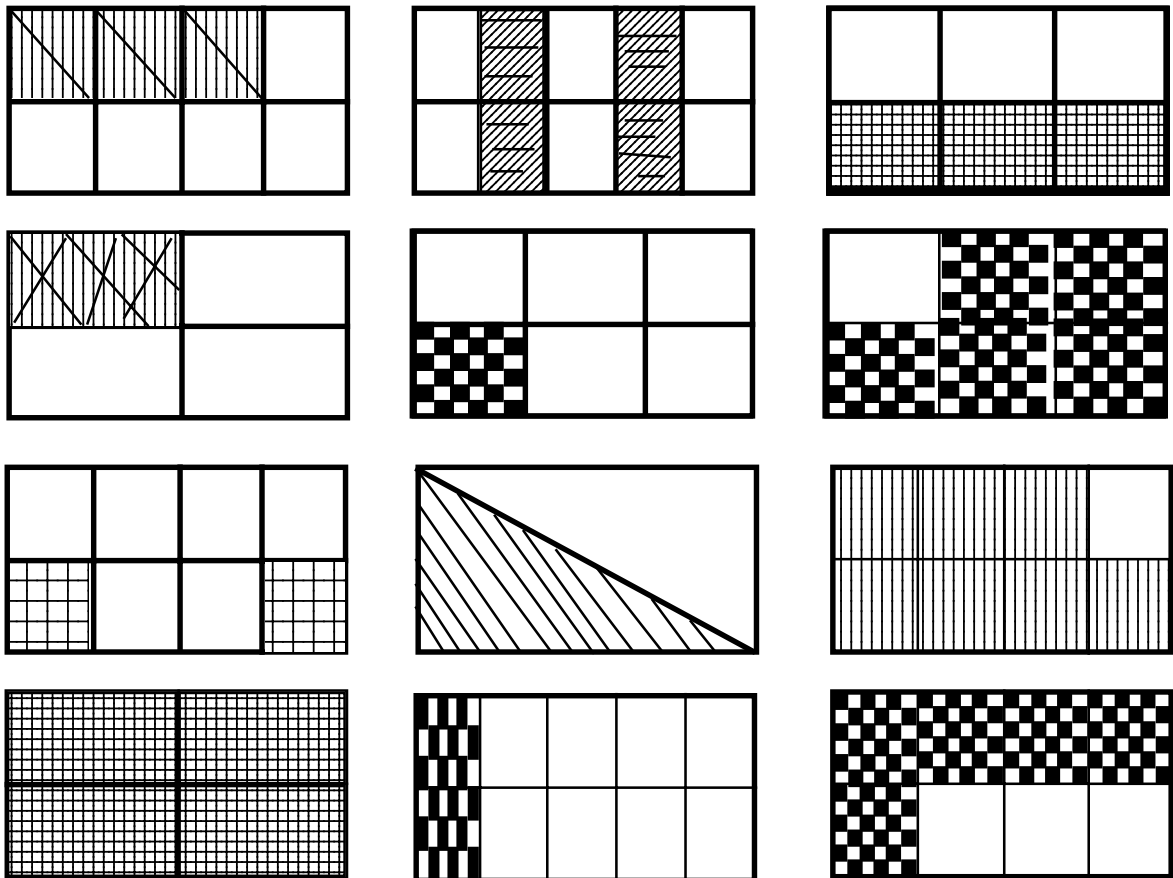
F.

$\frac{1}{2}$	$\frac{3}{5}$	$\frac{6}{6}$
$\frac{2}{3}$	$\frac{1}{8}$	$\frac{3}{4}$
$\frac{4}{6}$	$\frac{1}{3}$	$\frac{4}{8}$

Directions: Choose one gameboard for each game. When the leader uncovers a picture, mark your gameboard. Three-in-a-row is a winner!



THREE-IN-A-ROW



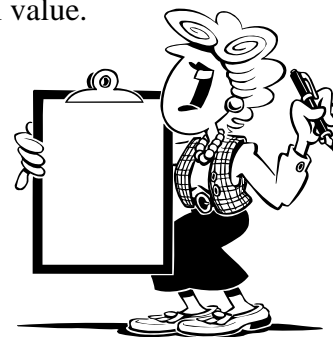
Valuable Words

5¢	10¢	25¢	50¢
A	B	C	D
E	F	G	H
I	J	K	L
M	N	O	P
Q	R	S	T
UV	W	XY	Z

Use the chart above to determine the value of words. Place a marker on all the Letters in a word. Add the values of each letter to determine the total value.

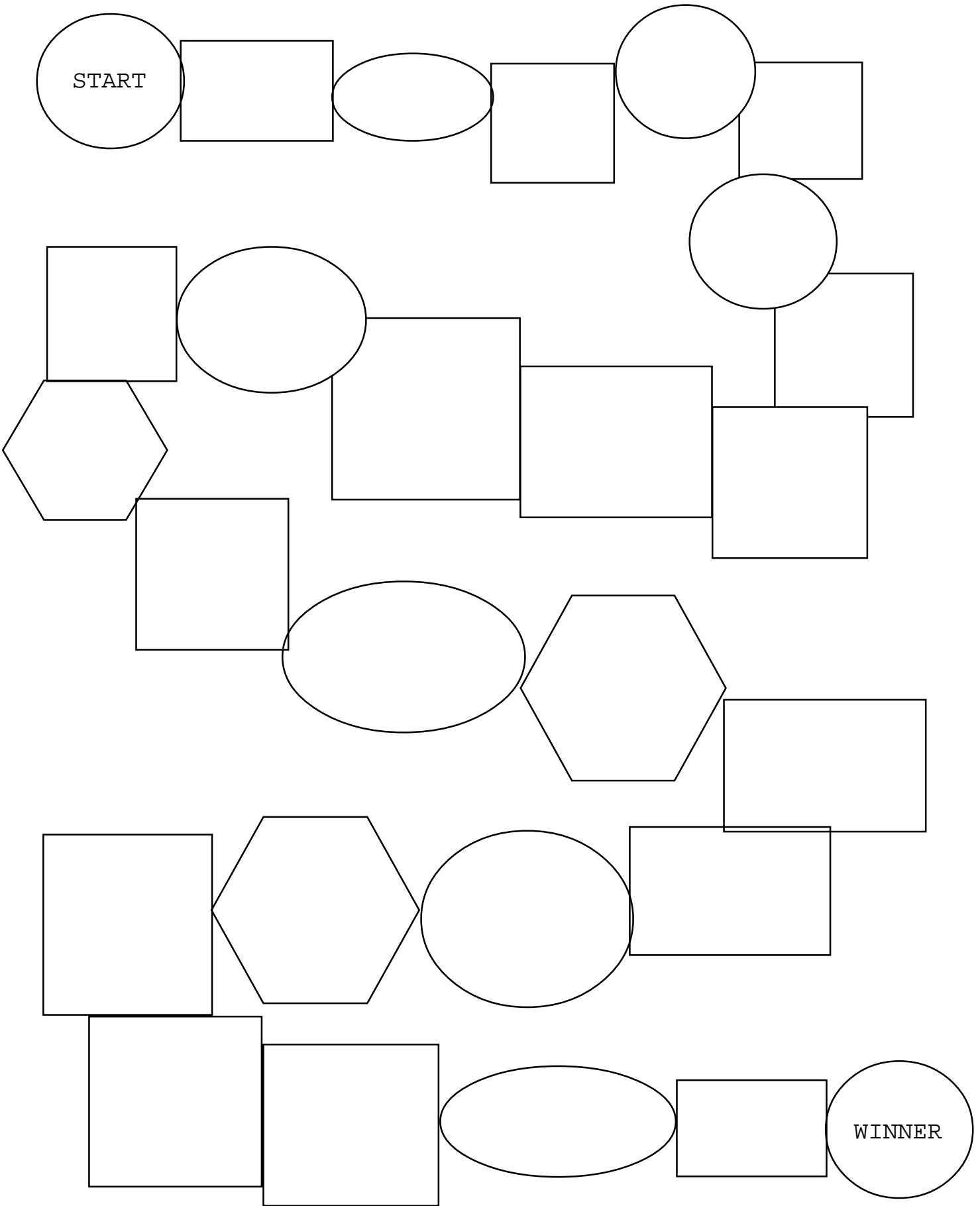
Example:

D = 50¢	C = 25¢
O = 25¢	A = 5¢
G = 25¢	T = 50¢
100¢	80¢



What is your name worth?

Gameboard outline



150

250

350

450

550

650

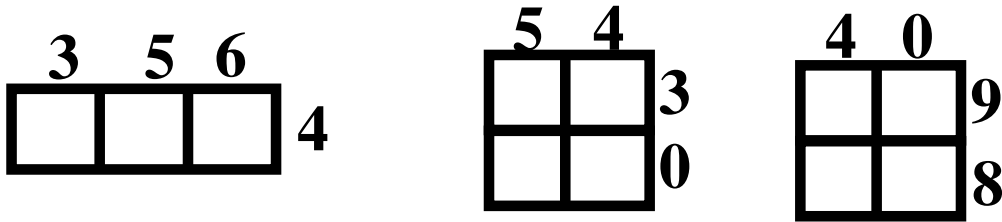
750

850

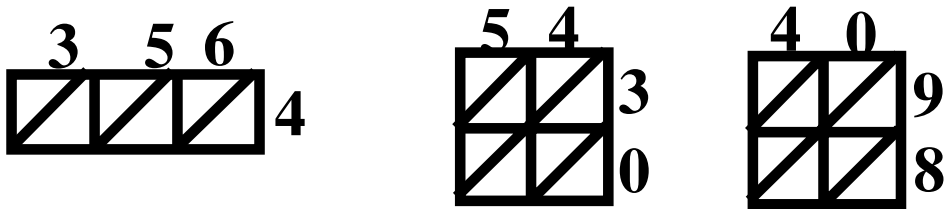
950

50

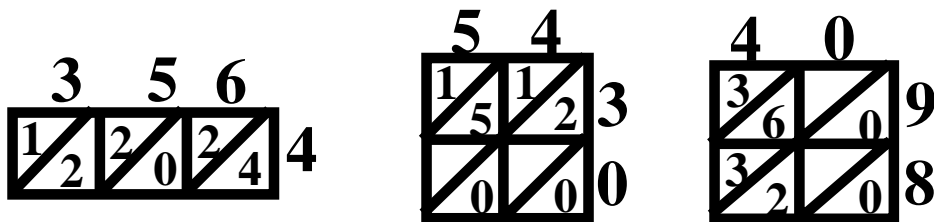
step 1: Place numbers outside a grid as illustrated.



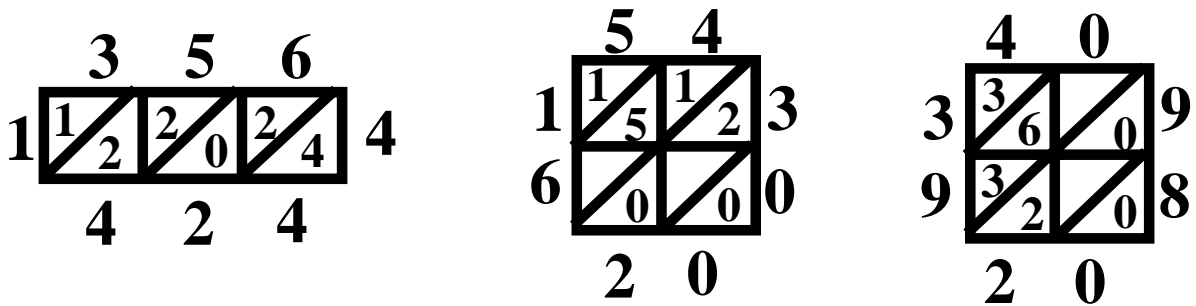
step 2: Draw the diagonals as illustrated.



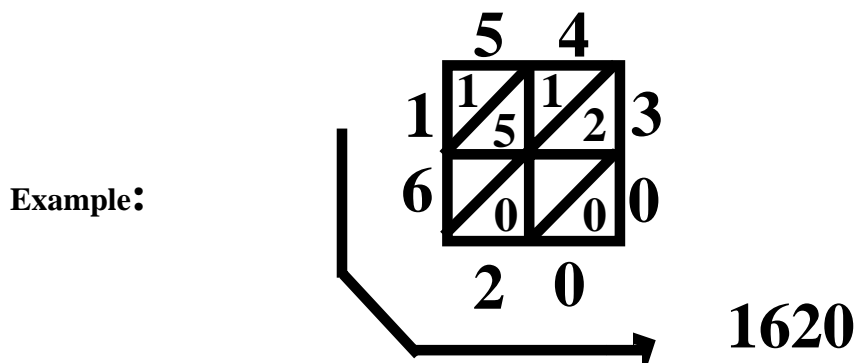
step 3: Multiply (basic facts) putting ones digits of products in lower part of box and tens digits in upper part.



step 4: Add the numbers along the diagonals.



step 5: Read product from left to right and around the corner.



Notice that this process will work for problems with factors of any size.

Using Napier's Bones

Name _____

