Name_____Date_____

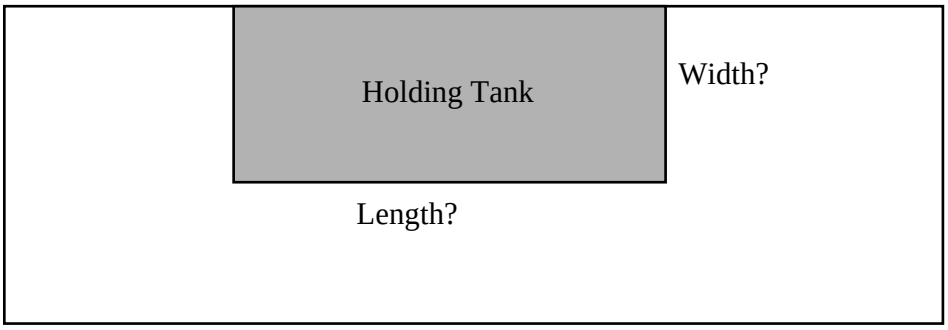
Space Ship Storage

NASA is planning to make a new space craft that will have a rectangular cargo bay. It is important for the bay to hold as much as possible, but it should be made with the smallest amount of material possible to cut down on costs.

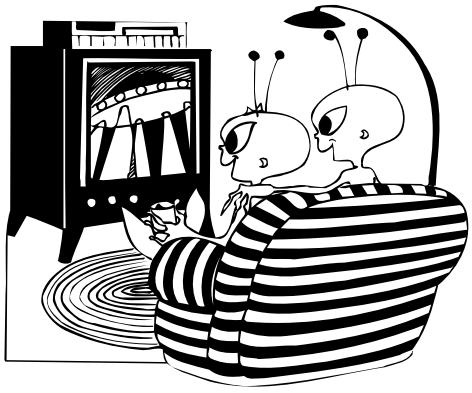
The designers are told that the rectangle should have a perimeter of 48 yards. How can they make this rectangle so that it will contain as much area as possible?

Cut two pieces of pipe cleaner 24 cm long. Use the two pieces to represent your 48 yards of perimeter. Experiment with various rectangles. What is the biggest area you can make?

Extension: Now NASA wants to make a rectangular holding area for specimens inside the Space Shuttle Cargo Bay. One wall of the holding tank will be along the wall of the shuttle. The other three walls will be made from a sheet of metal that is 32 feet long. What dimensions will the holding bay have if you want the maximum area possible?



Cargo Bay



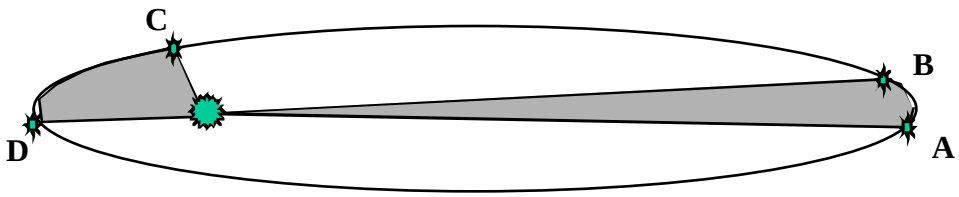
Name_____Date_____

Kepler's Laws

In the early 1600's Johannes Kepler was busy studying the skies. He figured out some laws that govern how the planets and other bodies such as comets travel. He first noticed that their orbits were in the shape of an ellipse, and he also noticed something about their speed.

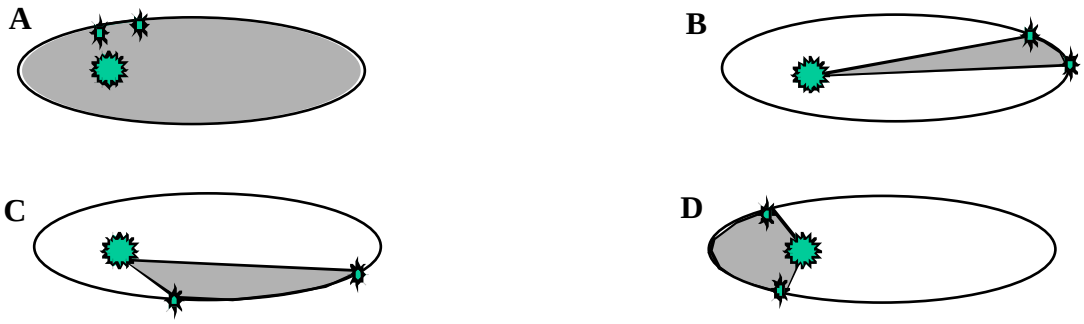
Planets sweep out equal areas in equal times.

Example: Imagine this is the orbit of a comet going around the sun. While the comet moves from point A to B, we can imagine that it covers a wedge of the ellipse shaded below.



While it moves from C to D, a different wedge is covered. Kepler's law says that when the time traveled is equal, the area of the wedges has to be equal.

1. Which of the diagrams below could represent equal time periods in a comet's path?

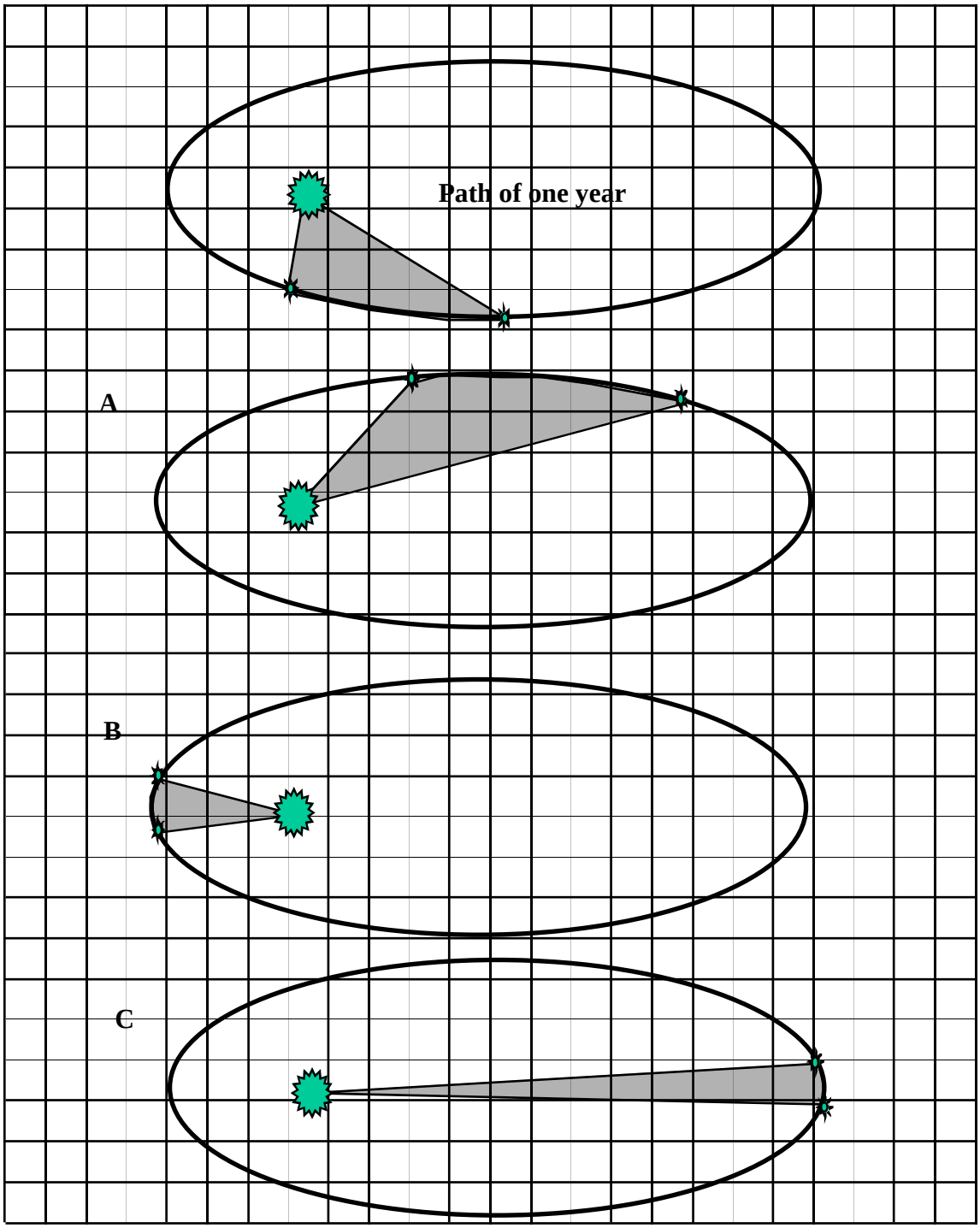


2. Does the planet move faster when it is close to the sun, or far away?

Name_____Date_____

Kepler's Laws (cont.)

The diagram below shows one year in the path of a comet. Which other diagram would also show about one year?

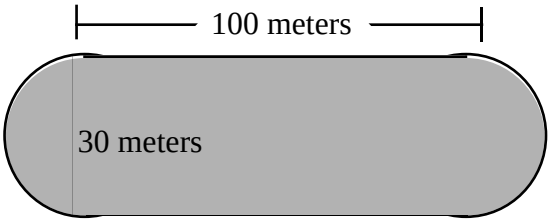


Name_____Date_____

Circumference Stumpers

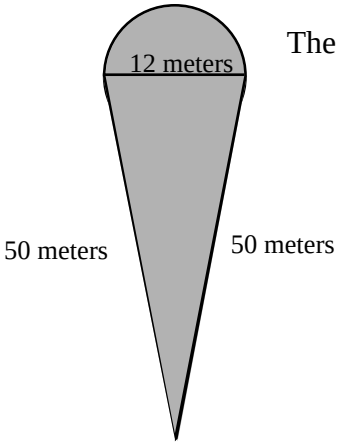
Find the perimeter of each shaded figure below.

1.



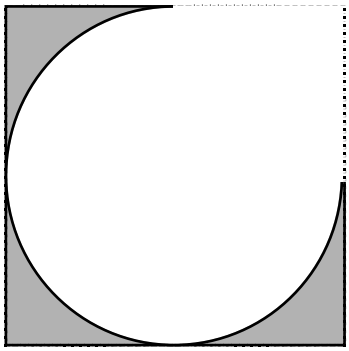
The ends of this track are semicircles.

2.



The top of this shape is a semicircle.

3.



24 meters

Name_____Date_____

Eyes on Space

Some of the world's biggest telescopes are listed below. In each case, the diameter is given. Find the radius and circumference. Use the pi key on your calculator, and round to the nearest tenth.

Telescope	Diameter	Radius	Circumference
Radio Telescope Arecibo, PR	1000 feet	_____	_____
Very Large Array Socorroo, NM (has 27 units of 82 feet each)	82 feet	_____	_____
Radio Telescope Effelsburg, Germany	100 meters	_____	_____
Hale Telescope Mount Palomar, CA	200 inch	_____	_____
Reflector scope Zelenchukskaya, Russia	236 inches	_____	_____
Yerk's Refractor William's Bay, Wisconsin	40 inches	_____	_____

Put the diameters above in order from smallest to largest.
Convert each diameter above to yards. (100 meters is about 330 feet.)

Diameter given above	Equivalent diameter in yards
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Estimation Problem Discussion Cards

Problem 1

Airline engineers need to know the weight of a plane and its cargo in order to make decisions that will enable the plane to take off. These decisions might involve the area of wings or size of fuel tanks.

A certain plane can hold 200 passengers and it is estimated that they will weigh an average of 150 pounds with weights ranging from 60 pounds to 300 pounds.

What error can occur if they use the lightest weight as an estimate?
What error can occur if they use the heaviest weight as an estimate?
What error can occur if they use the average weight as an estimate?
Which is best? Is any estimate adequate?

Problem 2

An apple farmer is planning the budget for his upcoming year. His income is based solely on the amount of apples his trees produce. In his newest orchard section, the trees produce an average of 112 pounds of apples per tree. But in some years and in some trees the production is as low as 80 pounds per tree and at best the production is 125 pounds per tree. He can sell his apples at 50 cents per pound.

What error can occur if they use the lightest weight as an estimate?
What error can occur if they use the heaviest weight as an estimate?
What error can occur if they use the average weight as an estimate?
Which is best? Is any estimate adequate?

Problem 3

Susan and Jim are running a concession stand for a baseball park. In planning how much food to prepare, they use statistics from previous sales. The park normally has 550 people attending. The lemonade sales per customer varies from 3 oz. per customer to 16 oz. per customer with an average of 7 oz. per customer.
What error can occur if they use the smallest measure as an estimate?
What error can occur if they use the largest measure as an estimate?
What error can occur if they use the average measure as an estimate?
Which is best? Is any estimate adequate?

Problem 4

Your job is to make a car parking lot that will hold 100 cars. You plan to arrange the lot with 2 double rows of 25 and 3 traffic lanes, each 25 feet wide. Cars vary in length from 12 to 18 feet. The average length is 13 feet.

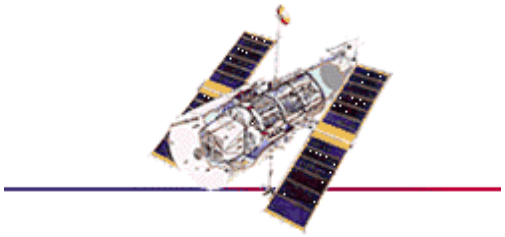
What error can occur if you use the shortest length as an estimate?
What error can occur if you use the longest length as an estimate?
What error can occur if you use the average length as an estimate?
Which is best? Is any estimate adequate?

Name_____Date_____

Hubble Telescope

Use π = 3.14

1. The Hubble Telescope has a mirror which is 94 inches in diameter.
What is its radius?_____
Circumference? _____



2. The Hubble Telescope is about 43 feet long and 14 feet wide. What is something on Earth which is about this size?

3. The Hubble weighs 25,500 pounds. How many tons is this? _____
About how many cars would it take to equal the weight of the Hubble? _____
About how many grown men would it take to equal the weight of the Hubble? _____

4. The Hubble orbits Earth about 340 miles above the surface of the Earth. _____
Find two cities in the US which are about that distance apart. _____

5. What is the advantage of having the Hubble telescope in space?

The Hubble has helped us see many space objects more clearly, and to discover many that we had not seen before. It has helped scientists detect a galaxy which is further away from us than any found before. It is estimated that this galaxy is 13,000,000,000 (13 billion) light years from us.

6. What number can you multiply 13 million by to get 13 billion?

13,000,000 x _____ = 13,000,000,000

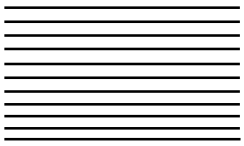
Name_____**Date**_____

Make Your Own Graduated Cylinders

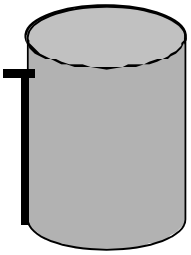
Materials: Various transparent cylinders with vertical sides such as olive jars, perfume sample vials
medicine bottles
graph paper with grids of various sizes
fine point marking pen that will write on glass or plastic
one standard measure that can measure a liter or other convenient amount

How to divide a length into ten equal parts

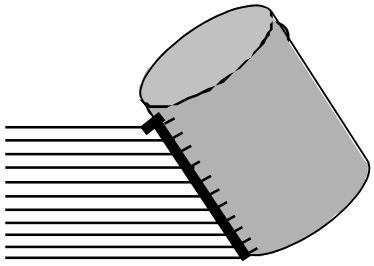
Use 11 parallel lines that divide a section of a page into ten equal spaces. These lines can be from notebook paper or graph paper. The height from the top line to the bottom needs to be less than the length of the object you want to divide.



Place the object that you want to divide so that the top edge is on the top line and the bottom edge is on the bottom line.



Suppose we want to divide the part of this cylinder marked by a heavy line into ten parts.



Tilt the cylinder, or a strip of paper cut to the same size, so that the top of the heavy line is on the top parallel line, and the bottom of the scale line is on the bottom parallel line. The parallel lines now show you positions to mark for the ten division lines.

1. Mark one of your containers so that each division line represents a deciliter (0.1 liter).
2. Are the lines far enough apart so that you can divide each space into ten equal parts?
3. Now measure a deciliter and pour it into a smaller container that is nearly the same size. Perhaps a large pill bottle would work. Divide this so that each mark represents a centiliter (0.01 liter). Are the lines far enough apart so that you can divide the spaces into ten equal parts again? If so these will be milliliters (0.001 liter).
4. Now measure a centiliter into a smaller container that is nearly the same size. (Some food coloring comes in plastic vials that may be about the right size. To use those, cut off the tops.) Divide this into milliliters.
5. Do you have a vial that you can divide into tenths of a milliliter? (A perfume sample vial might work.)
6. Keep making measuring containers that are more and more precise. What is the most precise container you can make? If you had smaller and smaller containers, what other factors might limit your precision or cause error?

Name_____**Date**_____

Precisely!

Discuss each situation with your group. Other groups may have different ideas and answers. Be prepared to explain why you chose the answer you did.

1. Dr. Morton's lab has a ruler that can be used to measure to the nearest millimeter, a micrometer that can be used to measure to the nearest millionth of a meter, and a measuring stick that can be used to measure to the nearest centimeter. He also has a scale that can be used to measure to the nearest ten grams, and a balance that can be used to measure to the nearest tenth of a milligram. He has a dose spoon that can be used to measure to the nearest centiliter, a cup that can be used to measure to the nearest deciliter, and a graduated cylinder that can be used to measure to the nearest milliliter. Which tool should he use to measure each of the following? Explain.

    a. Weight of a newborn baby.
    b. Weight of a headache powder he is prescribing.
    c. The amount of water he wants to use in his tea pot.
    d. The amount of liquid penicillin he needs to add in making an antibiotic capsule.
    e. Height of an elderly patient.
    f. Length of a antibiotic capsule.

2. Dr. Morton's three assistants are helping him make some anti-itch powder. Tom uses the scale and weighs out 320 grams of cornstarch to use as the base for the powder. Sue uses the balance and weighs out 50.2 milligrams of itch reliever for the powder. Ben uses the balance and weighs out 1.3 milligrams of perfumed salts to use in the powder. They mix this together, put it in a package, and label the package, "Anti-itch Powder – 320.0515 grams" Is there an error here?

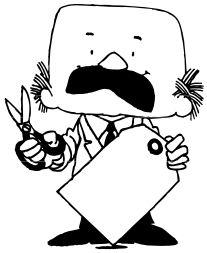
3. Dr. Morton has asked his assistants to measure a triangular region that showed up on an x-ray. The region is a right triangle, and Tom measures one leg to be 11 cm long. Ben measure the other leg and finds that it is 6 cm long. They both used the measuring stick. Sue uses the Pythagorean Theorem and reports that the hypotenuse is 12.529964 cm long. Is there an error here?

4. Discuss the best tools and techniques to use in mixing three ingredients to make a dry medicine that is combined by weight. The medicine is very strong and should be taken with extreme caution.

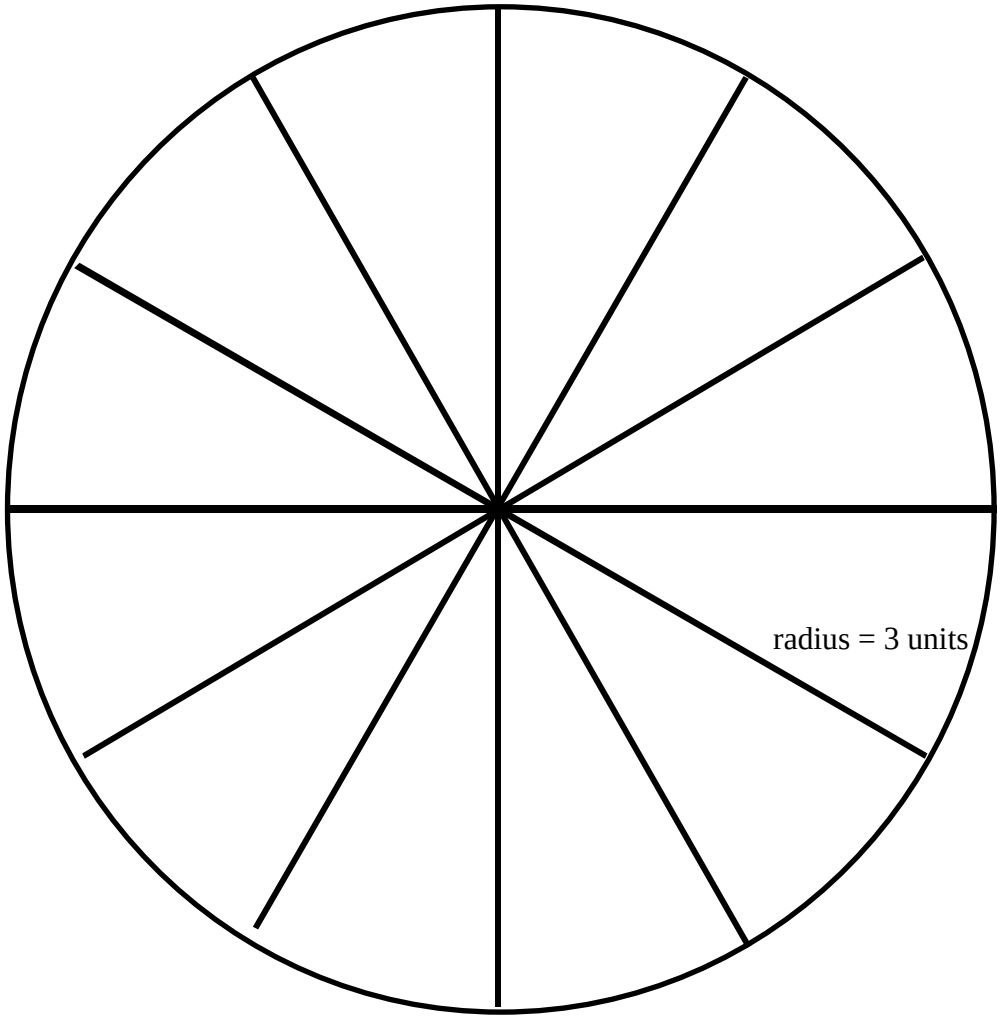
5. Discuss the best tools and techniques to use in measuring and constructing two congruent right triangles that will be used to hold up a shelf. The shelf is about the width of a notebook and should be about table height.

6. Discuss the best tools and techniques to use in measuring three liquids that will be used in a lotion to soothe aching muscles.

Name_____Date_____



Slicing π



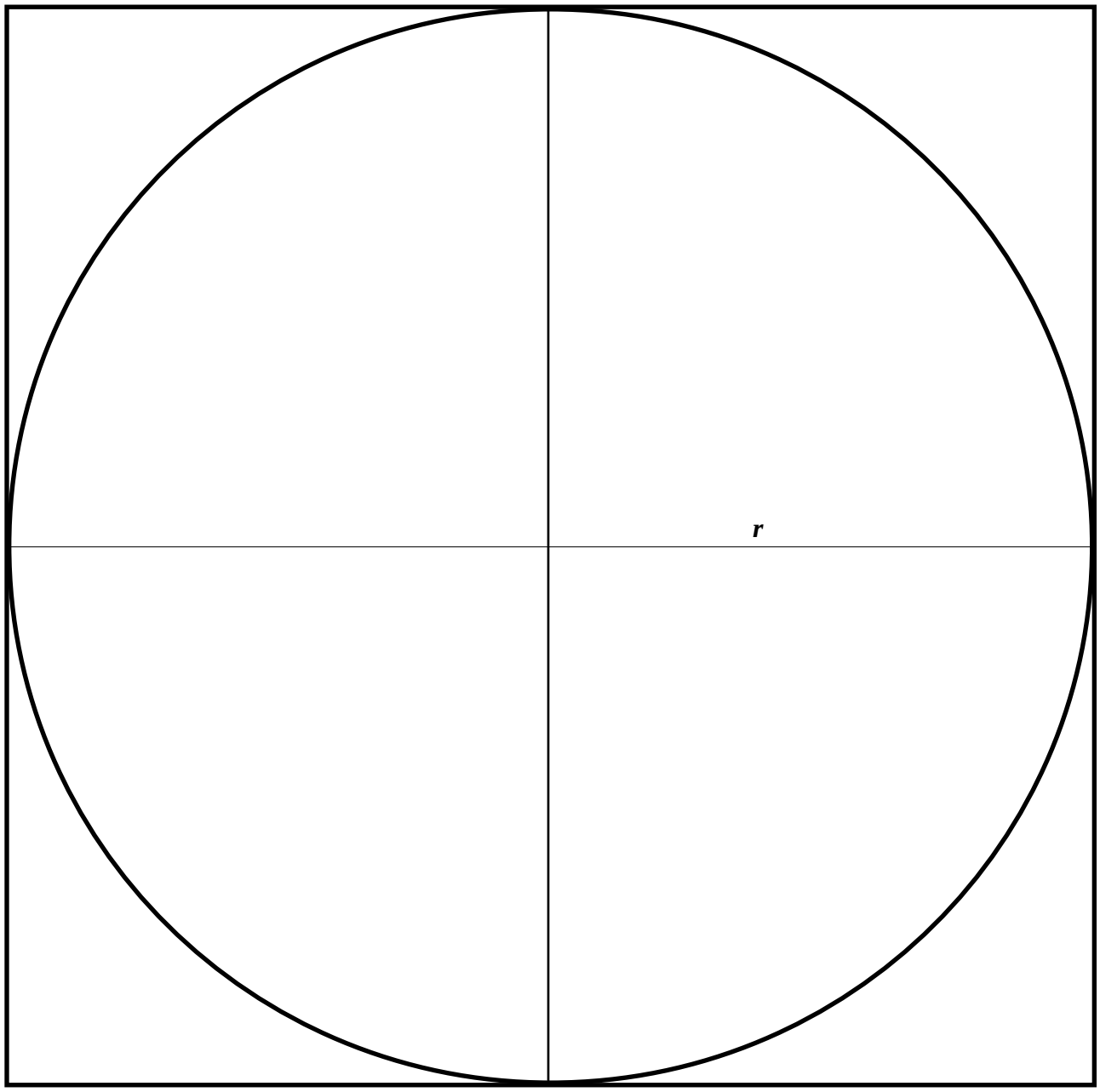
Cut the wedges from the diagram above and rearrange them into a shape as much like a rectangle as you can make it. What is the width of your "rectangle?" What is the length?

If this were a rectangle, what would its area be?

If instead of 3 units, you use the variable r as the radius, what would the area be?

Name_____Date_____

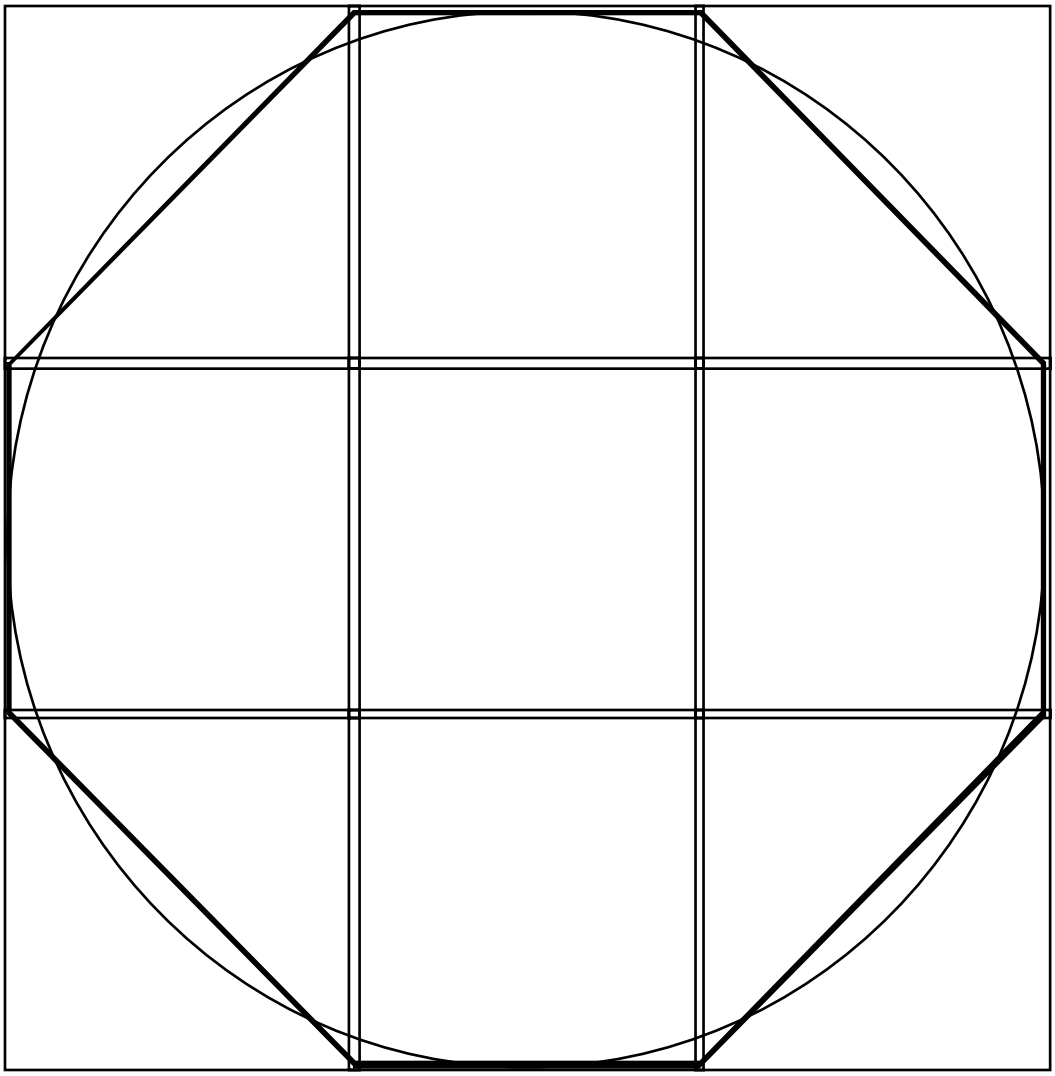
Bean π



1) Fill the circle with a layer of beans.
2) Put aside the beans you used to fill the circle.
3) Now cut apart the four squares and arrange them into a line. Each square has area = r^2.
4) Use your beans to fill in the line of squares. Start at the left and fill in as far as you can go. How many squares were you able to fill in? What number do you think this is?

Name_____Date_____

Nearly π



1. As you can see, the area of the circle and the area of the octagon are very close. If the radius of the circle is 1unit, what is its area?

2. If the radius of the circle is 1 unit, what is the side length of each small square?

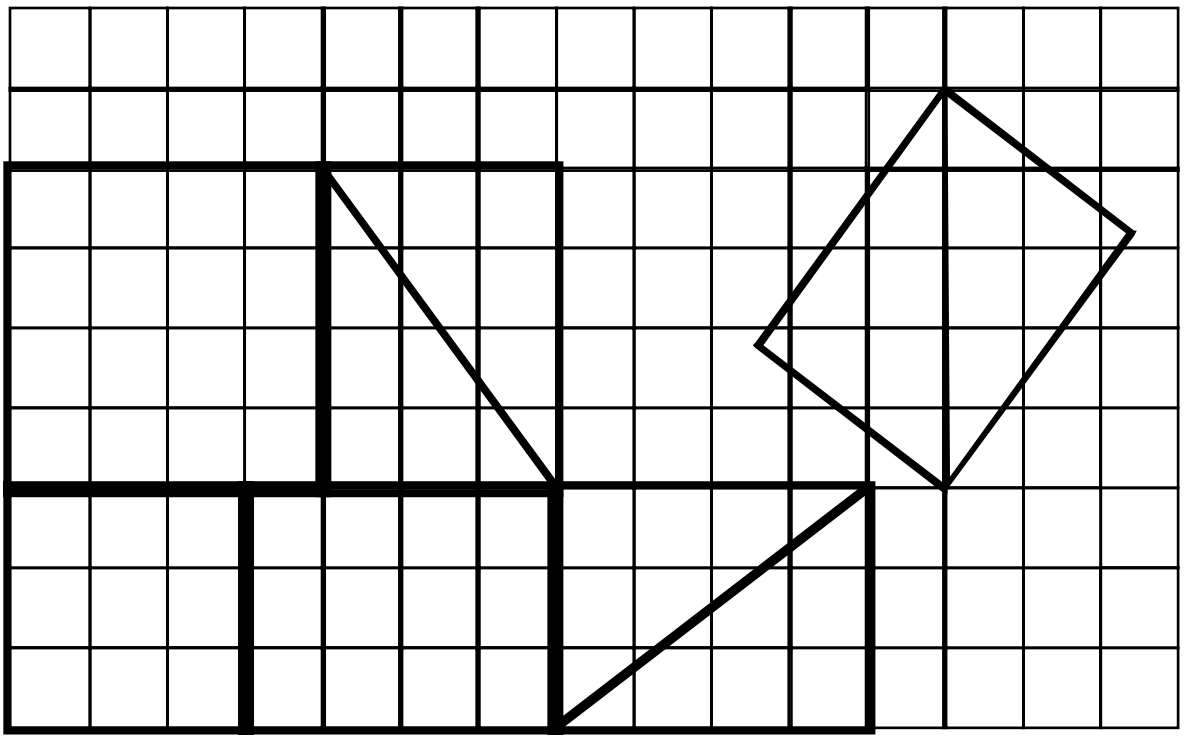
3. What is the area of each square? Of each triangle?

4. What is the area of the entire octagon?

5. How does this compare with the value of π ?

Name_____Date_____

Shape Exploration



The pieces above include a 3 x 3 square, a 4 x 4 square, a 3 x 4 rectangle, and some triangles that are formed by cutting the 3 x 4 rectangle along the diagonal. The figure above shows that the hypotenuse of this triangle is 5.

1. Find the area and perimeter of each of the different shapes.

2. Make as many parallelograms as you can from two or more of the pieces above. Record your results on grid paper.

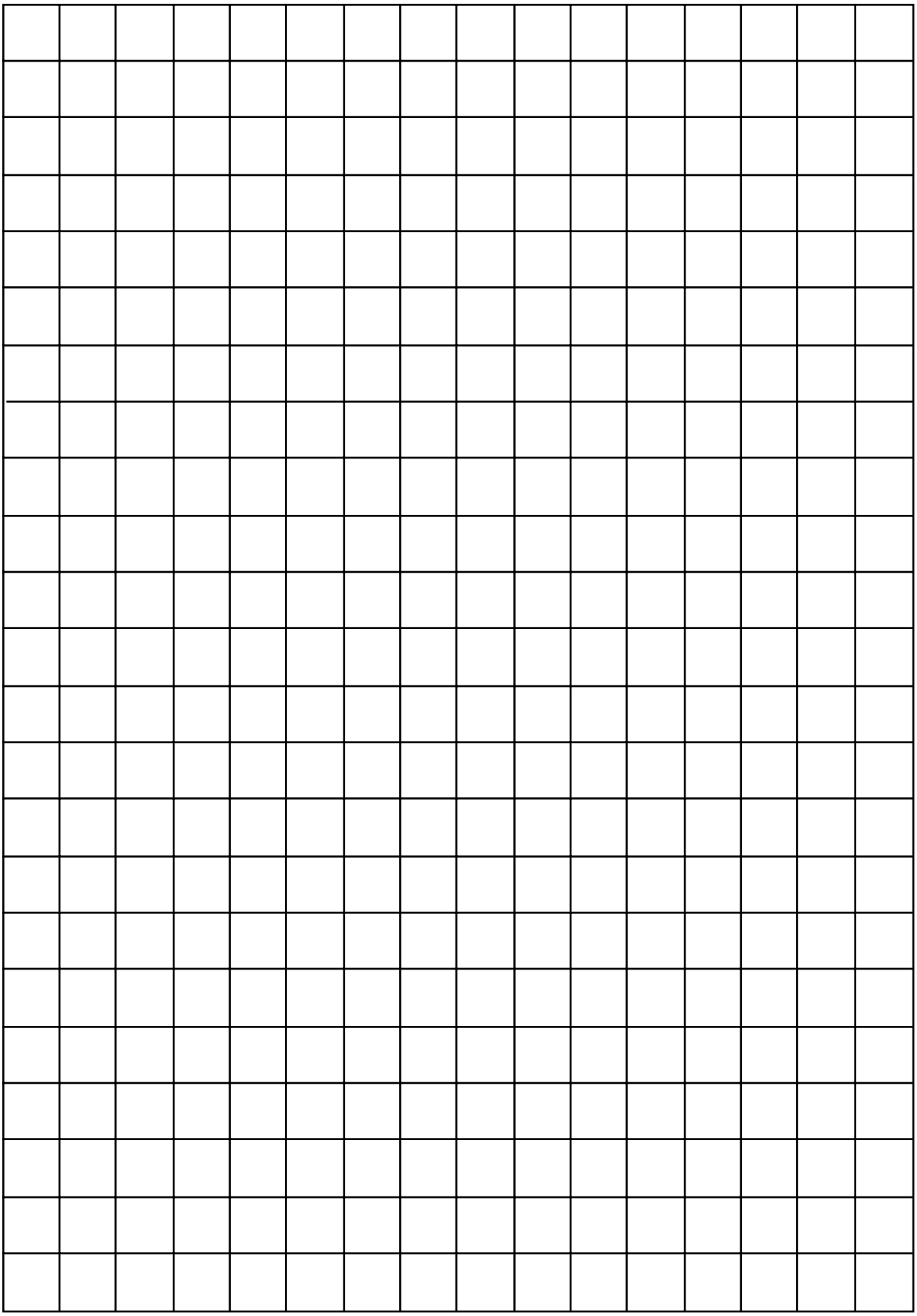
3. Make as many trapezoids as you can. Record your results on grid paper.

4. Find the area and perimeter of each parallelogram and trapezoid that you drew. You will be able to get the perimeters and areas by looking at the various pieces used in making the shape.

5. Can you determine a way to get the area of any parallelogram? any trapezoid?

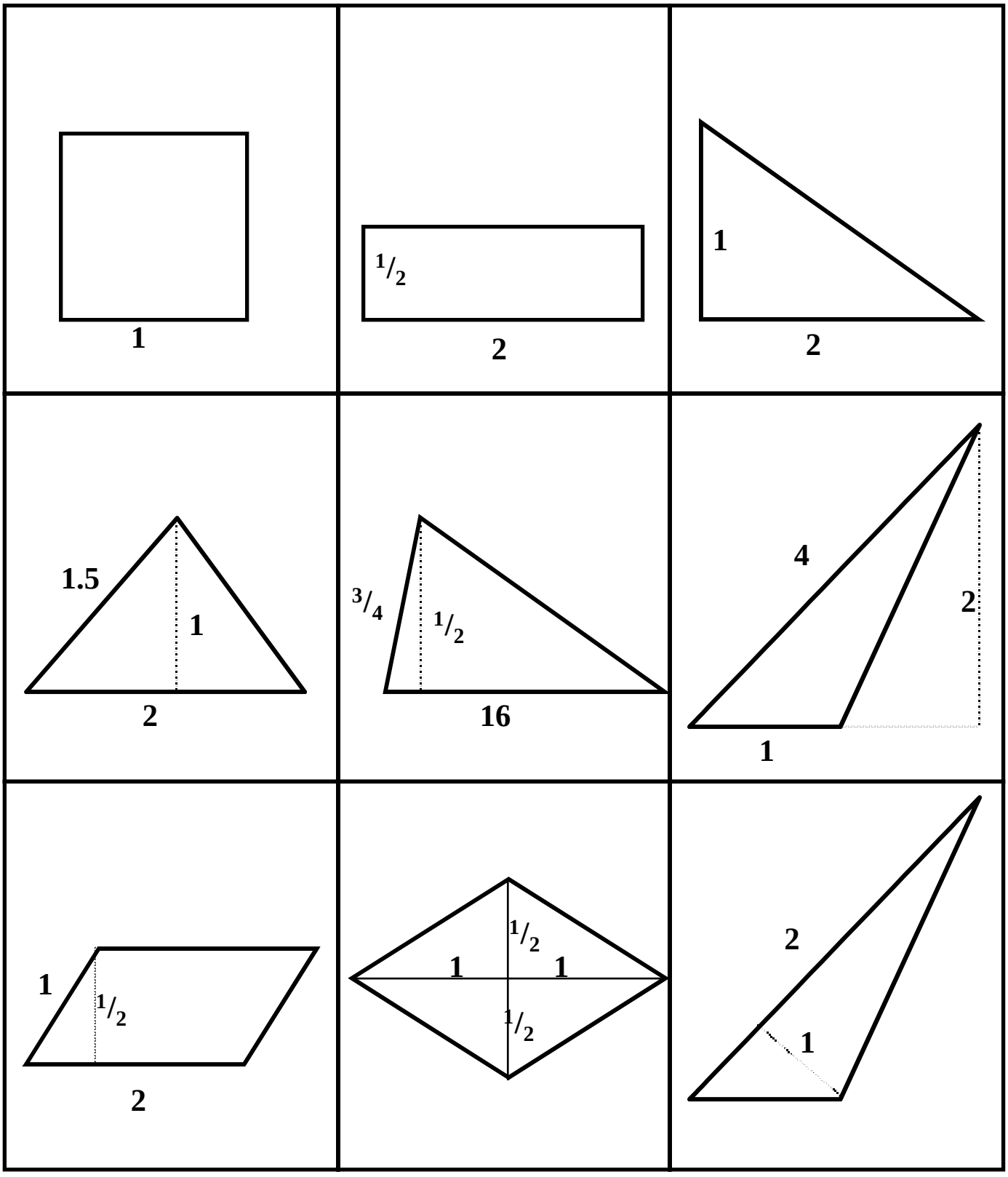
Name_____Date_____

Grid Paper



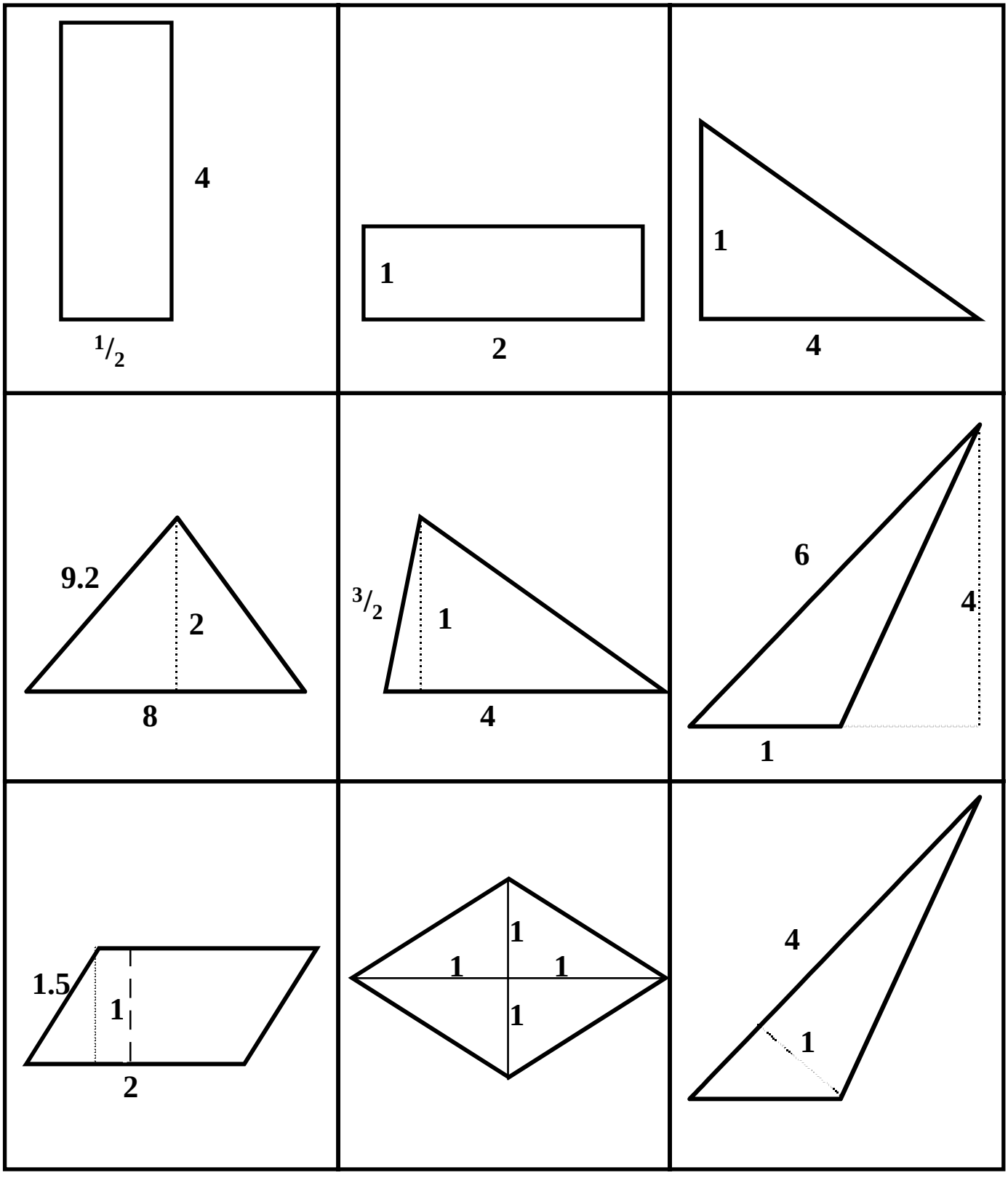
Name_____Date_____

Pick-Up Area



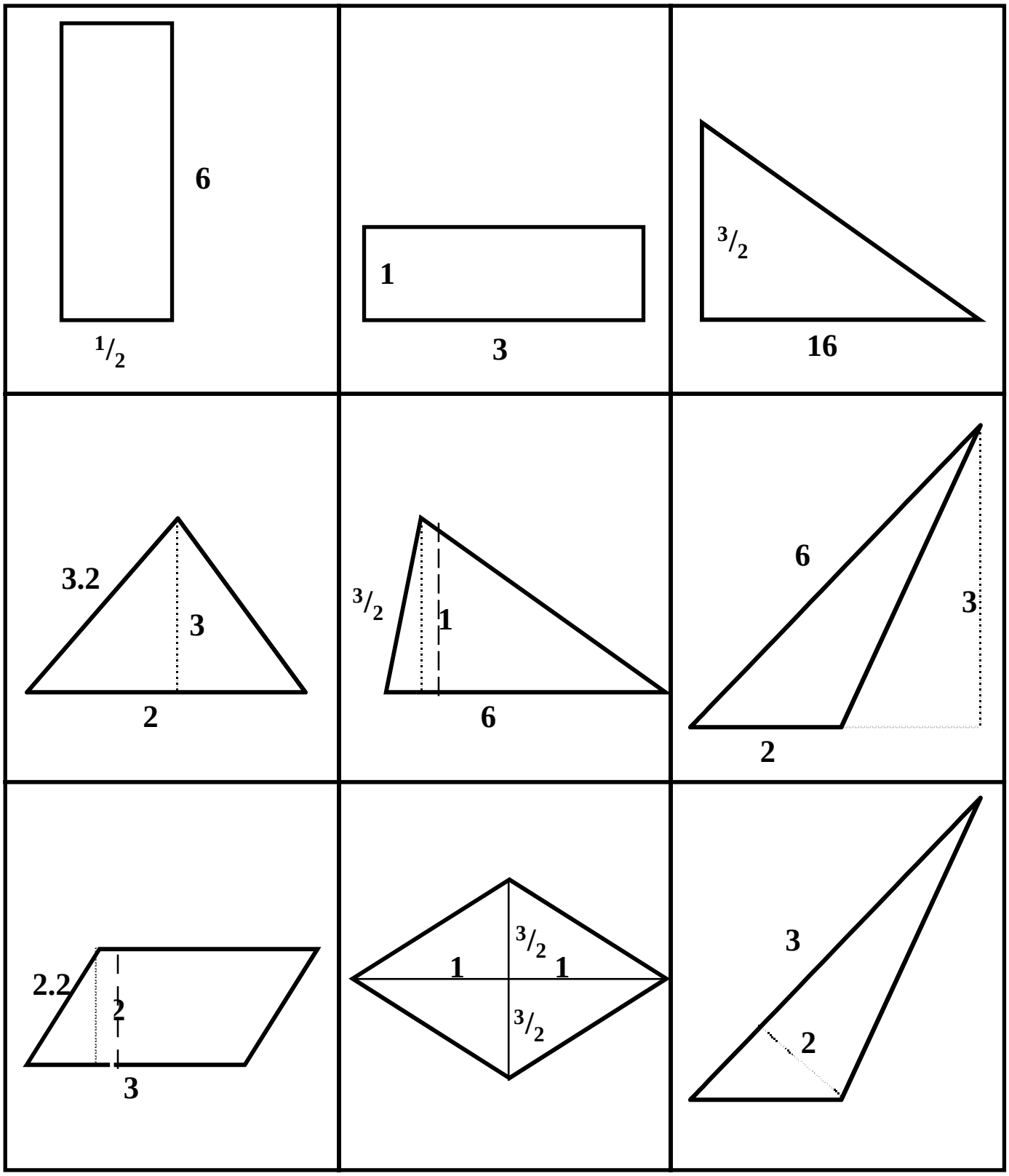
Name_____Date_____

Pick-Up Area



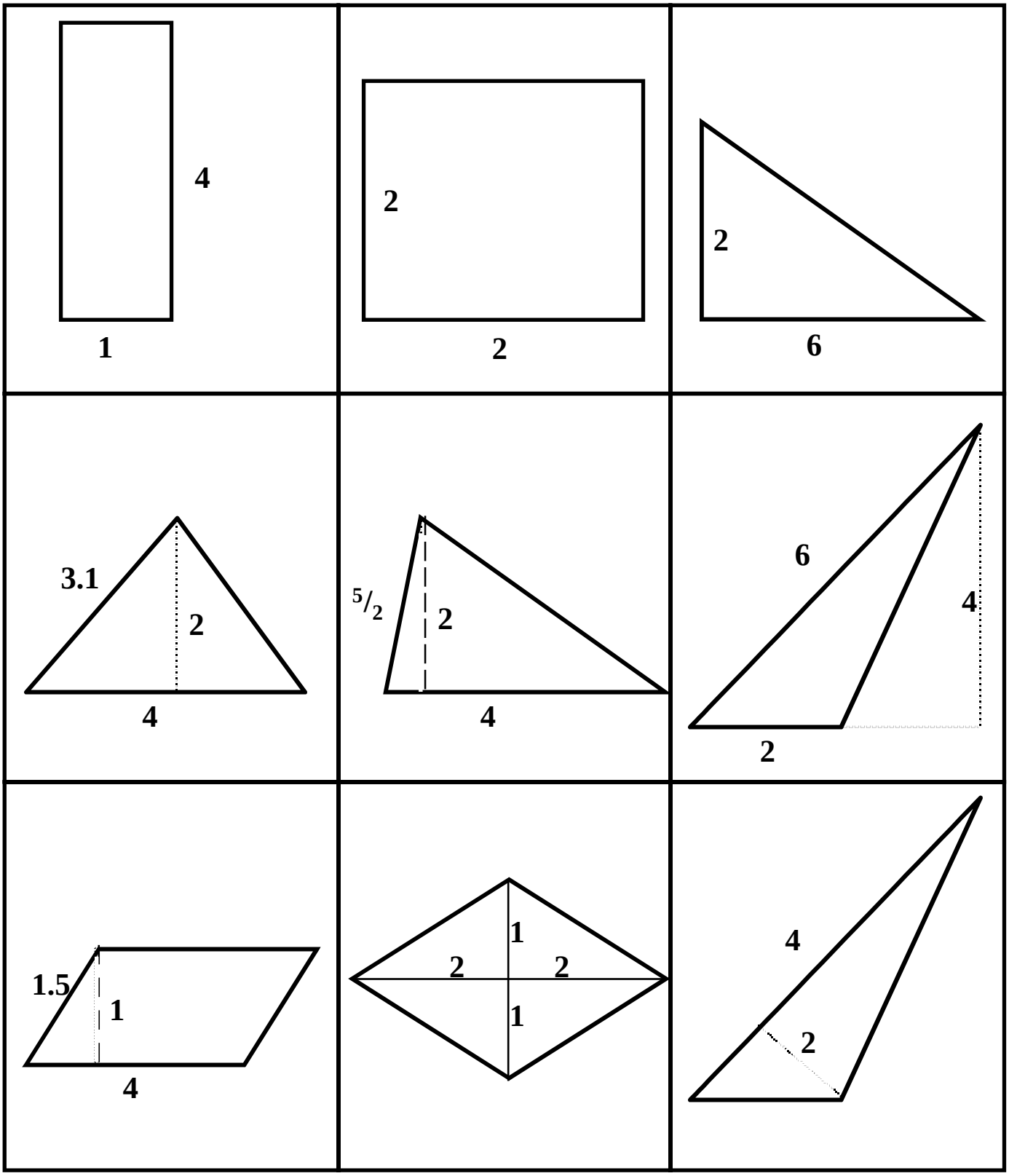
Name_____Date_____

Pick-Up Area



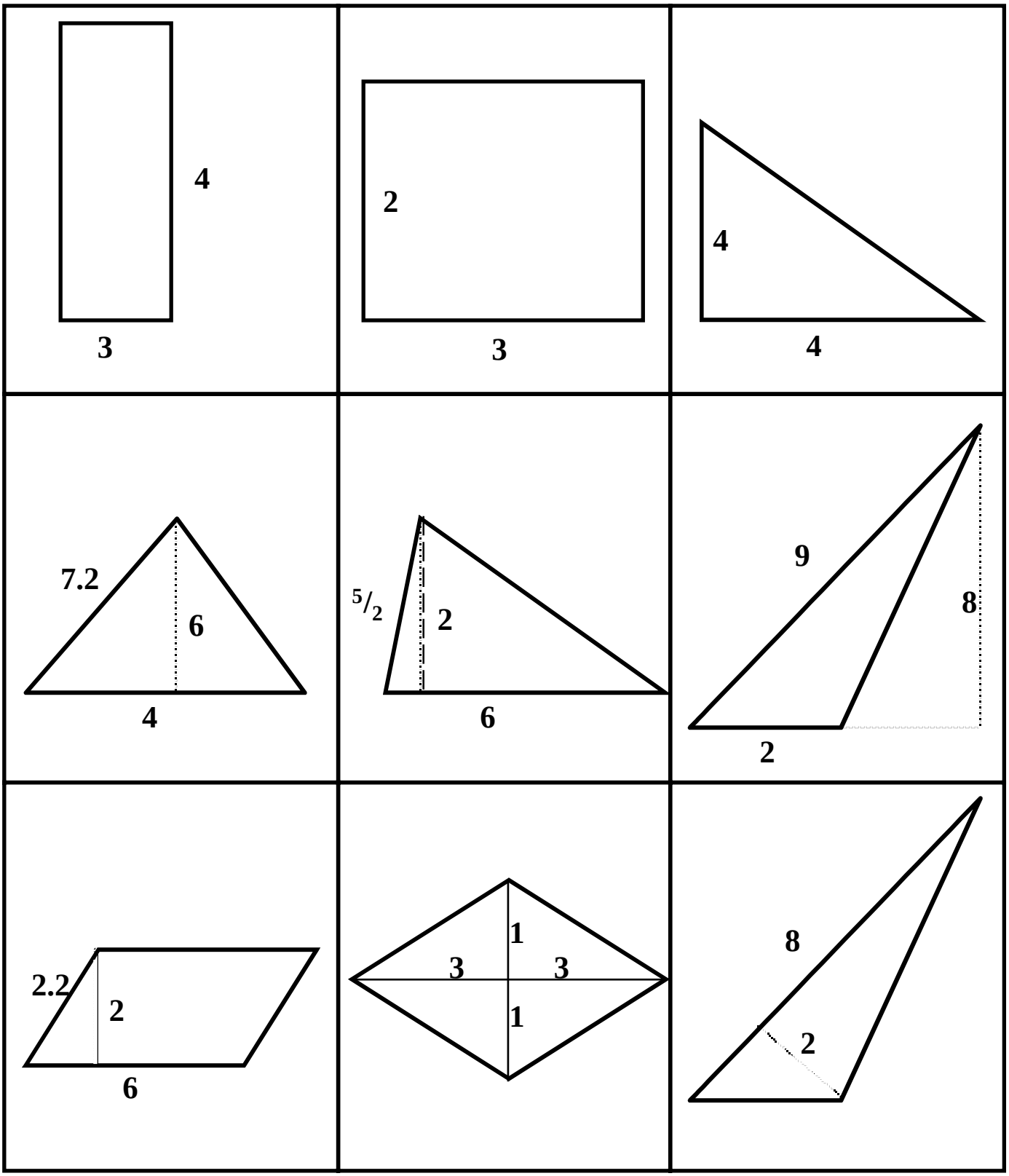
Name_____Date_____

Pick-Up Area



Name_____Date_____

Pick-Up Area



Name_____Date_____

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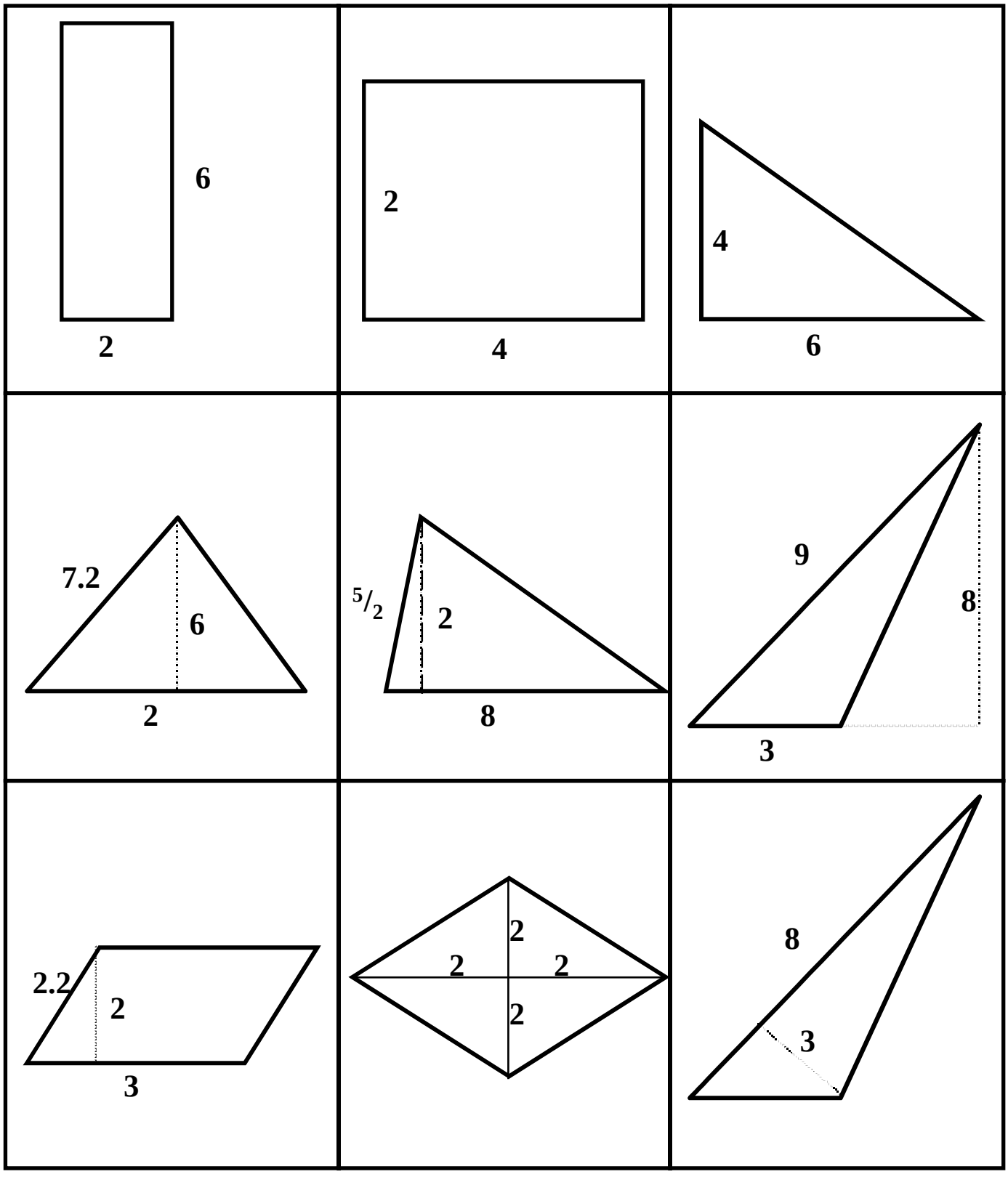
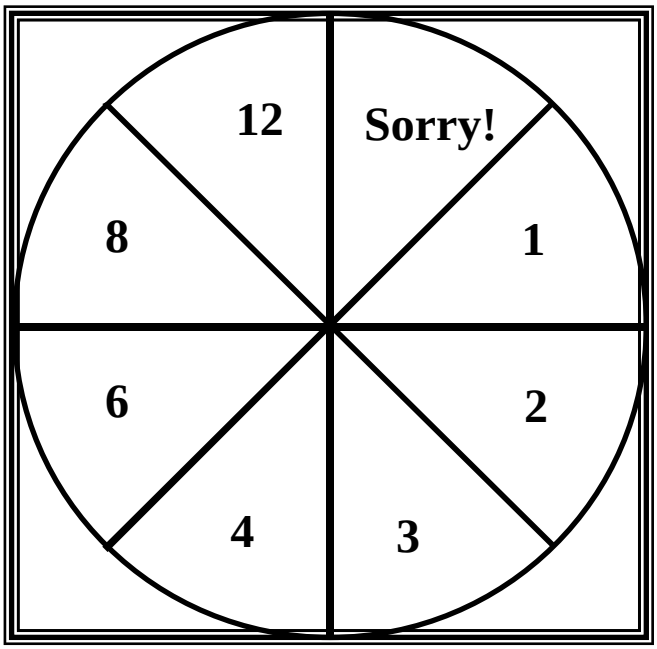
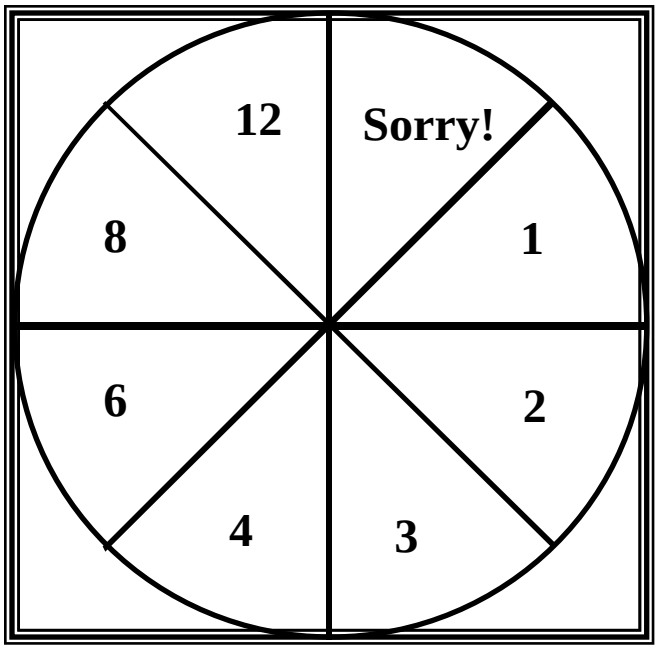
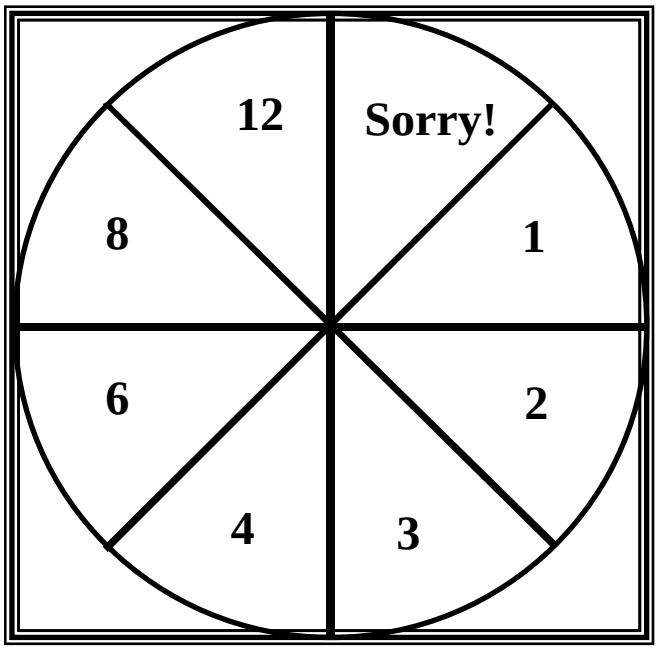


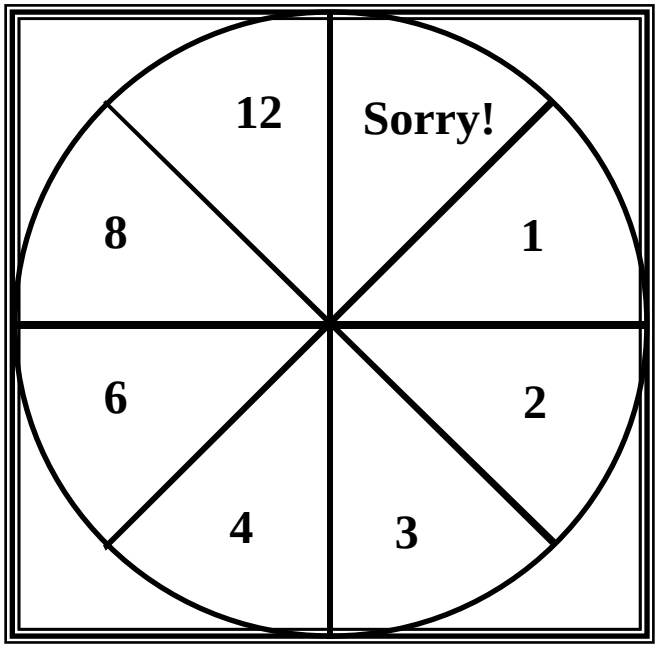
Name_____Date_____

Pick-Up Area





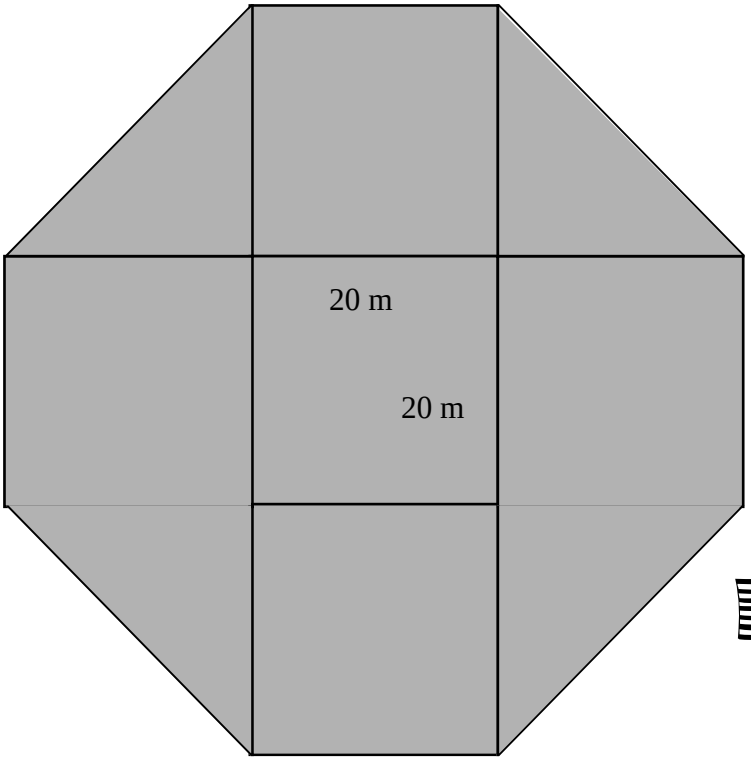


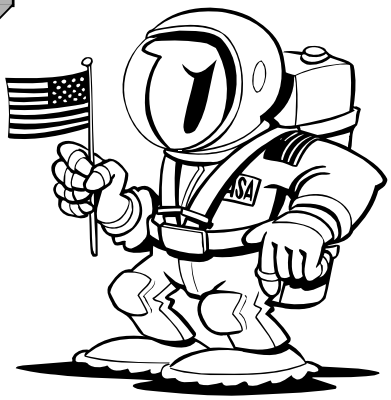


Name_____Date_____

Finding Area

1. Find the area of the space station shown below. Note: All vertical and horizontal segments meet at right angles.





2. What is the name of this shape?

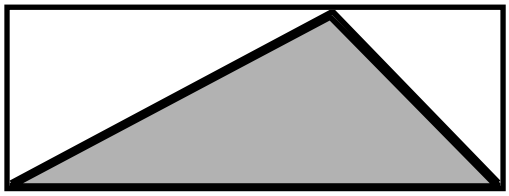
3. Do all eight interior angles of the shape have the same measure? What is their measure? Explain your answer.

4. Do all eight sides of this shape have the same measure? Explain your answer.

Name_____Date_____

Mini Review - Area

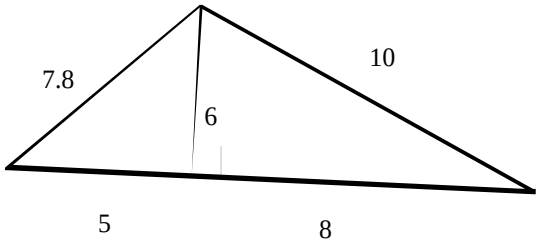
1. The area of the rectangle shown is 48 square cm. What is the area of the shaded triangle?



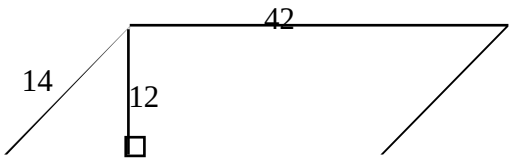
2. The area of the rectangle shown is 48 square cm. What is the area of the parallelogram shown?

Find the area of each figure shown. Measurements are in inches.

3.

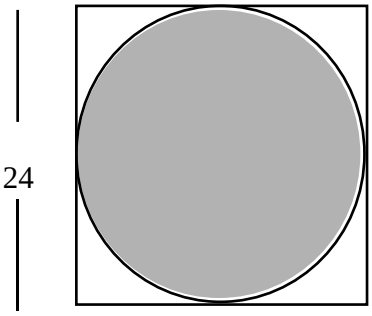


4.

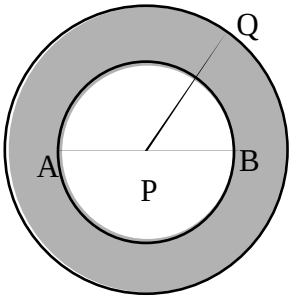


Find the shaded area. Measurements are in centimeters.

5.



6.



AB = 18, PQ = 12

Name_____Date_____

Mini Review – Area (cont.)

Fill in each blank below.

7. 1 square foot = _____ square inches

8. 1 square yard = _____ square feet

9. 1 square meter = _____ square cm

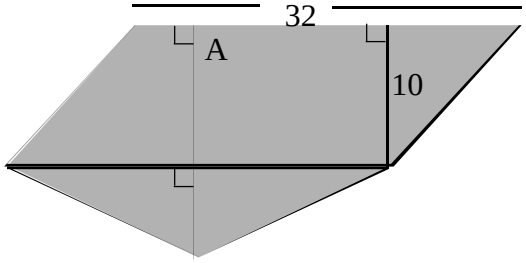
10. 1 square cm = _____ square mm

11. 36 square yards = _____ square feet

12. 3000 square cm = _____ square m

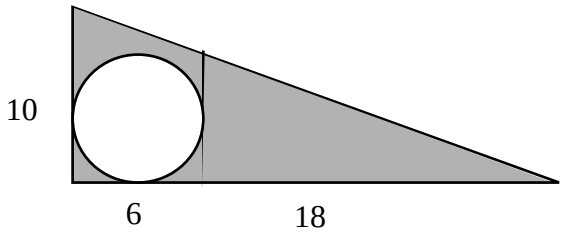
Find each shaded area below. Show your work. Measurements are in inches.

13.

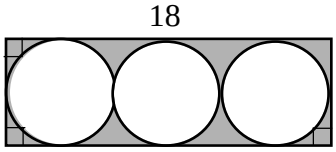


AB = 17

14.



15.



16.