Central *Context* Design

Central Context:

Conceptual Unit: Flying

Application Unit: Archeology

Jan de Lange

From:

Vlieg er eens in (Dutch), IOWO, Utrecht, NL 1980

Flying Through Math Wings for Learning, Scotts Valley CA, 1991

Digging Numbers, Mathematics in Context, Encyclopedia Brittannica, Chicago IL 2003

Oxford, 2013

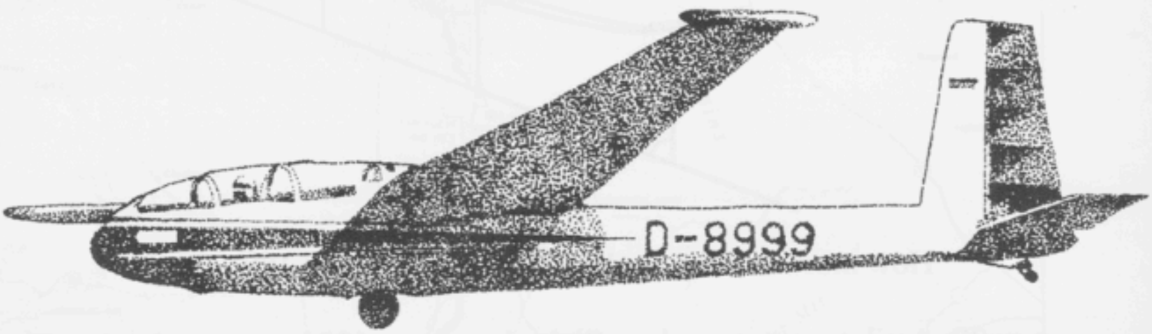
30. a. Make a cross in the middle of a blank page. This represents an airport. Draw the region where the plane can be launched from and still land at the airport, given:

(scale: 10 km = 1 cm)
glide ratio 1:30
altitude 2000 meters
no wind.

b. What is the glide angle of this plane?

c. The plane flies at a speed of 60 km per hour. One day there is a bit of wind coming from the west at 20 km/h. Indicate in your drawing (started in a) the region where the plane can now be launched from, keeping in mind the effect of the wind.

31.



Blanik L-13

In a book on airplanes it says, "The Blanik L-13 has a glide ratio of 5%."

a. Explain what this means.

b. Compute the glide angle.

Context: Flying; Gliding a sailplane

Content: Concept of Glide Ratio; Glide Angle, Tangent

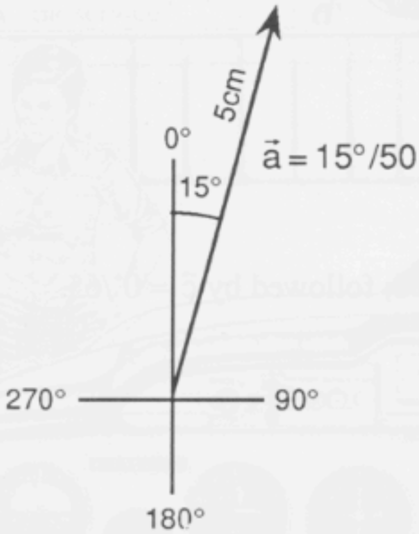
The following exercises ask you to draw a number of flying trips. First draw the flight with the separate vectors, each vector indicating one "leg." At the end, you can draw the result vector and label it with slash notation.

Example: $\vec{a} = 15°/50$.

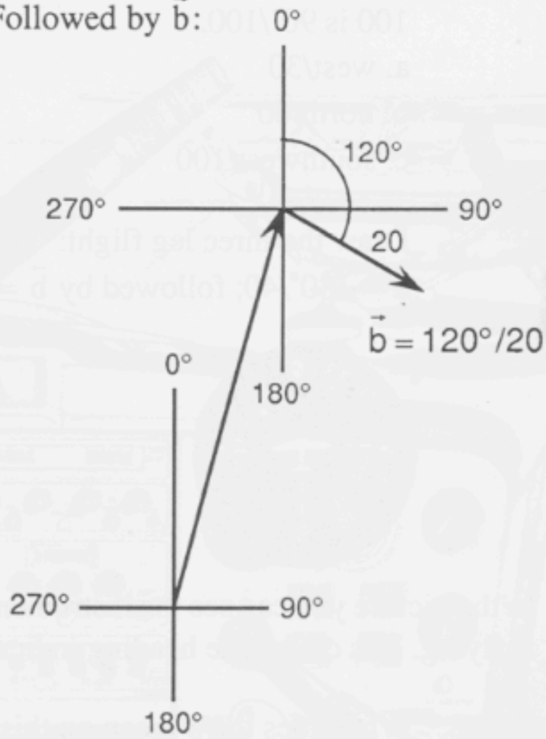
$\vec{b} = 120°/20$.

Let your scale be 10 km = 1 cm.

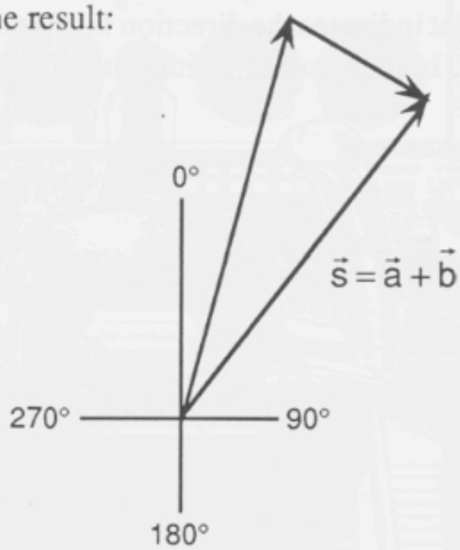
First $\vec{a}$:



Followed by $\vec{b}$:



Then the result:



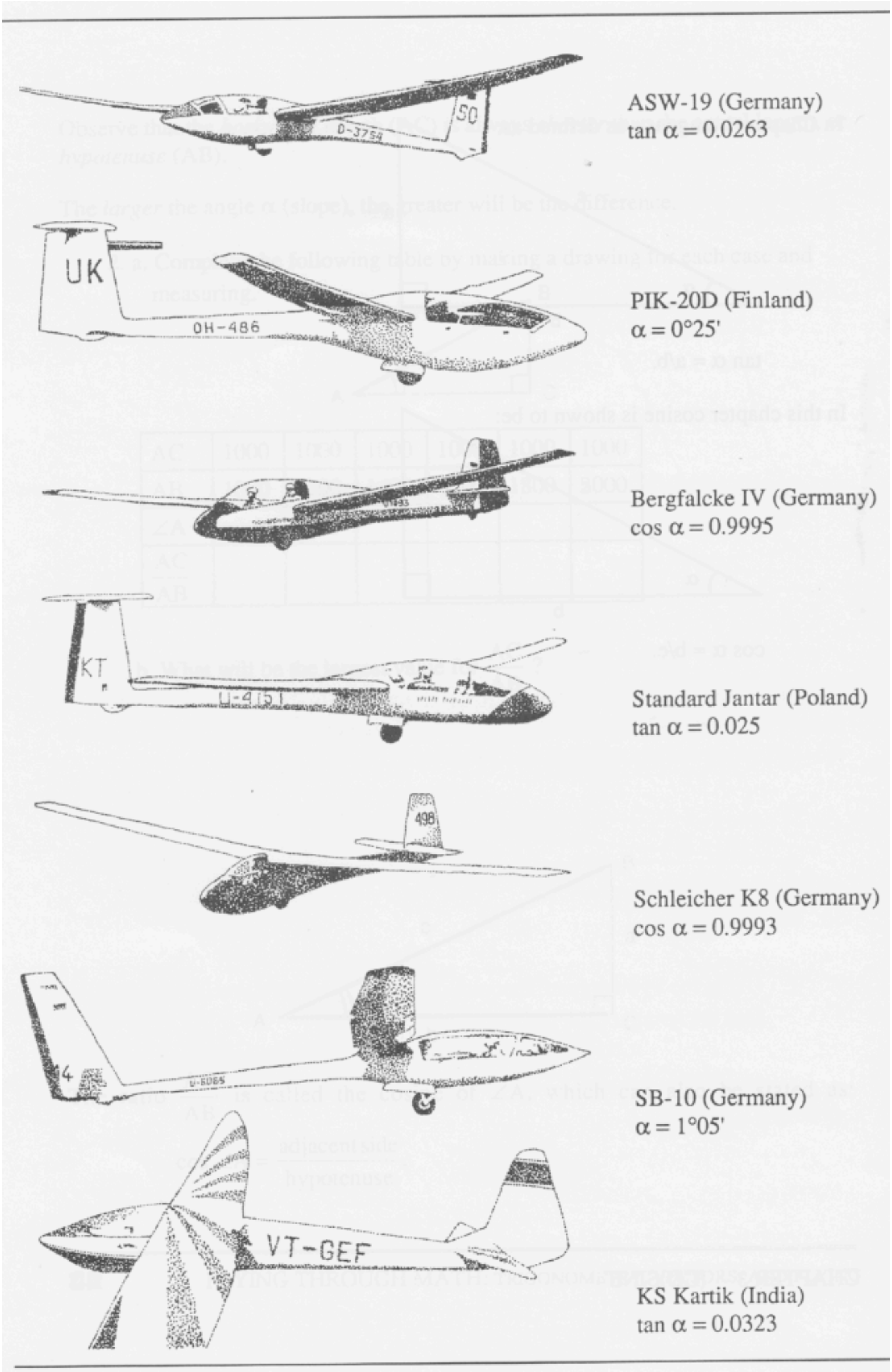
$\vec{s} = \vec{a} + \vec{b}$

Measure the direction and length, then write the result vector in slash notation.

$\vec{s} = 39°/48$ (more or less).

Context: Flying: Navigating an Airplane

Content: Concept of Vectors



Context: Flying; Comparing Qualities of Gliders

Content: Concept of Angles. Tan, Sin, Cos

Math Vectors

A **vector** has a *direction* and a *magnitude* (length).

Example: $\vec{a} = 140°/30$.
140° indicates the direction, 30 the magnitude.

1. Using grid paper, draw the vector $\vec{a} = 53°/50$. (1 grid unit equals ten km.)

2. Assuming that $\vec{a}$ represents a flight starting at airport A, how many km east of the airport does the airplane travel? How many km north of the airport?

3. Answer the same questions for the vector $\vec{b} = 14°/41$.

4. If the airplane travels a path equal to $\vec{a} + \vec{b}$, how far to the east and north does it travel?

A flight can also be described in the following way:

5. a. Draw the vector $\vec{c}$ = 50 east/ 30 north.
   b. Add to $\vec{c}$ the following vector: $\vec{d}$ = 20 east/ 40 north.
   c. Write the solution, using the same notation: $\vec{c} + \vec{d}$.

You can also write vectors such as "$\vec{c}$ = 50 east/ 30 north" as "$\vec{c} = \begin{pmatrix} 50E \\ 30N \end{pmatrix}$."

6. Draw $\vec{e} = \begin{pmatrix} 20E \\ 40N \end{pmatrix}$ and $\vec{f} = \begin{pmatrix} 40W \\ 10N \end{pmatrix}$. Draw $\vec{e} + \vec{f}$ and write the sum.

Context: Flying; Navigating when Flying

Content: Concept of Vectors

A *tun*, pictured on the right, has a unique value: it represents only 18 uinals, or 360 days. It is thought that the Maya departed from the base-20 system in this position so that the tun would have 360 days (instead of 400) and be closer in length to the 365-day solar year.

17. Make drawings for 359 days and 361 days.

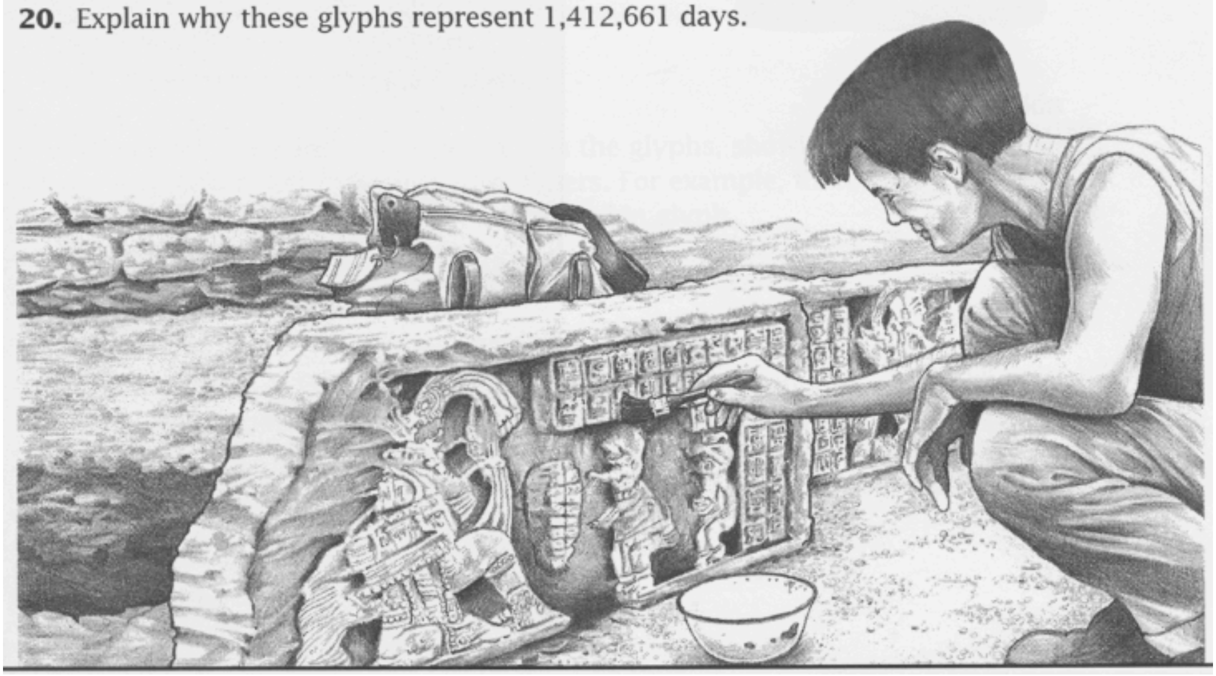
The date on the right includes the katun glyph, the glyph for 7,200 days.

18. How many days are represented by the above glyphs?

19. Explain why the glyph on the right represents 1,440,000 days.

The glyphs shown below are from the stone carving shown on page 5.

20. Explain why these glyphs represent 1,412,661 days.



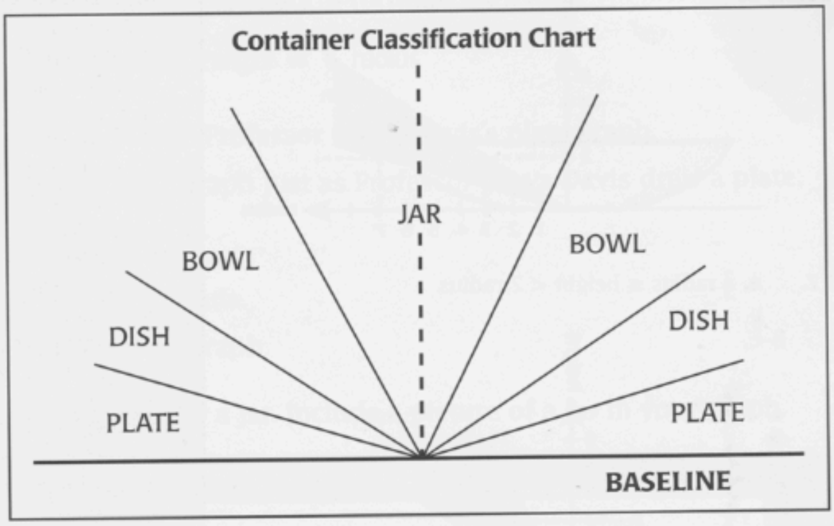
Context: Archeology; Maya Counting

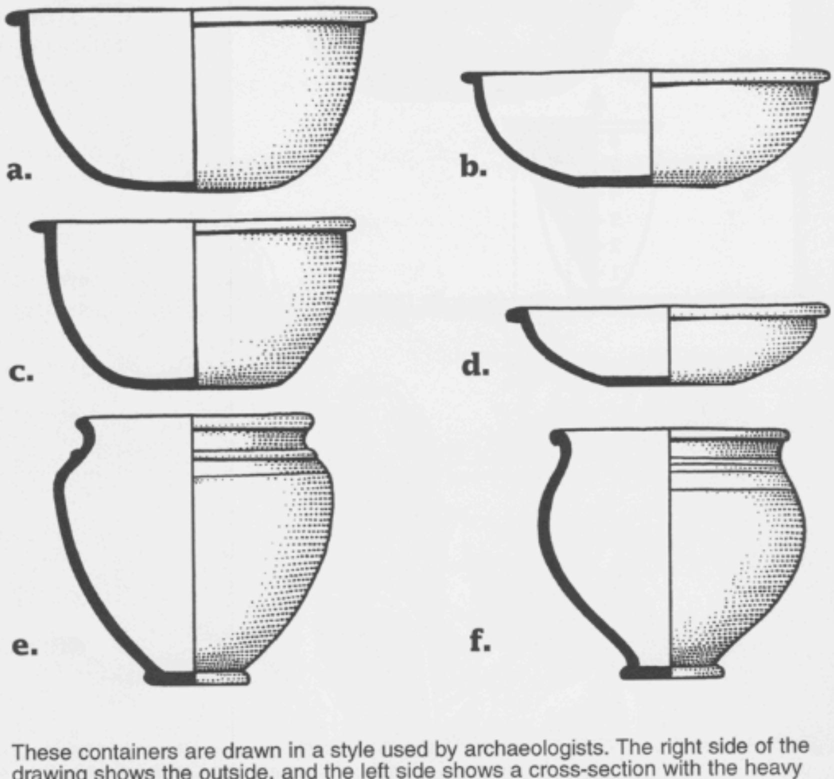
Content: Application of Number Systems

After attending Professor Olaya-Davis's presentation, Dr. Allison Laws had a clever idea. She designed the chart on the right for classifying containers.

19. Explain how Dr. Laws's container classification model works.

20. Use **Student Activity Sheet 4** and Dr. Laws's model to classify the six containers pictured below on the right.

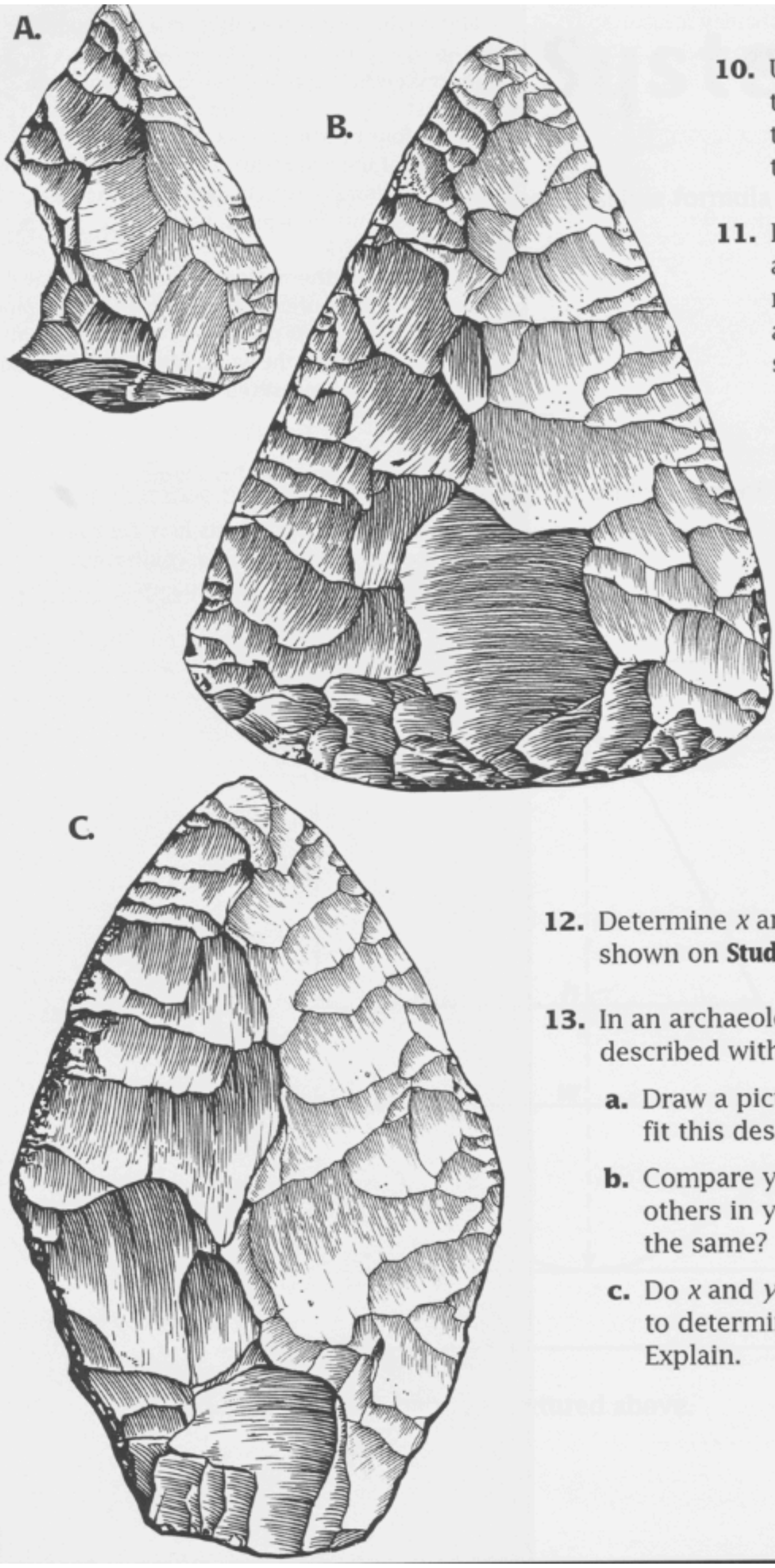




These containers are drawn in a style used by archaeologists. The right side of the drawing shows the outside, and the left side shows a cross-section with the heavy black line showing the thickness of the sides.

Context: Archeology; Classification wit angles

Content: Application of Geometry



10. Use **Student Activity Sheet 11** to find ℓ, w, d, and h for the three hand axes shown on the left.

11. Is it possible to find two axes that have the same measurements for ℓ, w, d, and h, but are different shapes? Why or why not?

Archaeologists sometimes reduce the four measurements ℓ, w, d, and h to two numbers, x and y:

$$x = \frac{h}{w} \times 100$$

$$y = \frac{\ell}{d}$$

12. Determine x and y for the three hand axes shown on **Student Activity Sheet 11.**

13. In an archaeologist's report, a hand ax is described with $x = 64$ and $y = 3$.

a. Draw a picture of a hand ax that could fit this description.

b. Compare your drawing with those of others in your class. Do they all look the same?

c. Do x and y provide enough information to determine the shape of an ax? Explain.

Context: Archeology; Classification of Axes

Content: Application of Algebra