## Penny Barge Calculations

## Givens:

The number of pre-1982 pennies has a mass of 3.1 grams. However, pennies made after 1982 are about $\mathbf{2 . 5}$ grams. So the average is about $\mathbf{2 . 7 8}$ grams.

| Penny Mass: 2.78 grams or .0973 ounces | Cube Volume $=\operatorname{LxWxH}$ |
| :--- | :--- |
| 1 gram $=0.035$ ounces | Pyramid Volume $=L x W x H / 3$ |
| Water weight: 62.4 pounds per cubic foot | Cylinder Volume $=\operatorname{Pir}^{2} \mathrm{H}$ |
| Water weight: 28316.847 grams per cubic foot | Triangular Volume $=1 / 2 \mathrm{x}$ base x height |
| 1 Cubic Foot $=12 " \mathrm{x} 12 " \mathrm{x} 12$ " | Sphere Volume $=4 \mathrm{Pir}^{3} / 3$ |
| 1 pound $=453.6$ grams $=16$ ounces | Cone Volume $=\mathrm{Pi} \mathrm{r}^{2} \mathrm{~h} / 3$ |

## Directions:

1. Sketch three (3) vessel in 3D in the space below. Dimension the vessels. Break the form into recognizable 3D forms so volume can be calculated. (20)

| A. | B. | C. |
| :--- | :--- | :--- |
|  |  |  |

2. Show all math to determine surface of each Barge to know the material is 144 square inches or less. (40)

| A. | B. | C. |
| :--- | :--- | :--- |
|  |  |  |
| sq. in. | sq. in. |  |

3. Show all math to determine volume of each Barge or water to be displaced before sinking. (40)

| A. B. | C. |  |
| :--- | :--- | :--- |
|  |  |  |
|  |  |  |
|  |  |  |

Select the largest volume to construct for your vessel. This will take the most pennies to sink or will it because it might weigh more? Draw the top, side and front views below with dimensions. (100)

| Step | Show Math with all units of measure. No units, no credit! | Answer |
| :---: | :---: | :---: |
| 4. Recalculate surface area of your barge design. Show all formulas and math. |  | $\ldots$ SQ. IN. |
| 5. Recalculate volume of your barge design. Show all formulas and math. |  | CU. IN. |
| 6. Determine the number of cubic inches in a cubic foot |  | $\ldots \mathrm{Cu} . \mathrm{In}$. |
| 7. Convert the barge volume in cubic inches to cubic feet. |  | $\ldots \mathrm{Cu} . \mathrm{Ft}$. |
| 8. Determine the pounds of water the barge must displace to sink. |  | lbs. of water |
| 9. Convert pounds to ounces by multiplying. |  | $\underbrace{\text { oz. }}$ |
| 10. Determine the mass of the barge in grams using the scale. |  | $\ldots$ g |
| 11. Convert grams to ounces by multiplying. |  | $\qquad$ oz. |
| 12. Determine the allowable penny load by subtracting the weight of the barge from the weight of the displaced water. |  | $\qquad$ ounces of pennies |
| 13. Determine the number of pennies the barge will hold by converting ounces of pennies to pennies. |  | $\ldots$ pennies |
| 14. Convert to dollars. |  | \$ |

Record actual number of pennies to sink barge when tested in water tank. $\qquad$ pennies

Record estimate and actual penny numbers on homeroom sheet.

## Reflection

If number of actual pennies and calculated pennies are not equal, explain why below.
Describe any mishaps in penny load calculations. (5)

Describe any mishaps in vessel construction. (5)

Describe any mishaps with the testing. (5)

Include other scientific phenomena that could aid in buoyancy. (5)

