

## Density Problems

### Sample Problem

The mass of a rock is found to be 75 g, and its volume, as determined by the displacement method, is 3 cm<sup>3</sup>. Determine the density of the rock.

### Answer

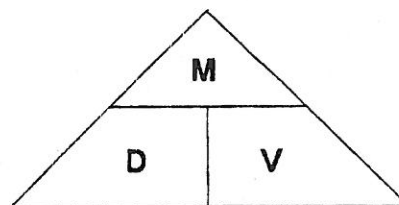
1. List each of the known and unknown quantities.

$$M = 75 \text{ g}$$
$$V = 3 \text{ cm}^3$$
$$D = ?$$

2. Write the equation correctly in symbols.

$$D = M/V$$

If you need a memory device, try the memory triangle. A triangle with a T in its centre should have the letters placed correctly in each space (as in the manner in which the equation was first defined to you). Solving for any quantity is always the way the symbols are positioned.



Therefore,  $D = M/V$  or  $V = M/D$  or  $M = D \times V$

3. Substitute the known quantities in the symbolic equation and solve for the unknown quantity.

$$D = 75 \text{ g/cm}^3$$

$$D = 25 \text{ g/cm}^3$$

4. Make a final written statement (including correct units) that answers the question.

The density of the stone is 25 g/cm<sup>3</sup>.

### Problems

Solve the following problems showing all the steps in your answer. The density of water is 1 g/mL.

1. A rock is dropped into a full can of water and causes 25 mL of water to spill out. The mass of the rock is 150 g. Calculate the density of the rock in g/cm<sup>3</sup>.
2. (a) A student measures the dimensions of a rectangular block of wood as 5 cm for width, 10 cm for length and 2 cm for depth. Find the volume of the block.  
(b) If the mass is 65 g, what is the density of the block?  
(c) Will the block float or sink in water? Give a reason for your answer.

3. (a) A student finds what looks like a large diamond, and uses the displacement method to determine volume. After the object is placed in a graduated cylinder of 50 mL water, the water level rises to 60 mL. What is the volume of the object in  $\text{cm}^3$ ?
- (b) The mass of the possible diamond is 25 g. Determine its density.
- (c) If the density of diamond is  $3.5 \text{ g/cm}^3$  and crown glass is  $2.5 \text{ g/cm}^3$ , and quartz is  $2.7 \text{ g/cm}^3$ , what is the identity of the found object?
4. A student has a platinum ring of mass 40 g. If the density of platinum is  $21.5 \text{ g/cm}^3$ , what is the volume of the ring?
5. A brass cube of density  $8 \text{ g/cm}^3$  is 2 cm on each side.
- (a) Determine the volume of the cube.
- (b) Calculate the mass of the cube of brass.
- (c) State whether this cube will float or sink in mercury (density of mercury is  $13.6 \text{ g/mL}$ ).
6. An ice cube measuring 3 cm each side weighs 24.3 g.
- (a) Determine the density of the ice cube.
- (b) Explain why this ice cube will float on water.
- (c) Would this ice cube float or sink in methyl alcohol (density is  $0.79 \text{ g/mL}$ )? Give a reason for your answer.
- (d) If the ice cube was placed in 50 mL of water and allowed to melt, approximately what would the final volume of the water be after melting?
7. A piece of paraffin wax (density is  $9 \text{ g/cm}^3$ ) has a mass of 900 g.
- (a) What is the volume of the wax?
- (b) If the wax was melted to the liquid state, approximately what would its volume be?
- (c) Would this wax float or sink in water?
8. A tin box of dimensions 5 cm by 5 cm by 4 cm has a mass of 80 g.
- (a) Determine the average density of the box.
- (b) Tin has a density of  $7.3 \text{ g/cm}^3$ . Explain why this box would float on water.
- (c) Suppose the box has a hole in each side. Would it continue to float? Give a reason for your answer.
9. Ordinary table salt has a density of  $2.2 \text{ g/cm}^3$ . What mass of salt would fill a box of dimensions 3 cm by 8 cm by 10 cm?
10. (a) Archimedes, a famous Greek philosopher and scientist, measured the volume of the king's crown by the displacement method so that he would not destroy the crown. If he found that it displaced 200 mL of water and had a mass of 1800 g, what was the density of the crown?
- (b) Knowing that gold has a density of  $19.3 \text{ g/cm}^3$ , what did he conclude about the chemical composition of the crown?