Doing calculations with density

Measuring density

To find the density of a material, you need to know the mass and volume of a solid sample of the material. Mass is measured with a balance or a scale. For simple shapes you can calculate the volume. For irregular objects the *displacement method* is used to find the volume. Suppose you want to know the volume of five steel nuts. You record the volume of water in the graduated cylinder before inserting the nuts. Then you gently drop the five nuts in and record the volume again. The volume of the nuts is the change in volume.

Densities of common substances

TABLE 1.2.

Densities of common substances

Material	Density (g/cm^3)	Material	Density (g/cm^3)
Platinum	21.5	Nylon Plastic	2.3
Lead	11.3	Rubber	1.2
Iron	7.8	Liquid water	1.0
Titanium	4.5	Polyethylene plastic	0.94
Aluminum	2.7	Ice	0.92
Glass	2.7	Oak (wood)	0.60
Granite	2.6	Pine (wood)	0.44
Concrete	2.3	Cork	0.12

Solved problem

45 grams of titanium are added to a graduated cylinder containing 50 mL of water. What will the cylinder read after the titanium has been added?

Asked: *Volume of graduated cylinder after adding 45 grams of titanium*

Given: *45 grams of titanium, density of titanium d=4.5 g/cm^3, 50 mL of water*

Relationships: $d = m/V$

Solve: $d = m \div V$, *therefore* $V = m \div d$

$$V = 45\ g \div 4.5\ g/cm^3 = 10\ mL.$$

The titanium adds 10 mL to the cylinder which now reads 60 mL.

Answer: *60 mL*

Discussion: *This is an example of a displacement method measurement.*