

RTQ!

Part I: In the Beginning

Directions: Write all of your responses on a separate sheet of paper. When calculations are required you must show your work in the manner demonstrated by your instructor.

Density is mass per unit volume. This definition leads to this formula: $D = M/V$ where D is for density, M is for mass, and V is for Volume. So, Density equals Mass divided by Volume.

Volume is a measure of the space an object occupies. The volume of a regular rectangular solid such as block of wood can be found by multiplying its length, width and height (or thickness): $V = L \times W \times H$.

- Francis finds that a certain block of wood measures 24 cm long by 12 cm wide and is 6.0 cm thick. Francis then gives this block to his lab partner Scarlet to weigh. She puts the block on an electronic balance and finds its mass to be 216 g.
 - What is the mass of the block of wood?
 - What is the height of the block of wood?
 - What is the volume of the block of wood?
 - What is the density of the block of wood?
 - What is the block made of?
- Joanna is presented with a piece of thin metal foil. She places it on a balance and finds that its mass is 1.08 g. Joanna then measures the foil and finds that it is 15.0 cm long, 12.0 cm wide, but too thin to measure its thickness with her ruler. Her teacher tells her that this type of metal has a density of 3.00 g/cm^3 .
 - What is the mass of the foil?
 - Use the formula for density and do some algebra to solve for volume (V).
 - Calculate the volume of the foil.
 - Use the formula for volume and solve it for height (thickness).
 - Calculate the thickness of the foil.
 - Is the metal thick? Explain.
- Jenny weighs her favorite graduated cylinder on an electronic balance and finds its mass to be 137.23 g. She carefully adds 32.6 mL of a mystery fluid to it and then weighs the cylinder and fluid. This time the balance reads 185.53 g.
 - What is the mass of the graduated cylinder?
 - What is the mass of the cylinder with the mystery fluid?
 - What is the mass of just the mystery fluid?
 - Describe in complete sentences how to calculate the density of the mystery fluid.
 - Now calculate the density of the mystery fluid.
 - What device did Jenny use to find the mass of the graduated cylinder and fluid?

It takes heat the change the temperature of an object. The amount of heat can be calculated using this formula:

$$Q = mc\Delta T.$$

Q is the heat, m is the mass, c is a constant called the specific heat capacity, and ΔT is the difference in temperature.

Liquid water has a specific heat capacity of $c = 4.19 \text{ J/g}\cdot^\circ\text{C}$.

Solid aluminum has a specific heat capacity of $c = 0.909 \text{ J/g}\cdot^\circ\text{C}$

Have you heard of Conservation of Energy? It means that energy is never created or destroyed, it can only be transferred, and so the total amount of energy remains constant. In this case heat lost by one object will be gained by another object, or

$$|Q_{\text{lost}}| = |Q_{\text{gained}}|$$

4. Chen measures out 45.67 g of water and heats it from a 23.4°C to 56.7°C .
 - A) What is the original temperature of the water?
 - B) What is the final temperature of the water?
 - C) What is ΔT ?
 - D) What is the mass of the water?
 - E) What is the specific heat capacity of the water?
 - F) How much heat was added to the water?
 - G) What scientific law tells us that energy is never created or destroyed?

5. Marlene puts a 87.78 g block of brass into boiling water at 100.1°C until it is hot. She then places the brass block into a bath of 142.16 g of cold water whose temperature was 10.4°C . The final temperature of everything was 18.7°C .
 - A) What is the original temperature of the cold water?
 - B) What is the final temperature of the cold water?
 - C) What is ΔT for the water?
 - D) How much heat did the cold water gain?
 - E) How much heat did the brass block lose?
 - F) Use the formula for heat given above and solve it for “c” the specific heat.
 - G) What is the mass of the block of brass?
 - H) What is ΔT for the block of brass?
 - I) Now calculate the specific heat of brass.
 - J) Where did Marlene put the block of brass?