

Substances and Their Properties: Mastery Check

Learning target: I can tell substances from mixtures, separate identifying properties from object properties, calculate and use density, and plan a set of tests to identify an unknown.

Retrieval and mastery check About 35 min Individual MS-PS1-2 · practice independent practice writing

Name _____ Date _____ Period _____

Directions

Complete Part A on your own without notes; it has twelve items that mix multiple choice, short answer, calculation and a drawing. Use the reference table for the calculations. Then complete the Part B synthesis in a full paragraph. Show the calculation for every numeric item and write units on every number.

You will need: This worksheet, Pencil, Calculator

Reference table for this check (real rounded values at normal air pressure)

Substance	Density (g/cm ³)	Melting point (°C)
Aluminum	2.7	660
Zinc	7.14	420
Iron	7.87	1538
Copper	8.96	1085
Silver	10.5	962
Palladium	12.0	1555
Gold	19.3	1064

Part A: Retrieval (12 items)

1. Which of these is a single substance rather than a mixture? 1 pt
- ☐ A. Air
 - ☐ B. Wood
 - ☐ C. Copper
 - ☐ D. Brass (copper mixed with zinc)

2. A gray metal bar needs to be identified. Which property of the bar could identify the substance it is made of? 1 pt

- ☐ A. Its mass
- ☐ B. Its volume
- ☐ C. Its melting point
- ☐ D. Its shape

3. True or false: If a block of gold is cut exactly in half, each half has half the density of the original block. 1 pt

☐ True ☐ False Explain your thinking:

4. A shiny gray chip has a mass of 54.0 g and a volume of 20.0 cm³. Calculate its density and name the substance from the reference table. 2 pts

5. Silver and palladium are both shiny, silvery-gray metals. Name one measurement from the reference table that would tell them apart more reliably than density, and explain why it is more reliable. 1 pt

6. At sea level water boils at 100 °C. In a mountain town 2,500 m above sea level, where air pressure is lower, water boils at a temperature that is: 1 pt

- ☐ A. higher than 100 °C
- ☐ B. lower than 100 °C
- ☐ C. exactly 100 °C, because boiling point never changes
- ☐ D. impossible to predict without knowing the amount of water

7. Flammability is called a _____ property because it can only be observed while the substance changes into new substances. 1 pt

8. What is the mass of a copper piece with a volume of 5.0 cm^3 ? Show the calculation using the reference table. 2 pts

9. A spoon of sugar stirred into water leaves a clear liquid that stays clear. A spoon of flour stirred into water leaves a cloudy liquid that settles into a layer. Which solid dissolved in water, and what two observations tell you? 1 pt

10. A scientist measures an unknown's density as 7.3 g/cm^3 , and two metals in her table are within 0.3 g/cm^3 of that value. What should she do next? 1 pt

- ☐ A. Measure the density again, more carefully
- ☐ B. Measure a different identifying property, such as melting point
- ☐ C. Choose the metal that is more common
- ☐ D. Report that the sample must be a mixture

11. Oxygen gas is invisible. Is it still a substance? Answer yes or no and give one reason using the word *macroscopic*. 1 pt

12. Three liquids that do not mix are poured into one jar: liquid X (density 0.80 g/cm^3), liquid Y (1.00 g/cm^3) and liquid Z (1.30 g/cm^3). A bead with a density of 1.10 g/cm^3 is dropped in. Draw the jar with the three liquids in the correct order, label each with its density, and draw the bead where it comes to rest. 2 pts

Part B: Synthesis

- 13.** You are handed a jar of unlabeled white powder and told it is either table salt, sugar or chalk. Plan three tests, using only properties from this lesson, that would identify it. For each test say what result each candidate would give. Then explain why a scientist usually runs more than one test even when the first result seems clear. 4 pts

Two formulas, one rule

Density = mass $\div$ volume. If you know the density and the volume, mass = density $\times$ volume. The one rule for deciding whether a property can identify a substance: ask whether every sample of that substance, big or small, would give the same value. If yes, it can identify; if the value changes with the amount, it cannot.

Write the hardest item

Write one new multiple-choice item for this check that a student who has only memorized the formula for density would get wrong, but a student who understands that density is an identifying property would get right. Include four options, mark the correct one, and write two sentences explaining why each wrong option is tempting.