Matter, Mixtures and Reactions

Use this key to check answers and read the explanations.

1. Which change alters the form of a material while keeping its chemical identity the same?

A. Ice melts into liquid water.
B. An iron nail forms rust.
C. Sugar darkens as new compounds form.
D. A candle wick burns.

Correct answer: A. Ice melts into liquid water.
Ice and liquid water contain the same substance in different phases. The other changes produce different substances.

2. Which description of a material is a chemical property?

A. It has a mass of 12 grams.
B. It is silvery gray.
C. It can burn in air.
D. It is solid at room temperature.

Correct answer: C. It can burn in air.
Burning is a reaction that transforms substances. Color, mass and the observed state can be described without changing what the material is.

3. Which sample contains more than one substance mixed together?

A. Pure helium
B. Dry air
C. Distilled water
D. Pure copper

Correct answer: B. Dry air
Dry air contains several gases, including nitrogen and oxygen. The other samples each name one substance.

4. Which formula shows a compound made of two different elements?

A. Cl_2
B. O_2
C. S_8
D. MgO

Correct answer: D. MgO
MgO includes magnesium and oxygen. The other formulas contain more than one atom but use just one element symbol each.

5. Carbon dioxide is dissolved in a bottle of plain sparkling water. Which substance is the solvent in the liquid?

A. Carbon dioxide
B. Water
C. Carbon
D. Oxygen

Correct answer: B. Water
Water is the liquid medium in which carbon dioxide is dissolved. The dissolved carbon dioxide is the solute.

6. A uniform block has a mass of 24 grams and a volume of 8 cubic centimeters. What is its density?

A. 3 grams per cubic centimeter
B. 8 grams per cubic centimeter
C. 16 grams per cubic centimeter
D. 32 grams per cubic centimeter

Correct answer: A. 3 grams per cubic centimeter
Density is mass divided by volume. Dividing 24 grams by 8 cubic centimeters gives 3 grams per cubic centimeter.

7. A solid block has uniform composition. It is cut into two equal pieces, with no change in temperature. Which property of each piece matches the original block?

A. Amount of material
B. Mass
C. Volume
D. Density

Correct answer: D. Density
Each piece has half the mass and half the volume. Dividing one by the other gives the same density as before.

8. At a fixed temperature, a sample of water can hold up to 9 grams of a sugar in solution. A model shows 12 grams of total sugar at equilibrium, with some undissolved. How much is undissolved?

A. 12 grams
B. 9 grams
C. 3 grams
D. 21 grams

Correct answer: C. 3 grams
The solution contains 9 grams of dissolved sugar. The remaining 3 grams are outside the solution as undissolved solid.

9. A metal surface develops a different color. Which added finding would most directly confirm a chemical change?

A. The new surface layer is a different compound from the original metal.
B. The new surface layer feels rougher.
C. The surface looks darker in dim light.
D. The new surface layer has a larger exposed area.

Correct answer: A. The new surface layer is a different compound from the original metal.
A different compound shows that a new substance formed. Color, texture and area alone could change without establishing a chemical reaction.

10. A bottle contains two different liquids in separate layers. Each layer looks uniform on its own. How should the whole sample be classified?

A. A pure element
B. A homogeneous solution
C. A pure compound
D. A heterogeneous mixture

Correct answer: D. A heterogeneous mixture
A sample taken solely from one layer differs in composition from a sample from the other. The whole mixture is therefore heterogeneous.

11. The expression 2 NH_3 represents two molecules of ammonia. How many hydrogen atoms are represented altogether?

A. 3
B. 2
C. 6
D. 8

Correct answer: C. 6
Each molecule contains three hydrogen atoms. The coefficient of 2 means there are two such molecules, so the total is six hydrogen atoms.

12. A sealed container holds 18 grams of one substance and 7 grams of another. They react. The container itself is excluded from the measurements. What is the resulting mass of all contents together?

A. 11 grams
B. 25 grams
C. 18 grams
D. 32 grams

Correct answer: B. 25 grams
The closed container keeps all the matter inside, even if some products are gases. The total is still 18 plus 7 grams.

13. A worksheet compares four ways to edit the expression H_2O. Which edit changes the chemical identity shown?

A. Replace H_2O with 4 H_2O.
B. Replace H_2O with 2 H_2O.
C. Replace H_2O with 3 H_2O.
D. Replace H_2O with H_2O_2.

Correct answer: D. Replace H_2O with H_2O_2.
Changing a subscript changes the atom counts inside each molecule. H_2O_2 is hydrogen peroxide. Changing the number in front changes only how many water molecules are shown.

14. An enthalpy diagram places the reactants at 90 kilojoules and the products at 65 kilojoules on the same scale. What does it show for the reaction as written?

A. A 25-kilojoule decrease, so the reaction is exothermic
B. A 25-kilojoule increase, so the reaction is endothermic
C. A 65-kilojoule decrease, so the reaction is exothermic
D. A 155-kilojoule increase, so the reaction is endothermic

Correct answer: A. A 25-kilojoule decrease, so the reaction is exothermic
Subtract the reactants' enthalpy from the products' enthalpy. The change is 65 minus 90, or -25 kilojoules. A negative enthalpy change is exothermic.

15. In a fictional particle model, each reaction event uses two X_2 particles and one Y_2 particle to form two X_2Y particles. The model starts with five X_2 and two Y_2 particles. When no more events can occur, how many X_2Y are made and how many X_2 remain?

A. 2 X_2Y made and 3 X_2 left
B. 4 X_2Y made and 0 X_2 left
C. 4 X_2Y made and 1 X_2 left
D. 5 X_2Y made and 1 X_2 left

Correct answer: C. 4 X_2Y made and 1 X_2 left
The two Y_2 particles allow two reaction events. Together those events use four X_2 and make four X_2Y, leaving one X_2 particle unused.