ANSWER KEY.

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4.1 Introduction for Reactions

AP Chemistry | ANSWER KEY

Back up every answer with evidence: name the new substance or describe a new property.

1. Classify each change as physical or chemical.

(a) dry ice, $CO_2(s)$, turning into $CO_2(g)$

(b) a match burning

(c) salt dissolving in water

(d) milk going sour and smelling different

(e) cutting copper wire into short pieces

(a) Physical (only the phase changes; still CO_2) (b) Chemical (heat and light; ash and gases form)

(c) Physical (still NaCl; evaporate the water to get it back) (d) Chemical (new substances with a new smell)

(e) Physical (still copper, just smaller pieces)

2. A piece of magnesium ribbon is dropped into hydrochloric acid. The acid fizzes, the test tube gets warm, and the ribbon slowly disappears. Is this a physical or chemical change? Give two pieces of evidence and name the gas that forms.

Chemical change.

Evidence 1: a gas forms (bubbles). Evidence 2: energy is released (the tube gets warm).

The gas is hydrogen, $H_2(g)$, a new substance that was not there before.

3. A student heats a beaker of water until it boils. She sees bubbles and says, "Bubbles mean a gas formed, so boiling is a chemical change." Do you agree? Explain.

Disagree. The bubbles are water vapor, $H_2O(g)$. It is the same substance as the liquid, so no new substance formed. Boiling is a physical change. Evidence such as bubbles is not proof.

4. A clear, colorless solution of lead(II) nitrate is poured into a clear, colorless solution of potassium iodide. The mixture turns cloudy, and a bright yellow solid settles to the bottom.

(a) What is the yellow solid called?

(b) Is this a physical or chemical change? Explain.

(a) A precipitate (it is lead(II) iodide, PbI_2).

(b) Chemical. A new solid formed from two solutions, and it has a new color. It is a new substance that does not dissolve in water.

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5. Predict one observation you would expect for each reaction before you mix anything.

(a) Zinc reacts with hydrochloric acid. One product is hydrogen gas.

(b) Silver nitrate solution is mixed with sodium chloride solution. One product is silver chloride, a solid that does not dissolve in water.

(c) Methane gas burns in a lab burner and releases energy.

(a) Bubbles or fizzing. (b) The mixture turns cloudy and a solid (precipitate) settles. (c) Heat and light (a flame; the area gets warmer).

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6. Which diagram shows a chemical change? Justify your answer using the particles.

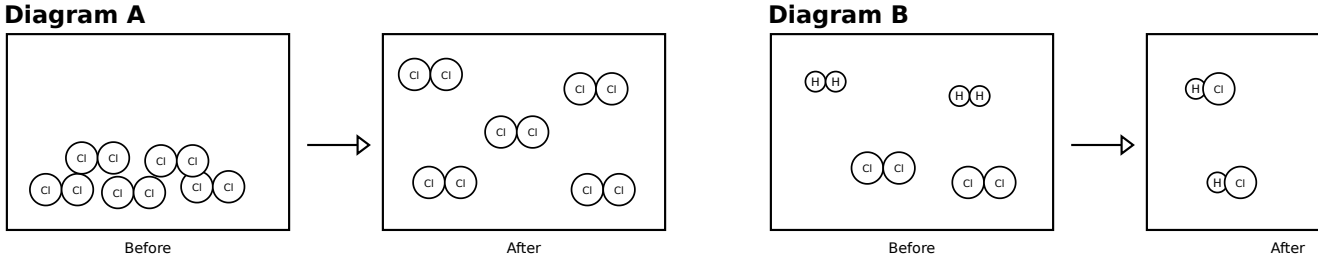


Diagram B. The H_2 and Cl_2 molecules are gone, and new HCl molecules formed: the atoms rearranged into new combinations. In Diagram A, every particle is still Cl_2; the molecules only spread apart (a phase change), so it is physical. In B the atoms are conserved: 4 H and 4 Cl before and after.

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7. Sugar is stirred into water until it disappears. A second sample of sugar is heated in a pan until it turns black and smells burnt. Classify each change and explain how you know.

Dissolving: physical. The sugar molecules spread out among the water molecules but are still sugar; evaporating the water gives the sugar back.

Heating until black: chemical. A new black solid (carbon) and a new smell show that new substances formed.

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8. Two clear solutions, HCl(aq) and NaOH(aq), are mixed. The mixture stays clear and colorless, so a student concludes that no reaction happened. Describe a measurement the student could make to test this claim, and the result that would show a chemical change.

Measure the temperature of each solution before mixing and of the mixture after mixing (use a thermometer). A temperature rise shows that energy was released, which is evidence that a reaction happened (a new substance, water, formed).

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