ANSWER KEY.

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Identifying Redox Reactions

Chemistry | ANSWER KEY

Assign an oxidation number to every atom on both sides. If any oxidation number changes, the reaction is redox: the element whose number goes up is oxidized, and the one whose number goes down is reduced.
Use the tables, finished rows and word banks where they are given.

1. Test each reaction. The first row is done for you.

Reaction	Oxidation numbers that change	Redox?	Oxidized	Reduced
$2Na + Br_2 \rightarrow 2NaBr$	Na: 0 → +1; Br: 0 → −1	yes	Na	Br
$Mg + 2HCl \rightarrow MgCl_2 + H_2$	**Mg: 0 → +2; H: +1 → 0**	**yes**	**Mg**	**H**
$KOH + HNO_3 \rightarrow KNO_3 + H_2O$	**none (acid-base)**	**no**	**none**	**none**
$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$	**C: −4 → +4; O: 0 → −2**	**yes**	**C**	**O**
$BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl$	**none (double repl.)**	**no**	**none**	**none**
$2KClO_3 \rightarrow 2KCl + 3O_2$	**Cl: +5 → −1; O: −2 → 0**	**yes**	**O**	**Cl**

Double replacement and acid-base reactions never change an oxidation number.

2. Write the half-reactions. Remember: e^- on the right means oxidation, and e^- on the left means reduction.

Reaction	Oxidation half-reaction	Reduction half-reaction
$Mg + Cu^{2+} \rightarrow Mg^{2+} + Cu$	**$Mg \rightarrow Mg^{2+} + 2e^-$**	**$Cu^{2+} + 2e^- \rightarrow Cu$**
$2Al + 3Cu^{2+} \rightarrow 2Al^{3+} + 3Cu$	**$2Al \rightarrow 2Al^{3+} + 6e^-$**	**$3Cu^{2+} + 6e^- \rightarrow 3Cu$**

Match the electrons: Al loses 6 and Cu^{2+} gains 6 in the second reaction.

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3. The substance that is reduced is the oxidizing agent. The substance that is oxidized is the reducing agent. Name both. The first row is done for you.

Reaction	Oxidizing agent	Reducing agent
$2Mg + O_2 \rightarrow 2MgO$	O_2 (O is reduced)	Mg (Mg is oxidized)
$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$	**Fe_2O_3 (Fe: +3 → 0)**	**CO (C: +2 → +4)**
$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$	**$CuSO_4$ (Cu^{2+}: +2 → 0)**	**Zn (0 → +2)**

The agent is the whole reactant that contains the element being reduced or oxidized.

4. Problem 1 had two reactions with hydrochloric or nitric acid. In $KOH + HNO_3$, what moves from one reactant to the other? In $Mg + 2HCl$, what moves? Explain why only one of them is redox.

Sentence frame: *In $KOH + HNO_3$, a _____ moves from the acid to the base, so no oxidation numbers change. In $Mg + 2HCl$, _____ move from Mg to H^+, so it is redox.*

$KOH + HNO_3$: a proton (H^+) moves from the acid to the base (OH^-); every oxidation number stays the same, so it is not redox.

$Mg + 2HCl$: 2 electrons move from Mg to the two H^+ ions; Mg goes 0 → +2 and H goes +1 → 0, so it is redox.

5. Decide whether each change is chemical or physical, and give the evidence. The first row is done for you.

Word bank: a gas forms, a precipitate forms, color change, energy released or absorbed, same substance

What happens	Chemical or physical?	Evidence
A piece of zinc in hydrochloric acid fizzes.	chemical	a gas forms
Ice melts on the counter.	**physical**	**same substance (water)**
Clear $BaCl_2$ and Na_2SO_4 solutions are mixed, and a white solid appears.	**chemical**	**a precipitate forms**
A steel wool pad turns orange-brown after a week in damp air.	**chemical**	**color change (rust)**
Water boils on a stove, and bubbles rise.	**physical**	**bubbles are steam (water)**

Bubbles alone do not prove a reaction: boiling makes bubbles too.

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