Oxidation and reduction practice answer key

13. Which of the following is a base?
a) KOH
b) C_2H_5OH alcohol
c) Br^- ← base
d) CH_3OH alcohol
e) CO_2 ← acid anhydride

14. Which of the following is a strong acid?
a) H_2CO_3 weak
b) HF weak
c) H_3PO_4 weak
d) $HClO_3$ oops.
e) HNO_3 both are on our strong acid list

15. Which of the following is an acid in aqueous solutions?
a) H_2CO_3
b) Al_2O_3 ← basic anhydride
c) CH_4 neutral
d) H_2O neutral
e) BaO ← basic anhydride

16. SO_2 turns into which acid in solution?
a) HNO_3
b) H_2SO_3 ($SO_2 + H_2O \rightarrow H_2SO_3$)
c) H_2SO_4
d) H_2S
e) HNO_2

17. What is the oxidation number of C in CO_3^{2-}?
a) +6
b) +4
c) +2
d) +1
e) −1
$x + 3(-2) = -2$ $x = +4$

18. What is the oxidation number of Br in $KBrO_4$?
a) +1 b) −1 c) +5 d) +7 e) +8
$1 + x + 4(-2) = 0$ $x = +7$

19. For each change below, label the change of the underlined element as **O**xidation, **R**eduction, or Neither
R $\underline{Cu}^{2+} \rightarrow \underline{Cu}^{0}$ +2 → 0
O $\underline{C}H_4 \rightarrow \underline{C}O_2$ −4 → +4
R $\underline{H_2O_2} \rightarrow \underline{H_2O}$ −1 → −2
N $\underline{CO_2} \rightarrow \underline{H_2CO_3}$ +4 → +4
THIS IS ACID-BASE

20. How many milliliters of 0.123 M NaOH solution contain 25.0 g of NaOH (molar mass = 40.00 g/mol)?
a) 5.08 mL
b) 50.8 mL
c) 508 mL
d) 625 mL.
e) 5080 mL.
See pages 4 & 5

21. If you need 1.00 L of 0.125 M H_2SO_4, how would you prepare this solution?
a) Add 950. mL of water to 50.0 mL of 3.00 M H_2SO_4.
b) Add 500. mL of water to 500. mL of 0.500 M H_2SO_4.
c) Add 750 mL of water to 250 mL of 0.375 M H_2SO_4.
d) Dilute 36.0 mL of 1.25 M H_2SO_4 to a volume of 1.00 L.
e) Dilute 20.8 mL of 6.00 M H_2SO_4 to a volume of 1.00 L.
See pages 4 & 5

22. What is the ion concentration in a 0.12 M solution of $BaCl_2$?
a) $[Ba^{2+}] = 0.12$ M and $[Cl^-] = 0.12$ M.
b) $[Ba^{2+}] = 0.12$ M and $[Cl^-] = 0.060$ M.
c) $[Ba^{2+}] = 0.12$ M and $[Cl^-] = 0.24$ M.
d) $[Ba^{2+}] = 0.060$ M and $[Cl^-] = 0.060$ M.
e) $[Ba^{+}] = 0.12$ M and $[Cl^-] = 0.12$ M.

23. What is the molarity of the solution that results when 60.0 g NaOH is added to enough water to make 500. mL solution?
a) 1.33 M
b) 12.0 M
c) 3.00 M
d) 8.0 M
e) 1.50 M
See pages 4 & 5

Rules for Assigning Oxidation States

(These rules are hierarchical. If any two rules conflict, follow the rule that is higher on the list.)

1. The oxidation state of an atom in a free element is 0.

Examples: Cu (0 ox state) Cl_2 (0 ox state)

2. The oxidation state of a monoatomic ion is equal to its charge.

Examples: Ca^{2+} (+2 ox state) Cl^- (−1 ox state)

3. The sum of the oxidation states of all atoms in:

- A neutral molecule or formula unit is 0.

Example: H_2O — 2(H ox state) + 1(O ox state) = 0

- An ion is equal to the charge of the ion.

Example: NO_3^- — 1(N ox state) + 3(O ox state) = −1

4. In their compounds, metals have positive oxidation states.

- Group 1A metals *always* have an oxidation state of +1.

Example: NaCl (+1 ox state)

- Group 2A metals *always* have an oxidation state of +2.

Example: CaF_2 (+2 ox state)

5. In their compounds, nonmetals are assigned oxidation states according to the table shown here. Entries at the top of the table take precedence over entries at the bottom of the table.

When assigning oxidation states, keep these points in mind:

- The oxidation state of any given element generally depends on what other elements are present in the compound. (The exceptions are the group 1A and 2A metals, which are *always* +1 and +2, respectively.)
- Rule 3 must always be followed. Therefore, when following the hierarchy shown in rule 5, give priority to the element(s) highest on the list and then assign the oxidation state of the element lowest on the list using rule 3.
- When assigning oxidation states to elements that are not covered by rules 4 and 5 (such as carbon), use rule 3 to deduce their oxidation state once all other oxidation states have been assigned.

Oxidation-Reduction Worksheet

For each reaction below, identify the atom oxidized, the atom reduced, the oxidizing agent, the reducing agent, the oxidation half reaction, the reduction half reaction, and then balance the equation by the method of oxidation-reduction showing all electron transfers.

1. $Mg + 2HCl \rightarrow MgCl_2 + H_2$
2. $2Fe + 3V_2O_3 \rightarrow Fe_2O_3 + 6VO$
3. $KMnO_4 + KNO_2 + 2H_2SO_4 \rightarrow MnSO_4 + 2H_2O + KNO_3 + K_2SO_4$
4. $K_2Cr_2O_7 + SnCl_2 + HCl \rightarrow CrCl_3 + SnCl_4 + KCl + H_2O$
5. $KMnO_4 + NaCl + H_2SO_4 \rightarrow Cl_2 + K_2SO_4 + MnSO_4 + H_2O + Na_2SO_4$
6. $K_2Cr_2O_7 + H_2O + S \rightarrow SO_2 + KOH + Cr_2O_3$
7. $KClO_3 + C_{12}H_{22}O_{11} \rightarrow KCl + H_2O + CO_2$
8. $H_2C_2O_4 + K_2MnO_4 \rightarrow CO_2 + K_2O + Mn_2O_3 + H_2O$
9. $Mn(NO_3)_2 + NaBiO_3 + HNO_3 \rightarrow HMnO_4 + Bi(NO_3)_3 + NaNO_3 + H_2O$
10. $H_2C_2O_4 + KMnO_4 \rightarrow CO_2 + K_2O + Mn_2O_3 + H_2O$

Redox practice worksheet

Name: _____ **Date:** _____

1. In which substance is the oxidation number of nitrogen zero?

   A. NH_3 B. N_2 C. NO_2 D. N_2O

2. What is the oxidation number of carbon in $NaHCO_3$?

   A. $^{+}6$ B. $^{+}2$ C. $^{-}4$ D. $^{+}4$

3. In the reaction $Al^0 + Cr^{3+} \rightarrow Al^{3} + Cr^0$, the reducing agent is

   A. Al^0 B. Cr^{3+} C. Al^{3+} D. Cr^0

4. In the reaction $2K + Cl_2 \rightarrow 2KCl$, the species oxidized is

   A. Cl_2 B. Cl^{-} C. K D. K^{+}

5. As an S^{2-} ion is oxidized to an S^0 atom, the number of protons in its nucleus

   A. decreases B. increases

   C. remains the same

6. Given the probable reaction for the nickel-cadmium battery:

   $2Ni(OH)_3 + Cd \rightleftharpoons 2Ni(OH)_2 + Cd(OH)_2$

   Which species is oxidized during the discharge of the battery?

   A. Ni^{3+} B. Ni^{2+} C. Cd^0 D. Cd^{2+}

7. If element X forms the oxides XO and X_2O_3, the oxidation numbers of element X are

   A. $^{+}1$ and $^{+}2$ B. $^{+}2$ and $^{+}3$

   C. $^{+}1$ and $^{+}3$ D. $^{+}2$ and $^{+}4$

8. Oxygen has a positive oxidation number in the compound

   A. H_2O B. H_2O_2 C. OF_2 D. IO_2

9. What is the oxidation number of sulfur in H_2SO_4?

   A. 0 B. −2 C. +6 D. +4

10. In the equation
    $Cu(s) + 2Ag^{+}(aq) \rightarrow Cu^{2+}(aq) + 2Ag(s)$,
    the oxidizing agent is

    A. Cu^0 B. Ag^{+} C. Cu^{2+} D. Ag^0

11. In the reaction $Al + Cr^{3+} \rightarrow Al^{3+} + Cr$, the reducing agent is

    A. Al B. Cr^{3+} C. Al^{3+} D. Cr

12. In the compound Na_2HPO_4, which element has a negative oxidation number?

    A. H B. O C. P D. Na

Answer:

a) The chemical formulae of the two chlorides are $AuCl$ and $AuCl_3$.

b) i) The chemical equation is: $3Cu(s) + 2AuCl_3(aq) \rightarrow 3CuCl_2(aq) + 2Au(s)$
   The ionic equation is: $3Cu(s) + 2Au^{3+}(aq) \rightarrow 3Cu^{2+}(aq) + 2Au(s)$

   ii) Chloride ions (Cl^{-})

   iii) Copper has been oxidised to Cu^{2+}. Each copper atom has lost two electrons.

c) $Au^{3+}(aq) + 2e^{-} \rightarrow Au^{+}(aq)$

d) Add potassium iodide solution to test for the presence of an oxidising agent. The solution changes from colourless to brown.

e) i) $3Au^{+}(aq) \rightarrow 2Au(s) + Au^{3+}(aq)$

   ii) Some $Au^{+}(aq)$ ions have been reduced to gold atoms and the rest have been oxidised to $Au^{3+}(aq)$.

Practice Question

Copper exists in the oxidation states of +1 and +2.

a) Write the chemical formulae of

   i) the two oxides of copper. Cu_2O and CuO

   ii) the two iodides of copper. CuI and CuI_2

b) Copper(I) oxide is a reddish-brown solid. It reacts with excess dilute sulphuric acid to form copper(II) sulphate, copper and one other product.

   i) Write the chemical equation for the reaction.
   $Cu_2O(s) + H_2SO_4(aq) \rightarrow CuSO_4(aq) + Cu(s) + H_2O(l)$

   ii) Describe what can be seen when copper(I) oxide is added to excess dilute sulphuric acid.
   Reddish-brown solid disappears, blue solution of copper(II) sulphate and reddish-brown precipitate of copper are formed.

   iii) Write the ionic equation for the reaction.
   $2Cu_2O(s) + 2H^{+}(aq) \rightarrow Cu^{2+}(aq) + Cu(s) + H_2O(l)$

   iv) State which substance has been oxidised and reduced in this reaction.
   Copper(I) oxide has been oxidised to copper(II) sulphate, and also has been reduced to copper.

How to understand oxidation and reduction. How does oxidation and reduction work. Meaning oxidation and reduction. Oxidation-reduction worksheet answer key. Oxidation and reduction answer key.

Determine the oxidation number of the elements in each of the following compounds: a. H2CO3 H: +1, O: -2, C: +4 b. N2 N: 0 c. Zn(OH)42- Zn: 2+, H: +1, O: -2 d. NO2- N: +3, O: -2 e. LiH Li: +1, H: -1 f. Fe3O4 Fe: +8/3, O: -2 Identify the species being oxidized and reduced in each of the following reactions: a. Cr+ + Sn4+ Cr3+ + Sn2+ Cr+: oxidized, Sn4+: reduced b. 3 Hg2+ + 2 Fe (s) 3 Hg2 + 2 Fe3+ Hg2+: reduced, Fe: oxidized c. 2 As (s) + 3 Cl2 (g) 2 AsCl3 As: oxidized, Cl2: reduced Would you use an oxidizing agent or reducing agent in order for the following reactions to occur? a. ClO3- ClO2 reducing agent b. SO42- S2- reducing agent c. Mn2+ MnO2 oxidizing agent d. Zn ZnCl2 oxidizing agent Write balanced equations for the following redox reactions: a. 2 NaBr + Cl2 2 NaCl + Br2 b. Fe2O3 + 3 CO 2 Fe + 3 CO2 in acidic solution c. 5 CO + I2O5 5 CO2 + I2 in basic solution Write balanced equations for the following reactions: a. Cr(OH)3 + Br2 CrO42- + Br- in basic solution 10 OH- + 2 Cr(OH)3 + 3 Br2 2 CrO42- + 8 H2O + 6 Br- b. O2 + Sb H2O2 + SbO2- in basic solution 2 OH- + 2 Sb + 3 O2 + 2 H2O 2 SbO2- + 3 H2O2 c. HCOOH + MnO4- CO2 + Mn2+ in acidic solution 6 H+ + 2 MnO4- + 5 HCOOH 2 Mn2+ + 8 H2O + 5 CO2 d. ClO2- ClO2 + Cl- in acidic solution 5 ClO2- + 4 H+ 4 ClO2 + Cl- + 2 H2O Write the balanced half reactions of the following reactions: a. NiO2 + 2 H2O + Fe Ni(OH)2 + Fe(OH)2 in basic solution 2 H2O + NiO2 + 2 e- Ni(OH)2 + 2 OH- 2 OH- + Fe Fe(OH)2 + 2 e- b. CO2 + 2 NH2OH CO + N2 + 3 H2O in basic solution CO2 + H2O + 2 e- CO + 2 OH- 2 OH- + 2 NH2OH N2 + 2 e- + 4 H2O c. 2 H+ + H2O2 + 2 Fe2+ 2 Fe3+ + 2 H2O in acidic solution H2O2 + 2 e- + 2 H+ 2 H2O Fe2+ Fe3+ + e- d. H+ + 2 H2O + 2 MnO4- + 5 SO2 2 Mn2+ + 5 HSO4- in acidic solution 8 H+ + MnO4- + 5 e- Mn2+ + 4 H2O SO2 + 2 H2O HSO4- + 3 H+ + 2 e-