

11. OXIDATION NUMBERS, REDOX REACTIONS

These problems are intended to *supplement* the problems in the textbook, not *replace* them.

Questions

What is the oxidation number of each atom in the following?

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|--------------------|---------------------------------|--------------------------------------|---------------------------------------|
| 1. KMnO_4 | 4. SrCr_2O_7 | 7. Na_2CrO_4 | 9. CO_3^{2-} |
| 2. NH_4^+ | 5. Mn_2O_3 | 8. $\text{HC}_2\text{H}_3\text{O}_2$ | 10. $\text{H}_4\text{As}_2\text{O}_7$ |
| 3. SbF_5 | 6. $\text{Cr}_2(\text{SO}_4)_3$ | | |

What is the oxidizing agent and what is the reducing agent in each of the following reactions?

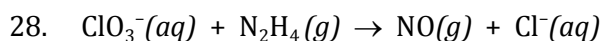
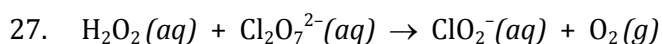
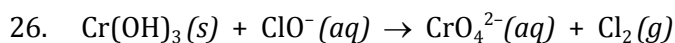
- $2 \text{Fe}_2\text{O}_3(l) + 3 \text{C}(s) \rightarrow 4 \text{Fe}(l) + 3 \text{CO}_2(g)$
- $5 \text{Fe}^{2+}(aq) + \text{MnO}_4^-(aq) + 8 \text{H}^+(aq) \rightarrow 5 \text{Fe}^{3+}(aq) + \text{Mn}^{2+}(aq) + 4 \text{H}_2\text{O}(l)$
- $\text{HgO}(s) + \text{Zn}(s) \rightarrow \text{Hg}(l) + \text{ZnO}(s)$
- $2 \text{K}_2\text{Cr}_2\text{O}_7(aq) + 3 \text{C}_2\text{H}_5\text{OH}(aq) + 8 \text{H}_2\text{SO}_4(aq) \rightarrow 2 \text{Cr}_2(\text{SO}_4)_3(aq) + 2 \text{K}_2\text{SO}_4(aq) + 3 \text{HC}_2\text{H}_3\text{O}_2(aq) + 11 \text{H}_2\text{O}(l)$
- $2 \text{NH}_4^+(aq) + 2 \text{MnO}_2(s) + \text{Zn}(s) \rightarrow \text{Mn}_2\text{O}_3(s) + 2 \text{NH}_3(aq) + \text{H}_2\text{O}(l) + \text{Zn}^{2+}(aq)$
- $2 \text{Cr}_2\text{O}_3(s) + 3 \text{Si}(s) \rightarrow 4 \text{Cr}(s) + 3 \text{SiO}_2(s)$
- $6 \text{H}^+(aq) + 5 \text{H}_2\text{C}_2\text{O}_4(aq) + 2 \text{MnO}_4^-(aq) \rightarrow 10 \text{CO}_2(g) + 2 \text{Mn}^{2+}(aq) + 8 \text{H}_2\text{O}(l)$
- $\text{PbO}_2(s) + 4 \text{Cl}^-(aq) + 4 \text{H}^+(aq) \rightarrow \text{PbCl}_2(s) + 2 \text{H}_2\text{O}(l) + \text{Cl}_2(g)$

Complete and balance the following redox reactions which occur in acidic solution:

- $\text{Cr}_2\text{O}_7^{2-}(aq) + \text{I}^-(aq) \rightarrow \text{Cr}^{3+}(aq) + \text{I}_2(s)$
- $\text{Mn}^{2+}(aq) + \text{NaBiO}_3(s) \rightarrow \text{Bi}^{3+}(aq) + \text{Na}^+(aq) + \text{MnO}_4^-(aq)$
- $\text{As}(s) + \text{ClO}_3^-(aq) \rightarrow \text{H}_3\text{AsO}_3(aq) + \text{HClO}(aq)$
- $\text{Fe}^{2+}(aq) + \text{HBrO}_3(aq) \rightarrow \text{Fe}^{3+}(aq) + \text{Br}_2(l)$
- $\text{MnO}_2(s) + \text{SO}_3^{2-}(aq) \rightarrow \text{Mn}^{2+}(aq) + \text{S}_2\text{O}_6^{2-}(aq)$

Complete and balance the following redox reactions which occur in basic solution:

- $\text{CN}^-(aq) + \text{MnO}_4^-(aq) \rightarrow \text{CNO}^-(aq) + \text{MnO}_2(s)$
- $\text{NO}_2^-(aq) + \text{Al}(s) \rightarrow \text{NH}_3(aq) + \text{Al}(\text{OH})_4^-(aq)$



Answers

If you cannot figure out how to get the correct answer, go to your instructor, Science Tutoring Center, etc.

1. K is +1, O is -2, Mn is +7

10. H is +1, O is -2, As is +5

2. H is +1, N is -3

11. ox agent is Fe_2O_3 and red agent is C

3. F is -1, Sb is +5

12. ox agent is MnO_4^- and red agent is Fe^{2+}

4. Sr is +2, O is -2, Cr is +6

13. ox agent is HgO and red agent is Zn

5. O is -2, Mn is +3

14. ox agent is $\text{K}_2\text{Cr}_2\text{O}_7$ and red agent is $\text{C}_2\text{H}_5\text{OH}$

6. Cr is +3, O is -2, S is +6

15. ox agent is MnO_2 and red agent is Zn

7. Na is +1, O is -2, Cr is +6

16. ox agent is Cr_2O_3 and red agent is Si

8. H is +1, O is -2, C is 0

17. ox agent is MnO_4^- and red agent is $\text{H}_2\text{C}_2\text{O}_4$

9. O is -2, C is +4

18. ox agent is PbO_2 and red agent is Cl^-

