***Chemistry***

**4: Stoichiometry of Chemical Reactions**

**4.2: Classifying Chemical Reactions**

13. Indicate what type, or types, of reaction each of the following represents:

(a) 

(b) 

(c) 

Solution

(a) oxidation-reduction (addition); (b) acid-base (neutralization); (c) oxidation-reduction (combustion)

15. Silver can be separated from gold because silver dissolves in nitric acid while gold does not. Is the dissolution of silver in nitric acid an acid-base reaction or an oxidation-reduction reaction? Explain your answer.

Solution

An oxidation-reduction reaction, because the oxidation state of the silver changes during the reaction.

17. Determine the oxidation states of the elements in the compounds listed. None of the oxygen-containing compounds are peroxides or superoxides.

(a) H3PO4

(b) Al(OH)3

(c) SeO2

(d) KNO2

(e) In2S3

(f) P4O6

Solution

(a) H +1, P +5, O –2; (b) Al +3, H +1, O –2; (c) Se +4, O –2; (d) K +1, N +3, O –2; (e) In +3, S –2; (f) P +3, O –2

19. Classify the following as acid-base reactions or oxidation-reduction reactions:

(a) 

(b) 

(c) 

(d) 

(e) 

(f) 

Solution

(a) acid-base; (b) oxidation-reduction: Na is oxidized, H+ is reduced; (c) oxidation-reduction: Mg is oxidized, Cl2 is reduced; (d) acid-base; (e) oxidation-reduction: P3– is oxidized, O2 is reduced; (f) acid-base

21. Complete and balance the following acid-base equations:

(a) HCl gas reacts with solid Ca(OH)2(*s*).

(b) A solution of Sr(OH)2 is added to a solution of HNO3.

Solution

(a) ; (b) 

23. Complete and balance the following oxidation-reduction reactions, which give the highest possible oxidation state for the oxidized atoms.

(a) 

(b)  (single displacement)

(c) 

(d)  (products are a strong base and a diatomic gas)

Solution

(a) ; (b) ; (c) ; (d) 

25. Complete and balance the equations for the following acid-base neutralization reactions. If water is used as a solvent, write the reactants and products as aqueous ions. In some cases, there may be more than one correct answer, depending on the amounts of reactants used.

(a) 

(b) 

(c) 

Solution

(a) ; (b) , (a solution of H2SO4; (c) 

27. The military has experimented with lasers that produce very intense light when fluorine combines explosively with hydrogen. What is the balanced equation for this reaction?

Solution



29. Great Lakes Chemical Company produces bromine, Br2, from bromide salts such as NaBr, in Arkansas brine by treating the brine with chlorine gas. Write a balanced equation for the reaction of NaBr with Cl2.

Solution



31. Lithium hydroxide may be used to absorb carbon dioxide in enclosed environments, such as manned spacecraft and submarines. Write an equation for the reaction that involves 2 mol of LiOH per 1 mol of CO2.(Hint:Water is one of the products.)

Solution



33. Complete and balance the equations of the following reactions, each of which could be used to remove hydrogen sulfide from natural gas:

(a) 

(b) 

Solution

; (b) 

35. Write balanced chemical equations for the reactions used to prepare each of the following compounds from the given starting material(s). In some cases, additional reactants may be required.

(a) solid ammonium nitrate from gaseous molecular nitrogen via a two-step process (first reduce the nitrogen to ammonia, then neutralize the ammonia with an appropriate acid)

(b) gaseous hydrogen bromide from liquid molecular bromine via a one-step redox reaction

(c) gaseous H2S from solid Zn and Svia a two-step process (first a redox reaction between the starting materials, then reaction of the product with a strong acid)

Solution

(a) step 1: , step 2: ; (b) ; (c)  and 

37. Complete and balance each of the following half-reactions (steps 2–5 in half-reaction method):

(a) 

(b) 

(c) 

(d) 

(e) 

(f) 

(g) 

(h) 

Solution

(a) ; (b) ; (c) ; (d) ; (e) ; (f) ; (g) ; (h) 

39. Balance each of the following equations according to the half-reaction method:

(a) 

(b) 

(c) 

(d) 

(e) 

Solution

For an example of the fully worked out solution, see the solution to Exercise 26. (a); (b) ; (c) ; (d); (e) 

41. Balance each of the following equations according to the half-reaction method:

(a) 

(b) 

(c) 

Solution

For an example of the fully worked out solution, see the solution to Exercise 26. (a) ; (b) ; (c) 

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