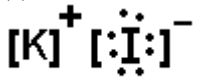
SHORT ANSWER

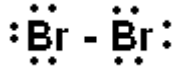
1. ANS:
   3, 4, 6, and 8

2. ANS:
   Ionic compounds are hard solids at SATP, have high melting and boiling points, and are conductive in liquid and aqueous states.

3. ANS:
   (a)

   (b)

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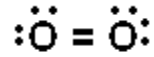
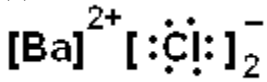
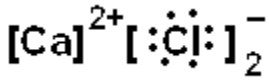
   

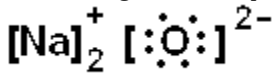
   (d)

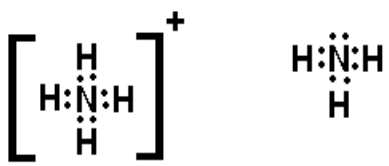
4. ANS:
   They may be solids, liquids, or gases at SATP (a great variation in melting and boiling points), are brittle in solid form (not flexible, malleable, ductile, or bendable), and are nonlustrous (not shiny).
5. ANS:
   Substance IV is most likely to be an ionic compound because its high solution conductivity indicates that ions are present in the solution.
6. ANS:
   When two nonmetals react with each other, they try to form stable octets. To do this, they share electrons. If one atom is much more electronegative than the other, they will not share the electrons equally. Thus, one end of the bond is more negative than the other and the bond is polar.
7. ANS:
   Atoms are more stable when they have eight valence electrons. Nonmetals will try to gain electrons to form a stable octet and metals will try to give away electrons to form a stable octet. Thus, metals give electrons to nonmetals. Subsequently, the two oppositely charged ions are attracted to one another.
8. ANS:
   Calcium forms an ion with a 2+ charge and chlorine forms an ion with a 1^- charge. This means that the smallest unit with a zero charge would require one calcium ion and two chloride ions.

9. ANS:
   Sodium forms an ion with a 1+ charge and oxygen forms an ion with a 2– charge. This means that the smallest unit with a zero charge would require two sodium ions and one oxide ion.

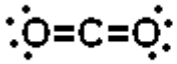
   

10. ANS:
    ammonium ion ammonia

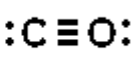
    

11. ANS:

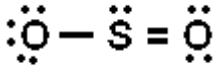
carbon dioxide



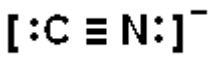
carbon monoxide



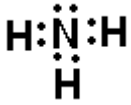
12. ANS:
Between the one sulfur atom and two oxygen atoms, there are 18 valence electrons. The only way for three atoms to attain stable octets is to arrange themselves as shown in the following diagram.



13. ANS:
A carbon atom and a nitrogen atom have nine valence electrons. The negative charge means that there are altogether ten electrons with which the atoms can attain stable octets. The only way to do this is with a triple bond as shown in the following diagram.



14. ANS:
The following diagram shows the electron dot diagram for ammonia. The high electronegativity of nitrogen compared to hydrogen causes the electrons to spend more time with the nitrogen, thus causing a partial negative charge at the nitrogen atom and a partial positive charge at the hydrogen atoms.



15. ANS:
a. $H_2SO_{4(aq)} + 2NaOH_{(aq)} \rightarrow 2HOH_{(l)} + Na_2SO_{4(aq)}$
ANS:
b. $2HgO_{(s)} \rightarrow 2Hg_{(l)} + O_{2(g)}$
ANS:
c. $Cu_{(s)} + 2AgNO_{3(aq)} \rightarrow Cu(NO_3)_{2(aq)} + Ag_{(s)}$
ANS:
d. $3CaCl_{2(aq)} + 2Na_3PO_{4(aq)} \rightarrow Ca_3(PO_4)_{2(s)} + 6NaCl_{(aq)}$
ANS:
e. $2HNO_{3(aq)} + Ba(OH)_{2(aq)} \rightarrow 2HOH_{(l)} + Ba(NO_3)_{2(aq)}$
ANS:
f. $4Fe_{(s)} + 3O_{2(g)} \rightarrow 2Fe_2O_{3(s)}$
ANS:
g. $2Fe_{(s)} + 3Cu(NO_3)_{2(aq)} \rightarrow 3Cu_{(s)} + 2Fe(NO_3)_{3(aq)}$
ANS:
h. $2AlCl_{3(aq)} + 3Na_2CO_{3(aq)} \rightarrow Al_2(CO_3)_{3(s)} + 6NaCl_{(aq)}$
ANS:
i. $CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(g)}$
ANS:
j. $2K_{(s)} + 2HOH_{(l)} \rightarrow H_{2(g)} + 2KOH_{(aq)}$
ANS:
k. $3HCl_{(aq)} + Al(OH)_{3(s)} \rightarrow 3HOH_{(l)} + AlCl_{3(aq)}$
ANS:
l. $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$
ANS:
m. $2Na_{(s)} + 2HOH_{(l)} \rightarrow H_{2(g)} + 2NaOH_{(aq)}$
ANS:
n. $2HCl_{(aq)} + Mg(OH)_{2(s)} \rightarrow 2HOH_{(l)} + MgCl_{2(aq)}$

16. ANS:
hydrogen gas and zinc chloride

17. ANS:
water and carbon dioxide

18. ANS:
$2FeCl_{3(aq)} + 3Zn_{(s)} \rightarrow 3ZnCl_{2(aq)} + 2Fe_{(s)}$

19. ANS:
$C_2H_5OH_{(l)} + 3O_{2(g)} \rightarrow 2CO_{2(g)} + 3H_2O_{(g)}$

20. ANS:
$2Ga_2O_{3(s)} \rightarrow 4Ga_{(s)} + 3O_{2(g)}$

26. Remember that for non-polar bonds, difference in electronegativity is zero, polar bonds difference in electronegativity is less than 1.7 and greater than 0 and for ionic bonds, difference in electronegativity is greater than 1.7.

ESSAY

28. ANS:

-Water is a polar molecule.
-Hydrogen bonds are formed as a result of the large electronegativity difference between oxygen and hydrogen.
-High boiling point: hydrogen bonds must be overcome to boil water.
-Cohesion: hydrogen bonding holds molecules together.
-Adhesion: polar molecules are attracted to charged surfaces.
-Attraction to charged objects: the molecules are polar.

29. ANS:
-Brittle: if lattice is shifted by an impact, like charges are forced next to each other and repel.
-Relatively strong attraction between ions: the ionic bonds must be overcome to a large degree to break down the crystal lattice and allow the substance to melt.
-Ions arrange themselves so that there is maximum proximity to ions of opposite charge, but maximum distance from ions of same charge. A crystal lattice is formed and ordered particles result in a solid.

30. ANS:
Pros
-Apply modern methods to contain environmental damage.
-Community can force mining company to repair land when the project is complete.
-Community can force mining company to remove contaminants.
-Jobs will be generated.
-There will be more money going into the local economy.

Cons
-Cyanide is extremely toxic.
-Open-pit mines are an eyesore.
-Open-pit mines cause extreme damage to the local environment.
-Community may not have power to enforce environmental rules.

31. ANS:
-Nitrogen monoxide is produced by gasoline engine.
-Platinum/palladium catalyst encourages decomposition of nitrogen monoxide to nitrogen and oxygen.
Carbon dioxide and water produced by combustion are greenhouse gases. They are not harmless in large amounts.

32. i) A reaction will occur since Zn is higher in the activity series and more reactive, therefore itis able displace silver from the compound
$Zn\ (s) + 2\ AgNO_3 \rightarrow Zn(NO_3)_2 + 2\ Ag$

ii) There is no reaction since lead is lower in the activity series and not as reactive as iron. Lead will not displace iron from the compound.