1. Which is best described as a covalent compound?
   a. CaS
   b. Ba(NO₃)₂
   c. NbCl₅
   d. CoBr₂
   e. IBr

2. The ionic compound formed from lithium ion and the chromate ion (CrO₄²⁻) is:
   a. LiCrO₄
   b. Li₃CrO₄
   c. Li₂CrO₄
   d. Li₄CrO₄
   e. Li₆CrO₄

3. Which of the following anions has a -3 charge?
   a. nitride ion (N³⁻)
   b. carbonate ion (CO₃²⁻)
   c. cyanide ion (CN⁻)
   a and b
   e. all of the above

4. Which of the following salts is not soluble in water?
   a. CsCl
   b. CrCl₃
   c. lead (II) nitrate
   d. calcium acetate
   e. copper (II) sulfide

5. How many valence electrons are available for the Lewis structure of SeO₂?
   a. 14
   b. 16
   c. 18
   d. 20
   e. 22

6. The valence shell electron configuration for an element is nsⁿnp². How many covalent bonds to hydrogen atoms would be formed by this element?
   a. 1
   b. 2
   c. 3
   d. 4
   e. 5
7. Which violates the octet rule?
   a. sulfur hexafluoride $\text{SF}_6$
   b. $\text{PCl}_5$
   c. $\text{BCl}_3$
   d. $\text{a and b}$
   c. all of the above

---

8. Indium would be expected to form ionic compounds where the charge on the indium ion is:
   a. $+2$
   b. $+3$
   c. $-1$
   d. $-2$
   e. $-5$

   $\text{In}$ is in group 3A and it is a metal
   it will lose 3 e to form a $+3$ ion.

---

9. What is the oxidation number of chlorine in the chlorite ion, $\text{ClO}_2^-$?
   a. $-1$
   b. $+1$
   c. $+3$
   d. $+5$
   e. $+7$

   $\text{CE} + 2(-2) = -1$
   $\text{CE}$ must be $+3$

   "oxygen in compounds is reliably $-2$"

---

10. The bicarbonate ion is also called the hydrogen carbonate ion. Which formula is correct for this ion?
   a. $\text{HCO}_3^-$
   b. $\text{HCO}_5^-$
   c. $\text{H}_2\text{CO}_4^-$
   d. $\text{H}_2\text{CO}_5^-$
   e. $\text{HCO}_3^-$

   see table 3.3 in the text
   and your lecture notes.

   this is a polyatomic ion that you are expected to know.

---

11. As the elements of Period 2 are considered from left to right, there is an increase in
   a. ionization energy.
   b. number of valence electrons.
   c. electronegativity.
   d. $\text{a and b}$
   c. all of the above

---

12. Which is the correct formula for ammonium chloride?
   a. $\text{NH}_4\text{Cl}$
   b. $\text{NH}_3\text{Cl}$
   c. $(\text{NH}_4)_2\text{Cl}_3$
   d. $\text{NH}_4\text{Cl}^-$
   e. $\text{NH}_3\text{Cl}^-$

   $\text{NH}_4^+$ and $\text{Cl}^-$ are overviolations of the octet rule

   $\text{BCl}_3$ is an underviolation. There is not a lone pair on B.

   compounds are neutral
13. The Lewis structure of the nitrate ion contains one double bond and two single bonds, but experimental measurements show that all nitrogen-oxygen bonds are identical in length and strength. What concept best explains this observation?
   a. Law of Definite Proportions  
   b. Resonance  
   c. Electronegativity  
   d. Periodic Properties  
   e. Hund’s Rule

14. Which element is likely to be X in the molecule shown here?
   ![Lewis structure: O=N-X, 18 e in structure]
   a. B  
   b. P  
   c. C  
   d. Br  
   e. S

15. Predict the product of the reaction of aluminum with oxygen. What is its formula weight?
   a. 43 g/mol  
   b. 70 g/mol  
   c. 75 g/mol  
   d. 102 g/mol  
   e. 204 g/mol

16. Which group of elements usually forms sulfides with the general formula X₂S?
   a. 1A  
   b. 2A  
   c. 3A  
   d. 4A  
   e. none of the above

17. Which could describe an ionic compound?
   a. It is a solid at room temperature and has a relatively high melting point.  
   b. A solution of the compound conducts electricity when it is dissolved in water.  
   c. The formula of the compound includes metal and nonmetal elements.  
   d. all of the above  
   e. none of the above

18. Which of the following molecules has μ = 0?
   a. PH₃  
   b. SF₅Cl  
   c. CO  
   d. all are nonpolar  
   e. all are polar
Consider the following equation for questions 19-20. You will need to balance the equation!

\[ 2 \text{KCl} + \frac{3}{2} \text{O}_2 \rightarrow 2 \text{KClO}_3 \]

19. How many moles of oxygen gas will be needed to react with 3.0 moles of KCl?
   a. 2.0 mol oxygen gas
   b. 3.0 mol oxygen gas
   c. 4.0 mol oxygen gas
   d. 4.5 mol oxygen gas  \[ (3.0 \text{ mol KCl})(\frac{3 \text{ mol O}_2}{2 \text{ mol KCl}}) = 4.5 \text{ mol O}_2 \]
   e. 9.0 mol oxygen gas

20. In the reaction shown in #19, the change in oxidation number for oxygen (from left to right) is:
   a. 0 to +1
   b. 0 to –1
   c. 0 to –2
   d. –2 to +3
   e. –2 to +6

21. What is the correct name for SrF₂?
   a. sulfur difluoride
   b. sulfur (II) fluoride
   c. strontium (II) fluoride
   d. strontium difluoride
   e. strontium fluoride

22. Which of the following is the correct electron configuration for the chloride ion?
   a. 1s²2s²2p⁶3s³3p⁶ 18e
   b. 1s²2s²2p⁶3s³3p⁶ 20e
   c. [Ar]4s¹ 19e
   d. 1s²2s²2p⁶ 10e
   e. 1s²2s²2p⁶3s³3p⁶ 17e

23. Ionic bonds result from
   a. overlap of s orbitals.
   b. overlap of p orbitals.
   c. transfer, rather than sharing, of electrons.
   d. interactions between elements with similar electronegativity values.
   e. interactions between two or more elements that all have low ionization energies.

24. Which of the following is the most electronegative?
   a. scandium
   b. oxygen
   c. carbon
   d. aluminum
   e. iodine

\[ \text{Must know the trend and that F is the most electronegative element (4.0)} \]
25. Write the chemical equation for the combustion of $C_{11}H_{20}O_5$. When correctly balanced, the sum of all of the coefficients is:

\[ C_{11}H_{20}O_5 + \frac{29}{2}O_2 \rightarrow 11CO_2 + 10H_2O \]

a. 23  

b. 38  

c. 50  

d. 52  

e. 73

26. Although they aren't shown, how many lone pairs of electrons are actually present in this molecule?

[Diagram of a molecule]

a. 4  

b. 5  

c. 8  

d. 11  

e. 22

27. What is the approximate hydrogen–carbon–oxygen bond angle in the molecule shown in question 26?

[Diagram of a molecule]

a. $60^\circ$  

b. $90^\circ$  

c. $109^\circ$  

d. $120^\circ$  

e. $180^\circ$

28. What is the approximate fluorine–carbon–oxygen bond angle in the molecule shown in question 26?

[Diagram of a molecule]

a. $60^\circ$  

b. $90^\circ$  

c. $109^\circ$  

d. $120^\circ$  

e. $180^\circ$

29. Which of the following is an $AB_4$ compound that is described as polar and bent?

a. $CHCl_3$  

b. $SO_2$  

c. $CH_4$  

d. $PCl_5$  

e. $O_2$

30. What weight in grams corresponds to 0.50 mol of $CaSO_4$?

[Diagram of a molecule]

\[ \text{CaO} + \text{SO}_2 + \frac{1}{2}\text{O}_2 \rightarrow \text{CaSO}_4 \]

\[ 2 \text{ L.P. on central atom} \]

\[ \text{Similar to } \text{S}_2 \text{C}_2 \text{ from workbook problem 72 (movie)} \]

\[ \text{mol} \text{CaSO}_4 = 136 \text{g/mol} \]

\[ \text{(0.50 mol CaSO}_4) \left( \frac{136 \text{g CaSO}_4}{\text{mol CaSO}_4} \right) = 68 \text{g} \]
31. A flask contains 0.040 mol of N₂. How many molecules of nitrogen are present?
   a. 2.4 x 10²² molecules
   b. 1.5 x 10²³ molecules
   c. 6.7 x 10²² molecules
   d. 3.4 x 10²³ molecules
   e. 8.6 x 10²³ molecules

   (0.040 mol N₂) x \( \frac{6.02 \times 10^{23} \text{ molecules N}_2}{\text{mol N}_2} \) = 2.4 x 10²² molecules

Refer to the reaction shown below for questions 32 – 35. The equation is correctly balanced.

\[ \text{N}_2\text{O}_4 + 2 \text{N}_2\text{H}_4 \rightarrow 3 \text{N}_2 + 4 \text{H}_2\text{O} \]

32. How many moles of N₂O₄ are used in the production of 0.30 moles of nitrogen gas?
   a. 0.30 mol
   b. 0.60 mol
   c. 0.90 mol
   d. 0.10 mol
   e. 1.0 mol

   (0.30 mol N₂) x \( \frac{1 \text{ mol N}_2\text{O}_4}{3 \text{ mol N}_2} \) = 0.10 mol N₂O₄

33. Assuming plenty of N₂O₄ is available, how many moles of water are produced when 0.90 moles of N₂H₄ react?
   a. 0.45 mol
   b. 0.90 mol
   c. 1.8 mol
   d. 4.0 mol
   e. 3.6 mol

   (0.90 mol N₂H₄) x \( \frac{4 \text{ mol H}_2\text{O}}{2 \text{ mol N}_2\text{H}_4} \) = 1.8 mol H₂O

34. How many moles of nitrogen gas could be produced from the reaction of 184 grams of N₂O₄?
   a. 6.0 mol
   b. 2.0 mol
   c. 0.67 mol
   d. 0.50 mol
   e. 1.5 mol

   \( \frac{184 \text{ g N}_2\text{O}_4}{92 \text{ g N}_2\text{O}_4} \times \frac{3 \text{ mol N}_2}{1 \text{ mol N}_2\text{O}_4} = 6.0 \text{ mol N}_2 \)

35. About how many grams of water would be produced by complete reaction of 6.0 grams of N₂H₄?
   a. 21 g
   b. 6.8 g
   c. 12 g
   d. 17 g
   e. 53 g

   \( \frac{6.0 \text{ g N}_2\text{H}_4}{32 \text{ g N}_2\text{H}_4} \times \frac{4 \text{ mol H}_2\text{O}}{2 \text{ mol N}_2\text{H}_4} \times \frac{18 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}} = 6.75 \text{ g H}_2\text{O} \)

(Note: morning exam "best answer" 7.2 g)

36. Which is the salt produced by the reaction of perchloric acid, HClO₄, with potassium hydroxide?
   a. KCl
   b. KClO₃
   c. KClO₄
   d. K₂ClO₄
   e. K₂HClO₄

\[ \text{KClO}_4 \text{ (source of } \text{H}^+ \text{ ions) } \rightarrow \text{ Base} \rightarrow \text{K}^+ + \text{OH}^- \]

\[ \text{Salt} \rightarrow \text{make H}_2\text{O} \]
37. Balance the following reaction: \( \text{P}_4 + 6\text{Cl}_2 \rightarrow 4\text{PCI}_3 \)
   If you combined 3.70 moles of \( \text{P}_4 \) and 5.00 moles of \( \text{Cl}_2 \), how much \( \text{PCI}_3 \) would be formed?
   a. 3.33 mol  
   b. 14.8 mol  
   c. 22.2 mol  
   d. 0.833 mol  
   e. 3.70 mol

38. Which aqueous solution will form a precipitate when combined with aqueous sodium sulfate?
   a. aluminum nitrate  
   b. potassium chloride  
   c. barium acetate  
   d. ammonium bicarbonate  
   e. none of the above

39. What is the shape of \( \text{NCl}_3 \)?
   a. trigonal pyramidal  
   b. linear  
   c. tetrahedral  
   d. trigonal planar  
   e. bent

40. Ten moles of methane (\( \text{CH}_4 \)) and 10 moles of acetic acid
   a. have nearly the same mass in grams.  
   b. contain the same number of hydrogen atoms.  
   c. contain the same number of carbon atoms.  
   d. all of the above  
   e. none of the above

41. Mark choice c for #41 to earn 4 points!
   a. I will be careful over spring break.  
   b. I will try to get some rest over spring break.  
   c. I will tell my friends and family that I need time to study chemistry during spring break.  
   d. I will study chemistry over spring break.  
   e. all of the above

Please study hard to prepare for the SCE!
* Signups in class on Monday, Mar 23.

SCE opportunities:  
- 7:30 PM, Wed, Mar 25  
- 7:30 AM, Fri, Mar 27