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Dougherty Valley HS Chemistry
Bonding and Structure - Extra Practice

Worksheet #16*

Name: _____ **Period:** _____ **Seat #:** _____.

Give the name of the following ionic compounds

PAGE #1

1) Na_2CO_3 _____

2) $NaOH$ _____

3) $MgBr_2$ _____

4) KCl _____

5) $FeCl_2$ _____

6) $FeCl_3$ _____

7) $Zn(OH)_2$ _____

8) $BeSO_4$ _____

9) CrF_2 _____

10) Al_2S_3 _____

11) PbO _____

12) Li_3PO_4 _____

13) TiI_4 _____

14) Co_3N_2 _____

15) Mg_3P_2 _____

16) $Ga(NO_2)_3$ _____

17) Ag_2SO_3 _____

18) NH_4OH _____

19) $Al(CN)_3$ _____

20) $Be(CH_3COO)_2$ _____

For the following compounds, give the formulas:

Formula

22) sodium phosphide _____

23) magnesium nitrate _____

24) lead (II) sulfite _____

25) calcium phosphate _____

26) ammonium sulfate _____

27) silver cyanide _____

28) aluminum sulfide _____

29) beryllium chloride _____

30) copper (I) arsenide _____

31) iron (III) oxide _____

32) gallium nitride _____

33) iron (II) bromide _____

34) vanadium (V) phosphate _____

35) calcium oxide _____

36) magnesium acetate _____

37) aluminum sulfate _____

38) copper (I) carbonate _____

39) barium oxide _____

40) ammonium sulfite _____

41) silver bromide _____

42) lead (IV) nitrite _____

Compound Names and Formulas

For the list on the left, name the compound. For the list on the right, give the chemical formula that corresponds to the name

	Name		Formula
1)	NaF	13)	potassium fluoride
2)	K_2CO_3	14)	ammonium sulfate
3)	$MgCl_2$	15)	magnesium iodide
4)	$Be(OH)_2$	16)	Cupric sulfite
5)	SrS	17)	aluminum phosphate
6)	Cu_2S	18)	Plumbous nitrite
7)	ZnI_2	19)	cobalt (II) selenide
8)	$Ca_3(PO_4)_2$	20)	silver cyanide
9)	NH_4I	21)	Cupric bicarbonate
10)	$Mn(NO_3)_3$	22)	Ferrous oxide
11)	$FePO_4$	23)	lithium cyanide
12)	$CoCO_3$	24)	lead (IV) sulfite

Name the compounds below and say if they are covalent or ionic.

Formula	Name	Bond Type
1. $(NH_4)_2O$	_____	_____
2. N_2O_2	_____	_____
3. SO_2	_____	_____
4. $Mg_3(PO_3)_2$	_____	_____
5. P_4O_{10}	_____	_____
6. _____	Phosphorus pentachloride	_____
7. _____	dioxygen difloride	_____
8. _____	strontium borate	_____
9. _____	sulfur trioxide	_____
10. _____	sodium sulfate	_____

Naming Chemical Compounds
Ionic and Covalent Bonds

The following are a good mix of naming and formula writing problems to help you get some practice. I will expect that you know how to name both ionic and covalent compounds in your work.
Remember that transition elements must have the Roman Numeral in the "NAME" to describe which charge it has

Name the following chemical compounds:

1) $NaBr$ _____

2) $Ca(C_2H_3O_2)_2$ _____

3) P_2O_5 _____

4) $Ti(SO_4)_2$ _____

5) $FePO_4$ _____

6) K_3N _____

7) SO_2 _____

8) $CuOH$ _____

9) $Zn(NO_2)_2$ _____

10) V_2S_3 _____

Write the formulas for the following chemical compounds:

11) Silicon dioxide _____

12) Nickel (III) sulfide _____

13) Manganese (II) phosphate _____

14) Silver acetate _____

15) Diboron tetrabromide _____

16) Magnesium sulfate heptahydrate _____

17) Potassium carbonate _____

18) Ammonium oxide _____

19) Tin (IV) selenide _____

20) Carbon tetrachloride _____

Ionic Compounds Chemical Formulas Worksheet

→ For #1-12, write the correct name of the ionic compound for the chemical formula given.

1. HI
2. $Sr(OH)_2$
3. $AgNO_3$
4. CuI_2
5. $Pb(NO_3)_2$
6. $Al(MnO_4)_3$
7. NiO
8. HgS
9. $Sn(ClO_3)_2$
10. Hg_2S
11. $Cr_2(SO_3)_3$
12. $Fe(SCN)_2$

→ For #13-24, write the correct chemical formula for the name of the ionic compound given.

13. Iron (II) Hydride
14. Calcium Acetate
15. Zinc Chlorate
16. Iron (II) Bromide
17. Strontium Permanganate
18. Potassium Phosphate
19. Barium Peroxide
20. Aluminum Carbonate
21. Magnesium Fluoride
22. Copper (III) Hydroxide
23. Calcium Nitrate
24. Copper (I) Sulfate

→ For #25-30, write the names of each ionic compound, the names and how many atoms of each element in each of the compounds. See example for help.

EXAMPLE: $BaCl_2$ **Name of compound**: barium chloride
Elements + # of atoms of each element: Barium (1 atom), chlorine (2 atoms)

25. NaBr
    Name of compound:
    Elements + # of atoms of each element:
26. Ag_2CrO_4
    Name of compound:
    Elements + # of atoms of each element:
27. $CdCr_2O_7$
    Name of compound:
    Elements + # of atoms of each element:
28. $Pb_3(PO_4)_2$
    Name of compound:
    Elements + # of atoms of each element:
29. $Mn(C_2H_3O_2)_2$
    Name of compound:
    Elements + # of atoms of each element:
30. $Fe_2(SO_4)_3$
    Name of compound:
    Elements + # of atoms of each element:

6-Naming Practice

Fill in the name or formula for the following **COVALENTLY** bonded **MOLECULES**:

Name	Formula
Sulfur trioxide	
	S_2Cl_2
	CSe_2
	CF_5

Name	Formula
	ICl_3
Phosphorous trichloride	
	N_2O_3
	As_2O_5

Fill in the name or formula for the following **IONICALLY** bonded **COMPOUNDS**:

Name	Formula
Lead (II) Chloride	
	NaCl
Tin (IV) Bromate	

Name	Formula
Calcium Chloride	
Iron (III) Oxide	
	Cr_2O_3

Identify as **Ionic or Covalent (Molecular)** and fill in the name or formula:

Ionic or Covalent (Molecular)	Name	Formula
	aluminum hydroxide	
	aluminum sulfate	
	ammonium nitrate	
	ammonium sulfate	
		P_4O_{10}
		BF_3 *
	bismuth trichloride	
		BrF_5
	calcium acetate	
	calcium perchlorate	
	carbon dioxide	
	carbon monoxide	

* **In this compound try considering Boron to be a metal ion. Consider how many electrons it would typically lose to match the electron configuration of [He] to determine its charge. In fact, although we have drawn BF_3 as an example of a molecular compound with trigonal planar geometry, experiments have shown the bonding to be primarily ionic. Remember that although we describe non-metal/non-metal bonds as covalent, and metal/non-metal bonds as ionic, that many exceptions exist, and that no bond has solely ionic or covalent character.**

COMPOUND WORKSHEET

Write chemical formula as requested. Show subscript numbers where needed.

1. hydrochloric acid _____
2. sodium chloride _____
3. uranium hexafluoride _____
4. strontium nitrate _____
5. calcium chloride _____
6. acetic acid _____
7. phosphoric acid _____
8. ammonia _____
9. chlorine _____
10. lithium sulfate _____
11. potassium chromate _____
12. calcium hydroxide _____
13. aluminum foil _____
14. ammonium sulfate _____
15. sulfuric acid _____
16. ammonium iodide _____
17. acetylene _____
18. rubidium nitrite _____
19. lead (II) sulfite _____
20. copper (I) sulfide _____
21. aluminum oxide _____
22. magnesium bromide _____
23. sodium chlorate _____
24. iron (II) chloride _____
25. hydrogen gas _____
26. silver chromate _____
27. zinc bicarbonate _____
28. barium oxide _____
29. aluminum nitrate _____
30. diphosphorus pentoxide _____
31. aluminum hydroxide _____
32. chromium (III) oxide _____
33. lithium phosphate _____
34. ice _____
35. nitrogen dioxide _____
36. iron (III) oxide _____
37. sodium peroxide _____
38. copper (II) oxide _____
39. liquid nitrogen _____
40. lead (II) acetate _____
41. lead (IV) fluoride _____
42. ferrous bromide _____
43. carbonic acid _____
44. silver bisulfite _____
45. Copper (II) hydroxide _____
46. nitric acid _____
47. mercury (II) bromide _____
48. Tin (IV) sulfide _____
49. hydrofluoric acid _____
50. potassium phosphate _____
51. iodine tribromide _____
52. phosphorus pentafluoride _____

Inorganic Nomenclature Worksheet

1. ammonium phosphide
2. sodium nitrate
3. cupric bromide
4. aluminum sulfate
5. potassium nitrate
6. Iron(II) carbonate
7. Lead(II) phosphate
8. diphosphorus pentoxide
9. cupric hydroxide
10. calcium fluoride
11. nickel(III) sulfate
12. silver cyanide
13. ammonium sulfite
14. zinc sulfate
15. tin(II) chloride
16. antimony(III) chloride
17. silver sulfide
18. magnesium hydroxide
19. ammonium carbonate
20. nickel(III) acetate
21. sodium chromate
22. chromium(III) hydrogen sulfate
23. potassium permanganate
24. silver perchlorate
25. potassium phosphate
26. nickel(III) iodide
27. mercurous oxide
28. Plumbous chlorite
29. hydrogen iodide
30. Iron (III) bicarbonate
31. magnesium nitrate
32. iron(III) chromate
33. Iron(II) chromate
34. copper(II) hydroxide
35. cuprous carbonate
36. chromium(III) acetate
37. calcium chlorate
38. ammonium oxide
39. aluminum perchlorate
40. zinc bicarbonate
41. Calcium phosphate
42. silver hypochlorite
43. ammonium phosphate
44. ferrous chlorite
45. potassium sulfide
46. tin(IV) bromide
47. lithium chromate
48. magnesium hydrogen sulfate
49. Iron(II) phosphate
50. calcium sulfate
51. aluminum acetate
52. calcium chloride
53. barium chromate
54. Cobalt(III) chloride
55. barium chloride
56. sulfurous acid
57. potassium hydroxide
58. zinc hydrogen sulfite
59. sodium sulfite
60. Cobalt(II) sulfate
61. ferric oxide
62. silver phosphate
63. sodium hypochlorite
64. ammonium chromate
65. barium carbonate
66. calcium iodide
67. cupric sulfate
68. cuprous chloride
69. ferric carbonate
70. zinc phosphate
71. sodium nitrite
72. silver oxide
73. Nickel(II) bromide
74. magnesium oxide
75. mercuric perchlorate
76. lithium hypochlorite
77. oxygen difluoride
78. cobalt(II) hydrogen sulfate
79. acetic acid (see #128)
80. barium hypochlorite
81. ammonium hydroxide
82. cobalt(II) iodide
83. chromium(II) bicarbonate
84. sodium hydroxide
85. silver nitrate
86. mercury(II) nitrate
87. hydrochloric acid
88. aluminum hydrogen sulfite
89. cobalt(III) hydrogen sulfate
90. ferric hydrogen carbonate
91. phosphorus pentabromide
92. Nickel(II) chloride
93. ammonium aluminum sulfate
94. iron(III) hydrogen carbonate
95. mercury(I) hydrogen phosphate
96. plumbic hydrogen carbonate
97. mercuric hydrogen carbonate
98. mercurous hydrogen phosphate
99. copper(II) sulfate
100. chromium(III) dihydrogen phosphate
101. sodium acetate
102. zinc sulfite
103. silver bicarbonate
104. potassium iodide
105. Lead(IV) chlorite
106. Mercury(I) chromate
107. Plumbous nitrite
108. potassium dichromate
109. magnesium carbonate
110. calcium bicarbonate
111. aluminum hydroxide
112. Cobalt(II) oxide
113. ferric permanganate
114. ammonium chromate
115. nitrogen triiodide
116. sulfur trioxide
117. ammonium dichromate
118. ferric bicarbonate
119. ammonium perchlorate
120. Cobalt(III) acetate
121. Cobalt(II) hydroxide
122. ferrous chromate
123. ferric bromide
124. zinc sulfate
125. boron phosphide
126. ferric bicarbonate
127. cupric hydrogen sulfate
128. acetic acid (diff. from 79)
129. barium hydrogen sulfite
130. nitric acid
131. calcium sulfide
132. copper(I) hydrogen sulfate
133. zinc permanganate
134. ferric carbonate
135. hydrobromic acid
136. hydrocyanic acid
137. hydrogen cyanide
138. sulfuric acid
139. copper(I) sulfate
140. chromium(III) oxide
141. aluminum oxide
142. Cobalt(II) hydrogen sulfate
143. barium carbonate
144. mercuric chloride
145. ferrous chromate
146. cupric hydroxide
147. perchloric acid
148. ferric phosphate
149. Plumbous oxide
150. Cobalt(III) chlorate

If a formula can be named more than one correct way, then give all. For example, $Fe(HCO_3)_3$ can be named four different ways. They are iron(III) bicarbonate, iron(III) hydrogen carbonate, ferric bicarbonate, and ferric hydrogen carbonate. The second way would be best. (some will require prefixes)

151. HgF_2
152. KCl
153. $KMnO_4$
154. $KClO_4$
155. ZnO
156. $Ba(OH)_2$
157. NH_4MnO_4
158. $CaCO_3$
159. $Ba_3(PO_4)_2$
160. Fe_2O_3
161. CoF_3
162. H_2CO_3
163. K_2SO_4
164. $NaHSO_4$
165. PF_5
166. Ag_2O
167. $Pb(ClO_2)_2$
168. Cu_2CrO_4
169. $Ca(ClO_4)_2$
170. $HC_2H_3O_2$
171. LiI
172. $Al_2(SO_4)_3$
173. HBr
174. $Hg_2(ClO)_2$
175. $CrCl_3$
176. H_3PO_4
177. $LiMnO_4$
178. $Fe_2(HPO_4)_3$
179. Na_2CO_3
180. $Mg(HCO_3)_2$
181. $Sn_3(PO_4)_4$
182. HNO_3
183. $ZnCl_2$
184. NaH_2PO_4
185. Hg_2Cl_2
186. $Fe(NO_2)_2$
187. $CuNH_4PO_4$
188. $NaMgPO_4$
189. $Sn(HCO_3)_4$
190. $NaMnO_4$
191. KF
192. $CaSO_4$
193. HCl
194. $SbCl_3$
195. As_4O_{10}
196. NH_4Cl
197. NH_4NO_3
198. IF_5
199. $NaHCO_3$
200. $Ba(OH)_2$
201. $FeCl_3$
202. HF
203. $PbSO_4$
204. KrF_2
205. $NaCl$
206. P_2O_5
207. $AlBr_3$
208. $Ba(NO_3)_2$
209. BrF_5
210. P_4O_6
211. $FePO_4$
212. Hg_2SO_4
213. KH
214. $Co_2(SO_3)_3$
215. N_2O_3
216. N_2O
217. $Fe(NO_2)_3$
218. $Sn_3(PO_4)_2$
219. H_2O_2
220. $Be(OH)_2$
221. $Sr(HCO_3)_2$
222. $Sr(OH)_2$
223. P_4S_{10}
224. Hg_2O_2
225. $Hg_2(OH)_2$
226. NH_4F
227. XeF_6
228. $K_2Cr_2O_7$
229. NH_4OH
230. $(NH_4)_3PO_4$
231. N_2O_5
232. $SnCrO_4$
233. Al_2O_3
234. $CuCO_3$
235. ClO_2
236. CuS
237. MgI_2
238. $CoCl_3$
239. $NaCN$
240. Hg_3N_2
241. BrO_3
242. SiF_4
243. Sb_2O_5
244. LiH
245. SF_6
246. SnI_4
247. KOH
248. K_2O
249. H_2SO_4
250. lithium oxide
251. xenon trioxide
252. gold(I) chloride
253. gold(I) cyanide
254. sodium oxide
255. potassium chlorate
256. mercurous nitrite
257. nickel(II) fluoride
258. potassium cyanide
259. manganese dioxide
260. osmium tetrachloride
261. rubidium carbonate
262. trisulfur dinitride
263. nitrogen trichloride
264. vanadium(V) oxide
265. selenium tetrafluoride
266. stannous hypochlorite
267. tellurium hexafluoride
268. lanthanum(III) phosphate
269. sodium hydrogen sulfate
270. chromium(III) hydrogen phosphate
271. $NaOH$
272. NI_3
273. ClF_3
274. P_3N_5
275. UF_6
276. NBr_3
277. Cl_2O_3
278. CsF
279. CO
280. Cu_2S
281. $KHCO_3$
282. $SbCl_5$
283. CO_2
284. HgO
285. PCl_3
286. PBr_5
287. IF_7
288. Cl_2O
289. CCl_4
290. XeF_4
291. $Hg(OH)_2$
292. CaH_2
293. As_4O_6
294. BN
295. CoS
296. N_2O_4
297. H_3BO_3
298. I_2O_5
299. PbO
300. $NaBr$
301. Li_2CrO_4
302. ICl
303. SO_3
304. Hg_2O
305. NaH
306. OsO_4
307. XeF_2
308. $Ca(C_2H_3O_2)_2$
309. $NaC_2H_3O_2$
310. $Al(OH)_3$
311. Li_2HPO_4
312. $Ca(NO_3)_2$
313. $Ni(ClO_4)_2$
314. $Mn(NO_3)_2$
315. $Au(H_2PO_4)_3$
316. $Al(C_2H_3O_2)_3$
317. $KAl(SO_4)_2$
318. $Al(MnO_4)_3$
319. $(NH_4)_3PO_4$
320. $CoSO_4$
321. $MgCl_2$
322. $CuSO_4$
323. $NaHS$
324. $MgSO_4$
325. NaH_2PO_4
326. Na_2CrO_4
327. $Pb(CH_3COO)$
328. $Be(ClO_4)_2$
329. $(NH_4)_2Cr_2O_7$
330. $Ba(BrO_3)_2$
331. $AuCl_3$
332. Al_2S_3
333. Na_2HPO_4
334. $Mg_3(PO_4)_2$
335. $CuSO_3$
336. $KAl(C_2O_4)_2$
337. $Cr_2(SO_3)_3$
338. $HClO$
339. $HClO_2$
340. $HClO_3$
341. $HClO_4$
342. $Mn(IO_3)_2$
343. $KBrO3$
344. $Fe(ClO_4)_3$
345. $Cr(OH)_3$

Nomenclature Practice

Write correct formulas of the compounds formed when the positive ions in the vertical column combine with the negative ions listed across the top row. The first two are done for you.

	Nitrate NO_3^-	**Sulfate** SO_4^{2-}	**carbonate**	**phosphate**	**hydroxide**	**chromate**	**Cyanide**
Sodium	$NaNO_3$	Na_2SO_4					
Silver							
Ammonium							
Mercury (I)							
Zinc							
Calcium							
Magnesium							
Copper (I)							
Lead (IV)							
Aluminum							
Manganese (III)							
Cobalt (III)							
Copper (II)							
Iron (III)							
Lead (II)							
Potassium							
Barium							
Hydrogen							

	Carbonate CO_3^{2-}	**Dichromate** $Cr_2O_7^{2-}$	**acetate**	**sulfide**	**chloride**	**sulfite**
sodium	Na_2CO_3	$Na_2Cr_2O_7$				
silver						
ammonium						
Mercury (II)						
tin(II)						
calcium						
magnesium						
Copper (II)						
Lead (IV)						
aluminum						
manganese(III)						
cobalt(III)						
Copper (I)						
Iron (II)						
Lead (II)						
potassium						
barium						

Naming Ionic Compounds

Write the names for the following compounds.

1. $LiOH$ _____
2. Na_2SO_4 _____
3. $SbCl_3$ _____
4. $Al(OH)_3$ _____
5. $Sb(NO_3)_3$ _____
6. $Al_2(SO_4)_3$ _____
7. HgO _____
8. Fe_2S_3 _____
9. $Pb(NO_3)_2$ _____
10. K_2SO_3 _____
11. $ZnCl_2$ _____
12. Ag_2S _____
13. $NH4CH_3COO$ _____
14. Al_2S_3 _____
15. $NaOH$ _____
16. $Fe_3(PO_4)_2$ _____
17. $AgNO_3$ _____
18. $MgSO_4$ _____
19. $Ni(ClO_3)_2$ _____
20. $CuCl$ _____
21. $BaCO_3$ _____
22. $(NH_4)_2SO_4$ _____
23. $NaHCO_3$ _____
24. $Hg(NO_3)_2$ _____
25. Na_2O _____

Write the formulas for the following compounds.

Remember—cross the charges to the subscripts.

Example: sodium sulfide is Na_2S because Na has a 1+ charge and S has a 2- charge.

26. Magnesium hydroxide _____
27. Sodium nitrate _____
28. Ammonium phosphate _____
29. Potassium chlorate _____
30. Zinc sulfate _____
31. Copper (II) sulfate _____
32. Calcium nitrate _____
33. Magnesium sulfite _____
34. Ammonium chloride _____
35. Iron (II) chloride _____
36. Chromium (III) chloride _____
37. Ammonium carbonate _____
38. Barium sulfate _____
39. Sodium carbonate _____
40. Potassium nitrate _____
41. Sodium peroxide _____

For each of the compounds below tell if it is a covalent or ionic bond. Write down the name or formula and draw the Lewis structure.

Name	Formula	Ionic/ Covalent	Lewis Structure
Sodium Chloride			
Carbon Tetrafluoride			
	$MgCl_2$		
	K_2O		
Nitrogen trihydride			
	SF_6		
Ammonium phosphate			
Calcium Phosphide			
	BH_3		
Silicon Disulfide			
phosphorus trifluoride			
	H_2O		
	PCl_3		
	CF_4		
aluminum sulfate			

VSEPR Practice

Directions: For each of the following compounds answer the following items –
[*] AXE formula
[*] Electronic Geometry
[*] Molecular Geometry
[*] Bond Angle(s)
[*] Draw the Lewis Structure below

[1] SeF_2

[2] CO_3^{2-}

[3] XeO_4

[4] ClF_5

[5] Br_3^-

[6] SO_3^{2-}

[7] CO_2

[8] KrF_4

[9] SF_4

[10] O_3

[11] $CHCl_3$

[12] NH_4^+

[13] SO_2

[14] IF_5

Answers Here

#1			
#2			
#3			
#4			
#5			
#6			
#7			
#8			
#9			
#10			
#11			
#12			
#13			
#14			

Lewis structure WS

[1] PBr_3 [2] N_2H_2 [3] CH_3OH [4] NO_2^{-1} [5] C_2H_4

[6] Write the Lewis dot structure for each of these molecules. Some are easy, some are not. A few violate the octet rule. (ODD letters, A = 1, C = 3, E = 5...)

a. CF_4	b. HF	c. NBr_3	d. C_2H_2
e. CO	f. H_2S	g. CH_3Br	h. AsH_3
i. OF_2	j. N_2	k. CS_2	l. BF_3
m. H_2O_2	n. F_3NO	o. H_2CO	p. CH_3OH
q. BrF_5	r. SF_6	s. HCN	t. HNC

[7] Write the Lewis dot structure for each of these ions.

a. ammonium ion
b. hypochlorite ion
c. hydronium ion
d. hydroxide ion
e. nitride ion (N^{3-})
f. cyanide ion
g. cyanate ion, OCN^- (C = central atom)
h. peroxide ion
i. $GaBr_4^-$
j. $P_2H_6^{2+}$

[8] Compounds with the same formula, but different structures, are called isomers. For each formula below, draw the Lewis dot structure **of each isomer obeying the octet rule** (if you know how to, go ahead, if not, only write one Lewis structure).

a. C_2H_6O
b. C_2H_4O
c. C_4H_{10}
d. C_3H_6
e. C_3H_4

QUICK CHECK • 4

Using VSEPR Theory, name and sketch the shape of the following molecules.

1. N_2	7. HF
2. H_2O	8. CH_3OH
3. CO_2	9. H_2S
4. NH_3	10. I_2
5. CH_4	11. $CHCl_3$
6. SO_3	12. O_2

Determine whether the following molecules are polar or nonpolar.

1. N_2	7. HF
2. H_2O	8. CH_3OH
3. CO_2	9. H_2S
4. NH_3	10. I_2
5. CH_4	11. $CHCl_3$
6. SO_3	12. O_2

LEWIS STRUCTURES & SHAPES

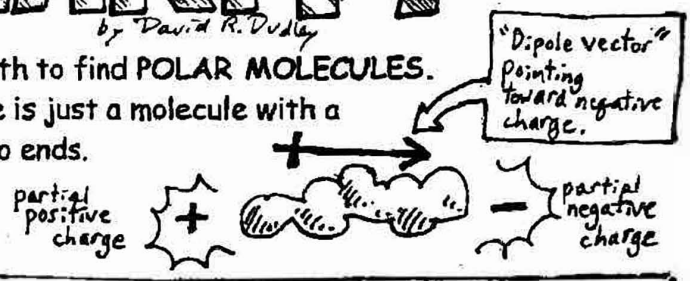
PCl_5 SN = ____ Electron Shape _____ Molecular Shape _____	XeF_4 SN = ____ Electron Shape _____ Molecular Shape _____	SO_3 SN = ____ Electron Shape _____ Molecular Shape _____
XeF_2 SN = ____ Electron Shape _____ Molecular Shape _____	AlH_3 SN = ____ Electron Shape _____ Molecular Shape _____	GeF_2 SN = ____ Electron Shape _____ Molecular Shape _____
SiH_4 SN = ____ Electron Shape _____ Molecular Shape _____	SF_6 SN = ____ Electron Shape _____ Molecular Shape _____	NO_2 SN = ____ Electron Shape _____ Molecular Shape _____

SN	Bond Angle(s)	Electron Shape	Orbital Hybridization
2			
3			
4			
5			
6			

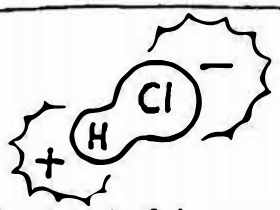
The BARE ESSENTIALS of POLARITY

by David R. Dudley

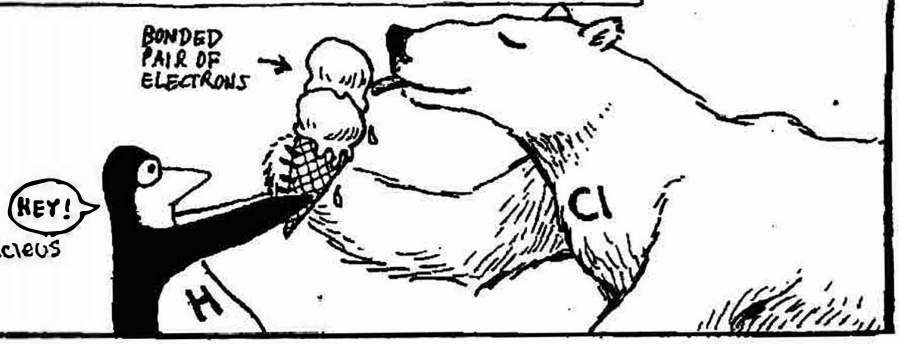
You don't have to go to the ends of the earth to find POLAR MOLECULES. They're all over the place. A polar molecule is just a molecule with a difference in electrical charge between two ends.



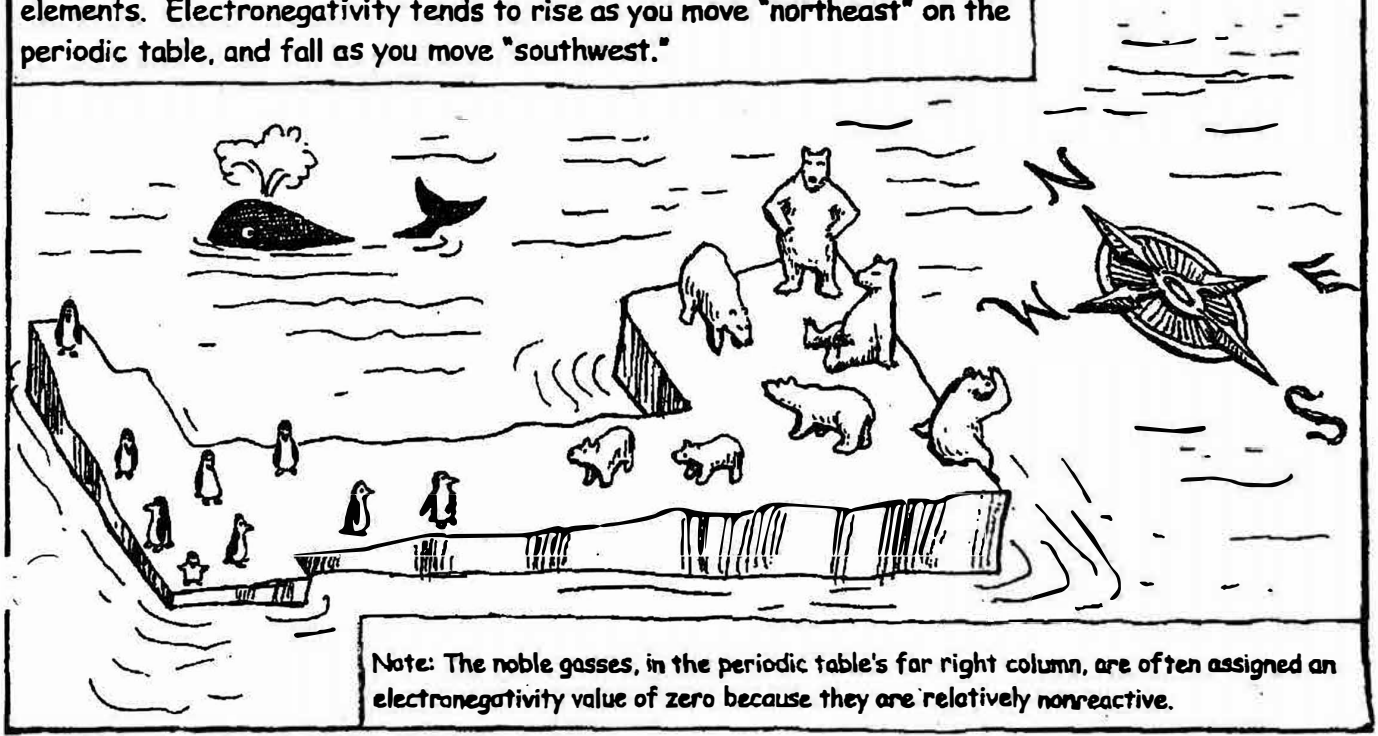
The electrical imbalance of POLARITY is caused by differences in ELECTRONEGATIVITY between atoms. Electronegativity is the ability of an atom/nucleus to attract bonding electrons toward itself.



In HCl, the bonded pair of electrons spends more time near the chlorine's nucleus because chlorine is more electronegative than hydrogen.



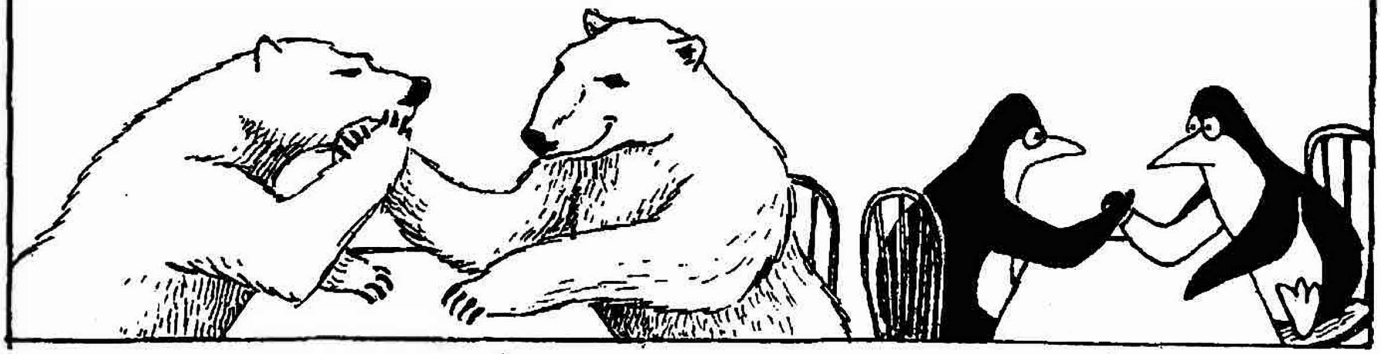
The periodic table shows a general trend in the electronegativity of the elements. Electronegativity tends to rise as you move "northeast" on the periodic table, and fall as you move "southwest."



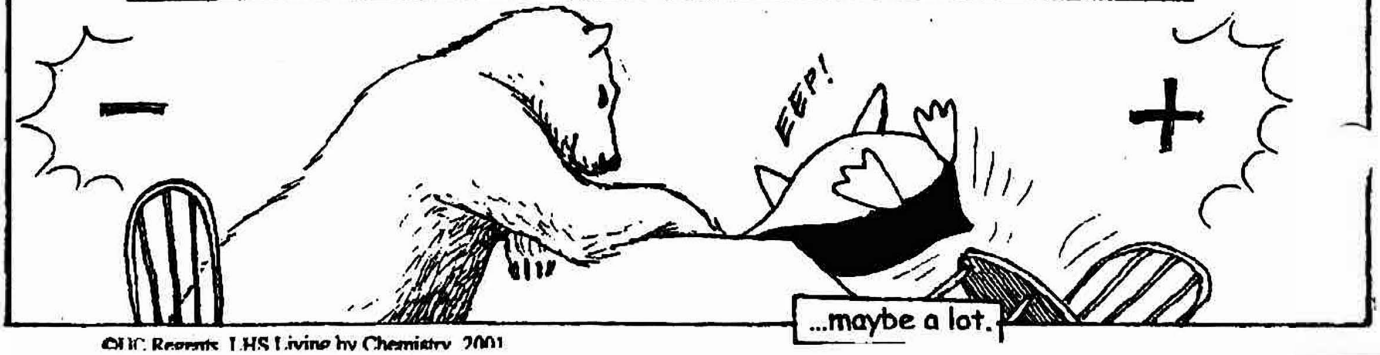
Note: The noble gasses, in the periodic table's far right column, are often assigned an electronegativity value of zero because they are relatively nonreactive.

When two atoms with unequal electronegativity values bond, they do not share the bonding electrons evenly. The bonding electrons spend more time around the more electronegative atom, creating a PARTIAL NEGATIVE CHARGE on that atom. The other atom then has a PARTIAL POSITIVE CHARGE, and the bond is polar.

So the polarity of a bond is a function of the difference between the electronegativity values of two bonding atoms. Bonded atoms with equal electron-attracting strength will have nonpolar bonds.

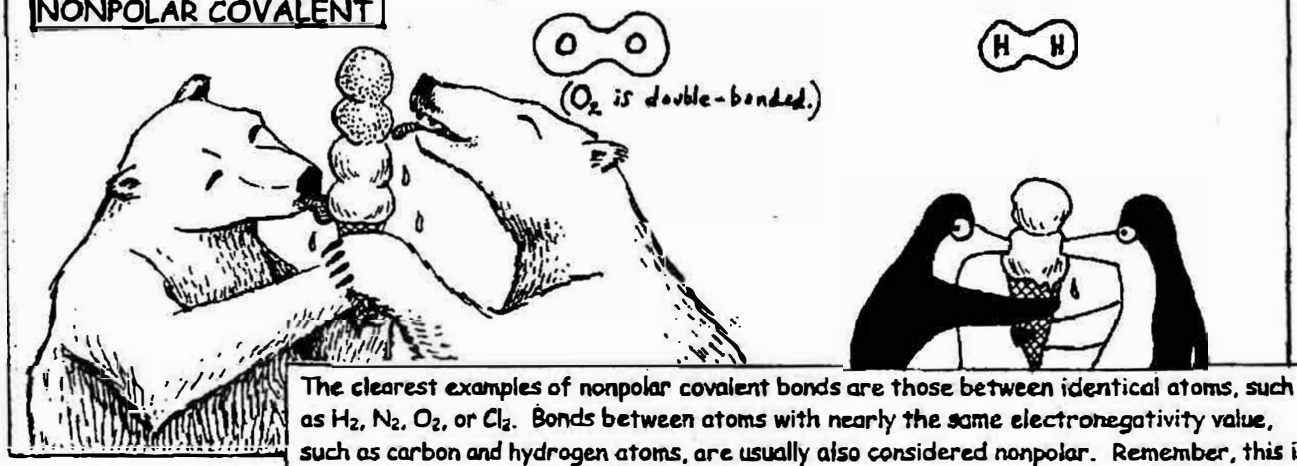


However, if the electronegativity of two bonded atoms is unequal, then their bond will be polarized—maybe a little...



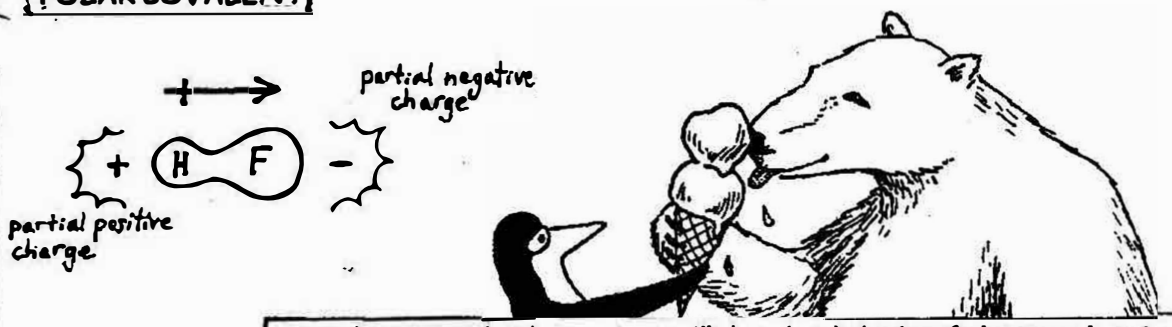
Because the elements have such varying electronegativities and can come together in so many different combinations, there is really a **CONTINUUM OF POLARITY IN BONDING**. For convenience, we can break the continuum down into three categories: (1) nonpolar covalent, (2) polar covalent, and (3) ionic.

NONPOLAR COVALENT



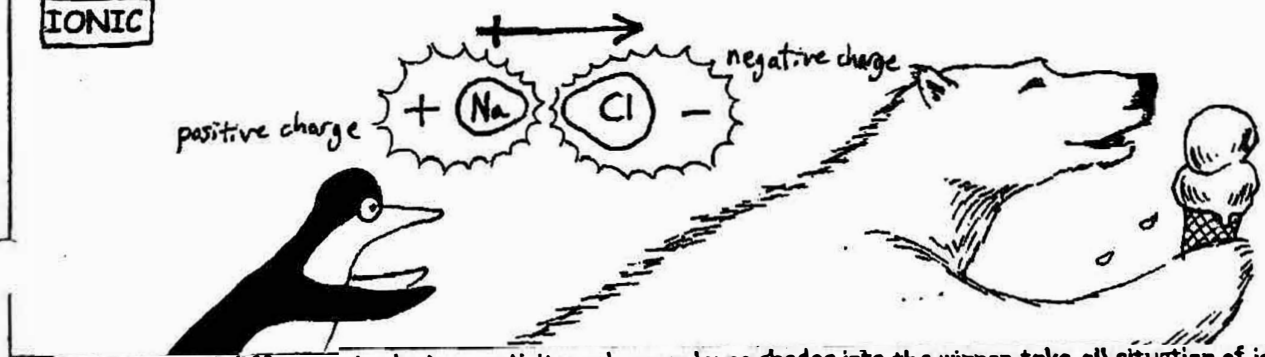
The clearest examples of nonpolar covalent bonds are those between identical atoms, such as H_2, N_2, O_2, or Cl_2. Bonds between atoms with nearly the same electronegativity value, such as carbon and hydrogen atoms, are usually also considered nonpolar. Remember, this is really a continuum, and conventional distinctions are somewhat artificial.

POLAR COVALENT



In a polar covalent bond, two atoms still share bonded pairs of electrons, but those electrons are decidedly more attracted to one atom than the other. Examples include bonds between carbon and oxygen atoms, or between hydrogen and fluorine atoms.

IONIC

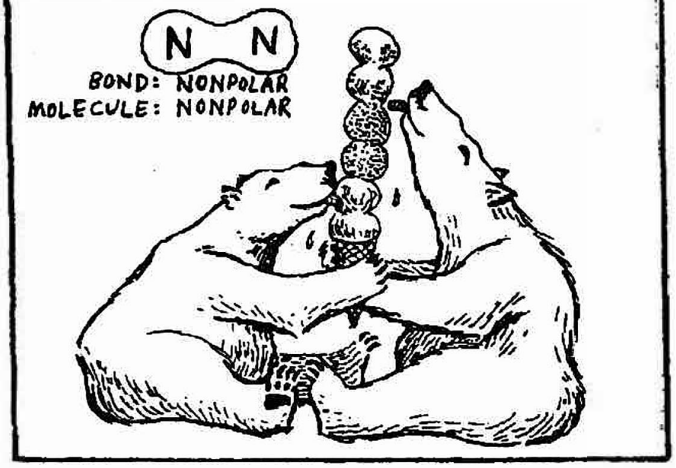


At the extreme of difference in electronegativity, polar covalence shades into the winner-take-all situation of ionic bonding. The more electronegative atom seizes all the bonding electrons and becomes a negative ion, while the other atom becomes a positive ion. The opposite charges on the i onsattract each other.

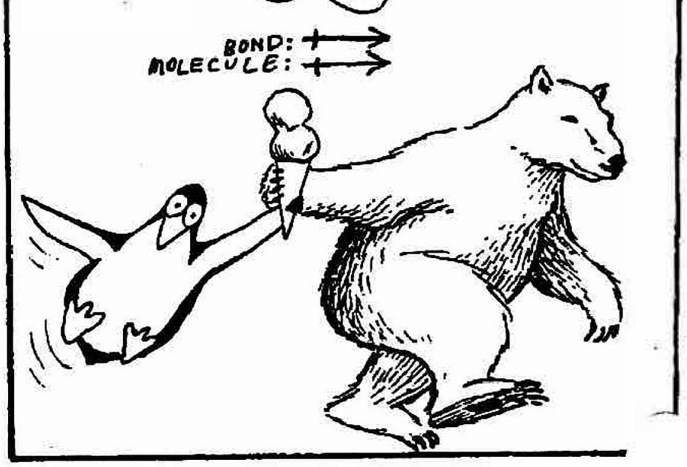
Polar bonds between atoms constitute **DIPOLES**. Actually, the word "dipole" can refer to several different things that are relevant here: (1) the polarity of an individual polar bond between atoms, (2) the net polarity of a polar molecule that may have several polar covalent bonds within it, and (3) the polar molecule itself.

Confusing? Let's look at some examples:

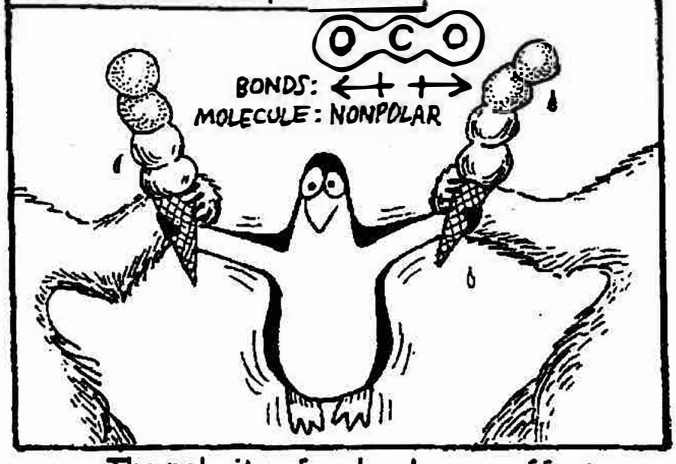
An N_2 molecule *isn't* a dipole (it's not a polar molecule), and it doesn't *have* any dipoles (polar bonds) within it.



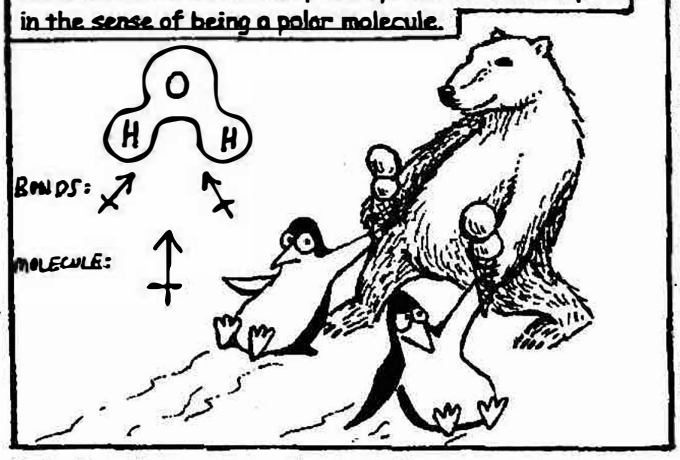
HCl *has* a dipole (a polar bond) and it *is* a dipole (a polar molecule).



On the other hand, CO_2 *has* two dipoles (two polar bonds), but the CO_2 molecule itself *is not* a dipole because its polar bonds cancel each other out and make the molecule nonpolar overall.



Like CO_2, H_2O *has* two dipoles (two polar bonds). But because of H_2O's bent shape (caused by lone pairs of electrons on the oxygen atom), H_2O also has a dipole in the sense of an overall polarity. So H_2O *is* a dipole in the sense of being a polar molecule.



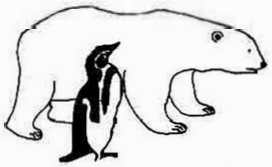
The polarity of molecules can affect many of their other properties, such as their solubility, their boiling and melting points, and their odor.

Student Worksheet

Polar Bears and Penguins

Name: _____

Period: ____ Date: _____



Purpose: In this lesson you will be exploring polarity and bonding between atoms in greater detail. A comic book will provide new information about these topics and will introduce you to the concept of electronegativity, which helps us to understand partial charges.

Use the comic book called "The Bare Essentials of Polarity" to answer the following questions.

1. How does the comic book define a "polar molecule?"

2. Define electronegativity as you understand it, after reading the first two pages of the comic book.

3. Interpret the picture at the bottom of page 1. Explain how the iceberg, penguins, and polar bears represent trends in electronegativity.

4. What is the artist trying to represent when there are two polar bears arm wrestling together, or two penguins arm wrestling together?

5. What three types of bonds are represented on page 3 of the comic book? What happens to the bonding electrons in each type of bond?

6. Explain why there are four scoops of ice cream in the illustration of O_2 on page 3.

7. What do the six scoops of ice cream represent in the illustration of N_2 on page 4?

8. Describe what you think is happening to the penguin in the CO_2 molecule in the picture on page 4.

9. Name three things that the picture of CO_2 on page 4 illustrates about the molecule.

10. Describe what you think is happening to the penguins in the illustration of H_2O on page 4.

11. Explain what you think the crossed arrow represents in the comic book. 

12. What are the two definitions of "dipole" given in the comic book?

Making Sense

What does electronegativity have to do with polarity?

If you finish early. . .

Using polar bears and penguins, create an illustration showing a hydrogen sulfide molecule, H_2S. (Hint: You may wish to start with a Lewis dot structure.)

Student Worksheet

Sniffing It Out...

Name: _____

Period: _____ Date: _____

Part I – Review of Polarity: Use the comic strip called "The Bare Essentials of Polarity" to answer the following questions.

1. On page 1, the polar bear is licking the ice cream cone but the penguin can't reach it. Explain how this represents the bond in HCl. Be specific about what the scoops of ice cream represent and where they are positioned between the bear and the penguin.

2. Explain how the picture at the bottom of page 1 with the iceberg, penguins, and polar bears, represents trends in electronegativity.

3. Use the pictures on page 3 to explain the differences between a nonpolar covalent, polar covalent, and ionic bond.

4. Use the pictures on page 4 to explain why N_2 and CO_2 are nonpolar, while HCl and H_2O are polar.

5. Pick your favorite scene in the comic strip. Explain how it relates to polarity and why it appeals to you.

In the “Molecular Geometry” column, write one the following molecular shapes in the appropriate spot in the table.
Note that some terms may be used more than once.

bent	seesaw	T-shaped	trigonal bipyramidal
linear	square planar	tetrahedral	trigonal pyramidal
octahedral	square pyramidal	trigonal planar	

In the “Example of a Molecule” column, write one of the following chemical formulas in the appropriate spot in the table.

CO_2	ClF_3	PF_3	SF_2	SO_2	XeF_2
CF_4	ClF_5	PF_5	SF_4	SO_3	XeF_4
			SF_6		

In the “Example of a Polyatomic Ion” column, write one of the following chemical formulas in the appropriate spot in the table.

Br_3^-	ClO_2^-	NO_2^+	PF_4^-	SO_4^{2-}
	ClO_3^-	NO_2^-	PF_6^-	SF_5^+
	ClF_4^-	NO_3^-		

In the “Total Number of Valence Electrons” column, write one of the following numbers in the appropriate spot in the table.

16 18 20 22 24 26 28 32 34 36 40 42 48

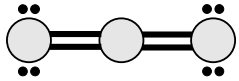
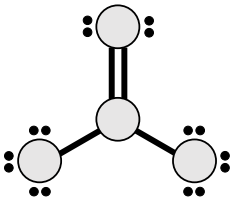
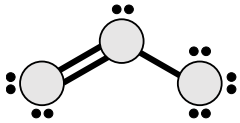
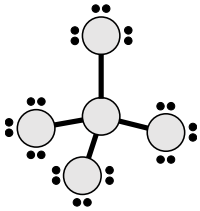
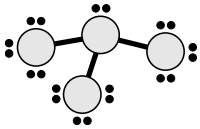
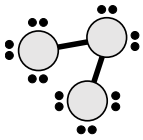
Bonding Domains around central atom	Nonbonding Domains around central atom	Total # of Electron Domains around central atom	Electron Domain Geometry	Molecular Geometry	Example of a Molecule	Example of a Polyatomic Ion	Total Number of Valence Electrons
2	0	2	linear				
3	0	3	trigonal planar				
2	1	3	trigonal planar				
4	0	4	tetrahedral				
3	1	4	tetrahedral				
2	2	4	tetrahedral				
5	0	5	trigonal bipyramidal				
4	1	5	trigonal bipyramidal				
3	2	5	trigonal bipyramidal			N/A	
2	3	5	trigonal bipyramidal				
6	0	6	octahedral				
5	1	6	octahedral			N/A	
4	2	6	octahedral				

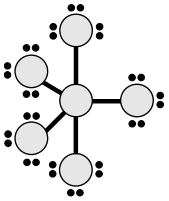
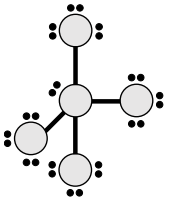
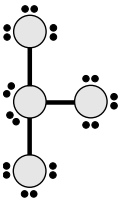
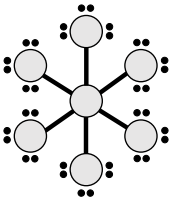
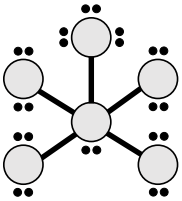
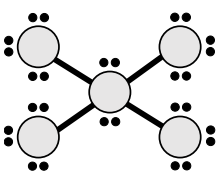
Use the periodic table to determine the total number of valence electrons for each molecule or polyatomic ion.

Chemical Formula	Total Number of Valence Electrons
CO_2	
CF_4	
ClF_3	
ClF_5	
PF_3	
PF_5	
SF_2	
SF_4	
SF_6	
SO_2	
SO_3	
XeF_2	
XeF_4	

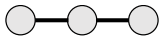
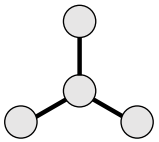
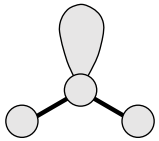
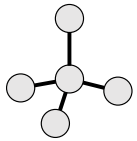
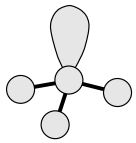
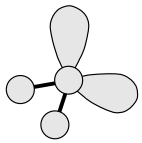
Chemical Formula	Total Number of Valence Electrons
Br_3^-	
ClO_2^-	
ClO_3^-	
ClF_4^-	
NO_2^+	
NO_2^-	
NO_3^-	
PF_4^-	
PF_6^-	
SO_4^{2-}	
SF_5^+	

Write the total number of valence electrons for each of the following Lewis dot structures. **PAGE #30**

Lewis Dot Structure	Total Number of Valence Electrons
	
	
	
	
	
	

Lewis Dot Structure	Total Number of Valence Electrons
	
	
	
	
	
	
	

For each type of molecular geometry, identify the number of bonding and nonbonding domains around the central atom. In addition, write the name of the molecular shape.

Molecular Geometry	Bonding Domains around central atom	Nonbonding Domains around central atom	Name of Molecular Shape
			
			
			
			
			
			

Molecular Geometry	Bonding Domains around central atom	Nonbonding Domains around central atom	Name of Molecular Shape