① 5. The big jump in IE (5-6) is because the 6th e⁻ to be removed comes from the valence shell.

② 5A → 5 valence electrons

③ Bismuth b/c it is in Group 5A

④ The 2nd & 3rd e⁻ both come from the p subshell so they experience similar shielding. However, the 4th e⁻ is in the s subshell, so it has less shielding (higher $Z_{eff}$), so it is more attracted to the nucleus & takes more energy to remove

⑤ $n=1 \rightarrow n=7$ (ground state)

$$E_1 = \frac{-2.18\times10^{-18}\,J}{1^2} = -2.18\times10^{-18}\,J$$

$$E_7 = \frac{-2.18\times10^{-18}\,J}{7^2} = -4.45\times10^{-20}\,J$$

$$\Delta E = E_{photon} = 2.14\times10^{-18}\,J$$

$$E = \frac{hc}{\lambda} \qquad \lambda = \frac{hc}{E} = \frac{6.626\times10^{-34}(2.998\times10^{8})}{2.14\times10^{-18}} = 9.3\times10^{-8}\,m$$

93 nm

⑥ $^{58}Ni^{2+}$

28 protons $1.673\times10^{-27}\,kg = 4.684\times10^{-26}\,kg$

30 neutrons $\times\ 1.675\times10^{-27}\,kg = 5.025\times10^{-26}\,kg$

28 e⁻ $\times\ 9.109\times10^{-31}\,kg/e^- = 2.368\times10^{-29}\,kg$

$$\text{mass } {}^{58}Ni^{2+} = 9.712\times10^{-26}\,kg \left|\frac{10^3\,g}{1\,kg}\right. = 9.712\times10^{-23}\,g$$

$$V = \frac{4}{3}\pi r^3 \qquad r = 63\,pm \left|\frac{10^{-12}\,m}{1\,pm}\right. = 6.3\times10^{-11}\,m \left|\frac{1\,cm}{10^{-2}\,m}\right. = 6.3\times10^{-9}\,cm$$

$$V = \frac{4}{3}\pi(6.3\times10^{-9}\,cm)^3 = 1.05\times10^{-24}\,cm^3 \left|\frac{1\,mL}{1\,cm^3}\right. = 1.05\times10^{-24}\,mL$$

$$\text{Density} = 9.712\times10^{-23}\,g / 1.05\times10^{-24}\,mL = 92.7\,g/mL$$

7. $D = \frac{\text{mass}}{\text{volume}}$ → increases as you move down + right
volume → decreases as you move up and right

atoms within a given shell increase in mass (more protons + neutrons) and decrease in volume as you move to the right. Both of these cause the density to increase

B < N < O < F

8. H: $H^+$ or $H^-$ F: $F^-$
Sr: $Sr^{2+}$ Se: $Se^{2-}$
Al: $Al^{3+}$ Ar: no common charge
P: $P^{3-}$

9. metal / non metal = ionic non-metal / non-metal = covalent
N/N = covalent N/Na = ionic Ca/H = ionic
Sc/Cl = ionic Cl/F = covalent Na/H = ionic

10. $Na^+$ $N^{3-}$ = $Na_3N$ $Mg^{2+}$ $N^{3-}$ = $Mg_3N_2$
$Al^{3+}$ $P^{3-}$ = AlP $Se^{2-}$ $K^+$ = $K_2Se$

11. Variable charge are in the d + f block. Zn + Cd are not variable because $d^{10}$ is stable
• Also P block elements below metalloids

a. ~~Ag~~ ~~Zn~~ (Bi) (Re) (Mn) (In)
b. (Ru) ~~Cd~~ (Sn) (Zr) ~~K~~ ~~At~~

12. Fe: $[Ar]\ 4s^2\ 3d^6$

$Fe^{+2}$: $[Ar]\ 3d^6$

$Fe^{+3}$: $[Ar]\ 3d^5$

In: $[Kr]\ 5s^2\ 4d^{10}\ 5p^1$

$In^{+1}$: $[Kr]\ 5s^2\ 4d^{10}$

$In^{+3}$: $[Kr]\ 4d^{10}$

Cu: $[Ar]\ 4s^1\ 3d^{10}$

$Cu^{+}$: $[Ar]\ 3d^{10}$

$Cu^{2+}$: $[Ar]\ 3d^9$

Mn: $[Ar]\ 4s^2\ 3d^5$

$Mn^{2+}$: $[Ar]\ 3d^5$

$Mn^{+7}$: $[Ar]$

13. NaH → Sodium hydride

$BeF_2$ → beryllium fluoride

$(NH_4)_2O$ → ammonium oxide

$Na_2CO_3$ → sodium carbonate

$CrCl_6$ → chromium (VI) chloride

$Fe_2S_3$ → iron (III) sulfide

14. Zinc chloride
+2 −1
$ZnCl_2$

Thallium (I) Phosphate
+1 −3
$Tl_3PO_4$

Thallium (III) phosphide
+3 −3
TlP

Tin (IV) oxide
+4 −2
$SnO_2$

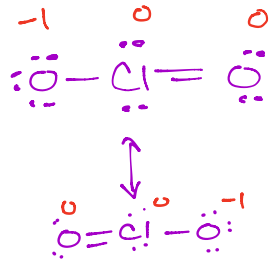
Sodium nitride
+1 −3
$Na_3N$

Sodium nitrite
+1 −1
$NaNO_2$

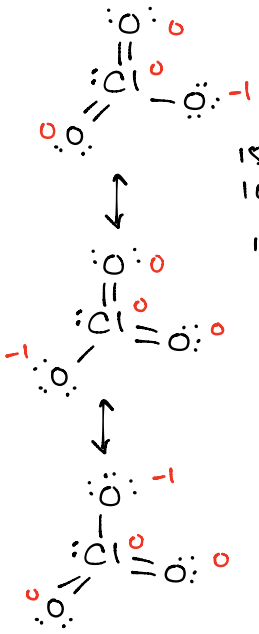
Sodium nitrate
+1 −1
$NaNO_3$

Iron (III) selenide
+3 −2
$Fe_2Se_3$

15 → 19

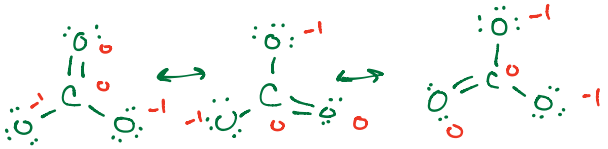


15. Chlorine
16. 1 double bond
17. See image
18. See image
19. See image (2)

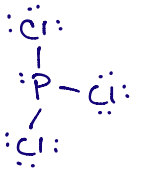


15. Chlorine
16. 2 double bonds
17. See image
18. See image
19. 3

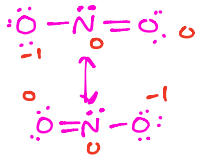
15. Carbon
16. 2 double bonds
17. See image
18. See image
19. None



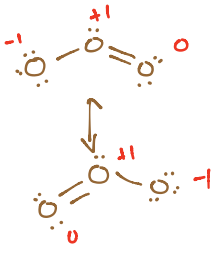
15. Carbon
16. 1 double bond
17. See image
18. See image
19. 3



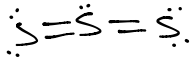
15. Phosphorus
16. 8
17. See image
18. See image
19. None



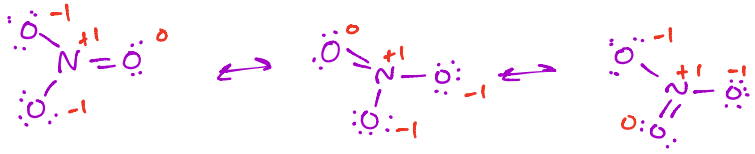
15. Nitrogen
16. 1 double bond
17. See image
18. See image
19. 2



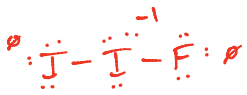
15. Oxygen
16. 1 double bond
17. See image
18. See image
19. 2



15. Sulfur
16. 2 double bonds
17. See image
18. See image
19. None

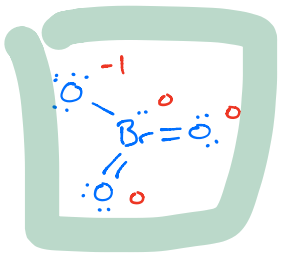


15. Nitrogen
16. One double bond
17. See image
18. See image
19. 3

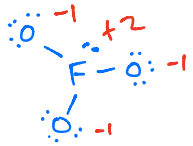


15. Iodine
16. Ø
17. see image
18. See image
19. no resonance

20.

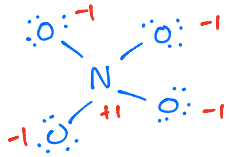


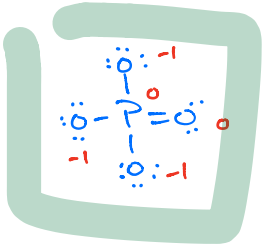
vs.



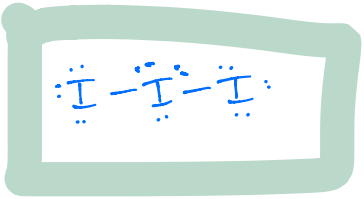
Br can expand its octet and form a structure that has much less formal charge.

F is restricted to an octet. The only way to draw the structure is with a lot of formal charge = BAD





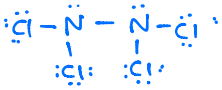
Since P can expand its octet, it can have a lot less formal charge



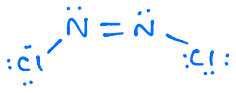
no place to put the last 2 e⁻

It is not possible to draw a structure of $F_3^-$ without violating the octet rule. Expanded octets are required!

21.



$N_2H_4$



$N_2Cl_2$

22. $N_2O_2$ → dinitrogen dioxide

$N_2O_4$ dinitrogen tetraxide

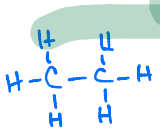
$C_2H_6$ → dicarbon hexahydride

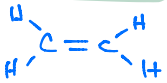
$SF_6$ Sulfur hexafluoride

23. 

single bonds are longer than double bond

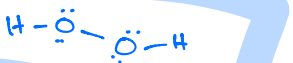
double bonds longer than triple





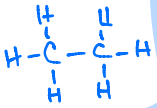
single longer than double

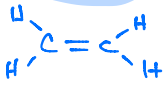
24. 



single bonds are longer than double

double bonds are longer than triple





single bonds are longer than double

25. $HCl$ = hydrochloric acid (ide rule)

$H_2SO_4$ = Sulfuric acid (ate rule)

$HNO_3$ = nitric acid (ate rule)

$HBrO_2$ = bromous acid (ite rule)

$HBrO_4$ = perbromic acid (ate rule)

$HBrO$ = hypobromous acid (-ite rule)

26. Nitrous acid → $HNO_2$
↳ nitrite →

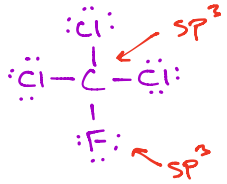
Hydrobromic acid → HBr
↳ Bromide →

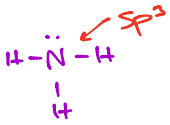
Sulfurous acid → $H_2SO_3$
↳ sulfite →

Acetic acid → $HC_2H_3O_2$
↳ acetate →

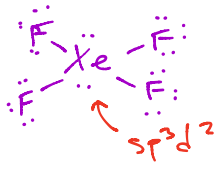
Carbonic acid → $H_2CO_3$
↳ carbonate →

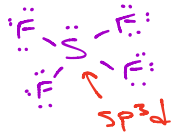
27.

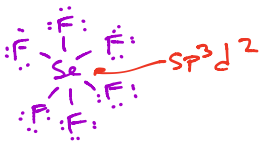


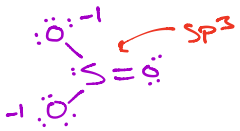





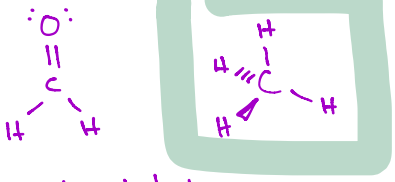



28.



tetrahedral = 109.5

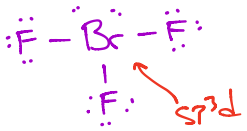
trig. planar = 120

Low par commands more space.

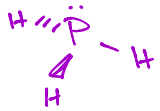
Low par commands more space.

Low par commands more space.

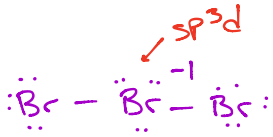
29.



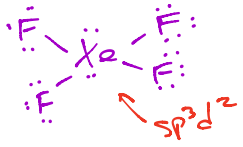

electron geometry: trig. bipyramidal
molecular geometry: T-shaped



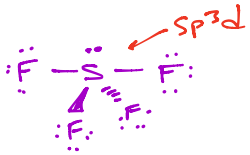
electron geometry: tetrahedral
molecular geometry: trig. pyramidal



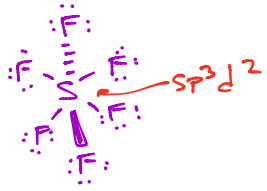

electron geometry: trig. bipyramidal
molecular geometry: linear



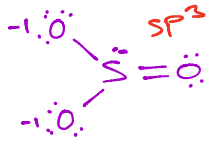

electron geometry: octahedral
molecular geometry: square planar




electron geometry: trig. bipyramidal
molecular geometry: see-saw

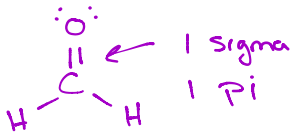


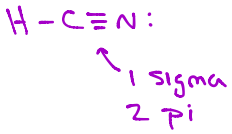

electron geometry: octahedral
molecular geometry: octahedral



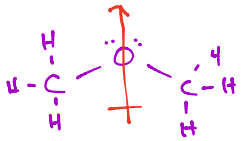

electron geometry: tetrahedral
molecular geometry: trig. pyramidal

30.

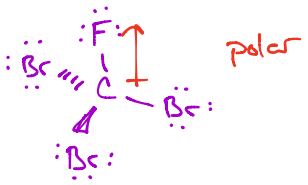


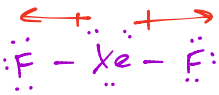

31.



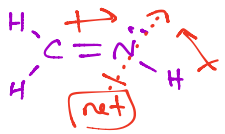
yes, polar



polar



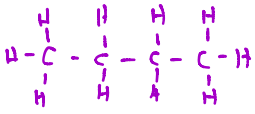
NOT polar




polar

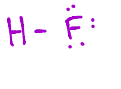
32.

LDF
Dipole
H-bond



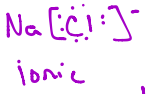
LDF only

P-H bonds are NOT polar!
LDF only



LDF
Dipole
H-bond

LDF
Dipole



ionic compound

LDF
ion/ion

33. Stronger Intermolecular force = ↑ $T_b$

$CH_4$ + $CF_4$ are both non polar. Both LDF. $CF_4$ is bigger, so stronger LDF ∴ higher $T_b$

$CBr_3F$ is polar and bigger. So stronger LDF AND dipole/dipole

$NH_3$ is polar and can H-bond. $PH_3$ is LDF only

H-F can H-bond, so stronger IMF

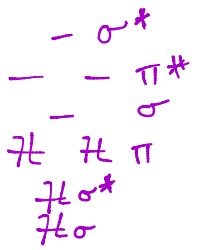
$TeH_2$ + $SeH_2$ are both nonpolar, so LDF only. $TeH_2$ is bigger, so stronger LDF

34.

$C_2$ 8 Valence e⁻

unpaired = ∅

BO = $\frac{6-2}{2} = 2$

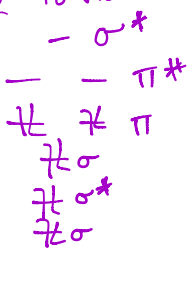


CO 10 VE

∅ unpaired

BO = $\frac{8-2}{2}$

BO = 3

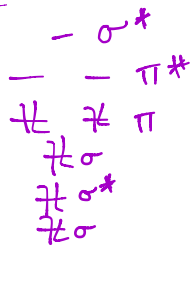


$CN^{-1}$ 10 VE

∅ unpaired

BO = $\frac{8-2}{2}$

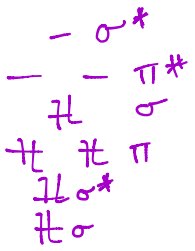
BO = 3



$N_2$ 10 V.E.

unpaired = ∅

BO = $\frac{8-2}{2} = 3$

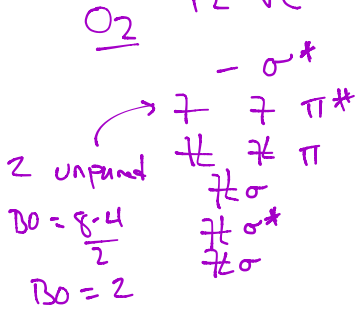


$O_2$ 12 VE

2 unpaired

BO = $\frac{8-4}{2}$

BO = 2

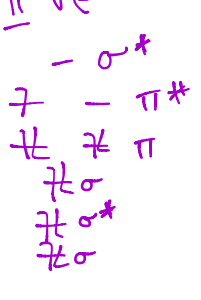


NO 11 VE — odd, so radical

1 unpaired

BO = $\frac{8-3}{2}$

BO = 2.5

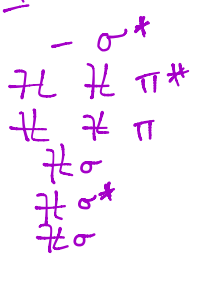


$F_2$ 14 VE

∅ unpaired

BO = $\frac{8-6}{2}$

BO = 1

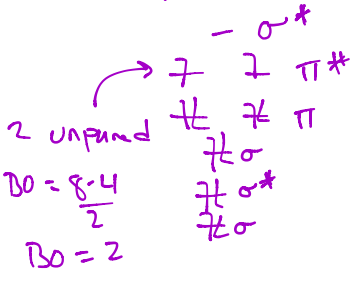


$OF^+$ 12 VE

2 unpaired

BO = $\frac{8-4}{2}$

BO = 2



$OF^{-1}$ 14 VE

0 unpaired

BO = $\frac{8-6}{2}$

BO = 1