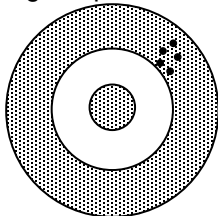


1. The following target represents someone who is:



a) accurate, but not precise

b) precise, but not accurate

c) both precise and accurate

d) neither precise, nor accurate

accuracy is a measure of how close one is to the actual target/goal. Precision is how close the individual trials are to each other (reproducibility)

2. How close a measurement is to the true value is the \_\_\_\_\_ of the measurement and is communicated as \_\_\_\_\_

a) accuracy, % error

b) accuracy,  $\pm$  notation

c) precision, % error

d) precision,  $\pm$  notation

% error is a method to show mathematically how far one is from the accepted value

3. Consider the following data:

mass of slab	35.24 g
length of slab	35.14 cm
width of slab	15.85 cm
height of slab	0.68 cm

What is the density of the slab? Show work.

$$D = m/v$$

$$V = l \cdot w \cdot h$$

$$= 35.14 \cdot 15.85 \cdot 0.68$$

$$= 378.74 \text{ cm}^3 \text{ (2 sig figs due to 0.68)}$$

$$D = 35.24/378.74$$

$$= 0.093 \text{ g/cm}^3$$

4. Question was removed

5. Which one of the following elements is diatomic?

a) Cl

c) Mg

b) S

d) C

6. Convert 0.00527 km into cm. Show work.

$$\frac{0.00527 \text{ km}}{1 \text{ km}} \left| \frac{1000 \text{ m}}{1 \text{ km}} \right| \left| \frac{100 \text{ cm}}{1 \text{ m}} \right| = 527 \text{ cm}$$

7. The accepted value for the density of aluminum is  $2.70 \text{ g/cm}^3$ . Your measurements indicate that the density is  $2.80 \text{ g/cm}^3$ . Is this an indication of the accuracy or precision of the measurement?

This is an indication of accuracy, how close one is to the accepted value.

8. The measured density of aluminum is actually  $2.80 \pm 0.03 \text{ g/cm}^3$ . Is the  $\pm$  value an indication of the accuracy or precision of the measurement?  
The  $\pm 0.03$  is show the accuracy of the measuring device.

9. Write the following in scientific notation with correct sig figs:

$$5000 \text{ g} \quad \underline{5 \times 10^3 \text{ g}}$$

$$0.00350 \text{ L} \quad \underline{3.50 \times 10^{-3} \text{ L}}$$

$$45.8 \text{ kg} \quad \underline{4.58 \times 10^1 \text{ kg}}$$

$$0.0000000262 \text{ km} \quad \underline{2.62 \times 10^{-8} \text{ km}}$$

$$375 \times 10^3 \text{ mL} \quad \underline{3.75 \times 10^5 \text{ mL}}$$

10. What gas is formed when Zn metal is mixed with hydrochloric acid, HCl?

- a) CO<sub>2</sub>                      c) O<sub>2</sub>  
b) He                         d) H<sub>2</sub>

Single replacement rxn  $\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$

11. Which property is always conserved during a chemical reaction?

- a) mass                      c) pressure  
b) volume                  d) solubility

12. A cylinder is weighed empty and with a liquid.

Cylinder with liquid	51.85 g
Cylinder, empty	40.11 g
Volume of liquid in cylinder	7.0 mL

What is the density of the liquid?

- a) 13 g/mL                  c) 5.7 g/mL  
b) 7.4 g/mL                d) 1.7 g/mL

$$m = 51.85 \text{ g} - 40.11 \text{ g} = 11.74 \text{ g}$$

$$D = m/V$$

$$= 11.74 / 7.0$$

$$= 1.7 \text{ g/mL (2 sig figs due to volume measurement)}$$

13. Which one of the following is the correct formula for aluminum oxide?

- a) AlO                      c) Al<sub>2</sub>O<sub>3</sub>  
b) Al<sub>6</sub>O<sub>6</sub>                  d) Al<sub>3</sub>O<sub>2</sub>

Al has a +3 charge and O has a -2 charge

14. What is the name of the compound CF<sub>4</sub>?

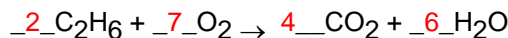
- a) fluorocarbonate  
b) carbon tetrafluoride  
c) tricarbo fluoride  
d) carbon difluorate

15. Sodium nitride has the formula Na<sub>3</sub>N. What is the formula for magnesium nitride?

- a) Mg<sub>2</sub>N                    c) Mg<sub>3</sub>N<sub>2</sub>  
b) Mg<sub>3</sub>N                    d) Mg<sub>2</sub>N<sub>3</sub>

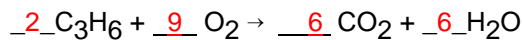
Mg has a +2 charge and N has a -3 charge

16. Which set of coefficients balances the equation for the complete combustion of ethane, C<sub>2</sub>H<sub>6</sub>?



- a) 1,3,2,3                  c) 2,6,4,5  
b) 1,6,2,6                  d) 2,7,4,6

17. When this expression is balanced,



what is the coefficient of oxygen, O<sub>2</sub>?

- a) 6                            c) 12  
b) 9                            d) 18

18. An acid was neutralized by the following reaction:  
 $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$

This reaction would be classified as...

- a) synthesis  
b) decomposition  
c) double replacement  
d) single replacement

Two compounds react to form two new compounds

19. Which reaction below would be classified as a decomposition reaction?



- b)  $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$   
c)  $2\text{AgNO}_3 + \text{Cu}^\circ \rightarrow \text{Cu}(\text{NO}_3)_2 + 2\text{Ag}^\circ$   
d)  $\text{Ba}(\text{OH})_2 + \text{H}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{H}_2\text{O}$

1 reactant breaks down into 2 or more products

20. The complete combustion of ethane, C<sub>2</sub>H<sub>6</sub>, produces

- a) C<sub>2</sub>H<sub>5</sub>OH                  c) CO<sub>2</sub> and H<sub>2</sub>  
b) CH<sub>3</sub>COOH                d) CO<sub>2</sub> and H<sub>2</sub>O

complete combustion of a hydrocarbon will always result in the production of carbon dioxide and water

21. Of the three particles; protons, neutrons, and electrons, which one(s) are responsible for most of the **mass** of an atom?

- a) the protons only
- b) the electrons only
- c) the neutrons only
- d) the protons and neutrons

e) the protons and electrons

mass of the electron is negligible compared to that of the proton and neutron

**Questions 22 - 25** refer to the following terms. Each answer may be used once, more than once, or not at all.

- a) proton
- b) neutron
- c) electron
- d) proton and neutron

22. Moves very quickly around the nucleus. **electron**

23. Has a mass of 1 amu. **proton**

24. Has a charge of -1. **electron**

25. Defines the volume of the atom. **electron**

26. If you constructed an atomic model the size of the classroom, the nucleus might be formed from

- a) several softballs
- b) several ping pong balls
- c) several pieces of sand

27. The **modern** periodic table has the elements arranged in order of increasing

- a) electron energy
- b) atomic number
- c) atomic size
- d) molar mass

atomic number is the number of protons.

28. Which element would be the best conductor?

- a) Sn
- b) S
- c) As
- d) P

Sn (tin) is a metal and therefore a good conductor.

**Questions 29 – 32** refer to the following families.

Each answer may be used once, more than once, or not at all.

- a) halogen family
- b) alkaline earth metal family
- c) alkali metal family
- d) noble gas family

29. Very unreactive **noble gases (8 valence)**

30. Form 2+ ions **alkaline earth metals (2 valence)**

31. React with water **alkali earth metals**

32. Includes Ca, Mg, and Ba **alkaline earth metals**

33. The fact that hydrogen forms diatomic molecules makes it similar to the \_\_\_\_\_ family.

- a) halogen
- b) alkali metal
- c) noble gas
- d) alkaline earth metal

34. The fact that hydrogen has one valence electron makes it similar to the \_\_\_\_\_ family.

- a) halogen
- b) alkali metal
- c) noble gas
- d) alkaline earth metal

35. Properties of metals include:

- a) brittleness
- b) poor conductivity
- c) dull surface
- d) can be pounded into sheets

the delocalized arrangement of the electrons in the electron sea model make metals ductile and malleable

36. Which family contains examples of metals, semi-metals, and non-metals?

- a) H/Li
- b) C/Si
- c) F/Cl
- d) He/Ne

group 14/4 contains carbon (non metal), silicon (semi metal/metalloid), and tin (metal)

37. List the elements, P, As, S in order of largest to smallest atomic radius.

- a)  $P > As > S$                       c)  $S > P > As$   
b)  $As > P > S$                       d)  $P > S > As$

As is in period 4, which makes it larger than P, due to shielding. P is larger than S due to Zeff.

38. When a neutral Cl atom becomes a  $Cl^-$  ion how and why does the size change?

- a) bigger / more electron-electron repulsion  
b) smaller / more electron-proton attraction  
c) bigger / more electron-proton repulsion  
d) smaller / more electron-electron attraction

The addition of the extra electron causes the electron cloud to increase due to less attraction from the nucleus and more  $e^-/e^-$  repulsions

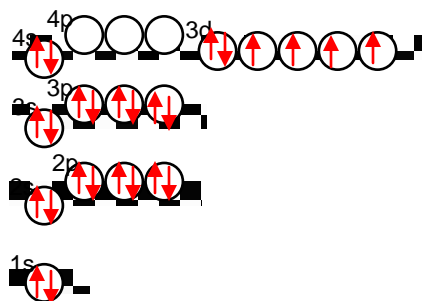
39. Where are the largest atoms located on the periodic table?

- a) upper right                      c) upper left  
b) lower right                      d) lower left

The size of the atom increases down a group due to shielding and decreases from left to right due to increased pull from the nucleus. Therefore Fr would be the largest atom.

Questions 40 – 42 refer to the iron, Fe, atom:

40. Fill in the orbital diagram for Fe ( $Z=26$ ).



41. Iron's electrons that are farthest from the nucleus occupy the \_\_\_\_ orbital.

- a) 4s                      c) 3p  
b) 4p                      d) 3d

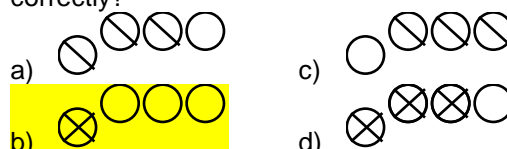
Electrons in 3d are of higher energy than electrons in 4s. The 4s orbital and 3d orbitals overlap.

42. Iron's electrons that have the highest energy occupy the \_\_\_\_ orbital.

- a) 4s                      c) 3p  
b) 4p                      d) 3d

Because the electrons  $4s\ e^-$  are in the 4<sup>th</sup> energy level which is of higher energy compared to the 3d

43. Which electrons are being placed into orbitals correctly?

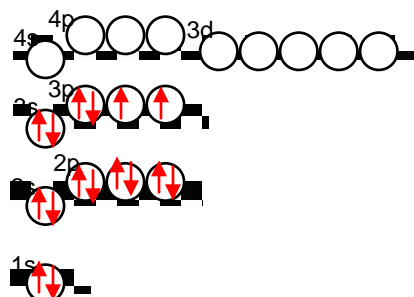


a and c violate the aufbau principle because the lower energy levels are not filled before filling a higher level.

d violates hund's rule because orbitals of equal energy must contain one electron before pairing.

Questions 44 – 46 refer to the sulfur, S, atom:

44. Fill in the orbital diagram for S ( $Z=16$ ).



45. How many orbitals in sulfur have only one electron?

- a) zero                      c) 2  
b) 1                      d) 3

46. How many electrons in sulfur are available for bonding (valence electrons)?

- a) 2                      c) 6  
b) 4                      d) 8

sulfur has 6 valence electrons and is able to expand its octet into the open d orbitals.

47. Which element below has the greatest ionization energy?

- a) Na                      c) Mg  
b) K                        d) Ca

ionization energy decreases down a group due to shielding and increases across the period due to  $Z_{eff}$  (pull from the nucleus)

**Questions 48 – 51** refer to an isotope with a mass number of 31, 16 protons, and a charge of 2-.

48. The atomic number is \_\_\_\_.

- a) 14      b) 15      c) 16      d) 18

number of protons is the same as atomic number (Z)

49. The isotope contains \_\_\_\_ electrons.

- a) 14      b) 15      c) 16      d) 18

because it has a charge of 2- there are two extra electrons than protons.

50. The nucleus contains \_\_\_\_ neutrons.

- a) 14      b) 15      c) 16      d) 18

mass # =  $p^+ + n^0$

51. The element is \_\_\_\_.

- a) Si      b) P      c) S      d) Ar

atomic number 16

52. Give the 4 quantum numbers for sulfur.

- a) 3, 1, -1, 1/2              c) 3, 2, -1, -1/2  
b) 3, 1, -1, -1/2            d) 3, 2, -1, 1/2

refer to orbital notation in question 44

53. Give the 4 quantum numbers for Iron.

- a) 3, 2, -2, -1/2              c) 3, 3, -2, -1/2  
b) 3, 2, 2, -1/2                d) 3, 3, 2, -1/2

refer to orbital notation in question 40

54. How many electrons can fit into a d sublevel?

- a) 2      b) 6      c) 10      d) 14

5 orbitals each can hold 2 electrons

55. How many electrons can fit on  $n=5$ ?

- a) 18      b) 25      c) 36      d) 50

max electrons in an energy level =  $2n^2$

56. A photon has  $4.67 \times 10^{-21}$  J of energy what is the wavelength in meters?

- a)  $4.25 \times 10^{-5}$               c)  $1.98 \times 10^{-25}$   
b)  $9.27 \times 10^{-46}$             d) 23500

$$E = \frac{hc}{\lambda}$$

$$\lambda = \frac{hc}{E} = \frac{6.636 \times 10^{-34} \times 3.00 \times 10^8}{4.67 \times 10^{-21}}$$

$$= 4.25 \times 10^{-5} m$$

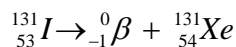
57. What is the charge carried by a beta particle?

- (A) -1                              (C) +1  
(B) 0                                (D) +2

Beta particle has same mass and charge of an electron

58. Iodine-131 undergoes "beta decay". What other particle is produced?

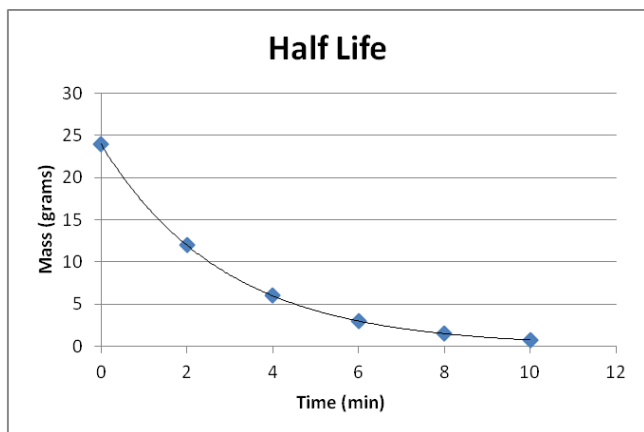
- (A) Xe-131                      (C) I-130  
(B) Te-131                      (D) Sb-127



59. What type of radiation is simply a very energetic form of light?

- (A) alpha                        (C) gamma  
(B) beta                         (D) positron

**Questions 60 - 62** refer to the graph you are going to make below.  
A radioisotope's half-life is 2.000 minutes. Graph the mass of the sample vs. time for 6 minutes starting with a 24.00 gram sample.



60. How much of the sample would be left after 8.00 minutes?  
(A) 3.00 grams (C) 0.75 grams  
(B) 1.50 grams (D) 0.375 grams

61. How much time must pass before you will have only 1/8th of your original sample?  
(A) 4 minutes (C) 8 minutes  
(B) 6 minutes (D) 10 minutes

24 \* 1/8 = 3 from graph at time 6 minutes 3 grams remain

62. If you began with a 48.00 gram sample, how would the half-life change?  
(A) it would double  
(B) it would remain the same  
(C) it would be half as much

63. Iodine-131 has a half-life of 8 days. What percent of a sample would remain after 24 days?  
(A) 75% (B) 50% (C) 25% (D) 12.5%

With a half life of 8 days three half lives will pass in the 24 day period. Starting with 100%

100 → 50 → 25 → 12.5 (→ represents 1 half life). 12.5 % would remain

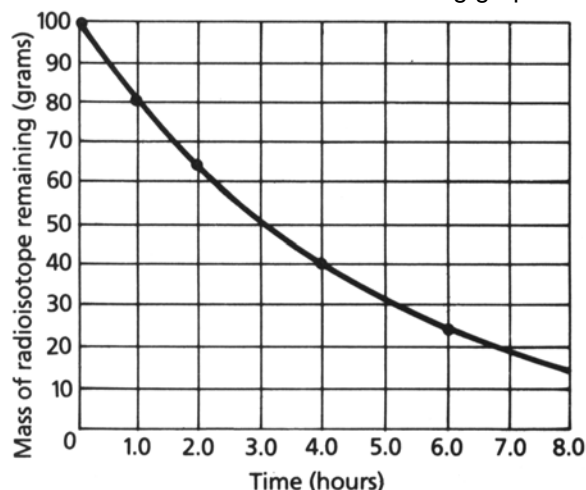
64. The isotope Bi-214 decays from 60.00 g to 7.50 g in 1 hour. What is its half-life?  
(A) 5 minutes (C) 15 minutes  
(B) 10 minutes (D) 20 minutes

60.0 → 30.0 → 15.0 → 7.50 3 half lives pass

60/3 = 20

One half life is 20 mins

**Questions 65 - 66** refer to the following graph:



65. According to the above data, what is the half-life of the substance?

(A) 1.0 hrs (C) 3.0 hrs  
(B) 2.3 hrs (D) 8.0 hrs

Time between 100 and 50 is 3.0 hrs

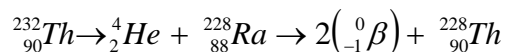
66. What percent of the original sample remains after 4 hours?

(A) 80% (C) 60%  
(B) 75% (D) 40%

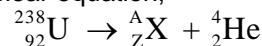
After 4 hours 40 grams remain according to the graph therefore 40% remains

67. The decay series of Th-232 involves an alpha decay and then two beta decays. What is the result of these decays?

(A) Th-228 (C) Fr-224  
(B) Rn-228 (D) Pb-207



68. In the nuclear equation,



the letters Z and A are, respectively

(A) 90 and 242 (C) 94 and 234  
(B) 94 and 242 (D) 90 and 234

Charge and mass must be conserved.

69. Radioactive C-14 has a half-life of about 5,000 years. If a fossil is only about 6% as radioactive as expected for living tissue of the same mass, the age of the fossil is about:

(A) 5,000 yrs (C) 20,000 yrs  
(B) 10,000 yrs (D) 40,000 yrs

Assuming a living sample has 100%  $m_i = 100$ ,  
 $m_f = 6$ ,  $n = \text{half life cycles} = T/t_{1/2}$

$$2^n = \frac{m_i}{m_f}$$

$$n = \frac{\ln\left(\frac{m_i}{m_f}\right)}{\ln 2} = \frac{\ln\left(\frac{100}{6}\right)}{\ln 2} = 4.05888$$

$$T = n * t_{1/2} = 5000 * 4.05888 \approx 20000 \text{ yrs}$$

70. Predict the type of bonding formed by the following pairs of atoms from their position on the periodic table.

- a) LiI                      metallic / ionic / covalent
- b) NO                      metallic / ionic / covalent
- c) ICl                      metallic / ionic / covalent
- d) SnPb                    metallic / ionic / covalent
- e) CuO                      metallic / ionic / covalent

71. State whether each bond is ionic, nonpolar covalent, or polar covalent.

- a) Rb – N    \_\_\_\_ ionic (metal + nonmetal) \_\_\_\_
- b) As – Cl    \_\_\_\_ covalent \_\_\_\_ (2 non metals) \_\_\_\_
- c) Na – At    \_\_\_\_ ionic (metal + non metal) \_\_\_\_
- d) Cl – Br    \_\_\_\_ covalent \_\_\_\_ (2 non metals) \_\_\_\_

## Ionic Bonding

72. Draw Lewis electron dot symbols for:

N		N <sup>3-</sup>	
O		O <sup>2-</sup>	
F		F <sup>-</sup>	
Ne			
Na		Na <sup>+</sup>	
Mg		Mg <sup>2+</sup>	
Al		Al <sup>3+</sup>	

See attached page

73. When K reacts with F<sub>2</sub>, the compound KF is formed.

K, \_\_\_\_ (gains/loses) 1 electron(s) while F, \_\_\_\_ (gains/loses) 1 electron(s).

74. Cl will be isoelectronic with the noble gas, Ar, when it \_\_\_\_ (gains / loses) 1 e<sup>-</sup>.

Isoelectronic means the same number of electrons

75. Add dots to the element symbols below to show the Lewis electron dot symbols for the following and state the bonding capacity.

Li	Be	B	C	N	O	F	Ne

See attached page

76. Draw Lewis structures for the following molecules:

- a)  $\text{H}_2\text{O}$  \_\_\_\_\_
- b)  $\text{CH}_4$  \_\_\_\_\_
- c)  $\text{PCl}_3$  \_\_\_\_\_
- d)  $\text{LiH}$  \_\_\_\_\_
- e)  $\text{H}_2\text{S}$  \_\_\_\_\_
- f)  $\text{BF}_3$  \_\_\_\_\_
- g)  $\text{C}_2\text{H}_4$  \_\_\_\_\_
- h)  $\text{CO}_2$  \_\_\_\_\_

See attached page

77. Give the molecular geometry

- a)  $\text{H}_2\text{O}$  bent \_\_\_\_\_
- b)  $\text{CH}_4$  tetrahedral \_\_\_\_\_
- c)  $\text{PCl}_3$  trigonal planar \_\_\_\_\_
- d)  $\text{LiH}$  ionic no VSEPR \_\_\_\_\_
- e)  $\text{H}_2\text{S}$  bent \_\_\_\_\_
- f)  $\text{BF}_3$  trigonal planar \_\_\_\_\_
- g)  $\text{C}_2\text{H}_4$  trigonal planar \_\_\_\_\_
- h)  $\text{CO}_2$  linear \_\_\_\_\_

78. Are the following polar or non polar molecules

- a)  $\text{H}_2\text{O}$  polar \_\_\_\_\_
- b)  $\text{CH}_4$  non polar \_\_\_\_\_
- c)  $\text{PCl}_3$  polar \_\_\_\_\_
- d)  $\text{LiH}$  ionic \_\_\_\_\_
- e)  $\text{H}_2\text{S}$  polar \_\_\_\_\_
- f)  $\text{BF}_3$  non polar \_\_\_\_\_
- g)  $\text{C}_2\text{H}_4$  non polar \_\_\_\_\_
- h)  $\text{CO}_2$  non polar \_\_\_\_\_

79. Draw the Lewis structure for hydrogen peroxide,

$\text{H}_2\text{O}_2$ ,  $\text{H}-\text{O}-\text{O}-\text{H}$ . The molecule contains:  
\_\_\_\_ # shared (bonding) pairs of electrons and  
\_\_\_\_ # unshared (lone) pairs of electrons.

See attached page



80. Given the following Lewis structures, state the shape of the molecules.

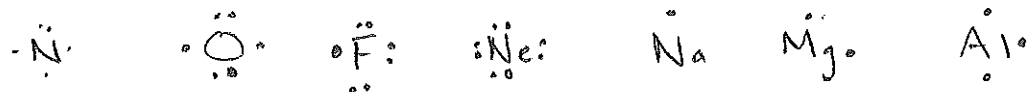
<b>Molecule:</b>	AlH <sub>3</sub>	SiF <sub>4</sub>	NH <sub>3</sub>	H <sub>2</sub> Te	HCl
<b>Lewis Structure:</b>					
<b>Areas of electron density</b>					
<b>Molecular Geometry:</b>					
<b>Polar / Nonpolar?:</b>					

See attached page

81. What type of IMF (intermolecular force) is associated with each of the following **molecules**:

<b>Molecule:</b>	AlH <sub>3</sub>	HF	NH <sub>3</sub>	H <sub>2</sub> S	Ar
<b>IMF:</b>	London dispersion Dipole-dipole H-bonding	London dispersion Dipole-dipole H-bonding	London dispersion Dipole-dipole H-bonding	London dispersion Dipole-dipole H-bonding	London dispersion Dipole-dipole H-bonding

72.



75.



1 bond

2 bonds

3 bonds

4 bonds

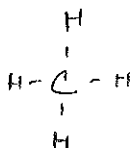
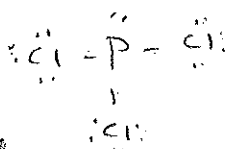
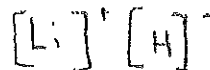
3 bonds  
can make 42 bonds  
can make 3

1 bond

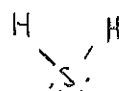
76.

Bent  
Polar

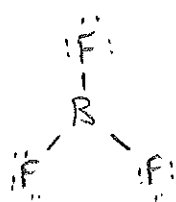
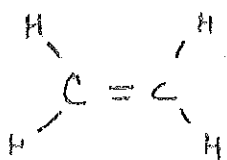
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tetrahedral  
non polartrigonal  
pyramidal  
polar

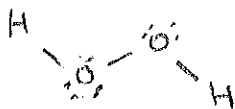
ionic

Bent  
Polar

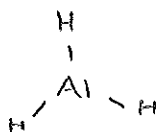
78

trigonal  
planar  
non polartrigonal  
planar  
non polarLinear  
non polar

79.

3 pairs shared  
4 pairs unshared

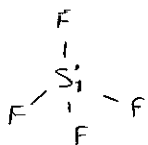
80.



3 atoms

trigonal  
planar

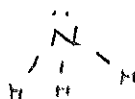
NP.



4 atoms

tetrahedral

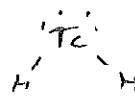
NP.



4 atoms

trigonal  
pyramidal

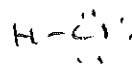
Polar



4 atoms

bent

polar



—

—

polar