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Answers:

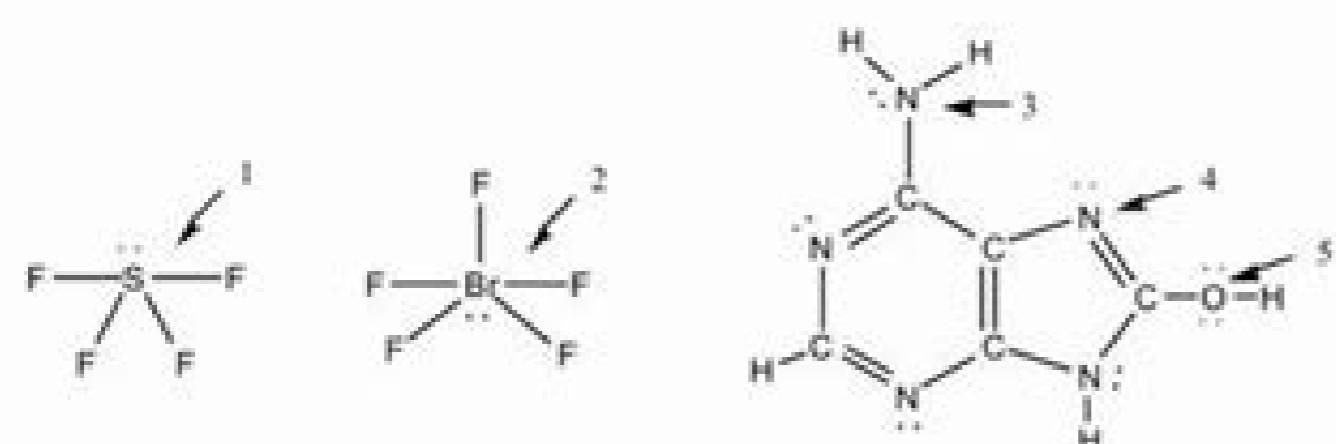
1. In each case, predict (a) the *approximate bond angle(s)*, (b) the *hybridization* around the underlined atom. (Note: It is helpful to first sketch the Lewis structure!)

Molecule or ion	(1) OF <sub>2</sub>	(2) H <sub>2</sub> CO	(3) NO <sub>2</sub> <sup>+</sup>	(4) BF <sub>3</sub>	(5) SbF <sub>5</sub>
(a) No. of valence e <sup>-</sup> 's	20	12	16	24	40
(b) Lewis structure					
(c) Approximate bond angle(s)	109.5°	120°	180°	120°	90°, 120°
(d) Hybridization	sp <sup>3</sup>	sp <sup>2</sup>	sp	sp <sup>2</sup>	sp <sup>3</sup> d
(e) Polar or non-polar molecule?	polar	polar	lon. Not applicable	non-polar	non-polar
(f) Geometry name	bent	trigonal planar	linear	trigonal planar	trigonal bipyramidal

2. For each of the molecules below fill in the indicated items in the chart. The central atoms are underlined>.

Molecule	(1) SO <sub>2</sub>	(2) HBF <sub>2</sub>	(3) XeF <sub>4</sub>	(4) CH <sub>2</sub> Cl <sub>2</sub>	(5) NF <sub>3</sub>
(a) No. of valence e <sup>-</sup> 's	18	18	36	20	26
(b) Lewis structure					
(c) Approximate bond angle(s)	120°	120°	90°	109.5°	109.5°
(d) Hybridization	sp <sup>2</sup>	sp <sup>2</sup>	sp <sup>3</sup> d <sup>2</sup>	sp <sup>3</sup>	sp <sup>3</sup>
(e) Polar or non-polar molecule?	polar	polar	non-polar	polar	polar
(f) Geometry name	bent	trigonal planar	square planar	tetrahedral	trigonal pyramidal

3. Predict (a) the *approximate bond angle*, (b) the *hybridization* around the indicated atoms (the atoms to which the arrows are drawn in the structures below). Write your answers near the corresponding labels (1 to 5) in the drawings. (Note: the lone pairs on the F atoms are omitted.)



page 1

Chem 1020  
Lewis structures worksheet

*Correct shapes included although Lewis only necessary if specifically asked for.*

Complete in the following table:

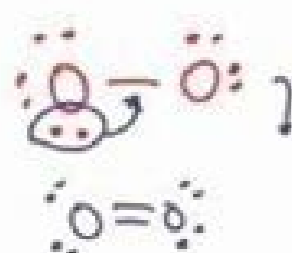
Group:	IA	IVA	VA	VIA	VIIA
Element:	H	C	N	O	F/Cl/Br/I
# valence electrons:	1	4	5	6	7
Normal # covalent bonds:	1	4	3	2	1

For the following neutral molecules, calculate the total number of valence electrons and draw the correct Lewis structure. (For neutral molecules, it's okay to assume the normal numbers of covalent bonds apply and that the central atom is the first non-H element in the formula.)

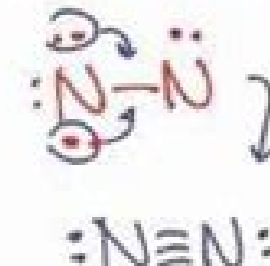
1. F<sub>2</sub> 7 + 7 = 14 ve total



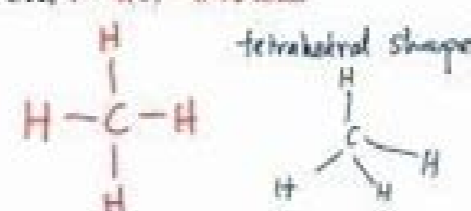
2. O<sub>2</sub> 6 + 6 = 12 ve total



3. N<sub>2</sub> 5 + 5 = 10 ve total



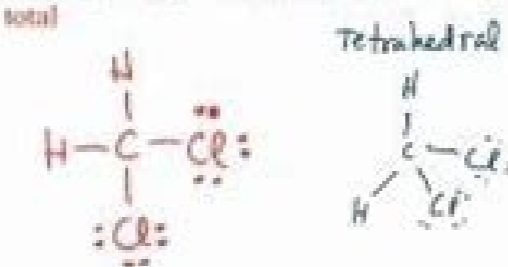
4. CH<sub>4</sub> 4 + 4(1) = 8 ve total



5. CH<sub>3</sub>Cl 4 + 3(1) + 7 = 14 ve total

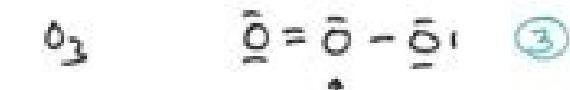
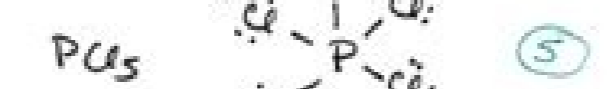
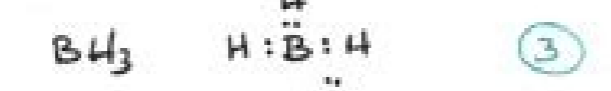
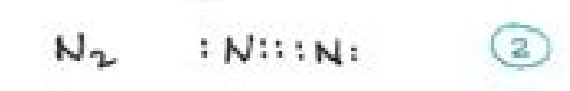
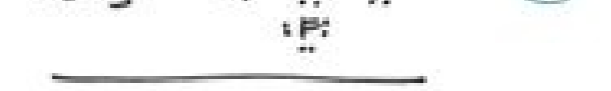
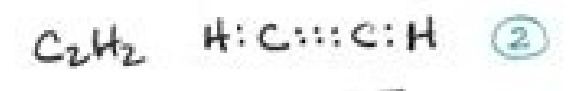
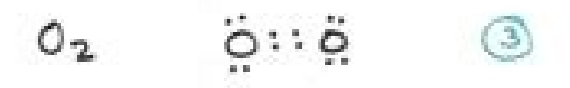
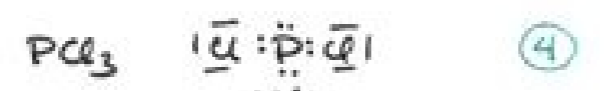
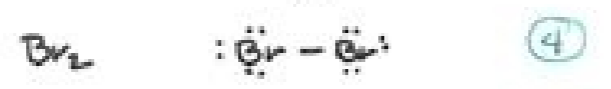
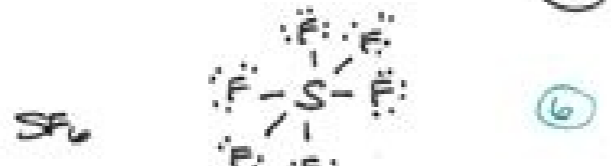
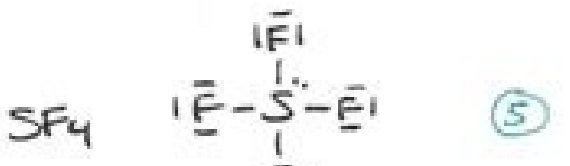
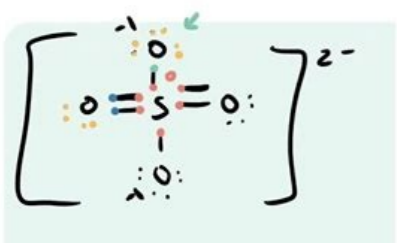


6. CH<sub>2</sub>Cl<sub>2</sub> 4 + 2(1) + 2(7) = 20 ve total



Lewis Dot Structure Flow Chart

Given the following structures to be drawn: N, Be <sup>2+</sup> , F <sup>-</sup> , CaF <sub>2</sub> , CH <sub>3</sub> CH <sub>3</sub> , CH <sub>2</sub> CH <sub>2</sub> , PO <sub>4</sub> <sup>3-</sup> , K <sub>2</sub> SO <sub>4</sub> , H <sub>2</sub> PO <sub>4</sub> .	<ol style="list-style-type: none"> <li>Look for isolated atoms: [N] is an atom in group 5. Place its 5 electrons in the 4 orbitals, maximizing the number of unpaired electrons.</li> <li>Look for simple ions: [Be<sup>2+</sup>], [F<sup>-</sup>]. Since atoms become ions by losing or gaining electrons to achieve full shells, ions have no dots. The questions and answers are the same.</li> <li>Look for substances with no radicals: [CaF<sub>2</sub>], [CH<sub>3</sub>CH<sub>3</sub>], [CH<sub>2</sub>CH<sub>2</sub>]. <ul style="list-style-type: none"> <li>Are any ionic (one atom from groups 1-3, the other from groups 4-7 including H)? Using the periodic table, determine the charges of the ions and write their dot structures as in part 2, above.</li> <li>The others must be covalent, with both atoms in groups 4-7 including H, [CH<sub>3</sub>CH<sub>3</sub>], [CH<sub>2</sub>CH<sub>2</sub>]. Draw the single bond structures making covalent bonds. Are single bonds sufficient, that is, do they conform to the 8 electron rule? If yes, as in CH<sub>3</sub>CH<sub>3</sub>, the structure is finished.</li> <li>If no, as in CH<sub>2</sub>CH<sub>2</sub>, where each "C" has only 7 electrons, make multiple bonds to give each atom (except H) 8 electrons.</li> </ul> </li> <li>We are left with radicals and compounds involving radicals: [PO<sub>4</sub><sup>3-</sup>], [K<sub>2</sub>SO<sub>4</sub>], [H<sub>2</sub>PO<sub>4</sub>]. Always draw the radicals first. Do not make O-O bonds in radicals. <ul style="list-style-type: none"> <li>When drawing PO<sub>4</sub><sup>3-</sup>, we draw the P first, attach the 4 oxygens around it (one bond is a coordinate covalent bond) and then add three additional electrons, one to each of three oxygens to account for the -3 charge.</li> <li>When drawing the SO<sub>4</sub> from K<sub>2</sub>SO<sub>4</sub>, we draw SO<sub>4</sub><sup>2-</sup> either because we know it normally has a -2 charge, or because we know it must bond ionically with K and each S must lose 1 electron to become charged -1. Thus, SO<sub>4</sub> must be charged -2.</li> </ul> </li> <li>The PO<sub>4</sub> in H<sub>2</sub>PO<sub>4</sub> is not charged since it will bond covalently with the 3 H atoms. (See conditions for ionic and covalent bonding in part 3, above.)</li> </ol>
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NOTE: although we might expect  $\text{SiO}_2$  to be similar to  $\text{CO}_2$ , it isn't.  $\text{SiO}_2$  (quartz) is a network solid... like diamond

Problem: draws Lewis structures that correspond to the following molecular graphics. Uracil: e) It is no longer used for this purpose because of the formation of the phosgenium thionium, Cl2CO. Be sure to indicate the presence of lonely pairs and formal charges. If the connectivity of a fan is ambiguous, a atomic framework will be provided for you. Piradivo: D (Diacytyle can be a bit tricky!) Response Click here to see a problem of solution Problem 1 ( \ pagearindex (6) } \ ) Carbon tetrachloride was previously used in fire extinguishers for electrical incursions. If more than one structure of Lewis can be designed for particular connectivity, draw all Lewis structures. Check your answers. Thanks for your participation! Problem 1 ( \ pagearindex (1) \ ) Write Lewis structures for the following: (Note that none of the solutions is using the expanded octet or formal charges) H2 HBR PCL3 SF2 H2CCH2 HNNH H2GNH NO A e " N2 CN CNÀ e à e "4h3o + \ ( \ CE (NH4 +) \ ) \ ( \ CE (BF4 -) \ ) HCCH CLCN \ ( \ CE (C2 ~ 2 +) \ ) Respodition B Response and Answer F Reply G Answer G Reply H Response I Response J Problem 1 ( \ pagearindex (3) } \ ) Write Lewis structures for: (Note that none of the solutions is using the expanded octet rule or formal charges) . Let us know here. Figure%: "HANDY" SOLUTION. If you are seeing this message, it means we are having trouble loading external resources on our website. Write the chemical equations for these combustion reactions using Lewis structures instead of chemical muscles. If you are behind a Web filter, check that the domains " .kastatic.org and " .kasandbox.org are unlocked. Answer Each van includes a sharing of . "odirbÀh" "odirbÀh" 1 amelborP :% arugiF .a .3# oEAtseuq me seic@Àpse sad amu adac ed ralucelom airtemoq ad emon o e ocin Àrtele ovitisopsid od emon o racindri .oEÀÀArepooc assov alep odagirbo otium .c :aieru .somotjÀ siam ranocida ofAN .c \ ) .3^4OP(ec(\ .sodamieug odnauq O2H e 2OC mezudorp lonate o otnauq lonatem o otnaT .Iuqa adad ©À setnatropmi etnemacigoluib saluc©Àlom sairjÀv me somotjÀ sod oEÀÀAisopid A \ ) }7 {xednlegaP(\ AMELBORP atspseR ?setnables oEÀs salpirt e salpud .selpmis sepiÀÀagil sa omoc \ ) }8 {xednlegaP(\ AMELBORP e rednospseR d rednospseR e rednospseR b atspseR amu a rednospseR :ocin Àbrac odicjÀ .aditroc ed sorrac snugla me levÀtsubmoc omoc odasu ©À .HOC3H .lonateM \ ) }4 {xednlegaP(\ MELBORP oEÀÀAutlos ad oedÀv mu rev arap iuqa euqic c atspseR b atspseR a atspseR ONOH .lisarB on levÀtsubmoc omoc etnemavisnetxe odasu ©À .HO5H2C .lonate O \ ) } anires odicjÀonima o .oinÀArgsof e onobracc ed oterolcartet arap siwel .ed sarurtitse sa avercsE .d \ ) } 2^3OS{ec(\ ?adarre jÀtse amica satsopser sad amu euq ahCÀ serodarabolac .ÀÀ .alpirt oEÀÀAgil amu me sodahlitrapmoc oEÀs snort@Àle sies e .alpuo oEÀÀAgil amu me sodahlitrapmoc oEÀs snort@Àle ortauq .oEÀÀAgil acinÀ amu me sodahlitrapmoc oEÀs snort@Àle siod .saluc©Àlom sassed amu adac arap siwel .ed sarurtitse sa avercsE .onamuh res mu omoc edaditnedi aus a emrifnoc euq somidep .etis osson od ratursed a raunitnoc arap .sorrjÀtilos serap e sepiÀÀagil salpit@Am odnanoiida saluc©Àlom sated siwel .ed sarurtitse sa etelpmoc .)HCCCCCH( onelitcaid e )HCCC3H( oniporp .)6H2C( onate .)4H2C( onelite ed soigÀtsev e )4HC( onatem odniliucni .sacin@Agro socimÀuq sotudorp mÀtroc ralos ametstis osson me satenalp sotium \ ) }5 {xednlegaP(\ AMELBORP adnospseR ?merfid sele omoc .somotjÀ rtenne

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