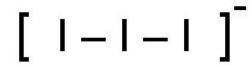
H 2.1	Pauling Electronegativity							
Li	Be	В	С	N	0	F		
1.0	1.5	2.0	2.5	3.0	3.5	4.0		
Na	Mg	Al	Si	Р	S	CI		
0.9	1.2	1.5	1.8	2.1	2.5	3.0		
K	Ca	Ga	Ge	As	Se	Br		
0.8	1.0	1.6	1.8	2.0	2.4	2.8		
Rb	Sr	In	Sn	Sb	Te	ı		
0.8	1.0	1.7	1.8	1.8	2.1	2.5		
Cs	Ва	TI	Pb	Pb	Po	At		
0.7	0.9	1.8	1.9	1.9	2.0	2.2		

Useful units Avogadro number Gas constant (SI) $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$ $R = 8.3145 \text{ J mol}^{-1} \text{ K}^{-1}$ $R = 0.08206 \text{ L atm mol}^{-1} \text{ K}^{-1}$ Gas constant

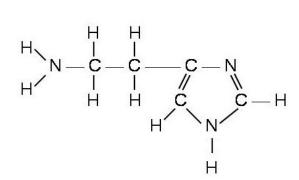
1 atm = 101 325 Pa = 760 mm Hg 1 m³ = 10³ L

- Q1 Consider the Lewis structure and the VSEPR-geometry of these molecules and decide which molecule has a linear structure.
 - **HCN** a)
 - NH_4^+ b)
 - $CO_3^{\frac{7}{2}}$ c)
 - d) SeF₂
 - H_2O e)
- $\mathbf{Q2}$ Complete the Lewis structure of the I₃-ion and identify the appropriate hybridization of the central I-atom
 - a)
 - b)
 - sp^3 c)
 - dsp^3 d)
 - $d^2 \bar{s} p^3$ e)
 - f) none of the above

l₂-ion:



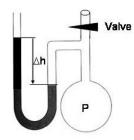
- Q3For which of these molecules do you predict the smallest bond angle?
 - CH_4 a)
 - b) NH_3
 - H_2S c)
 - d) CCl_4
 - e) SiF₄
- **Q4** As a response to allergens the body produces histamine. Complete the Lewis structure. How many sp³ hybridized carbon atoms do you identify in this molecule?
 - 2 a)
 - b) 3
 - 4 c)
 - 5 d)
 - e) none



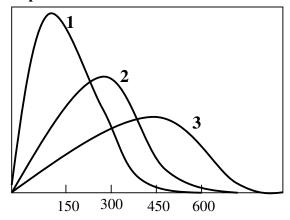
Histamine:

Q5	How	many σ-bonds do you identify in the Histamine molecule?
	o)	2
	a) b)	15
	/	17
	c)	
	d)	19 22
	e)	
Q6		ch of the following gas atoms or molecules has the largest root mean square city \mathbf{u}_{rms} in a sample of our atmosphere at STP?
	a)	Ar
	b)	CO_2
	c)	O_2
	d)	$\mathrm{CH_4}$
	e)	they have all the same u_{rms}
Q7	same	on effuses into a vacuum with a rate of 20mL/min. An unknown gas under the conditions effuses with a rate of 30.7mL /min. Which one of the following gases I it be?
	a)	Ne
	b)	He
	c)	NH_3
	d)	UF_6
	e)	H_2
Q8	Calc	ulate the average kinetic energy of Methane (CH ₄) in J/mol at t =25° C, P=1 atm
	,	717 J/mol
	,	11 J/mol
	,	477 J/mol
	,	2.4 J/mol
	e) 3	6.68 J/mol
Q9		t is the density in g/L of Helium (He) in a stratospheric weather balloon at an ide of ca 15,000 m; $t=$ - 43 $^{\circ}$ C, and $P=$ 66,000 Pa
	a)	0.138 g/L
	b)	14.01 g/L
	c)	138 g/L
	d)	0.000117 g/L
	e)	Additional information is needed

- What is the pressure in the closed container when you read a Δh of 125 mm on the open u-tube manometer filled with mercury at an atmospheric pressure of 101325 Pa?
 - a) 117990 Pa
 - b) 84659 Pa
 - c) 16665 Pa
 - d) 125 torr
 - e) 760 torr



- Q11 The *a* value in the van der Waals equation for Xe is _____ than Ne. The *b* value of Ne is _____ than Ar. Fill in the blanks using the words, respectively:
 - a) larger, larger
 - b) larger, smaller
 - c) smaller, larger
 - d) smaller, smaller
 - e) cannot be answered based on the information given
- Q12 Which one of the following statements can be deduced from the molecular distribution of speed graphs shown below, corresponding to 3 different gases having different molar masses M; the y-axis corresponds to the fraction of molecules with a particular speed:



Molecular Speed u m/s

- a) The average kinetic energy per mole of gas must be different for the three gases.
- b) $M_1 < M_2 < M_3$ (M is the molar mass).
- c) The temperature of Gas 3 must be higher than the temperature of Gas 1, otherwise its distribution function cannot be broader as shown.
- d) The molecules of Gas 2 move at a speed of 300 m/s and collide with each other, as a result the molecules undergo only a change in direction. The pressure exerted on the wall is a function of the frequency of collisions and the speed at which the particles are moving.
- e) All are false

Q13 Consider CO₂ and Ne under the following conditions:

Flask A, CO_2 (g)	Flask B, Ne (g)
2 moles	3 moles
740 K	370 K
0.50 atm	0.80 atm

Which of the following statements is *true*?

- a) The volume CO₂ occupies is twice the volume occupied by Ne.
- b) The force exerted when a CO₂ molecule collides with the walls is smaller than the force exerted when a Ne molecule collides with the walls.
- c) The average kinetic of a Ne molecule is twice the average kinetic energy of CO₂ molecule.
- d) The u_{rms} for the CO_2 molecules is smaller than the u_{rms} for the Ne molecules.
- e) All are false
- Q14 The valve between a 10-L tank containing a gas at 1 atm and a 3-L tank containing a gas at 0.5 atm is opened. Nothing else is changed in the environment. The two gases do not react. Calculate the final pressure in the tank:
 - a) 0.88 atm
 - b) 1.5 atm
 - c) 2.45 atm
 - d) 0.75 atm
 - e) Not enough information is given to solve for the final pressure.
- Q15 The hybridization of I in ICl₄ is:
 - a) sp
 - b) sp²
 c) sp³

 - d) \hat{dsp}^2
 - e) d^2sp^3
- Q16 Which of the following molecules (C: central atom) contains the shortest C-O bond:
 - a) CH₃OH
 - b) CH₂O
 - c) CO
 - d) CO_2
 - e) CH₃CH₂OH
- Q 17 Which of the following molecules has a resultant dipole moment $\mu \neq 0$?
 - a) CHCl₃
 - b) BF₃
 - c) TeF₄
 - d) a and c
 - e) all of the above

Q18 Which of the following is expected to be the best resonance structure of SCN

a)

b)

c)

d)

e)

$$s = c = N$$

19 Which of the following electron arrangement and molecular geometries around the central atom (1^{st} atom is the central atom) correctly correspond to the molecule in question:

- a) CO₂, electron arrangement: trigonal planar; geometry: bent
- b) ClF₃, electron arrangement: octahedral; geometry: T-shaped
- c) XeCl₄, electron arrangement: trigonal bipyramid; geometry: see-saw
- d) XeF₂, electron arrangement: trigonal bipyramid; geometry: linear
- e) b and c are correct

Q20 How many atoms are in the same plane for the following molecule?

$$\begin{array}{c|c} \bullet & \bullet & \bullet \\ \hline & & \downarrow \\ CH_3 - C - C \underline{\hspace{0.5cm}} C - C \underline{\hspace{0.5cm}} C - C \underline{\hspace{0.5cm}} N - C - CH_3 \end{array}$$

- a) 4
- b) 5
- c) 8
- d) 9
- e) 10

<u>∞</u>	1.215 0.95 1.179# Helium 4.002 602 ±2	10 24.55 Neon 0.90179.7+6	Δr	1.784# Argon		Ż	Krypton	800	165 161 X	Xenon 131 29 +2		R	Radon	(77)		
	4.215 0.95 0.179 ^H Heil	84.95 F 27.10 N 6.00 N	,3,5,7	29	3	X 115.78 X	-	5,7	165 161	4 × × × × × × × × × × × × × × × × × × ×		At Zin Br	9.914 FR	+		
(C)	7		17 ±1 239.1 172.2	3.17 H Chlorine		332.25	Bromine 70 904	5		lodine 126 904 47 +3	85 ±1,3,5,7	575	Astatine	017~)		
nt	16	8 -2 90.18 50.35 1.429 a Oxygen 15,999 4 ±3	16 ±2,4,6 377.8 388.4	Sulfur	34 -2,4,6	Se	Selenium 78 95 +3	52 -2,4,6	1261 723 T 861 T 861	Tellurium	44.2	Szz Po	Polonium	(~770)		
6	15	±3,5,4,2 N Sgen 74 ±7	±3,5,4	1.82 2. Phosphorus	±3,5	As Se	Arsenic 74.921 60 +2		$\overline{}$		+3,5		Bismuth 1	27 96 06		
E	. +		15 317.3		33	876	A 24	Ĩ.,	1 See Of 1		188	_		1		
<u>•</u>	14	H3 6 ±4,2 H3 4470 100 Carbon H27 12.010 7 ±8	14 ·	2.33 Silicon 2.28.085.5.+3	32	(1) (1) (1) (2) (2) (2) (3) (4) (4) (4) (4) (4) (4) (4) (4) (4) (4	Germanium	20	S356 505 730 730 730 730 730 730 730 730 730 730		۳	= 2023 601	Lead			
Ш	13	5 +3 4275 2300 2.34 Boron 10.811±7	13 +3 2793 A 43	2.7 Aluminum Aluminum 26.981 538 +2	31 +3	1 303 Ga 3107 Ge	Gallium 69.723	49 ₺	2346 430	Indium 114.818 +3	81 +3.1	—	allium			
Of The Elements)	444	1 140	2	+5	Z	٠÷	+2	C		+2,1			1		
5				<u> </u>	+2,1 30	Z 1180 693 7.14		1 48	19 594 Cd	2 t2 Ca	<u> </u>		1 Me	1		
<u> </u>				,	53	2836 1358 8.96	Copper 63.546 ±3	47	1234 AC		62	1338 AL	Gold 196.966 55 +2			
Ö				10	28 +2.3	3187 1726 8.90	Nickel 58.693 4 ±2	46 +2,4	3237 1825 12.0	Palladium 106.42	78 +2,4	2045	Platinum 195.078 ±2			
(1)					+2,3	0	It 10 ±9	+2,3,4	_	# 27 120 130 141	9,4,6	<u>_</u>	F.3	,		<u> </u>
$\frac{8}{5}$		e ge		6		76 1788 C	Cobalt 58.933 200 ±9		- 12	Rhodium 102.905 50 ±2	8 77 +2,3,4,6	4701 2716 22.5	Iridium 192.217±3	109	111	Meitnerium (266)
at	n states most state)	Atomic mass is accurate to ±1 in last decimal place unless otherwise indicated Examples: TI = 47.867 ± 0.001	± 0.002	œ		1809 7.86 TE	Iron 55.845 ±2	44 +2,3,4,6,8 45	2523 RU	Ruthenium 101.07 ±2	76 +2,3,4,6,8	SO	Osmium 190.23 ±3	108		Hassium (265)
dic Table	Oxidation states (Bold is most stable state)	Atomic mass is acc to ±1 in last decims unless otherwise in Examples: TI = 47.867 ± 0.001	Fe = 55.845 68, 2339]	7	6.5	_	Manganese 54.938 049 ±9	<u> </u>	18 E		75+7,6,4,2,-1 7	3453 Re 3300 C 31.0	Rhenium 186.207			Bohrium (262)
O	+4,3	- [Chem. 1996,	•	+6,3,2 25 +			42 +6,5,4,3,2 43	4912 MO 4538 1 G	mn	4,3,2 75+	3453		107	11.1	
5	22 3562	Titanium 47.867	Pure Appl.	9	24	2130	Chromium 51.996 1 ±6		2890 10.2	Molybder 95.94	74 +6,5,4,3,2	5828 3680 19.3	Tungsten 183.84	106		Seaborgium (266)
0	\overline{II}	4.5	g/L) Fe = 55.k [Atomic masses from <i>Pure Appl. Chem.</i> 1996, <i>68</i> , 2339]	2	3 +5,4,3,2	2175	Vanadium 50.941 5	.1 +5,3	5017 2740 8.55	Niobium 92.906 38 ±2	73 +5	2531 3287 166	Tantalum 180.947 9	105		Dubnium (262)
eri	Atomic Number - Boiling point (K) -	menting point (k) — Density at 300 K — (g (cm ³) (Densities marked with a are at 273 K and 1 afm and the	units are g/L) [Atomic r	4	+4,3	2087 2175 5.8	Titanium 47.867	4+	12 KJ 80	Zirconium 91.224 ±2 9	++ 7	H 32	Hafnium 178.49 ±2			Rutherfordium (261)
4	Atom	Densition (9 (Densitive with a and 1 at a an	units	•	±3 22	C 1943 45		+₃ 40	4682 2125 6.49		+₃ 72	2500 13.1		± 104	S	
	r			က	21		Scandium 44.955 910 ±8		3611 1799 4.5	Yttrium 88.905 85 ±2	22	730	Lanthanum 138.905 5 ±2		1323 1323 10.07	Actinium (227)
	8	4 +2 2745 Be 1560 Be 1.85 Beryllium 9.012 182 ±3	12 1363 922 922 922 922 922 922 922 922 922 92	Magnesium 24.305 0 ±6	+5	1125 Ca 1155 Ca	Calcium 40.078 ±4	38 +2	1050 1041 2.6	Strontium 87.62	2e +2	1 1002 Ba	Barium 137.327 ±7	88 +2	Ba Regional	Radium (226)
-	1.025 0899# Hydrogen 1.007 94 ±7	15 27 44 115 53 1141 Lithium 6.941±2† 9	² E		+1	Y	Potassium 39.098 3	+1	2 2 3 3 3 3 3 3 3 3 3 3	Rubidium 85.467 8 ±3	+1	ပ္ပ	sium 05 45 ±2	÷	973	Francium (223)
-	20.268 14.025 0.0899# Hydro 1.007	6.9	1156	86.22	19	336	Pot.	37	961 313 1.53	Rul 85.4	22	302	, C. 132.9	87	96 ₁	Fra

29	2968	8.80 Holmiu	30		Einsteini
) _₹ 99	2835 DV 1743 F	Gadolinium Terbium Dysprosium Holmiu 157 25 +3 158 925 34 +2 162 50 +3 164 020 22	6 +3 97 +43 98 +3 99	- C) <u>F</u> :
+3	٩	8.27 Terbium 158 925 34 +2	97 43 98		Berkelium Californium
64 +3 65	3539 1585 G d	Gadolinium	96	1340 CHI	Curium (247)
63 +32	1870 1090 5.26	Europium 151.964	+5,4 92 +6,5,4,3 93 +6,5,4,3 94 +6,5,4,3 95 +6,5,4,3	2880 1266 13.6	Plutonium Americium (243)
+3,4 60 +3 61 +3 62 +3,2 63	1345 ST 1090 F	Samarium 150.36 ±3	94 +6,5,4,3	3503 913 19.8	Plutonium (244)
_€ +	Jr 1289 Nd 1204 Dm 1345 C 1289 Md 1204 Dm 1345 C	Promethium (145)	93 +6,5,4,3	3503 20.4 S	Neptunium 237.048 2
_₹	3341 1289 7.00	Neodymium 144.24 ±3	92 +6,5,4,3	_	Uranium 238.028 9
59 +3,4		raseod) 40.907	91 +5,4	- Da 4407	Thorium Protactinium Uranium 232.038 1 231.035 88 ±2 238.028 9
58 +3.4 59	3699 Ce 1204	erium 10.116	51 06	5061 2028 11.7	Thorium 232.038 1