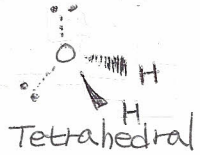
MC_Chem1A_Sp12_LecExam3 Name KEY

Please read the questions very carefully to understand what is being asked. If you do not understand anything, please ask your instructor. Use the reverse side of your question paper as scratch. No outside paper is allowed. You can use the periodic table and constant data provided. Total points = 39 + (16*3=)48 = 87

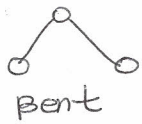
SHORT ANSWER. Please write the set-up equation and insert the raw data with units in the equation before doing your calculations. Write the word or phrase that best completes each statement or answers the question.

1) Draw (a) the electron pair geometry (2 pts. each) and (b) the molecular geometry (2 pts. each) next to each of the molecules below: 1) _____

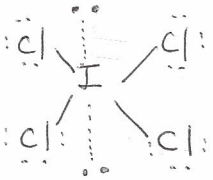
i) H_2O
2+6=8



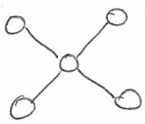
Tetrahedral


Bent

ii) $(ICl_4)^-$
7+28+1=36

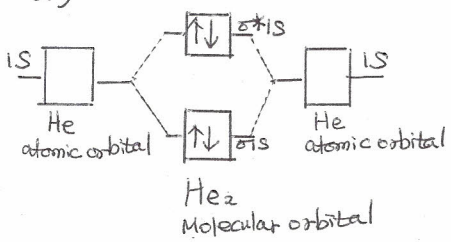


octahedral


square planar

2) (a) Draw the molecular orbital diagram (MO) of He_2 molecule (2 pts.) and (b) calculate its bond order (2 pts.) (c) Predict if the molecule is stable or not (1 pts.)? 2) _____

a)



He_2
Molecular orbital

b) bond order = $\frac{1}{2}$ (# of bonding − # of antibonding)

$\frac{1}{2}(2-2) = 0$

c) not stable.

3) A ball has a volume of 120.3 cm^3 and it contains 0.25 g of N_2 gas. Calculate the pressure inside the ball at 31°C (6 pts.) 3) 1.9 atm.

$pV = nRT$

$p = \frac{nRT}{V}$

$n: 0.25\,g\ N_2 \times \frac{1\,mole}{28\,g\ N_2} = 0.0089\,mole$

$R: 0.0821\ \frac{atm \cdot L}{mol \cdot K}$

$T: 31 + 273.15 = 304.15\,K$

$V: 120.3\,mL \times \frac{L}{1000\,mL} = 0.1203\,L$

$p = \frac{0.0089\,mole \cdot 0.0821\ \frac{atm\,L}{mol\,K} \cdot 304.15\,K}{0.1203\,L} = 1.847\,atm$

$= 1.9\,atm.$

V_1 P_1 1.0 atm T_1: 295.15

4) An inflated baloon has a volume of 6.0 L at ~~1 atm~~ pressure and at 22°C. Calculate its volume when it ascends to an altitude where the pressure is 0.45 atm and the temperature is -21°C. (6 pts.) V_2 P_2

4) 11 L

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

P_1 : 1.0 atm $\quad P_2$: 0.45 atm

V_1 : 6.0 L $\quad V_2$: ?

T_1 : 295.15 K $\quad T_2$: 252.15 K

$$\frac{1.0 \times 6.0}{295.15} = \frac{0.45\,V_2}{252.15} = 132.82\,V_2 = 1,512.9$$

$$V_2 = 11.39\ L$$

$$= 11\ L$$

$14 + 32 = 46\ g\ NO_2$

5) Calculate the density (in g/L) of NO_2 at 0.970 atm and 35°C. (6 pts.) 308.15K

5) 1.8 g/L

$$d = \frac{M \cdot P}{R \cdot T} = \frac{46\ g \cdot 0.970\ atm}{0.0821 \frac{atm\ L}{mol\ K} \cdot 308.15\ K}$$

$$= 1.764\ g/L$$

$$= 1.8\ g/L$$

6) Magnesium reacts with oxygen: $2Mg + O_2(g) \rightarrow 2MgO(s)$. How many grams of Magneium would react with all the oxygen in a 87.4 L container at 27°C and 3.5×10^{-7} torr pressure? (8 pts.) g of Mg? V 300.15K

6) ~~49×10^{-9}~~ 7.9×10^{-8} g Mg.

$$P: 3.5 \times 10^{-7}\ torr \times \frac{1\ atm}{760\ torr} = 4.6 \times 10^{-10}\ atm$$

V : 87.4 L

T : 300.15 K

$$PV = nRT \qquad n = \frac{PV}{RT} = \frac{4.6 \times 10^{-10}\ atm \cdot 87.4\ L}{0.0821 \frac{atm \cdot L}{mol\ K} \cdot 300.15\ K} = 1.63 \times 10^{-9}\ mole\ O_2$$

$$1.63 \times 10^{-9}\ mol\ O_2 \times \frac{2\ mol\ Mg}{1\ mol\ O_2} \times \frac{24.3\ g}{1\ mol\ Mg} = 7.9 \times 10^{-8}\ g\ Mg.$$

MULTIPLE CHOICE. On scantron, answer by filling the bubbles of the same number as the question number. Choose the one alternative that best completes the statement or answers the question. (3 poins each)

7) The atomic radius of main-group elements generally increases down a group because _____. 7) _____

A) the principal quantum number of the valence orbitals increases
B) effective nuclear charge decreases down a group
C) effective nuclear charge increases down a group
D) effective nuclear charge zigzags down a group
E) both effective nuclear charge increases down a group and the principal quantum number of the valence orbitals increases

8) The effective nuclear charge of an atom is primarily affected by _____. 8) _____

A) nuclear charge
B) orbital radial probability
C) outer electrons
D) inner electrons
E) electrondistribution

9) Which of the following has the largest second ionization energy? 9) _____

A) Si B) Mg C) Na D) P E) Al

10) The ion with the smallest diameter is _____. 10) _____

A) I^- B) O^{2-} C) Cl^- D) F^- E) Br^-

11) Which equation correctly represents the electron affinity of calcium? 11) _____

A) $Ca\,(g) \rightarrow Ca^+\,(g) + e^-$
B) $Ca\,(g) + e^- \rightarrow Ca^-\,(g)$
C) $Ca\,(g) \rightarrow Ca^-\,(g) + e^-$
D) $Ca^-\,(g) \rightarrow Ca\,(g) + e^-$
E) $Ca^+\,(g) + e^- \rightarrow Ca\,(g)$

12) Transition metals within a period differ mainly in the number of _____ electrons. 12) D

A) p
B) s
C) f
D) d
E) all of the above

13) Which of the following does not have eight valence electrons? 13) A

A) Ca^+
B) Br^-
C) Rb^+
D) Xe
E) All of the above have eight valence electrons.

14) In which of the molecules below is the carbon-carbon distance the shortest? 14) E

A) H_3C-CH_3
B) $H_2C=C=CH_2$
C) $H_3C-CH_2-CH_3$
D) $H_2C=CH_2$
E) $H-C\equiv C-H$

15) There are _____ valence electrons in the Lewis structure of CH_3CH_2Cl. 15) D

A) 10 B) 14 C) 18 D) 20 E) 12

16) To convert from one resonance structure to another, _____. 16) C

A) electrons and atoms can both be moved
B) only atoms can be moved
C) only electrons can be moved
D) neither electrons nor atoms can be moved
E) electrons must be added

17) Of the bonds C-N, C=N, and C≡N, the C-N bond is _____. 17) D

A) intermediate in both strength and length
B) strongest/longest
C) weakest/shortest
D) weakest/longest
E) strongest/shortest

18) Of the possible bonds between carbon atoms (single, double, and triple), _____. 18) C

A) a single bond is stronger than a double bond
B) a triple bond is longer than a single bond
C) a double bond is longer than a triple bond
D) a single bond is stronger than a triple bond
E) a double bond is stronger than a triple bond

19) Gaseous mixtures _____. 19) D

A) can only contain isolated atoms
B) are all heterogeneous
C) can only contain molecules
D) are all homogeneous
E) must contain both isolated atoms and molecules

20) The molar volume of a gas at STP is _____ L. 20) A

A) 22.4 B) 0.08206 C) 62.36 D) 1.00 E) 14.7

TRUE/FALSE. On scantron, choose "A" for a true answer and "B" for wrong answer. (3 pts each)

21) Possible shapes of AB_3 molecules are linear, trigonal planar, and T-shaped. 21) F F

22) If the temperature is lowered from 60°C to 30°C, the volume of a fixed amount of gas will be one half the original volume. 22) F F