第一大題：選擇(選出最適當的一個選項，每題 2 分)

1. What answer should be reported, with the correct number of significant figures, for the following calculation? $(433.621 - 333.9) \times 11.900$

A) 1.19×10^3　　B) 1.187×10^3　　C) 1.1868×10^3　　D) 1.18680×10^3　　E) 1.186799×10^3

2. Which of the following statements is **false** according to Dalton's Atomic Theory?

A) Atoms combine in simple whole number ratios to form compounds.

B) All atoms of chlorine have identical properties that distinguish them from other elements.

C) One carbon atom will combine with one oxygen atom to form a molecule of carbon monoxide.

D) Atoms of sodium do not change into another element during chemical reaction with chlorine.

E) An atom of nitrogen can be broken down into smaller particles that will still have the unique properties of nitrogen

3. What does "X" represent in the following symbol?
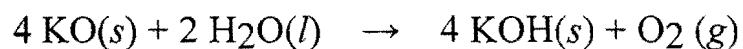
$$^{28}_{14}X$$

A) silicon　　B) sulfur　　C) zinc　　D) ruthenium　　E) nickel

4. Give the name for SnO.

A) tin oxide　　B) tin (I) oxide　　C) tin (II) oxide　　D) tin (III) oxide　　E) tin (IV) oxide

5. How many grams of oxygen are formed when 6.21 moles of KOH are formed?

$$4\,KO(s) + 2\,H_2O(l) \;\rightarrow\; 4\,KOH(s) + O_2\,(g)$$

A) $19.9\ g\ O_2$　　B) $27.9\ g\ O_2$　　C) $49.7\ g\ O_2$　　D) $3.59\ g\ O_2$　　E) $11.7\ g\ O_2$

6. What volume (in mL) will a sample of F_2 gas occupy in a syringe at 5.5 atm, if the F_2 has a volume of 25.0 mL at 1.2 atm?

A) 11 mL　　B) 17 mL　　C) 3.8 mL　　D) 5.5 mL　　E) 7.6 mL

7. For ΔE_{sys} to always be -, what must be true?
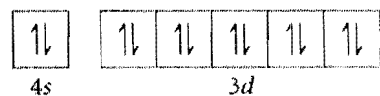
A) $q = w$　　B) $+q > -w$　　C) $+w > -q$　　D) $-w > +q$　　(E) $+q > +w$
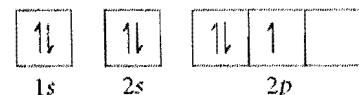
8. What are the possible orbitals for $n = 3$?

A) s, p, d　　B) s, p, d, f　　C) s　　D) s, p　　E) p, d, f

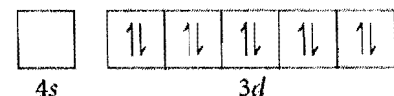9. Choose the valence orbital diagram that represents the ground state of Zn.

A)

B)

C)

D)

$1\downarrow$

4s

E)

$1\downarrow$	$1\downarrow$	$1\downarrow$	$1\downarrow$	1	1
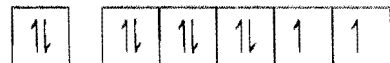
4s　　　　　3d

10. Which of the following represent the Lewis structure for Ca^{2+}?

A) $Ca^{:2+}$　　B) $Ca:$　　C) $\overset{..}{Ca:}^{2+}$　　D) $:\overset{..}{Ca}:^{2+}$　　E) Ca^{2+}

11. Determine the electron geometry (eg) and molecular geometry (mg) of CO_3^{2-}.

A) eg = tetrahedral, mg = tetrahedral　　B) eg = tetrahedral, mg = trigonal pyramidal

C) eg = trigonal planar, mg = bent　　D) eg = trigonal planar, mg = trigonal planar

E) eg = tetrahedral, mg = trigonal planar

12. According to the MO theory, which of the following molecules should **NOT** exist?

A) He_2^+　　B) He_2　　C) H_2^+　　D) H_2　　E) All of the above

13. What is the strongest type of intermolecular force present in CHF_3?

A) ion-dipole　　B) dispersion　　C) hydrogen bonding　　D) dipole-dipole　　E) None of the above

14. Which of the following compounds will be most soluble in ethanol (CH_3CH_2OH)?

A) trimethylamine ($N(CH_3)_3$)　　　　B) acetone (CH_3COCH_3)

C) ethylene glycol ($HOCH_2CH_2OH$)　　D) hexane ($CH_3CH_2CH_2CH_2CH_2CH_3$)

E) None of these compounds should be soluble in methanol.

15. Given the following balanced equation, determine the rate of reaction with respect to $[H_2]$.

$N_2(g) + 3 H_2 (g) \rightarrow 2 NH_3(g)$
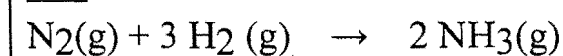
A) Rate = $+ \dfrac{3 \Delta[H_2]}{\Delta t}$

B) Rate = $- \dfrac{2}{3} \dfrac{\Delta[H_2]}{\Delta t}$

C) Rate = $+ \dfrac{3}{2} \dfrac{\Delta[H_2]}{\Delta t}$

D) Rate = $- \dfrac{1}{3} \dfrac{\Delta[H_2]}{\Delta t}$

E) It is not possible to determine without more information.

16. Which statement is true for the following reaction at equilibrium at $25^{O}C$?

$N_2(g) + O_2 (g) \rightleftharpoons 2NO(g);$　　$K = 4.1 \times 10^{-31}$

A) Concentration of NO is high　　　　B) Concentration of N_2 and O_2 are high

C) The rate of the reaction is very slow　　D) The rate of the reaction is high

E) The reaction does not go in the forward direction

17. Which of the following is a BrØnsted-Lowry acid?

A) NH_4^+　　B) CH_4　　C) NH_2^-　　D) NH_3　　E) Br_2

18. A 1.0 L buffer solution is 0.050 M $HC_2H_3O_2$ and 0.250 M $LiC_2H_3O_2$. Which of the following actions will destroy the buffer?

A) adding 0.050 moles of NaOH　　　　B) adding 0.050 moles of HCl

C) adding 0.050 moles of $HC_2H_3O_2$　　　D) adding 0.050 moles of $LiC_2H_3O_2$

E) None of the above will destroy the buffer.

19. Which of the following processes has a $\Delta S > 0$?

A) $2\ NH_3(g) + CO_2(g) \rightarrow NH_2CONH_2\ (aq) + H_2O(l)$

B) Lithium fluoride forms from its elements.

C) $2\ HBr(g) \rightarrow H_2\ (g) + Br_2\ (l)$

D) Sodium chloride dissolves in pure water.

E) All of the above processes have a $\Delta S > 0$.

20. What element is being reduced in the following redox reaction?

$\qquad H_2O_2\ (l) + ClO_2\ (aq) \rightarrow ClO_2^-(aq) + O_2(g)$

A) H　　B) O　　C) Cl　　D) N　　E) C

第二大題：問答(每題 10 分)

1. Explain what the term "mean free path" describes. How does it change with decreasing pressure?

2. Explain the difference between ΔH and ΔE.

3. How many orbitals are contained in the n = 2 level? Give the l and ml values of each of them.

4. Below is a list of successive ionization energies (in kJ/mol) for a period 3 element. Identify the element and explain how you came to that conclusion.

IE2 = 2250　　IE3 = 3360　　IE4 = 4560　　IE5= 7010　　IE6= 8500　　IE7 = 27,100

5. Explain why the lattice energy of MgS is approximately 4 times as large as that of NaCl.

6. Give the electron geometry, molecular geometry, and hybridization for both carbons in CH_3COOH.

附件：

Group →	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Period ↓																		
1	1 H																	2 He
2		4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
3		12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4		20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
5		38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6		56 Ba	57 La *	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
7		88 Ra	89 Ac *	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Nh	114 Fl	115 Mc	116 Lv	117 Ts	118 Og

*	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
**	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr