

Group Number :	Surname :	Signature
List Number :	Name :	
Student Number :	e-mail :	

1	1 H 1,008	2																18 He 4,003
2	3 Li 6,94	4 Be 9,012										5 B 10,81	6 C 12,01	7 N 14,01	8 O 16,00	9 F 19,00	10 Ne 20,18	
3	11 Na 22,99	12 Mg 24,31	3	4	5	6	7	8	9	10	11	12	13 Al 26,98	14 Si 28,09	15 P 30,97	16 S 32,06	17 Cl 35,45	18 Ar 39,95
4	19 K 39,10	20 Ca 40,08	21 Sc 44,96	22 Ti 47,87	23 V 50,94	24 Cr 52,00	25 Mn 54,94	26 Fe 55,85	27 Co 58,93	28 Ni 58,69	29 Cu 63,55	30 Zn 65,38	31 Ga 69,72	32 Ge 72,63	33 As 74,92	34 Se 78,97	35 Br 79,90	36 Kr 83,80
5	37 Rb 85,47	38 Sr 87,62	39 Y 88,91	40 Zr 91,22	41 Nb 92,91	42 Mo 95,95	43 Tc	44 Ru 101,1	45 Rh 102,9	46 Pd 106,4	47 Ag 107,9	48 Cd 112,4	49 In 114,8	50 Sn 118,7	51 Sb 121,8	52 Te 127,6	53 I 126,9	54 Xe 131,3
6	55 Cs 132,9	56 Ba 137,3	57-71	72 Hf 178,5	73 Ta 180,9	74 W 183,8	75 Re 186,2	76 Os 190,2	77 Ir 192,2	78 Pt 195,1	79 Au 197,0	80 Hg 200,6	81 Tl 204,4	82 Pb 207,2	83 Bi 209,0	84 Po	85 At	86 Rn
7	87 Fr	88 Ra	89-103	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
				57 La 138,9	58 Ce 140,1	59 Pr 140,9	60 Nd 144,2	61 Pm	62 Sm 150,4	63 Eu 152,0	64 Gd 157,3	65 Tb 158,9	66 Dy 162,5	67 Ho 164,9	68 Er 167,3	69 Tm 168,9	70 Yb 173,0	71 Lu 175,0
				89 Ac	90 Th 232,0	91 Pa 231,0	92 U 238,0	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

$$c = 2.998 \times 10^8 \text{ m s}^{-1} \quad g = 9.8 \text{ m s}^{-2} \quad h = 6.626 \times 10^{-34} \text{ J s} \quad R_H = 2.179 \times 10^{-18} \text{ J} \quad 0^\circ\text{C} = 273 \text{ K}$$

$$N_A = 6.02 \times 10^{23} \quad 1 \text{ cal} = 4.184 \text{ J} \quad 1 \text{ m} = 10^9 \text{ nm} = 10^{10} \text{ \AA} = 10^{12} \text{ pm} \quad 1 \text{ g} = 10^3 \text{ mg} = 10^6 \text{ \mu g}$$

$$1 \text{ atm} = 760 \text{ mmHg} = 760 \text{ torr} = 101325 \text{ Pa} = 101.325 \text{ kPa} = 1.01325 \text{ bar}$$

$$R = 0.08206 \text{ L atm mol}^{-1} \text{ K}^{-1} = 0.08314 \text{ L bar mol}^{-1} \text{ K}^{-1} = 8.314 \text{ J mol}^{-1} \text{ K}^{-1} = 8.314 \text{ L kPa mol}^{-1} \text{ K}^{-1}$$

$$\text{For water: } c = 4.184 \text{ J g}^{-1} \text{ K}^{-1} \quad K_f = 1.86 \text{ K kg mol}^{-1} \quad K_b = 0.512 \text{ K kg mol}^{-1}$$

$$1 \text{ Newton (N)} = 1 \text{ kg m s}^{-2} \quad 1 \text{ Joule (J)} = 1 \text{ N m} = 1 \text{ kg m}^2 \text{ s}^{-2} \quad 1 \text{ Watt (W)} = 1 \text{ J s}^{-1}$$

1) Silver has two naturally occurring isotopes: The  $^{107}\text{Ag}$  isotope has a mass of 106.91 amu, while the  $^{109}\text{Ag}$  isotope has a mass of 108.90 amu. What are the percent relative abundances of  $^{107}\text{Ag}$  and  $^{109}\text{Ag}$  isotopes, respectively? The atomic mass of silver is 107.87 amu.

- A) 34.4% - 65.6%
- B) 64.7% - 35.2%
- C) 51.8% - 48.2%
- D) 65.6% - 34.4%
- E) 48.2% - 51.8%

2) What is the energy (in Joules) of one mole of photons with a wavelength of 474 nm?

- A)  $4.00 \times 10^{-19} \text{ J}$
- B)  $4.19 \times 10^{-19} \text{ J}$
- C)  $2.09 \times 10^{-19} \text{ J}$
- D)  $2.53 \times 10^5 \text{ J}$
- E)  $4.19 \times 10^5 \text{ J}$

3) Calculate the pH of a 0.800 M aqueous solution of  $\text{CH}_3\text{CO}_2\text{Na}$ .  $K_a = 1.8 \times 10^{-5}$  for acetic acid ( $\text{CH}_3\text{CO}_2\text{H}$ )

- A) 2.42
- B) 4.68
- C) 9.32
- D) 11.38
- E) 13.64

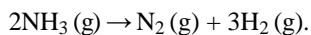
**Booklet A**

4) Given the tabulated data for potassium fluoride (KF) ionic salt, what is the electron affinity for fluorine atom?

the enthalpy of sublimation for potassium	+89.24 kJ/mol
first ionization energy for potassium	+418.90 kJ/mol
dissociation energy of F-F bond	+159.00 kJ/mol
enthalpy of formation for potassium fluoride	-567.30 kJ/mol
lattice enthalpy of crystalline potassium fluoride	-826.94 kJ/mol

- A) -847 kJ/mol      B) -288 kJ/mol      C) -408 kJ/mol      D) -328 kJ/mol      E) -926 kJ/mol

5) The decomposition of ammonia is



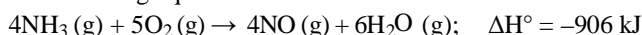
If  $K_p$  is  $1.5 \times 10^3$  at  $400^\circ\text{C}$ , what is the partial pressure of ammonia at equilibrium when the equilibrium partial pressure of  $\text{N}_2(\text{g})$  is 0.10 bar and that of  $\text{H}_2(\text{g})$  is 0.15 bar?

- A)  $2.2 \times 10^{-7}$  bar      B)  $4.7 \times 10^{-4}$  bar      C)  $1.0 \times 10^{-5}$  bar      D)  $4.4 \times 10^6$  bar      E)  $3.1 \times 10^{-3}$  bar

6) Which atom in each group (I) and (II) has the smallest atomic radius?

- (I) Ba, Hf, At      (II) As, Sb, Bi  
A) Ba, As      B) Ba, Bi      C) At, As      D) At, Bi      E) Hf, As

7) How much heat is released when a mixture of gases containing 10.0 g of  $\text{NH}_3(\text{g})$  and 20.0 g of  $\text{O}_2(\text{g})$  react according to the following equation?



- A) 96.5 kJ      B) 169.5 kJ      C) 56.5 kJ      D) 84.7 kJ      E) 113.3 kJ

8) Arrange the following compounds in order of increasing boiling point:

pentane ( $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$ ), methyl butane ( $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_3$ ), neopentane ( $\text{CH}_3\text{C}(\text{CH}_3)_3$ ).

- A) pentane < methyl butane < neopentane  
B) neopentane < methyl butane < pentane  
C) neopentane < pentane < methyl butane  
D) pentane < neopentane < methyl butane  
E) methyl butane < pentane < neopentane

9) An unknown nonvolatile compound is composed of 65.44% C, 29.07% O, and 5.49% H. When 5.34 g of this compound is dissolved in 60.00 g  $\text{H}_2\text{O}$ , the solution's freezing point was measured as  $-0.600^\circ\text{C}$ . What is the molecular formula of the compound?

- A)  $\text{C}_3\text{H}_3\text{O}$       B)  $\text{C}_9\text{H}_9\text{O}_3$       C)  $\text{C}_{15}\text{H}_{15}\text{O}_5$       D)  $\text{C}_{14}\text{H}_{10}\text{O}_5$       E)  $\text{C}_7\text{H}_5\text{O}_3$

10) According to the VSEPR theory, which of the following is the electron group geometry of  $\text{AsCl}_4^-$ ?

- A) square planar  
B) seesaw  
C) square pyramidal  
D) trigonal bipyramidal  
E) tetrahedral

11) Barium element has a density of  $3.59 \text{ g/cm}^3$  and crystallizes in the body-centered cubic unit cell. Calculate the radius of a barium atom in pm.

- A) 503 pm      B) 251 pm      C) 136 pm      D) 399 pm      E) 633 pm

12) Two solutions contain the same amount of water as a solvent. One of the solution includes 0.5 mol glucose ( $\text{C}_6\text{H}_{12}\text{O}_6$ ) while the other contains 0.2 mol of  $\text{CaCl}_2$ . If the freezing points of both solutions are the same, determine the van't Hoff (i) factor for the  $\text{CaCl}_2$  solution

- A) 2.50      B) 3.00      C) 1.50      D) 2.75      E) 0.40

**Booklet A**

- 13) Nitrogen,  $N_2$ , is soluble in blood and can cause intoxication at sufficient concentration. For this reason, the U.S. Navy advises divers using compressed air not to go below 38.1 m. The total pressure at this depth is 4.79 atm. If the solubility of nitrogen at 1.00 atm is  $1.75 \times 10^{-3}$  g/100 mL of water, and the mole percent of nitrogen in air is 78.1, what is the solubility of nitrogen in 100 mL water from air at 4.79 atm?  
A) 0.00884 g      B) 0.00982 g      C) 0.04910 g      D) 0.00655 g      E) 0.00491 g
- 14) A 125 g stainless steel ball bearing ( $c = 0.50 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$ ) at  $525^\circ\text{C}$  is dropped into 75.0 mL of water at  $28.5^\circ\text{C}$  in an open styrofoam cup. As a result, the water is brought to a boil when the temperature reaches  $100.0^\circ\text{C}$ . What mass of water vaporizes while the boiling is continuous?  
( $\Delta H_{\text{vap}} = 40.6 \text{ kJ mol}^{-1}$  for water, assume that the density of water is  $1.00 \text{ g mL}^{-1}$  at  $28.5^\circ\text{C}$ )  
A) 1.78 g      B) 1.83 g      C) 2.05 g      D) 2.83 g      E) 4.13 g
- 15) Find the enthalpy of vaporization (in kJ/mol) of methylamine, if the vapor pressure is 344 Torr at  $-25^\circ\text{C}$  and a normal boiling point is  $-6.4^\circ\text{C}$ .  
A) 245.5 kJ/mol  
B) 23453.0 kJ/mol  
C) 25.4 kJ/mol  
D) 34.6 kJ/mol  
E) 23.5 kJ/mol
- 16) Which of the following statements about viscosity are true?  
I) Viscosity is the liquid's resistance to flow.  
II) Viscosity decreases with a decrease in temperature.  
III) Viscosity is not related to the forces between molecules in a liquid.  
IV) Viscous liquids have low-rate flows.  
A) I and II      B) I and III      C) I and IV      D) II and IV      E) III and IV
- 17) According to Molecular Orbital theory, which is the **INCORRECT** statement for  $C_2^-$ ?  
A) The  $\sigma_{2p}$  orbital has two electrons.  
B) There is one unpaired electron.  
C) The bond order of molecule is 2.5.  
D) The molecule is paramagnetic.  
E) The  $\pi_{2p}$  orbitals have four electrons.
- 18) The following equilibrium corresponds to the reaction of hydrogen sulfide with methane to produce carbon disulfide and hydrogen gas.  
 $CH_4(g) + 2H_2S(g) \rightleftharpoons CS_2(g) + 4H_2(g)$ ;  $\Delta H = +232.5 \text{ kJ}$   
Accordingly, which of the following(s) should be done to proceed with the reaction to the right?  
I) Increasing the temperature  
II) Decreasing the volume  
III) Increasing the pressure  
IV) Increasing the volume  
V) Adding a catalyst  
A) Only I      B) I, II, and III      C) I and IV      D) I, II, III, V      E) I, IV, and V
- 19) For the reaction  $2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g)$ ,  $K_C = 1.8 \times 10^{-6}$  at  $184^\circ\text{C}$ . What is the value of  $K_P$  for the following reaction at  $184^\circ\text{C}$ ?  
 $NO(g) + \frac{1}{2} O_2(g) \rightleftharpoons NO_2(g)$   
A)  $2.2 \times 10^{-8}$       B) 49.2      C)  $2.2 \times 10^{-4}$       D) 121.7      E) 2896.3
- 20) Hypochlorous acid (HOCl) has an ionization (dissociation) constant of  $3.2 \times 10^{-8}$ . Calculate the percent ionization of 1.0 M HOCl solution.  
A) 0.018%      B) 0.032%      C) 0.57%      D) 1.79%      E) 17.90%

## Answer Key

Testname: FINAL-A-EN

- 1) C
- 2) D
- 3) C
- 4) D
- 5) B
- 6) C
- 7) E
- 8) B
- 9) C
- 10) D
- 11) A
- 12) A
- 13) D
- 14) B
- 15) E
- 16) C
- 17) A
- 18) C
- 19) D
- 20) A