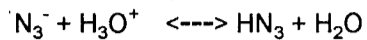


- 一. 答案依題目順序寫於答案卷上。(計算過程不必寫)  
 二. 每題四分, 選擇題答錯, 倒扣一分。  
 三. 作答完畢, 試題卷與答案卷一起繳交。  
 四.  $R=8.32 \text{ J/K}\cdot\text{mol}$

- 1) The numbers of protons(p), neutrons(n), and electrons(e) in  $^{127}_{53}\text{I}^-$  are:  
 (a) 52 p, 128 n, 53 e (b) 53 p, 127 n, 54 e (c) 53 p, 127 n, 52 e  
 (d) 53 p, 74 n, 54 e (e) 53 p, 74 n, 52 e
- 2) Write the names for the (a) Co and (b) Ar.  
 Write the chemical formulas for (c) chloric acid and (d) sodium bicarbonate
- 3) There is  $7.6 \times 10^{-5}$  g of KI per gram of NaCl in commercial table salt. Translate the concentration of KI in table salt into parts per million (ppm).
- 4) For a particular process  $q(\text{heat}) = -17 \text{ kJ}$  and  $w(\text{work}) = 21 \text{ kJ}$ . Which of the following statements is false?  
 (a) Heat flows from the system to the surroundings  
 (b) The system does work on the surroundings  
 (c)  $E(\text{internal energy}) = +4 \text{ kJ}$  (d) The process is exothermic  
 (e) None of the above is false
- 5) Consider the following processes:  
 $2\text{A} \rightarrow 1/2 \text{ B} + \text{C} \quad \Delta H_1 = 5 \text{ kJ/mol}$   
 $3/2 \text{ B} + 4\text{C} \rightarrow 2\text{A} + \text{C} + 3\text{D} \quad \Delta H_2 = -15 \text{ kJ/mol}$   
 $\text{E} + 4\text{A} \rightarrow \text{C} \quad \Delta H_3 = 10 \text{ kJ/mol}$   
 Calculate  $\Delta H$  for:  $\text{C} \rightarrow \text{E} + 3\text{D}$
- 6) Which of the following statements about quantum theory is incorrect?  
 (a) The energy and position of an electron cannot be determined simultaneously (b) Lower energy orbitals are filled with electrons before higher energy orbitals (c) When filling orbitals of equal energy, two electrons will occupy the same orbital before filling a new orbital (e) All of these are correct.
- 7) Which of the following molecules (or ions) has a dipole moment?  
 (a)  $\text{CO}_2$  (b)  $\text{CO}_3^{2-}$  (c)  $\text{NH}_4^+$  (d)  $\text{PF}_3$  (e) two of them do
- 8) As indicated by Lewis structures, which of the following species could probably not exist as a stable molecule  
 (a)  $\text{NH}_3$  (b)  $\text{N}_2\text{H}_2$  (c)  $\text{N}_2\text{H}_4$  (d)  $\text{N}_2\text{H}_6$  (e)  $\text{N}_2\text{O}_4$
- 9) Two of the following molecules are nonlinear:  $\text{NO}_2^-$ ,  $\text{C}_2\text{H}_2$ ,  $\text{N}_3^-$ ,  $\text{HCN}$ ,  $\text{CO}_2$ ,  $\text{H}_2\text{O}_2$ . Indicate these two molecules.
- 10) The hybridization of Br in  $\text{BrF}_3$  is  
 (a)  $sp$  (b)  $sp^2$  (c)  $sp^3$  (d)  $dsp^3$  (e)  $d^2sp^3$  (背面仍有題目, 請繼續作答)

- 11) Which of the following has the largest bond energy  
 (a)  $O_2$  (b)  $O_2^-$  (c)  $O_2^{2-}$  (d)  $O_2^+$  (e)  $O_2^{2+}$
- 12) You are given a small bar of an unknown metal, X. You find the density of the metal to be  $10.5 \text{ g/cm}^3$ . An x-ray diffraction experiment measures the edge of the unit cell as 409 pm. Assuming that the metal crystallizes in a face-centered cubic lattice, what is X most like to be?  
 (a) Ag (M=108 g/mol) (b) Rh (M=103 g/mol) (c) Pt (M=195 g/mol)  
 (d) Pb (M=207 g/mol) (e) none of these
- 13) At a given temperature the vapor pressures of pure liquid benzene and toluene are 745 torr and 290 torr, respectively. A solution prepared by mixing benzene and toluene obeys Raoult's law. At this temperature the vapor pressure of benzene over a solution in which the mole fraction of benzene is equal to 0.340 is  
 (a) 417 torr (b) 352 torr (c) 98.6 torr (d) 253 torr (e) none of these
- 14) the freezing point ( $T_f$ ) for t-butanol is  $25.5^\circ\text{C}$  and  $K_f$  is  $9.1^\circ\text{C/m}$ . Usually t-butanol absorbs water on exposure to the air. If the freezing point of a 10 g sample t-butanol is measured as  $24.59^\circ\text{C}$ , how many grams of water are present in the sample?  
 (a) 0.1 (b) 0.018 (c) 10 (d) 1.8 (e) 18 g
- 15) Initial rate data have been determined at a certain temperature for the gaseous reaction  $2\text{NO} + 2\text{H}_2 \rightarrow \text{N}_2 + 2\text{H}_2\text{O}$
- | $[\text{NO}]_0$ | $[\text{H}_2]_0$ | Initial Rate (M/s) |
|-----------------|------------------|--------------------|
| 0.1             | 0.2              | 0.0150             |
| 0.1             | 0.3              | 0.0225             |
| 0.2             | 0.2              | 0.0600             |
- The numerical value of the rate constant is:  
 (a) 7.5 (b)  $3 \times 10^{-3}$  (c) 380 (d) 0.75 (e)  $3.0 \times 10^{-4}$
- 16) If the equilibrium constant for  $\text{A} + \text{B} \rightleftharpoons \text{C}$  is 0.123, then the equilibrium constant for  $2\text{C} \rightleftharpoons 2\text{A} + 2\text{B}$  is  
 (a) 0.015 (b) 8.13 (c) 0.123 (d) 66.1 (e) 16.3
- 17) Initially 2.0 moles of  $\text{N}_2(\text{g})$  and 4.0 moles of  $\text{H}_2(\text{g})$  were added to a 1.0-liter container and the following reaction then occurred:  
 $3\text{H}_2(\text{g}) + \text{N}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$   
 The equilibrium concentration of  $\text{NH}_3(\text{g}) = 0.68 \text{ moles/liter}$  at  $700^\circ\text{C}$ .  
 $K$  ( $\text{moles}^{-2}\text{liter}^2$ ) at  $700^\circ\text{C}$  for the formation of ammonia is:  
 (a)  $3.6 \times 10^{-3}$  (b)  $1.4 \times 10^{-1}$  (c)  $1.1 \times 10^{-2}$  (d)  $5.0 \times 10^{-2}$  (e) none of these

18) What is the equilibrium constant for the following reaction ?



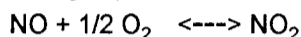
The  $K_a$  value for  $\text{HN}_3 = 1.9 \times 10^{-5}$ .

- (a)  $5.3 \times 10^{-10}$  (b)  $1.9 \times 10^{-9}$  (c)  $1.9 \times 10^{-5}$  (d)  $5.3 \times 10^4$  (e)  $1.9 \times 10^9$

19) Choose the correct statement.

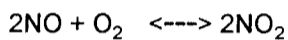
- (a) Exothermic reactions are always spontaneous
- (b) Free energy is independent of temperature
- (c) A reaction that exhibits a negative value of  $\Delta S$  cannot be spontaneous
- (d) At constant P and T, a decrease in free energy ensures an increase in the entropy of the system
- (e) None of the above statements is true

20) Consider the gas phase reaction



For which  $\Delta H^\circ = -57 \text{ kJ}$  and  $K = 1.5 \times 10^6$  at  $25^\circ \text{C}$ .

Calculate  $\Delta G^\circ$  at  $25^\circ \text{C}$  for the following reaction



- (a)  $-70.5$  (b)  $-5.91$  (c)  $-57$  (d)  $5.91$  (e)  $70.5 \text{ kJ}$

21) For a reaction in a voltaic cell both  $\Delta H^\circ$  and  $\Delta S^\circ$  are positive, which of the following statements is true?

- (a)  $E^\circ_{\text{cell}}$  will increase with an increase in temperature
- (b)  $E^\circ_{\text{cell}}$  will decrease with an increase in temperature
- (c)  $E^\circ_{\text{cell}}$  will not change when the temperature increases
- (d)  $\Delta G^\circ > 0$  for all temperatures
- (e) None of the above statements is true

22) Which of the following is paramagnetic?

- (a)  $\text{Zn}(\text{H}_2\text{O})_6^{2+}$  (b)  $\text{Co}(\text{NH}_3)_6^{3+}$  (strong field) (c)  $\text{Cu}(\text{CN})_3^{2-}$
- (d)  $\text{Mn}(\text{CN})_6^{2-}$  (strong field) (e) none of these

23) The number of half-lives needed for a radioactive element to decay to one-eighth of its original activity is (choose nearest number)

- (a) 2 (b) 3 (c) 5 (d) 10 (e) 100

24) Draw the chemical structure for 3-methyl-1-pentyne

25) All of the following terms are associated with the manufacture of gasoline except:

- (a) oligomerization (b) catalytic cracking (c) leaching
- (d) catalytic reforming (e) alkylation