
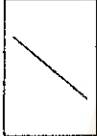
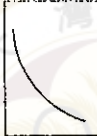
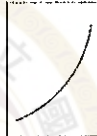


1A																										18 8A	
1 H 1.008	2 2A															13 3A	14 4A	15 5A	16 6A	17 7A	2 He 4.003						
3 Li 6.941	4 Be 9.012														5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18							
11 Na 22.99	12 Mg 24.31	3 3B	4 4B	5 5B	6 6B	7 7B	8 8B			9 9B	10 10B	11 11B	12 12B	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95								
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	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 65.39	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80										
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	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										
55 Cs 132.9	56 Ba 137.3	57 La 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.9	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 (210)	85 At (210)	86 Rn (222)										
87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (257)	105 Db (260)	106 Sg (263)	107 Bh (266)	108 Hs (268)	109 Mt (268)	110	111	112																

本試題含單選題 30 題(75 分), 及兩題敘述題(25 分), 總分 100 分

(I). 單選題 (選出一個最適當的答案): 每題答對 2.5 分, 答錯倒扣 1 分. (答案直接填入"選擇題作答區"內)

1. A student performed a kinetic study of the reaction $2 \text{NO} (\text{g}) + \text{O}_2 (\text{g}) \rightarrow 2 \text{NO}_2 (\text{g})$. The reaction was second order in NO and first order in O_2 . Which graph corresponds to plotting $1/[\text{NO}]$ vs. time?

- A)  B)  C)  D)  E) None of the above

2. Nuclear power plants produce electricity by carefully controlling the process of
A) nuclear fission B) nuclear fusion C) hydrogen burning D) all of the above E) none of the above

3. The rate constant for a first-order reaction has the value of $1.25 \times 10^{-3} \text{ s}^{-1}$. If the initial concentration of reactant is 2.5 mol/L, what will be the molar concentration of the reactant after 5 minutes?
A) 2.31 B) 1.72 C) 2.49 D) 0.78 E) none of the above

4. Reaction rates can change with
A) temperature B) the addition of a catalyst C) reactant concentrations
D) all of these E) none of these

5. Which of the following is true?
A) reduction takes place at the cathode B) reduction takes place at the anode
C) reduction takes place in the cell with the more positive reduction potential D) A and C E) B and C

6. In general, ΔS for a dissolution reaction is:
A) positive B) negative C) zero D) not enough information

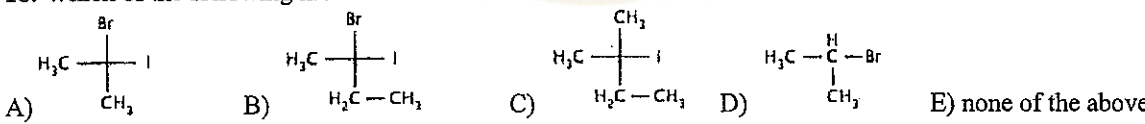
7. The solubility of AgBr increases with temperature. It is therefore
A) an exothermic process B) an endothermic process C) a spontaneous process D) A and C

8. The value of K_w increases slightly over the temperature range 0 to 60°C. Compared to its value at 0 °C, the pH of water at room temperature will be:
A) higher B) lower C) the same D) not enough information

9. Which of the following is a Lewis acid?
A) Fe^{2+} B) BH_3 C) NH_3 D) A and B E) A and C

10. It is determined that a certain reaction between two aqueous species is exothermic and produces at least one product that is a gas. Which set of reaction conditions would most decrease the yield of product?
A) High temperature, low pressure B) Low temperature, high pressure
C) High temperature, high pressure D) Low temperature, low pressure

見背面

11. Which of the following is temperature dependant?
 A) K_p B) K_c C) partition coefficients D) activity coefficients E) all of the above
12. A process can be spontaneous at low temperature but not spontaneous at high temperature if
 A) both ΔH and ΔS are positive B) both ΔH and ΔS are negative
 C) ΔH is positive and ΔS is negative D) ΔH is negative and ΔS is positive E) this can never happen
13. Calculate the amount of energy necessary to raise the temperature of 1 cup of water at 23 °C to steam at 105 °C. The specific heat capacity of water is $4.184 \text{ J}\cdot\text{K}^{-1}\cdot\text{g}^{-1}$ and the specific heat capacity of steam is $4.215 \text{ J}\cdot\text{K}^{-1}\cdot\text{g}^{-1}$. The density of water can be assumed to be $1.00 \text{ g}\cdot\text{ml}^{-1}$. For water, $\Delta H_{\text{vap}} = 40.66 \text{ kJ}\cdot\text{mol}^{-1}$. 1 cup = 0.2366 L
 A) 81.2 kJ B) 122 kJ C) 534 kJ D) 616 kJ E) None of the above
14. Which do you think has a higher boiling point, n-butanol or tert-butanol?
 A) n-butanol, because it forms stronger hydrogen bonds
 B) tert-butanol, because it forms stronger hydrogen bonds.
 C) n-butanol, because the linear molecule allows for greater dispersion forces.
 D) tert-butanol because the tetrahedral molecule allows for greater dispersion forces.
 E) they will be exactly the same.
15. Which has the highest vapor pressure at room temperature?
 A) methanol B) ethanol C) propanol D) butanol E) pentanol
16. At the same temperature and pressure, comparing one mole of a real gas that is described the following equation of state: $P(V - nb) = nRT$ where $b > 0$ to one mole of an ideal gas, the volume of the real gas will be
 A) larger B) smaller C) the same D) depending on the temperature E) depending on the pressure
17. Comparing the root-mean-squared velocities of H_2 and He gas.
 A) He is 2 times faster than H_2 B) He is 2 times slower than H_2
 C) He is 4 times faster than H_2 D) He is 4 times slower than H_2 E) none of the above
18. Which of the following molecules is chiral?

 A) B) C) D) E) none of the above
19. If you remove one of the electrons from N_2 what will happen to its bond length?
 A) increase B) decrease C) stay the same D) there will no longer be a bond
20. Valence bonding (VB) theory and molecular orbital (MO) theory both predict that N_2 has a bond order of three, one sigma bond and two pi bonds. What is the difference between these two models?
 A) The wavefunctions for the electrons are different B) The energies predicted would be different
 C) both A & B D) There are no differences between VB and MO for N_2
21. What do you predict for the hybridization of the central atom in CCl_3 ?
 A) not hybridized B) sp^3 C) sp^2 D) sp E) sp^3d^2
22. Rank from smallest to largest in terms of atom/ionic radius.
 A) S^{2-} , Cl^- , Ar, K^+ , Ca^{2+} B) Ca^{2+} , K^+ , Ar, Cl^- , S^{2-} C) Ca^{2+} , S^{2-} , K^+ , Cl^- , Ar
 D) Ar, K^+ , Cl^- , Ca^{2+} , S^{2-} E) Ar, Cl^- , K^+ , S^{2-} , Ca^{2+}
23. Which of the following sets of quantum numbers is allowed for an electron in a one electron atom?
 A) $n=4$, $l=3$, $m=3$, $m_s=0$ B) $n=3$, $l=1$, $m=2$, $m_s=-1/2$ C) $n=2$, $l=0$, $m=1$, $m_s=1/2$
 D) $n=2$, $l=3$, $m=3$, $m_s=1/2$ E) $n=6$, $l=5$, $m=(-3)$, $m_s=(-1/2)$

24. According to Bohr's model of the atom, which is the largest radius?
A) the n=1 state of H B) the n=2 state of H C) the n=3 state of Li^{2+}
D) the n=3 state of H E) the n=4 state of He^+
25. What geometry would you expect for the nitrate ion, NO_3^- based on VSEPR theory?
A) linear B) bent C) trigonal planar D) pyramidal E) distorted T
26. In Rutherford's experiment of scattering α particles off gold foil, he
A) observed that a small fraction of the α particles were negatively charged
B) observed that most of the α particles pass straight through the foil
C) observed that a small fraction of the α particles scattered backwards from the foil
D) both B & C E) all of the above
27. For the half reaction, $\text{X}^+ + \text{e}^- \rightarrow \text{X(s)}$ $E^\circ = -2.174 \text{ V}$, which is true?
A) X^+ is readily reduced B) X^+ is a good oxidizing agent C) X is a poor reducing agent
D) X is a good oxidizing agent E) X is readily oxidized
28. In the recent scandal, melamine ($\text{C}_3\text{H}_6\text{N}_6$) was added to Chinese milk and infant formula and led to potential kidney stones. Assuming the average nitrogen (N) content of protein is about 16.6 %, how many times in nitrogen content does melamine provide?
A) 2 B) 3 C) 4 D) 5 E) 6
29. How many σ - and π -bonds, respectively, are there in peroxyacetylnitrate, $\text{CH}_3\text{C}(\text{O})\text{OONO}_2$?
A) 9 and 2 B) 10 and 2 C) 10 and 1 D) 8 and 4
30. Predict the electronic configuration in the oxide ion in CaO.
A) $[\text{Ne}]$ B) $[\text{He}]2s^22p^5$ C) $[\text{He}]2s^22p^63s^2$ D) $[\text{Ne}]3s^23p^3$

(II). 敘述題 (共 25 分)

- 31). Provide brief explanation/description to the following questions (6 分 each):
(31A). When liquid oxygen (O_2) is poured between poles of a magnet, the liquid sticks to the magnet, instead of flowing past it. Why is O_2 paramagnetic?
(31B). Describe required properties of a functional pH indicator (pH paper) that changes colors around $\text{pH} = 5$.
- 32). The iodine clock reaction is $\text{I}^-(\text{aq}) + \text{BrO}_3^-(\text{aq}) + \text{H}^+(\text{aq}) \rightarrow \text{I}_2 + \text{Br}^- + \text{H}_2\text{O}$
(32A). Balance the chemical equation (4 分)
(32B). At two different temperatures, the time it takes for the blue color (I_2) to occur is listed below.
- | Temperature ($^\circ\text{K}$) | Time (sec) |
|----------------------------------|------------|
| 280 | 33 |
| 355 | 12 |
- Calculate the activation energy for this reaction (9 分).

試題隨卷繳回