

單選題：每題四分，答案一律寫在答案紙上，請標明題號依序作答，不倒扣。

- $^{14}\text{N}^{3-}$  has (a) 7 protons, 7 neutrons and 10 electrons (b) 7 protons, 7 neutrons and 7 electrons  
(c) 7 protons, 10 neutrons and 7 electrons (d) 4 protons, 10 neutrons and 7 electrons
- A white powder contains 43.64% phosphorous and 56.36% oxygen by mass. The compound has a mass of 283.88g. The compound's empirical formula is (a)  $\text{P}_2\text{O}_5$  (b)  $\text{P}_4\text{O}_{10}$  (c)  $\text{PO}_2$  (d)  $\text{P}_2\text{O}_4$
- Nitrogen dioxide can dissociate  

$$2\text{NO}_{2(g)} \rightarrow 2\text{NO}_{(g)} + \text{O}_{2(g)} \quad \Delta H_{\text{rxn}}^{\circ} = +114 \text{ kJ}$$
 Under which reaction conditions would you expect to produce the largest amount of oxygen?  
 (a) high temperature, high pressure (b) low temperature, high pressure  
 (c) high temperature, low pressure (d) low temperature low pressure
- For the reaction,  

$$2\text{NO}_{2(g)} \leftrightarrow 2\text{NO}_{(g)} + \text{O}_{2(g)}$$
 $K_p$  is  $4.48 \times 10^{-13}$  at  $25^{\circ}\text{C}$ . What is the value for  $K_c$ ?  
 (a)  $1.81 \times 10^{-16}$  (b)  $1.83 \times 10^{-14}$  (c)  $4.48 \times 10^{-13}$  (d)  $1.11 \times 10^{-9}$
- A solution is prepared by adding 0.10 mol of sodium sulfide, NaS, to 1.00L of water. Which of the following is correct?  
 (a) The solution is basic. (b) The solution is neutral (c) The solution is acidic.  
 (d) can not be known.
- A buffer is prepared by adding 50 mL of 0.10 HF to 25 mL of 0.20 M NaF.  $\text{p}K_a$  of HF is 3.14. What is the pH of the buffer? (Assume that the sodium hydroxide does not affect the volume of the solution)  
 (a) 3.14 (b) 5.83 (c) 7.35 (d) 10.80
- For the process  

$$\text{Benzene}_{(l)} \rightarrow \text{Benzene}_{(g)}$$
 at 1 atm,  $\Delta H_{\text{vap}}^{\circ} = 30.5 \text{ kJ/mol}$  and  $\Delta S_{\text{vap}}^{\circ} = 86.4 \text{ J/mol K}$ . Assuming these values are independent of temperature, what is the normal boiling point of benzene?  
 (a)  $0^{\circ}\text{C}$  (b)  $80^{\circ}\text{C}$  (c)  $353^{\circ}\text{C}$  (d)  $53^{\circ}\text{C}$
- How many electrons are transferred in the following reaction?  

$$\text{SO}_3^{2-}(\text{aq}) + \text{MnO}_4^{-}(\text{aq}) \rightarrow \text{SO}_4^{2-}(\text{aq}) + \text{Mn}^{2+}(\text{aq})$$
 (a) 2 (b) 5 (c) 6 (d) 10
- Consider a galvanic electrochemical cell with a cobalt electrode immersed in 0.001M  $\text{Co}^{2+}$  and a lead electrode immersed in 0.1M  $\text{Pb}^{2+}$ .  

$$\text{Co}^{2+} + 2e^{-} \rightarrow \text{Co} \quad E^{\circ} = -0.28 \text{ V}$$

$$\text{Pb}^{2+} + 2e^{-} \rightarrow \text{Pb} \quad E^{\circ} = -0.13 \text{ V}$$
 The  $E$  (not the standard potential!!) for this cell is ?  
 (a) -0.15 V (b) 0.15 V (c) 0.21V (d) 0.41V
- Which one of the following electromagnetic radiation has the largest momentum?  
 (a) infrared (b) visible light (c) microwave (d) ultra violet

\* 背面仍有試題 \*

(背面仍有題目,請繼續作答)

11. Which of the following has the central atom that is  $dsp^3$  hybridized?  
(a)  $SF_4^-$  (b)  $SCl_4$  (c)  $CCl_4$  (d)  $SF_5^-$
12. According to the molecular orbital model, the bond order in the NO molecule is  
(a) 0 (b) 1 (c) 2 (d) 2.5
13. The integrated rate law of a second-order reaction,  $aA \rightarrow$  products, is:  
(a)  $\ln[A] = -kt + \ln[A]_0$  (b)  $1/[A] = kt + 1/[A]_0$  (c)  $[A] = -kt + [A]_0$   
(d)  $\ln[A] = -kt + 1/[A]_0$
14. For which of the following reactions does the half-life **not** depend on the concentration of the reactant over the course of a reaction?  
(a) zero-order reaction (b) first-order reaction (c) second order (d) none.
15. Which of the following compounds has the lowest boiling point?  
(a)  $CH_3OCH_3$  (b)  $CH_3CH_2CH_3$  (c)  $CH_3COOH$  (d)  $CH_3CH_2CH_2CH_2CH_2CH_3$
16. A certain metal fluoride crystallizes in such a way that the fluoride ions occupy simple cubic lattice sites, while the metal atoms occupy the body centers of half the cubes. The formula for the metal fluoride is:  
(a)  $MF_2$  (b)  $M_2F$  (c)  $MF$  (d)  $MF_3$
17. Aluminum metal crystallizes in a face-centered cubic structure. The relationship between the radius of an Al atom ( $r$ ) and the length of an edge of the unit cell ( $E$ ) is:  
(a)  $r = E/2$  (b)  $r = (\sqrt{2}/4)E$  (c)  $r = (\sqrt{3}/4)E$  (d)  $r = 2E$
18. Doping Se with As would produce a \_\_\_ semiconductor with \_\_\_ conductivity compared to pure Se.  
(a)  $n$ -type, increased (b)  $n$ -type, decreased (c)  $p$ -type, increased (d)  $p$ -type, decreased.
19. Solid KF has a lattice energy of 804 kJ/mol and a heat of solution (in water) of -15 kJ/mol. RbF has a lattice energy of 768 kJ/mol and a heat of solution (in water) of -24 kJ/mol. Which salt forms stronger attractions with water?  
(a) KF, since it has a larger lattice energy (b) RbF, since it has a smaller lattice energy  
(c) KF, since it has a less negative heat of hydration (d) RbF, it has a more negative heat of hydration.
20. A solution of two liquids, A and B, shows negative deviation from Raoult's law.  
This means that:  
(a) molecules of A interact stronger with other A-type molecules. (b) the two liquids have a positive heat of solution (c) molecules of A interact weakly with B molecules  
(d) molecules of A interact more strongly with B than with A or B with B.
21. The empirical formula of a compound with a mass percent composition of 6.78% H, 31.43% N, 39.76% Cl, and 22.03% Co is consistent with which of the following complexes?  
(a)  $[Co(NH_3)_3Cl_3]$  (b)  $[Co(NH_3)_4Cl_2]Cl_2$  (c)  $[Co(NH_3)_5Cl]Cl_2$  (d)  $[Co(NH_3)_6]Cl_3$ .
22. Considering the crystal-field theory for coordination compounds. How many unpaired electrons are there in  $Ir(Br)_6^{4+}$ ? ( $Br^-$  is a weak-field ligand).  
(a) 4 (b) 3 (c) 2 (d) 0.

\*下頁仍有試題\*

23. If a tree dies and the trunk remains undisturbed for 13750 years, what percentage of original  $^{14}\text{C}$  is still present? (Half-life of  $^{14}\text{C} = 5730$  years).  
(a) 5.20% (b) 19.0% (c) 2.20% (d) 45.0%.
24. The dehydrogenation of ethane results in  
(a) propene (b) methene (c) ethene (d) propyne
25. For which of the following compounds are cis and trans isomers possible?  
(a) 2,3-dimethyl-2-butene (b) 3-methyl-2-pentene (c) 4,4-dimethylcyclohexanol  
(d) ortho-chlorotoluene.