

※請將選擇題作答於答案卷內之「選擇題作答區」。

一、 單選題 35% (第 1-10 題每題 2 分; 第 11-15 題每題 3 分)

- The van der Waals constant "a", that appears in the relationship of real gases $(P + an^2/V^2)(V-nb) = nRT$ corrects for
 - the average speed of the gas molecules
 - the density of gas molecules
 - the volume occupied by the gas molecules
 - the attractive forces between gas molecules
- In quantum mechanics, an "l" value of 2 corresponds to a letter designation of orbital:
 - s
 - p
 - d
 - f
- Which of the following species is non-polar?
 - PF₅
 - NF₃
 - IF₃
 - SF₄
- If solutions of equal molarity concentration are prepared, the one with the highest electrical conductivity will be:
 - [Pt(NH₃)₂Cl₂]
 - [Co(H₂O)₆]SO₄
 - K₃[CoCl₆]
 - [Co(NH₃)₅Cl]Cl₂
- The compound 2-chloro-1-pentene
 - has the formula C₅H₁₁Cl.
 - cannot exist as *cis* and *trans* isomers.
 - can exist as *cis* and *trans* isomers.
 - has 3 structural isomers.
- The ion [Co(NH₃)₆]²⁺ is octahedral and high spin. This complex is:
 - paramagnetic, with 1 unpaired electron.
 - paramagnetic, with 3 unpaired electrons.
 - paramagnetic, with 4 unpaired electrons.
 - diamagnetic.
- How many donor atoms enable EDTA to form a stable complex ion with lead?
 - 6
 - 2
 - 4
 - 3
- Which one of the following is *not* a redox reaction?
 - $Al(OH)_4^-(aq) + 4H^+(aq) \rightarrow Al^{3+}(aq) + 4H_2O(l)$
 - $C_6H_{12}O_6(s) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l)$
 - $Na_6FeCl_8(s) + 2Na(l) \rightarrow 8NaCl(s) + Fe(s)$
 - $2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$

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9. The unit of first order rate constant is
 (A) M/s (B) 1/(M.s) (C) 1/s (D) 1/(M².s)
10. Write the formula for diamminedichloroethylenediaminecobalt(III) bromide.
 (A) [CoCl₂(en)(NH₃)₂]Br
 (B) [CoCl₂(en)(NH₃)₂]Br₂
 (C) [CoCl₂(en)₂(NH₃)₂]Br
 (D) [CoCl₂(en)₂(NH₃)₂]Br₂
11. What is the molar solubility of CaF₂ (K_{sp} = 3.9 × 10⁻¹¹)?
 (A) 6.24 × 10⁻⁶ M (B) 4.41 × 10⁻⁶ M
 (C) 2.14 × 10⁻⁴ M (D) 9.27 × 10⁻⁵ M
12. If silver atoms follow a face-centered cubic unit cell pattern, what is the length of this unit cell if the atomic radius is 144.4 pm?
 (A) 144 pm (B) 179 pm
 (C) 408 pm (D) 635 pm
13. A fertilizer manufacturer uses the reaction between hydrogen and nitrogen to create ammonia (assume no other reactants or products). If 9.5 × 10³ moles of hydrogen and 1.7 × 10³ moles of nitrogen react at 277 K and 1.25 atm, what volume of ammonia is produced?
 (A) 2.1 × 10⁴ L (B) 3.0 × 10⁴ L (C) 6.2 × 10⁴ L (D) 1.9 × 10⁵ L
14. Consider the reaction of carbon monoxide with oxygen to produce carbon dioxide.
 $2 \text{CO (g)} + \text{O}_2 \text{(g)} \rightarrow 2 \text{CO}_2 \text{(g)}$
 At what temperature will this reaction be spontaneous according to Gibb's Energy?
 ΔH_f in kJ/mol for: CO (g) = -110.5, CO₂ (g) = -393.5
 S in J/mol K for: CO (g) = 197.6, CO₂ (g) = 213.6, O₂ (g) = 205.0
 (A) temps above 63.1 K
 (B) temps below 179.5 K
 (C) temps above 415.8 K
 (D) temps below 3273 K
15. How many grams of silver are deposited at a platinum cathode in the electrolysis of AgNO₃ (aq) by 5.30 amps of electric current in 4.0 hours?
 (A) 85.3 g
 (B) 42.6 g
 (C) 121 g
 (D) 188 g

※ 注意：請接續在第一部份選擇題之後，於「選擇題作答區」依序作答。

三、複選題 25%

(請以是非題方式回答，如：(A) O (B) X (C) X (D) O (E) X
每個選項1分，每錯一個選項倒扣 0.5分)

16. Consider the elementary step: $A + B \rightarrow C$. What type of elementary step is this?
(A) unimolecular (B) bimolecular
(C) termolecular (D) first order
(E) second order
17. Which one of these molecules could serve as a monomer for an addition polymer?
(A) $\text{ClCH}=\text{CH}_2$ (B) $\text{H}_2\text{C}=\text{CH}-\text{CN}$
(C) $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_2=\text{C}-\text{CH}=\text{CH}_2 \end{array}$ (D) $\begin{array}{c} \text{O} \\ || \\ \text{CH}_3-\text{C}-\text{OH} \end{array}$
(E) $\text{CH}\equiv\text{CH}$
18. Which of the following substances exhibit optical isomers?
(A) CH_3COOH (B) $\text{NH}_2\text{CH}(\text{CH}_3)\text{COOH}$
(C) $\text{CH}_3\text{CH}=\text{CHBr}$ (D) $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$
(E) $[\text{Co}(\text{en})_3]\text{Cl}_3$
19. Which of the following are diamagnetic
(a) O_2^+ (b) O_2^{2-} (c) N_2^+ (d) N_2 (e) O_2
20. From the values given for ΔH° and ΔS° at 298 K, which of the following reactions is spontaneous under standard conditions at 298 K?
(A) $2\text{PbS}(\text{s}) + 3\text{O}_2(\text{g}) \rightarrow 2\text{PbO}(\text{s}) + 3\text{SO}_2(\text{g})$
 $\Delta H^\circ = -844 \text{ kJ}; \Delta S^\circ = -165 \text{ J/K}$
(B) $2\text{POCl}_3(\text{g}) \rightarrow 2\text{PCl}_3(\text{g}) + \text{O}_2(\text{g})$
 $\Delta H^\circ = 572 \text{ kJ}; \Delta S^\circ = 179 \text{ J/K}$
(C) $\text{N}_2(\text{g}) + 3\text{F}_2(\text{g}) \rightarrow 2\text{NF}_3(\text{g})$
 $\Delta H^\circ = -249 \text{ kJ}; \Delta S^\circ = -278 \text{ J/K}$
(D) $\text{N}_2(\text{g}) + 3\text{Cl}_2(\text{g}) \rightarrow 2\text{NCl}_3(\text{g})$
 $\Delta H^\circ = 460 \text{ kJ}; \Delta S^\circ = -275 \text{ J/K}$
(E) $\text{N}_2\text{F}_4(\text{g}) \rightarrow 2\text{NF}_2(\text{g})$
 $\Delta H^\circ = 85 \text{ kJ}; \Delta S^\circ = 198 \text{ J/K}$

三、問答與計算題 ※本大題請於答案卷內之「非選擇題作答區」標明題號依序作答。

21. Calculate the K_{sp} of Hg_2Cl_2 , knowing the following standard reduction potentials. (10%)
 $\text{Hg}^{2+} + 2\text{e}^- \rightarrow \text{Hg} \quad \varepsilon^\circ = +1.62 \text{ V}$
 $2\text{Hg}^{2+} + 2\text{e}^- \rightarrow \text{Hg}_2^{2+} \quad \varepsilon^\circ = +0.92 \text{ V}$

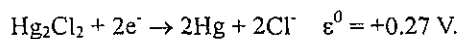
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題號： 21

科目：普通化學(A)

題號： 21

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22.

- (a) When an electron is accelerated through 80 V, what is the characteristic wavelength of this electron? (5%)
- (b) How much voltage is needed in order to accelerate an α -particle to the same wavelength? (5%)

23. Draw on the same figure, to compare their relative vapor pressures, the "phase diagrams" of

- (a) pure water
 (b) 0.10 *m* NaCl solution
 (c) 0.10 *m* Fe(NO₃)₃ solution, and
 (d) 0.10 *m* sucrose solution.

(10%)

24. Calculate q , w , ΔU , ΔH , ΔS , ΔG associated with the isothermal free expansion of 5.65 mol of ideal gas from 2.32 L to double the volume at 358 K. (10%)

Useful informations:

gas constant, $R = 0.08206 \text{ atm L mol}^{-1}\text{K}^{-1} = 8.314 \text{ J mol}^{-1}\text{K}^{-1}$

Faraday constant $F = 9.6485 \times 10^4 \text{ C mol}^{-1}$

Planck's constant, $h = 6.626 \times 10^{-34} \text{ J.s} = 6.626 \times 10^{-27} \text{ erg.s}$

Speed of light, $c = 2.9979 \times 10^8 \text{ m s}^{-1}$

$m_e = 9.11 \times 10^{-28} \text{ g}$, $e = 1.60 \times 10^{-19} \text{ C}$

1 joule (J) = 1 kg m² s⁻² = 1 C·V (coulomb·volt)

Atomic mass: He = 4.00

C = 12.0

O = 16.0

Ag = 107.87