

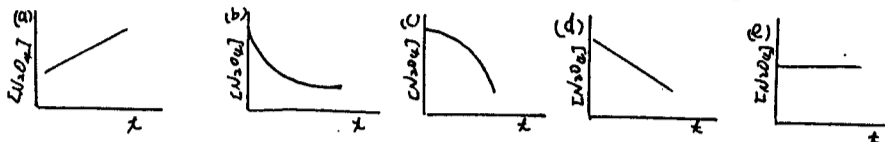
- 注意事項： 1. 答案一律寫在試卷上，否則不予計分。
2. 請標明題號依序作答，不必抄題。
3. 試題應隨同試卷繳回，不得攜出試場。

題 1 至 題 15 每題 2 分，題 16 至 題 19 每題 5 分。

- The correct name for VO_2 is
a. vanadium dioxide b. vanadium peroxide c. vanadium(II) oxide
d. vanadium(IV) oxide e. vanadium(II) peroxide.
- The electron configuration for iron in the $2+$ state is
a. $\text{Ar } 4s^2 3d^4$ b. $\text{Ar } 3d^6$ c. $\text{Ar } 4s^1 3d^5$ d. $\text{Ar } 4s^2 4d^4$ e. $\text{Ar } 4d^6$
- The Bohr model of the atom works reasonably well in the calculation of energy levels of which electron systems
a. all elements in the lithium family
b. all elements in the helium family
c. any one electron system
d. only hydrogen and helium
e. only hydrogen
- Which one of the following element pairs has the lowest electronegativity difference and thereby is the least polar?
a. SeF b. SeCl c. KBr d. NaCl e. KAt
- What shape does a molecule that possesses a VSEPR formula of AX_3E_2 have?
a. trigonal bipyramidal b. Square pyramidal c. pentagonal planar
d. T-shaped e. octahedral
- Calculate the entropy change, in J/mol-K , for the following phase change
 $\text{H}_2\text{O}(s) \rightarrow \text{H}_2\text{O}(l)$ $\Delta H_{\text{fusion}} = 80.0 \text{ Cal/g}$.
a. 5.27 b. 22.1 c. -22.1 d. -5.27 e. 0.293
- If ΔG° for Fe_2O_3 is -742.2 kJ/mol , and for Fe_3O_4 , ΔG° is -1015 kJ/mol ,
In nature, can Fe_2O_3 spontaneously convert to Fe_3O_4 ?
 $3\text{Fe}_2\text{O}_3(s) \rightarrow 2\text{Fe}_3\text{O}_4(s) + 1/2 \text{O}_2(g)$ $\Delta G^\circ = ?$
a. yes, -272.8 b. no, 272.8 c. yes, -469.4 d. no, 196.6
e. yes, -196.6
- Which one of the following molecules violates the octet rule?
a. H_2O_2 b. SF_2 c. Cl_2O d. OF_2 e. BF_3
- For a first order rate expression, which plot of the following will be a straight line?
note: $[\text{A}]$ is the concentration, t is time.
a. $\ln[\text{A}]$ vs. t b. $1/[\text{A}]$ vs. t c. $1/[\text{A}]$ vs. t^2 d. $[\text{A}]^2$ vs. t e. $\ln[\text{A}]$ vs. $1/t$

(背面仍有題目,請繼續作答)

(9) Which of the following graphs best describes the rate at which dinitrogen tetroxide decomposes to nitrogen dioxide, if this reaction is first order in dinitrogen tetroxide?



(10) For the reaction: $2\text{NO}(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow 2\text{NOCl}(\text{g})$, the following initial rates of reaction have been observed for certain reactant concentrations

[NO]	[Cl ₂]	rate, -d[Cl ₂]/dt
0.50 M	0.50 M	1.14 M/min
1.00 M	0.50 M	4.56 M/min
1.00 M	1.00 M	9.12 M/min

then the rate equation, $d[\text{NOCl}]/dt =$ (a) $k[\text{NO}][\text{Cl}_2]$ (b) $k[\text{NO}]^2[\text{Cl}_2]$ (c) $k[\text{NO}][\text{Cl}_2]^2$ (d) $k[\text{NO}]^3[\text{Cl}_2]$ (e) $k[\text{NO}][\text{Cl}_2]^3$

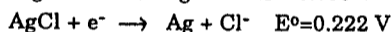
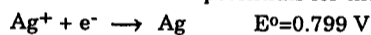
(11) To prepare a buffer with pH close to 3.4, you could use a mixture of (a) NH_4NO_3 and NH_3 (b) HOCl and NaOCl (c) HOAc and NaOAc (d) HNO_2 and KNO_2 (e) NaHCO_3 and Na_2CO_3

2. Explain the difference in the color of aqueous solutions of the following ions: 4%

$[\text{Co}(\text{NH}_3)_5(\text{NO}_2)]^{2+}$, $[\text{Co}(\text{NH}_3)_5(\text{H}_2\text{O})]^{3+}$, $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$
 yellow red violet

3. Ether, $(\text{C}_2\text{H}_5)_2\text{O}$, is prepared by the reaction of ethanol with sulfuric acid. What is the percent yield of the reaction that produces 12.5 g of ether from 36.0 g of ethanol. 4%

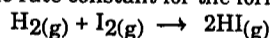
4. The standard reduction potentials for the reactions are:



Calculate the solubility product for AgCl . 4%

5. Trimethylphosphine, $(\text{P}(\text{CH}_3)_3)$, can act as a ligand. If trimethylphosphine is added to a solution of nickel(II) chloride in acetone, a blue compound that has a molecular mass of approximately 270 and contains 21.5% Ni, 26.0% Cl, and 52.5% $\text{P}(\text{CH}_3)_3$ can be isolated. This blue compound does not have any isomeric forms. What is the molecular formula and geometry of this blue compound. 4%

6. The rate constant for the formation of HI from the elements:



is $2.7 \times 10^{-4} \text{ L/mol}\cdot\text{s}$ at 600 K and $3.5 \times 10^{-3} \text{ L/mol}\cdot\text{s}$ at 650 K. Find the activation energy of this reaction. 4%

7. For a reaction: $\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$

When 1.00 mol of CaCO_3 (volume=34.2 mL) decomposes at 25 °C and 1 atm to give solid CaO (volume=16.9 mL) and $\text{CO}_2(\text{g})$. What are w and ΔG° for this reaction? 4%

8. Write a balanced equation that can describe each of the following reactions. 4%

(a) hot water vapor and hot carbon react to form water gas.

(b) ${}^6\text{C}^{14}$ undergoes β^- decay.