

普通化學單選題 25 題，每題 4 分，共 100 分。答錯不倒扣。

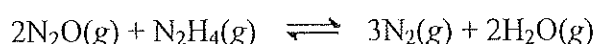
- How many protons, neutrons, and electrons does the atom ^{31}P have?
A) 15 protons, 15 neutrons, 31 electrons B) 16 protons, 16 neutrons, 15 electrons
C) 15 protons, 15 neutrons, 15 electrons D) 16 protons, 15 neutrons, 16 electrons
E) 15 protons, 16 neutrons, 15 electrons
- The average mass of a boron atom is 10.81. If you were able to isolate a single boron atom, what is the chance that you would randomly get an atom with mass 10.81?
A) 0% B) 0.81% C) about 11% D) 10.81% E) greater than 50%
- What is the empirical formula (實驗式) of a hydrocarbon (a compound that consists of only carbon and hydrogen) that contains 81.7% carbon by mass?
A) C_2H_6 B) C_3H_8 C) C_4H_{10} D) C_5H_{12} E) none of these
- Sulfuric acid may be produced by the following process:
 $4\text{FeS}_2 + 11\text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3 + 8\text{SO}_2$
 $2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$
 $\text{SO}_3 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_4$
How many moles of H_2SO_4 will be produced from 5.00 mol of FeS_2 ?
A) 6.11 mol B) 5.00 mol C) 10.0 mol D) 12.2 mol E) 20.0 mol
- In which state of the following compounds does nitrogen have the most positive oxidation state?
A) HNO_3 B) NH_4Cl C) N_2O D) NO_2 E) NaNO_2
- A sample of nitrogen gas has a volume of 160.0 mL at STP (標準狀態). What volume does the gas occupy if the absolute temperature and pressure are each quadrupled (四倍)?
A) 640.0 mL B) 40.00 mL C) 160.0 mL D) 400.0 mL E) 89.60 L
- Into a 3.90-liter container at 23°C are placed 1.18 mol of O_2 gas and 4.02 mol of solid C (graphite). If the carbon and oxygen react completely to form $\text{CO}(g)$, what will be the final pressure in the container at 23°C ? (Gas constant $R = 0.08206 \text{ L}\cdot\text{atm}/\text{K}\cdot\text{mol}$)
A) 14.7 atm B) 25.0 atm C) 0.571 atm D) 32.4 atm E) 7.35 atm

8. The value of the equilibrium constant (平衡常數) K is dependent on:

- I. the temperature of the system.
- II. the nature of the reactants and products.
- III. the concentration of the reactants.
- IV. the concentration of the products.

- A) I and II only B) II and III only C) III and IV only
D) three of these E) none of these

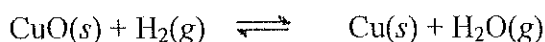
9. The following reaction is investigated (assume an ideal gas mixture).



Initially there are 0.08 mol of N_2O and 0.29 mol of N_2H_4 , in a 20.0-L container. If there is 0.050 mol of N_2O at equilibrium, how many moles of N_2 are present at equilibrium?

- A) 0.12 B) 0.053 C) 0.045 D) 0.15 E) 0.030

10. When the substances in the equation below are at equilibrium at pressure P and temperature T , how can the equilibrium be shifted to favor the products?



Change in enthalpy $\Delta H = -2.0$ kJ.

- A) Decrease the temperature.
- B) Add a catalyst.
- C) Increase the pressure by adding an inert gas such as nitrogen.
- D) Increase the pressure by means of a moving piston at constant temperature.
- E) Allow some gas to escape at constant pressure and temperature.

11. Calculate the pH of a 0.10 M solution of HOCl , $K_a = 3.5 \times 10^{-8}$.

- A) 4.23 B) 8.46 C) 3.73 D) 1.00 E) 3.23

12. Calculate $[\text{H}^+]$ in a 1.0 M solution of Na_2CO_3 .

(for H_2CO_3 , $K_{a1} = 4.3 \times 10^{-7}$ and $K_{a2} = 5.6 \times 10^{-11}$)

- A) $7.5 \times 10^{-6} M$ B) $6.6 \times 10^{-4} M$ C) $1.3 \times 10^{-2} M$ D) $7.5 \times 10^{-13} M$ E) none of these

13. The solubility of $\text{Fe}(\text{OH})_2$ in water is 7.9×10^{-6} mol/L at 25° C. What is K_{sp} for $\text{Fe}(\text{OH})_2$ at 25° C?

- A) 4.9×10^{-16} B) 2.0×10^{-15} C) 6.2×10^{-11} D) 2.5×10^{-10} E) none of these

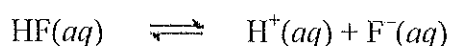
14. Consider the following numbered processes:

1. $A \rightarrow 2B$
2. $B \rightarrow C + D$
3. $E \rightarrow 2D$

ΔH for the process $A \rightarrow 2C + E$ is

- A) $\Delta H_1 + \Delta H_2 + \Delta H_3$ B) $\Delta H_1 + \Delta H_2$ C) $\Delta H_1 + \Delta H_2 - \Delta H_3$
D) $\Delta H_1 + 2\Delta H_2 - \Delta H_3$ E) $\Delta H_1 + 2\Delta H_2 + \Delta H_3$

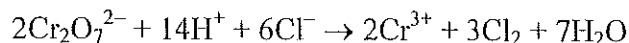
15. Consider the dissociation reaction of the acid HF.



Why is entropy ΔS negative?

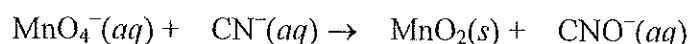
- A) Each HF molecule produces two ions when it dissociates.
- B) The ions are hydrated.
- C) The reaction is expected to be exothermic (放熱), and ΔS thus should be negative.
- D) The reaction is expected to be endothermic (吸熱), and thus ΔS should be negative.
- E) none of these

16. How many electrons are transferred in the following reaction?



- A) 2 B) 4 C) 6 D) 8 E) none of these

17. When the equation for the following reaction in basic solution is balanced, what is the sum of the coefficients?



- A) 13 B) 8 C) 10 D) 20 E) 11

18. Gold (atomic mass = 197 g/mol) is plated from a solution of chlorauric acid, HAuCl_4 ; it deposits on the cathode. Calculate the time it takes to deposit 0.65 g of gold, passing a current of 0.14 amperes. (1 faraday = 96,485 coulombs)

- A) 0.63 h B) 1.9 h C) 2.5 h D) 0.0025 days E) 1.3 h

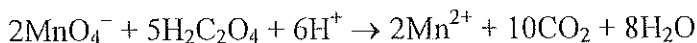
19. In Bohr's atomic theory, when an electron moves from one energy level to another energy level more distant from the nucleus,

- A) energy is emitted.
- B) energy is absorbed.
- C) no change in energy occurs.
- D) light is emitted.
- E) none of these

20. Which species has an unpaired electron?

- A) N_2 B) CO C) NO D) OH^- E) none of these

21. The following initial rate data were found for the reaction



$[\text{MnO}_4^-]_0$	$[\text{H}_2\text{C}_2\text{O}_4]_0$	$[\text{H}^+]_0$	Initial Rate (M/s)
1×10^{-3}	1×10^{-3}	1.0	2×10^{-4}
2×10^{-3}	1×10^{-3}	1.0	8×10^{-4}
2×10^{-3}	2×10^{-3}	1.0	1.6×10^{-3}
2×10^{-3}	2×10^{-3}	2.0	1.6×10^{-3}

Which of the following is the correct rate law?

- A) $\text{Rate} = k[\text{MnO}_4^-]^2[\text{H}_2\text{C}_2\text{O}_4]^5[\text{H}^+]^6$ B) $\text{Rate} = k[\text{MnO}_4^-]^2[\text{H}_2\text{C}_2\text{O}_4][\text{H}^+]$
C) $\text{Rate} = k[\text{MnO}_4^-][\text{H}_2\text{C}_2\text{O}_4][\text{H}^+]$ D) $\text{Rate} = k[\text{MnO}_4^-]^2[\text{H}_2\text{C}_2\text{O}_4]$
E) $\text{Rate} = k[\text{MnO}_4^-][\text{H}_2\text{C}_2\text{O}_4]^2$

22. Sodium oxide (Na_2O) crystallizes in a structure in which the O^{2-} ions are in a face-centered cubic lattice and the Na^+ ions are in tetrahedral holes. What is the number of Na^+ ions in the unit cell?

- A) 2 B) 4 C) 6 D) 8 E) none of these

23. When a 1.50-g sample of glutamic acid is dissolved in 100.0 g of H_2O , the resulting solution freezes at -0.190°C . K_f for H_2O is $1.86^\circ\text{C}/m$. The molar mass of glutamic acid is

- A) 14.7 g/mol B) 1.50 g/mol C) 189 g/mol D) 28.0 g/mol E) 147 g/mol

24. Choose the species with the highest boiling point.

- A) HF B) HCl C) HBr D) HI E) All are the same.

25. How many structural isomers (異構物) does pentane C_5H_{12} have?

- A) 1 B) 2 C) 3 D) 5 E) 4

Periodic Table of the Elements

1 IA 11A	2 IIA 2A											18 VIIIA 8A					
3 III 3A	4 IV 4A	5 VB 5B	6 VIB 6B	7 VIIB 7B	8 VIII 8	9 VIII 9	10 VIII 10	11 IB 1B	12 IIB 2B	13 IIIA 3A	14 IVA 4A	15 VA 5A	16 VIA 6A	17 VIIA 7A	18 VIIIA 8A		
1 H Hydrogen 1.008	2 He Helium 4.003	3 Li Lithium 6.941	4 Be Beryllium 9.012	5 B Boron 10.811	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180	11 Na Sodium 22.990	12 Mg Magnesium 24.305	13 Al Aluminum 26.982	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.066	17 Cl Chlorine 35.453	18 Ar Argon 39.948
19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.88	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.61	33 As Arsenic 74.922	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.80
37 Rb Rubidium 85.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.94	43 Tc Technetium 98.907	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.905	46 Pd Palladium 106.42	47 Ag Silver 107.868	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.71	51 Sb Antimony 121.760	52 Te Tellurium 127.6	53 I Iodine 126.904	54 Xe Xenon 131.29
55 Cs Cesium 132.905	56 Ba Barium 137.327	57-71 Lanthanide Series	72 Hf Hafnium 178.49	73 Ta Tantalum 180.948	74 W Tungsten 183.85	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.967	80 Hg Mercury 200.59	81 Tl Thallium 204.383	82 Pb Lead 207.2	83 Bi Bismuth 208.980	84 Po Polonium [209]	85 At Astatine [209]	86 Rn Radon 222.018
87 Fr Francium 223.020	88 Ra Radium 226.025	89-103 Actinide Series	104 Rf Rutherfordium [261]	105 Db Dubnium [262]	106 Sg Seaborgium [266]	107 Bh Bohrium [264]	108 Hs Hassium [269]	109 Mt Meitnerium [268]	110 Ds Darmstadtium [269]	111 Rg Roentgenium [272]	112 Cn Copernicium [277]	113 Nh Nihonium [284]	114 Fl Flerovium [289]	115 Uup Ununpentium [295]	116 Lv Livermorium [293]	117 Uus Ununseptium [294]	118 Uuo Ununoctium [294]

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