

普通化學

單選題，共 40 題，每題 2.5 分，共 100 分，答錯不倒扣。

- Which of the following atomic symbols is incorrect?
(A) $^{31}_{15}\text{P}$ (B) $^{19}_9\text{F}$ (C) $^{34}_{17}\text{Cl}$ (D) $^{39}_{19}\text{K}$ (E) $^{15}_8\text{C}$
- The ion $^{14}\text{N}^{3-}$ has
(A) 7 protons, 7 neutrons, 4 electrons (B) 7 protons, 7 neutrons, 3 electrons
(C) 7 protons, 14 neutrons, 7 electrons (D) 7 protons, 7 neutrons, 10 electrons
(E) 7 protons, 7 neutrons, 7 electrons
- Which of the following formulas is *not* correct?
(A) $\text{Ba}(\text{OH})_2$ (B) LiS (C) NaI (D) KCl (E) MgSO_3
- A sample of iron weighing 15.0 g contains how many moles of iron atoms?
(A) 3.72 mol (B) 0.269 mol (C) 0.118 mol
(D) 0.577 mol (E) 0.0780 mol
- An alkali metal oxide contains 83.01% metal by mass. Determine the identity of the metal.
(A) Cs (B) Li (C) K (D) Na (E) Rb
- Which compound has the smallest molar mass?
(A) C_2H_6 (B) CH_3Cl (C) CO_2 (D) $\text{C}_2\text{H}_4\text{O}$ (E) none of these
- Which of the following contains the greatest percentage of nitrogen by mass?
(A) NH_3 (B) HCN (C) N_2O (D) NO_2 (E) $\text{C}_6\text{H}_4\text{N}_3\text{O}_6$
- What volume of 2.0 M HCl can be prepared from 2.00 L of 9.00 M HCl?
(A) 444 mL (B) 4.50 L (C) 2.25 L (D) 9.00 L (E) none of these
- In the reaction $\text{Zn} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2$, which element, if any, is oxidized?
(A) Zn (B) H (C) O (D) S (E) none of these
- What are the oxidation numbers of carbon in CO_2 and CO_3^{2-} , respectively?
(A) +2, +6 (B) +4, +4 (C) -4, -4 (D) +4, +6 (E) -4, -6
- Body temperature is about 308 K. On a cold day, what volume of air at 273 K must a person with a lung capacity of 2.00 L breathe in to fill the lungs?

- (A) 1.13 L (B) 2.26 L (C) 1.77 L (D) 3.54 L (E) none of these
12. At STP (標準狀態) the mass of 680.0 mL of a certain gas is 0.850 g. What is a possible identity of this gas?
 (A) CO (B) Ar (C) O₂ (D) CO₂ (E) H₂
13. If, at a given temperature, the equilibrium constant for the reaction $\text{H}_{2(g)} + \text{Cl}_{2(g)} \rightleftharpoons 2\text{HCl}_{(g)}$ is 5.0, then the equilibrium constant for the reaction $\text{HCl}_{(g)} \rightleftharpoons (1/2)\text{H}_{2(g)} + (1/2)\text{Cl}_{2(g)}$ can be represented as
 (A) 0.040. (B) 25. (C) 0.45. (D) 0.20. (E) 5.0.
14. The equilibrium constant for $\text{A} + 2\text{B} \rightleftharpoons 3\text{C}$ is 1.0×10^{-6} . Determine the equilibrium constant for $4\text{A} + 8\text{B} \rightleftharpoons 12\text{C}$.
 (A) 1.0×10^{-24} (B) 1.0×10^{24} (C) 1.0×10^{-6}
 (D) 4×10^{-24} (E) 4×10^{-6}
15. Which of the following represents a conjugate acid-base pair?
 (A) H_2PO_4^- and PO_4^{3-} (B) HNO_3 and NO_3^- (C) HCl and NaOH
 (D) HSO_4^- and SO_3^{2-} (E) none of these
16. The HSO_4^- can act as either an acid or a base in water solution. In which of the following equations does HSO_4^- act as an acid?
 (A) $\text{HSO}_4^- + \text{H}_2\text{O} \rightarrow \text{SO}_4^{2-} + \text{H}_3\text{O}^+$ (B) $\text{HSO}_4^- + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_4 + \text{OH}^-$
 (C) $\text{HSO}_4^- + \text{H}_3\text{O}^+ \rightarrow \text{SO}_3 + 2\text{H}_2\text{O}$ (D) $\text{HSO}_4^- + \text{OH}^- \rightarrow \text{H}_2\text{SO}_4 + \text{O}_2^-$
 (E) none of these
17. What is the molarity of a NaOH solution if 25.0 mL of this solution reacts exactly with 22.30 mL of 0.253 M H_2SO_4 ?
 (A) 0.284 M (B) 0.451 M (C) 0.567 M
 (D) 0.226 M (E) 0.113 M
18. Calculate ΔE for a system that releases 32 J of heat while 69 J of work is done by it.
 (A) 32 J (B) 101 J (C) -101 J (D) 37 J (E) -37 J
19. Which of the following is the net ionic equation for the reaction that occurs during the titration of HNO_2 with KOH ?

- (A) $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$ (B) $\text{HNO}_2 + \text{KOH} \rightarrow \text{K}^+ + \text{NO}_2^- + \text{H}_2\text{O}$
 (C) $\text{HNO}_2 + \text{OH}^- \rightarrow \text{NO}_2^- + \text{H}_2\text{O}$ (D) $\text{HNO}_2 + \text{K}^+ + \text{OH}^- \rightarrow \text{KNO}_2 + \text{H}_2\text{O}$
 (E) $\text{HNO}_2 + \text{H}_2\text{O} \rightarrow \text{NO}_2^- + \text{H}_3\text{O}^+$
20. One mole of an ideal gas is expanded from a volume of 1.00 L to a volume of 10.18 L against a constant external pressure of 1.07 atm. Calculate the work. (1 L·atm = 101.3 J)
 (A) -9.82 J (B) -0.0970 J (C) 9.95 J
 (D) -9.30×10^2 J (E) -9.95×10^2 J
21. Consider the process $A_{(l)} \rightleftharpoons A_{(s)}$. An increase in temperature favors which direction?
 (A) to the right (B) to the left (C) neither
 (D) More information is needed.
22. What is the oxidation state of Mn in MnO_4^- ?
 (A) 1 (B) 9 (C) 7 (D) -1 (E) 3
23. 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) 4 (B) 10 (C) 3 (D) 2 (E) 6
24. Which of the following frequencies corresponds to light with the longest wavelength?
 (A) $9.12 \times 10^{12} \text{ s}^{-1}$ (B) $3.20 \times 10^9 \text{ s}^{-1}$ (C) $8.50 \times 10^{20} \text{ s}^{-1}$
 (D) $3.00 \times 10^{13} \text{ s}^{-1}$ (E) $4.12 \times 10^5 \text{ s}^{-1}$
25. Which form of electromagnetic radiation has the shortest wavelengths?
 (A) gamma rays (B) X rays (C) radio waves
 (D) microwaves (E) infrared radiation
26. For the elements Rb, F, and O, the order of increasing electronegativity (電負度) is
 (A) $\text{Rb} < \text{O} < \text{F}$. (B) $\text{Rb} < \text{F} < \text{O}$. (C) $\text{O} < \text{F} < \text{Rb}$.
 (D) $\text{F} < \text{Rb} < \text{O}$. (E) none of these.
27. In the gaseous phase, which of the following diatomic molecules would be the most polar?
 (A) NaCl (B) CsF (C) NaF (D) LiF (E) CsCl
28. Which of the following molecules contains a nitrogen atom that is sp^2 hybridized?
 (A) NO_2^- (B) NCl_3 (C) C_2N_2 (D) N_2 (E) HCN

29. What is the hybridization of C in the molecule CO?
(A) dsp^3 (B) sp^2 (C) d^2sp^3 (D) sp (E) sp^3
30. For the reaction $2A + B \rightarrow$ products, the following mechanism is proposed:
 $A + B \rightleftharpoons M$
 $A + M \rightarrow$ products
True or False? A catalyst never appears in a rate law.
(A) True (B) False
31. For the reaction $aA \rightarrow$ products, select the reaction order(s) that best fit(s) the observations.
The half-life is constant.
(A) zero order in A (B) second order in A (C) first order in A
(D) all of these (E) none of these
32. Which of the following is most likely to be a gas at room temperature?
(A) CH_3OH (B) C_8H_{18} (C) K_2O (D) O_2 (E) MgF_2
33. Which intermolecular force is the strongest?
(A) polar covalent bonds (B) ionic bonding (C) London dispersion forces
(D) hydrogen bonding (E) dipole-dipole interactions
34. An aqueous solution contains 46.6 g of KNO_3 in 270.8 mL of solution. What is the molarity of the solution?
(A) 0.125 M KNO_3 (B) 0.172 M KNO_3 (C) 1.70 M KNO_3
(D) 0.00801 M KNO_3 (E) 0.0575 M KNO_3
35. An aqueous solution contains 171.2 g of NaCl per liter. What is the molarity of the solution?
(A) 3.535 M (B) 2.930 M (C) 0.2066 M
(D) 0.1712 M (E) 2.501 M
36. What is the most abundant (by mass) element found in the human body?
(A) O (B) C (C) Ca (D) H_2O (E) H
37. In which group are the elements listed in correct order of increasing first ionization energy (游離能)?
(A) $Al > Si > P$ (B) $Na > P > Cl$ (C) $Cs > Na > K$

(D) $K > Ca > Ge$ (E) $Cs < Rb < Na$

38. What is the maximum oxidation state of chromium?

(A) +4 (B) +6 (C) +3 (D) +5 (E) none of these

39. Which transition metal can exist in all oxidation states from +2 to +7?

(A) Fe (B) V (C) Cu (D) Mn (E) Cr

40. How many isomers of C_4H_{10} are there?

(A) 5 (B) 6 (C) 2 (D) 3 (E) 4

PERIODIC TABLE OF THE ELEMENTS

GROUP	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
PERIOD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	1.008	6.94	9.0122	12.011	23.0042	24.305	26.9815	54.938	55.845	58.933	63.546	65.38	69.723	72.64	74.922	78.971	79.904	83.798
	H	Li	Be	B	C	N	O	F	Ne	Na	Mg	Al	Si	P	S	Cl	Ar	He
	1.008	6.94	9.0122	10.811	12.011	14.007	15.999	18.998	20.180	22.990	24.305	26.982	28.086	30.974	32.06	35.45	39.948	4.0026
	Hydrogen	Lithium	Beryllium	Boron	Carbon	Nitrogen	Oxygen	Fluorine	Neon	Sodium	Magnesium	Aluminum	Silicon	Phosphorus	Sulphur	Chlorine	Argon	Helium
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
	39.098	40.078	44.956	47.867	50.942	51.996	54.938	55.845	58.933	58.693	63.546	65.38	69.723	72.64	74.922	78.971	79.904	83.798
	Potassium	Calcium	Scandium	Titanium	Vanadium	Chromium	Manganese	Iron	Cobalt	Nickel	Copper	Zinc	Gallium	Germanium	Arsenic	Selenium	Bromine	Krypton
	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
	85.468	87.62	88.906	91.224	92.906	95.95	98	101.07	102.91	106.42	107.87	112.41	114.82	118.71	121.76	127.60	126.90	131.29
	Rubidium	Strontium	Yttrium	Zirconium	Niobium	Molybdenum	Technetium	Ruthenium	Rhodium	Palladium	Silver	Cadmium	Indium	Tin	Antimony	Tellurium	Iodine	Xenon
	55	56	57-71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
	Cs	Ba	La-Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
	132.91	137.33	138.91	178.49	180.95	183.84	186.21	190.23	192.22	195.08	196.97	200.59	204.38	207.2	208.98	209	210	222
	Caesium	Barium	Lanthanide	Hafnium	Tantalum	Tungsten	Rhenium	Osmium	Iridium	Platinum	Gold	Mercury	Thallium	Lead	Bismuth	Polonium	Astatine	Radon
	87	88	89-103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118
	Fr	Ra	Actinide	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh	Fl	Mc	Lv	Ts	Og
	Francium	Radium	Actinide	Rutherfordium	Dubnium	Seaborgium	Bohrium	Hassium	Meitnerium	Darmstadtium	Roentgenium	Copernicium	Nihonium	Flerovium	Moscovium	Livermorium	Tennessee	Oganesson

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LANTHANIDE	
57	La Lanthanum
58	Ce Cerium
59	Pr Praseodymium
60	Nd Neodymium
61	Pm Promethium
62	Sm Samarium
63	Eu Europium
64	Gd Gadolinium
65	Tb Terbium
66	Dy Dysprosium
67	Ho Holmium
68	Er Erbium
69	Tm Thulium
70	Yb Ytterbium
71	Lu Lutetium
ACTINIDE	
89	Ac Actinium
90	Th Thorium
91	Pa Protactinium
92	U Uranium
93	Np Neptunium
94	Pu Plutonium
95	Am Americium
96	Cm Curium
97	Bk Berkelium
98	Cf Californium
99	Es Einsteinium
100	Fm Fermium
101	Md Mendelevium
102	No Nobelium
103	Lr Lawrencium



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(1) Atomic weights of the elements 2013, Pure Appl. Chem., 88, 255-291 (2016)