

國立高雄師範大學 102 學年度學士班轉學生招生考試試題

系所別：化學系、生物科技系二年級

科 目：普通化學

※注意：1.不必抄題，作答時請將試題題號及答案依照順序寫在答案卷上，於本試題上作答者，不予計分。

2.限用藍色或黑色之鋼筆、原子筆作答，以鉛筆或其他顏色作答者不予計分。

Part I: Multiple-choice, single answer (60%)

- Choose the correct statement:
 - Neutrons have no charge and no mass.
 - An electron has $1/1837$ the mass of a proton.
 - The atomic number is the total number of protons and neutrons in the nucleus.
 - The charge of a proton is 1837 times the charge of an electron.
 - Electrons and protons have about the same mass.
- Choose the INCORRECT oxidation state:
 - C is 0 in H_2CO ,
 - C is +2 in HCOOH ,
 - Mn is +7 in KMnO_4 ,
 - S is +4 in H_2SO_3 ,
 - Fe is +2 in Fe_2O_3 ,
- What is the sum of the coefficients when the reaction $\text{Na} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2$ is balanced with the smallest integer coefficients?
 - 7,
 - 4,
 - 2,
 - 10,
 - 9.
- What is the molarity of 10.9 g KCl dissolved in 150.0 mL of water?
 - 0.0727 M,
 - 0.146 M,
 - 0.975 M,
 - 0.0219 M,
 - 0.667 M.
- Which of the following is probably the poorest electrical conductor?
 - 0.5 M K_2SO_4 ,
 - 0.5 M CaCl_2 ,
 - 0.5 M HF ,
 - 0.5 M CH_3OH ,
 - 0.5 M NH_3 ,
- The substance HI is a:
 - strong acid,
 - weak base,
 - strong base,
 - salt,
 - weak acid.
- The relationship between the "absolute temperature" on the Kelvin scale and the Celsius temperature is given by:
 - $T(\text{K}) = t(^{\circ}\text{C}) + 273.15$,
 - $t(^{\circ}\text{C}) = T(\text{K}) + 273.15$,
 - $T(\text{K}) = 5/8[t(^{\circ}\text{C})] - 32$,
 - $T(\text{K}) = 8/5[t(^{\circ}\text{C})] + 32$,
 - $t(^{\circ}\text{C}) = 98.6 + T(\text{K})$.
- Assuming ideal gas behavior, which of the following gases would have the lowest density at standard temperature and pressure?
 - SF_6 ,
 - CF_2Cl_2 ,
 - CO_2 ,
 - N_2 ,
 - Kr .

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9. The similar chemical behavior of the elements in a given group in the periodic table is best accounted for by the fact that atoms of these elements have:
- (A) the same number of isotopes,
 - (B) the same number of electrons,
 - (C) the same number of electrons in the outermost (valence) shell,
 - (D) similar nuclear structures,
 - (E) the same number of protons.
10. A chemical bond for which one of the bonded atoms provides both electrons for the bond is referred to as a:
- (A) double covalent bond,
 - (B) coordinate covalent bond,
 - (C) formal covalent bond,
 - (D) free radical bond,
 - (E) VSEPR bond.
11. Which of the following compounds has the highest boiling point?
- (A) NH_3 ,
 - (B) H_2O ,
 - (C) HF ,
 - (D) CH_4 ,
 - (E) HBr .
12. A solution prepared by dissolving 4.00 g KCl in 36.0 g H_2O is said to be:
- (A) 11.1% KCl by mass,
 - (B) 0.100% KCl by mass,
 - (C) 0.111% KCl by mass,
 - (D) 10.0% KCl by mass,
 - (E) 9.00% KCl by mass.
13. Which compound is most likely to be soluble in water?
- (A) butyl alcohol ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$),
 - (B) ethylene glycol ($\text{HOCH}_2\text{CH}_2\text{OH}$),
 - (C) hexane (C_6H_{14}),
 - (D) benzene (C_6H_6),
 - (E) iodine (I_2).
14. For the reaction: $2\text{N}_2\text{O}_5(\text{g}) \rightarrow 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$ at the time when N_2O_5 is being consumed at a rate of $-1.2 \times 10^{-4} \text{ M/s}$, what is the rate at which O_2 is being formed?
- (A) $1.2 \times 10^{-4} \text{ M/s}$,
 - (B) $2.4 \times 10^{-4} \text{ M/s}$,
 - (C) $6.0 \times 10^{-5} \text{ M/s}$,
 - (D) $3.0 \times 10^{-5} \text{ M/s}$,
 - (E) $4.8 \times 10^{-4} \text{ M/s}$.
15. What is the value for K_c , if $[\text{CO}] = 0.025$, $[\text{H}_2] = 0.013$ and $[\text{CH}_3\text{OH}] = 0.0028$ for the reaction $\text{CH}_3\text{OH}(\text{g}) \rightleftharpoons \text{CO}(\text{g}) + 2 \text{H}_2(\text{g})$?
- (A) 1.5×10^{-3} ,
 - (B) 0.12,
 - (C) 6.6×10^2 ,
 - (D) 8.6,
 - (E) 9.1×10^{-7} .
16. Which of the following substances present in the chemical reaction would be excluded from the equilibrium constant expression?
- (A) $\text{Na}^+(\text{aq})$,
 - (B) $\text{H}_2\text{O}(\text{g})$,
 - (C) Cl ,
 - (D) $\text{H}_2\text{O}(\text{l})$ (reactant and solvent),
 - (E) $\text{CO}(\text{g})$.

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17. Choose the strongest acid.
(A) HF, (B) H_2CO_3 , (C) HCN, (D) $\text{HC}_2\text{H}_3\text{O}_2$, (E) HClO_4 .
18. How will addition of sodium chloride affect the pH of a HCl solution?
(A) It will lower the pH. (B) The pH will not change.
(C) The solution becomes hotter. (D) The pH cannot be measured.
(E) It will raise the pH.
19. What is the $[\text{H}_3\text{O}^+]$ of a solution measured to be 0.20 M in sodium acetate and 0.40 M in acetic acid?
[$K_a = 1.8 \times 10^{-5}$]
(A) 1.8×10^{-5} M, (B) 9.0×10^{-6} M, (C) 3.6×10^{-5} M, (D) 7.2×10^{-5} M, (E) 4.7 M.
20. If some NH_4Cl is added to an aqueous solution of NH_3 :
(A) the pH of the solution will increase,
(B) the pH of the solution will decrease,
(C) the solution will not have pH,
(D) the pH of the solution will not change,
(E) NH_4Cl cannot be added to NH_3 .

Part II: Multiple-choice, single answer (40%)

1. How many atoms of silicon are contained in 8.50×10^{-5} grams?
(A) 1.44×10^{23} atoms, (B) 1.82×10^{18} atoms,
(C) 5.02×10^{30} atoms, (D) 5.02×10^{18} atoms,
(E) 1.82×10^{20} atoms.
2. A 10.0 g sample of bismuth tribromide, BiBr_3 , contains:
(A) 5.360×10^{22} total number of ions, (B) 0.322 mol BiBr_3 ,
(C) 3.14×10^{22} formula units BiBr_3 , (D) 1.34×10^{22} bromide ions,
(E) 4.020×10^{22} total number of ions.
3. Which metal will produce the most hydrogen per gram of metal?
(A) $2 \text{Li} + 2 \text{HCl} \rightarrow 2 \text{LiCl} + \text{H}_2$,
(B) $\text{Sn} + 4 \text{HCl} \rightarrow \text{SnCl}_4 + 2 \text{H}_2$,
(C) $2 \text{Fe} + 6 \text{HCl} \rightarrow 2 \text{FeCl}_3 + 3 \text{H}_2$,
(D) $\text{Mg} + 2 \text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$,
(E) $2 \text{Cr} + 6 \text{HCl} \rightarrow 2 \text{CrCl}_3 + 3 \text{H}_2$.
4. Oxygen gas at 34.5°C is compressed from 45.7 L to 34.5 L against a constant pressure of 750 mmHg. What is the work done in joules by the system?
(A) 1.12×10^3 J, (B) -1.12×10^3 J, (C) 9.09×10^4 J, (D) -9.09×10^4 J, (E) 4.55×10^3 J.

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5. Which of the following has the largest radius?
(A) Cl, (B) Ar, (C) Sc^{3+} , (D) K^+ , (E) P^{3-} .
6. After drawing the Lewis dot structure of CH_2CCl_2 , pick the INCORRECT statement of the following.
(A) The C-C bond is a double bond.
(B) The H-C bonds are single bonds.
(C) The Cl-C bonds are single bonds.
(D) Each carbon has a lone pair.
(E) Each chlorine has three lone pairs.
7. A magnesium sulfate heptahydrate solution, which is 18.00% by weight in the anhydrous compound, has a density at 20°C of 1.20 g/mL. What is the molality of the anhydrous compound in the solution? (Atomic weights: H = 1.0, O = 16.0, S = 32.1, Mg = 24.3)
(A) 5.54 M, (B) 1.79 M, (C) 1.82 M, (D) 1.25 M, (E) 1.49 M.
8. Data for the reaction $\text{A} + \text{B} \rightarrow \text{C}$ are given below. Find the rate constant for this system.
(A) $2.8 \times 10^{-2} \text{ M}^{-1}\text{s}^{-1}$, (B) $2.8 \times 10^{-2} \text{ Ms}^{-1}$,
(C) $2.8 \times 10^{-2} \text{ M}^2\text{s}^{-1}$, (D) $1.7 \times 10^{-3} \text{ M}^{-1}\text{s}^{-1}$,
(E) $1.7 \times 10^{-3} \text{ Ms}^{-1}$.

Experiment	[A], M	[B], M	Initial rate, M/s
1	0.030	0.060	2.5×10^{-5}
2	0.030	0.020	2.5×10^{-5}
3	0.060	0.060	10.0×10^{-5}

9. For the reaction $2 \text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2 \text{SO}_3(\text{g})$, $K_c = 2.8 \times 10^2$ at 1000 K. If a vessel is filled with these gases such that the initial concentrations are $[\text{SO}_2] = 0.025$, $[\text{O}_2] = 0.035$, and $[\text{SO}_3] = 0.046$, in which direction will a reaction occur and why?
(A) toward products because $Q = 53$,
(B) toward reactants because $Q = 0.019$,
(C) toward products because $Q = 96$,
(D) toward reactants because $Q = 2.8 \times 10^3$,
(E) it is at equilibrium because $Q = 1$.
10. (I) CH_3COOH , (II) $[\text{Cu}(\text{H}_2\text{O})_4]^{2+}$, (III) H_2O , (IV) CH_3NH_2 , (V) H_3O^+ . Which are Brønsted-Lowry acid?
(A) (I), (II) and (III); (B) (II), (III), and (IV); (C) (I), (II), (III) and (IV);
(D) (I), (II), (III), and (V); (E) (II), (III) and (V).

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Periodic Table of the Elements†

	1																18					
	1A																8A					
1	1 H 1.00794	2 He 4.00260															13 3A	14 4A	15 5A	16 6A	17 7A	
2	3 Li 6.941	4 Be 9.01218															5 B 10.811	6 C 12.0107	7 N 14.0067	8 O 15.9994	9 F 18.9984	10 Ne 20.1797
3	11 Na 22.9898	12 Mg 24.3050	3 3B	4 4B	5 5B	6 6B	7 7B	8 8B			11 1B	12 2B	13 Al 26.9815	14 Si 28.0855	15 P 30.9738	16 S 32.065	17 Cl 35.453	18 Ar 39.948				
4	19 K 39.0983	20 Ca 40.078	21 Sc 44.9559	22 Ti 47.867	23 V 50.9415	24 Cr 51.9961	25 Mn 54.9380	26 Fe 55.845	27 Co 58.9332	28 Ni 58.6934	29 Cu 63.546	30 Zn 65.409	31 Ga 69.723	32 Ge 72.64	33 As 74.9216	34 Se 78.96	35 Br 79.904	36 Kr 83.798				
5	37 Rb 85.4678	38 Sr 87.62	39 Y 88.9059	40 Zr 91.224	41 Nb 92.9064	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.906	46 Pd 106.42	47 Ag 107.868	48 Cd 112.411	49 In 114.818	50 Sn 118.710	51 Sb 121.760	52 Te 127.60	53 I 126.904	54 Xe 131.293				
6	55 Cs 132.905	56 Ba 137.327	57-71 La-Lu		72 Hf 178.49	73 Ta 180.948	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.217	78 Pt 195.084	79 Au 196.967	80 Hg 200.59	81 Tl 204.383	82 Pb 207.2	83 Bi 208.980	84 Po (209)	85 At (210)	86 Rn (222)			
7	87 Fr (223)	88 Ra (226)	89-103 Ac-Lr		104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (277)	109 Mt (268)	110 Ds (271)	111 Rg (272)										
	*Lanthanide series		57 La 138.905	58 Ce 140.116	59 Pr 140.908	60 Nd 144.242	61 Pm (145)	62 Sm 150.36	63 Eu 151.964	64 Gd 157.25	65 Tb 158.925	66 Dy 162.500	67 Ho 164.930	68 Er 167.259	69 Tm 168.934	70 Yb 173.04	71 Lu 174.967					
	†Actinide series		89 Ac (227)	90 Th 232.038	91 Pa 231.036	92 U 238.029	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)					