

國立高雄大學 108 學年度研究所碩士班招生考試試題

科目：普通化學

系所：應用化學系

是否使用計算機：是

考試時間：100 分鐘

本科原始成績：100 分

參考資料：

一、元素週期表

1 H 1.00794																		2 He 4.002602	
3 Li 6.941	4 Be 9.012182											5 B 10.811	6 C 12.0107	7 N 14.00674	8 O 15.9994	9 F 18.9984032	10 Ne 20.1797		
11 Na 22.989770	12 Mg 24.3050											13 Al 26.981538	14 Si 28.0855	15 P 30.973761	16 S 32.066	17 Cl 35.4527	18 Ar 39.948		
19 K 39.0983	20 Ca 40.078	21 Sc 44.955910	22 Ti 47.867	23 V 50.9415	24 Cr 51.9961	25 Mn 54.938049	26 Fe 55.845	27 Co 58.933200	28 Ni 58.6534	29 Cu 63.545	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.92160	34 Se 78.96	35 Br 79.504	36 Kr 83.80		
37 Rb 85.4678	38 Sr 87.62	39 Y 88.90585	40 Zr 91.224	41 Nb 92.90638	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.90550	46 Pd 106.42	47 Ag 107.8682	48 Cd 112.411	49 In 114.818	50 Sn 118.710	51 Sb 121.760	52 Te 127.60	53 I 126.90447	54 Xe 131.29		
55 Cs 132.90545	56 Ba 137.327	57 La 138.9055	72 Hf 178.49	73 Ta 180.9479	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.217	78 Pt 195.078	79 Au 196.96655	80 Hg 200.59	81 Tl 204.3833	82 Pb 207.2	83 Bi 208.98038	84 Po (209)	85 At (210)	86 Rn (222)		
87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 (269)	111 (272)	112 (277)		114 (289) (287)		116 (289)		118 (293)		

58 Ce 140.116	59 Pr 140.90765	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.964	64 Gd 157.25	65 Tb 158.92534	66 Dy 162.50	67 Ho 164.93032	68 Er 167.26	69 Tm 168.93421	70 Yb 173.04	71 Lu 174.967
90 Th 232.0381	91 Pa 231.035888	92 U 238.0289	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)

二、理想氣體常數，亞佛加厥常數，法拉第常數

$$R = 8.314 \text{ J/mol} \cdot \text{K} = 0.0821 \text{ L} \cdot \text{atm/K} \cdot \text{mol}; \text{ Avogadro's number} = 6.022 \times 10^{23}$$

$$F = 96500 \text{ C/mol } e^-$$

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一、 選擇題 (每題四分，共八十分)

1. Give the number of protons (p), neutrons (n), and electrons (e) in one atom of ^{238}U .
(A) 146 p, 92 n, 92 e
(B) 92 p, 146 n, 92e
(C) 146 p, 28 n, 146 e
(D) 238 p, 146 n, 238 e
2. An unknown compound with a molar mass of 155.06 g/mol consists of 46.47% C, 7.80% H, and 45.72% Cl. Find the molecular formula for the compound.
(A) $\text{C}_3\text{H}_6\text{Cl}$
(B) $\text{C}_9\text{H}_{18}\text{Cl}_3$
(C) $\text{C}_6\text{H}_{12}\text{Cl}$
(D) $\text{C}_6\text{H}_{12}\text{Cl}_2$
3. Determine the correct oxidation numbers for all three elements in $\text{Ca}(\text{ClO})_2$ in the order that the elements are shown in the formula?
(A) -2, +2, -1
(B) +2, -3, +2
(C) +2, -2, +1
(D) +2, +1, -2
4. If equal masses of $\text{O}_2(\text{g})$ and $\text{HBr}(\text{g})$ are in separate containers of equal volume and temperature, which one of these statements is *true*?
(A) The pressures of both gases are the same.
(B) The average kinetic energy of HBr molecules is greater than that of O_2 molecules.
(C) The average velocity of the O_2 molecules is less than that of the HBr molecules.
(D) The pressure in the O_2 container is greater than that in the HBr container.
5. Which of the following is consistent with a *spontaneous* process in the *forward* direction?
(A) $\Delta S_{\text{univ}} > 0$, $\Delta G < 0$, $T\Delta S_{\text{univ}} < 0$
(B) $\Delta S_{\text{univ}} < 0$, $\Delta G > 0$, $T\Delta S_{\text{univ}} < 0$
(C) $\Delta S_{\text{univ}} < 0$, $\Delta G < 0$, $T\Delta S_{\text{univ}} < 0$
(D) $\Delta S_{\text{univ}} > 0$, $\Delta G < 0$, $T\Delta S_{\text{univ}} > 0$

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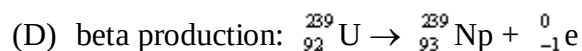
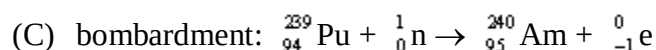
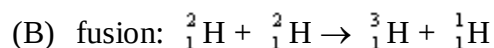
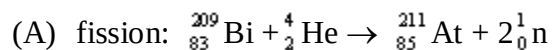
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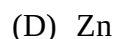
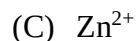
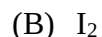
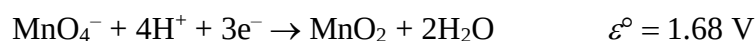
考試時間：100 分鐘

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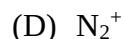
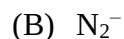
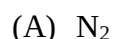
6. Which of the following balanced equations is labeled *incorrectly*?



7. Which of the following is the strongest oxidizing agent?



8. Which of the following has the largest bond order? (4 points)



9. How many of the following molecules have all of their atoms in the same plane?



10. For which of the following compound(s) are *cis* and *trans* isomers possible?



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- (B) 3-methyl-2-pentene
- (C) 4,4-dimethylcyclohexanol
- (D) *ortho*-chlorotoluene

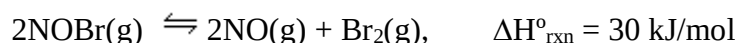
11. Which of the following molecules has a net dipole moment?

- (A) CO₂
- (B) SO₂
- (C) C₆H₆
- (D) SF₆

12. For the reaction $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$, $K_c = 50.2$ at 445°C. If $[\text{H}_2] = [\text{I}_2] = [\text{HI}] = 1.75 \times 10^{-3} \text{ M}$ at 445°C. Which of the following is true based on the above?

- (A) $Q_c > K_c$, the reaction proceeds from left to right to reach equilibrium
- (B) $Q_c < K_c$, the reaction proceeds from left to right to reach equilibrium
- (C) $Q_c > K_c$, the reaction proceeds from right to left to reach equilibrium
- (D) $Q_c = K_c$, the reaction is currently at equilibrium

13. For the following reaction at equilibrium, which change will cause the equilibrium to shift to the *left*?



- (A) Increase the container volume.
- (B) Remove some NO.
- (C) Decrease the temperature.
- (D) Add more NOBr.

14. A first-order reaction is 45% complete at the end of 43 minutes. What is the length of the half-life of this reaction?

- (A) 37 min
- (B) 2.7 h
- (C) 50 min
- (D) 62 min

15. Which of the following ground-state ions has the largest number of unpaired electrons?

- (A) Cr²⁺
- (B) Ni²⁺

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(C) Mn^{2+}

(D) Co^{2+}

16. Consider the weak bases below and their K_b values:

$\text{C}_6\text{H}_7\text{O}$ $K_b = 1.3 \times 10^{-10}$

$\text{C}_2\text{H}_5\text{NH}_2$ $K_b = 5.6 \times 10^{-4}$

$\text{C}_5\text{H}_5\text{N}$ $K_b = 1.7 \times 10^{-9}$

Arrange the conjugate acids of these weak bases in order of *increasing* acid strength.

(A) $\text{C}_5\text{H}_5\text{NH}^+ < \text{C}_6\text{H}_7\text{OH} < \text{C}_2\text{H}_5\text{NH}$

(B) $\text{C}_6\text{H}_7\text{OH} < \text{C}_5\text{H}_5\text{NH}^+ < \text{C}_2\text{H}_5\text{NH}$

(C) $\text{C}_2\text{H}_5\text{NH}_3^+ < \text{C}_5\text{H}_5\text{NH}^+ < \text{C}_6\text{H}_7\text{OH}$

(D) $\text{C}_6\text{H}_7\text{OH} < \text{C}_2\text{H}_5\text{NH}_3^+ < \text{C}_5\text{H}_5\text{NH}^+$

17. Given the following K_{sp} values, which statement about solubility in mol/L in water is correct?

	K_{sp}		K_{sp}
PbCrO_4	2.0×10^{-16}	Pb(OH)_2	1.2×10^{-15}
Zn(OH)_2	4.5×10^{-17}	MnS	2.3×10^{-13}

(A) PbCrO_4 , Zn(OH)_2 , and Pb(OH)_2 have equal solubilities in water.

(B) MnS has the highest molar solubility in water.

(C) PbCrO_4 has the lowest solubility in water.

(D) A saturated PbCrO_4 solution will have a higher $[\text{Pb}^{2+}]$ than a saturated Pb(OH)_2 solution.

18. Two well-known complex ions containing Ni are $[\text{Ni(H}_2\text{O)}_6]^{2+}$, which is green, and $[\text{Ni(en)}_3]^{2+}$, which is purple. Which one of these statements is true?

(A) The crystal field splitting energy (Δ) is greater for $[\text{Ni(en)}_3]^{2+}$ than for $[\text{Ni(H}_2\text{O)}_6]^{2+}$.

(B) $[\text{Ni(en)}_3]^{2+}$ absorbs energy in the red region of the spectrum.

(C) Both complex ions are diamagnetic.

(D) $[\text{Ni(H}_2\text{O)}_6]^{2+}$ transmits light with wavelengths of approximately 650–700 nm.

19. The molecule $\text{CH}_2\text{ClCHClBr}$ has how many chiral centers?

(A) 3

(B) 2

(C) 1

(D) 0

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20. What monomer(s) is (are) needed to make the polymer shown below?



(A) II and III

(B) II and IV

(C) I and II

(D) I and IV

二、 非選擇題 (共二十分)

1. A 9.56 g piece of solid CO_2 (dry ice) is allowed to sublime in a balloon. The final volume of the balloon is 1.00 L at 302 K. What is the pressure of the gas? (**5 points**)

2. Draw all possible isomers for the molecule formula of C_4H_8 . (**5 points**)

3. Calculate the molar solubility of CaF_2 in a 0.25 M solution of NaF(aq) . ($K_{\text{sp}}(\text{CaF}_2) = 4.0 \times 10^{-11}$) (**5 points**)

4. Calculate ΔG° for the following electrochemical cell: (**5 points**)

