

臺灣綜合大學系統 114 學年度學士班轉學生聯合招生考試試題

科目名稱	普通化學 A	類組代碼	共同考科
		科目碼	E0017

※本項考試依簡章規定所有考科均「不可」使用計算機。 本科試題共計 2 頁

計算及問答題：(100 分)

- (16 points) 25.0 kilograms of nitrogen gas and 5.00 kilograms of hydrogen gas are mixed and reacted to form ammonia.
 - (4 points) Write and balance the reaction.
 - (2 points) Which one is the limiting reagent?
 - (5 points) How many grams of ammonia will form?
 - (5 points) How many grams of excess reagent remain?
- (17 points total) Given the following equation:

$$\text{Al}_{(s)} + \text{MnO}_4^{-}{}_{(aq)} \rightarrow \text{MnO}_{2(s)} + \text{Al}(\text{OH})_4^{-}{}_{(aq)}$$
 - (1 point) What is the oxidizing agent?
 - (1 point) What element is reduced?
 - (5 points) Balance the reduction half reaction in acidic solution.
 - (5 points) Balance the oxidation half reaction in acidic solution.
 - (5 points) Balance the overall reaction in basic solution.
- (20 points) Draw the most stable Lewis structure (with the formal charge of each atom minimized) for the following molecules or ions. Please also indicate the shape of the molecule or the ions.
 - O_2
 - NO_3^{-}
 - SO_3
 - XeO_3
- (10 points) Consider the galvanic cell based on the following half-reactions, determine the overall cell reaction and calculate E° .

$$\text{Fe}^{2+}{}_{(aq)} + 2 e^{-} \rightarrow \text{Fe}_{(s)} \quad E^\circ = -0.44 \text{ V}$$

$$\text{Zn}^{2+}{}_{(aq)} + 2 e^{-} \rightarrow \text{Zn}_{(s)} \quad E^\circ = -0.76 \text{ V}$$
- (10 points) The heat combustion of acetylene, $\text{C}_2\text{H}_{2(g)}$, at 25°C , is -1299 kJ/mol . At this temperature, the enthalpy of formation (ΔH°_f) for $\text{CO}_{2(g)}$ and $\text{H}_2\text{O}_{(l)}$ are -393 and -286 kJ/mol , respectively. Calculate ΔH°_f for acetylene.
- (15 points) For O_2 , O_2^{+} , and O_2^{-} , draw the molecular orbital (MO) diagram, fill in the electrons and calculate the bond order for each. Which one has the strongest bond? Please draw clearly to receive full credit. For your convenience, you can draw only one MO diagram, but you must clearly indicate the electrons for each molecule and ions.
- (12 points) Draw all the geometrical isomers of $[\text{Cr}(\text{en})(\text{NH}_3)_2\text{BrCl}]^{+}$ (en = ethylenediamine). Which of these isomers also has an optical isomer? Please draw clearly to receive full credit. Circle the one that has an optical isomer and draw the optical isomer also.

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1 H 1.008																	2 He 4.003
3 Li 6.94	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.63	33 As 74.92	34 Se 78.97	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.95	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	57/71	72 Hf 178.5	73 Ta 180.9	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89/103	104 Rf (267)	105 Db (268)	106 Sg (271)	107 Bh (272)	108 Hs (270)	109 Mt (276)	110 Ds (281)	111 Rg (280)	112 Cn (285)	113 Nh (284)	114 Fl (289)	115 Mc (288)	116 Lv (293)	117 Ts (294)	118 Og (294)

57 La 138.9	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.2	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.2	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
89 Ac (227)	90 Th 232.0	91 Pa 231.0	92 U 238.0	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)