

國立彰化師範大學 99 學年度碩士班招生考試試題

系所：科學教育研究所

組別：丙組

科目：普通化學

☆☆請在答案紙上作答☆☆

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一. 單選題 (60%)

1. Consider the numbers 23.68 and 4.12. The sum of these numbers has ____ significant figures, and the product of these numbers has ____ significant figures.
(A) 3, 3 (B) 4, 4 (C) 3, 4 (D) 4, 3 (E) none of these
2. Given reaction $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$, you mix 1 mol each of nitrogen and hydrogen gases under the same conditions in a container fitted with a piston. Calculate the ratio of volumes of the container ($V_{\text{final}}/V_{\text{initial}}$).
(A) 0.67 (B) 1.00 (C) 1.33 (D) 1.50 (E) none of these
3. Calculate the ratio of the effusion rates of N_2 and N_2O .
(A) 0.637 (B) 1.57 (C) 1.25 (D) 0.798 (E) 1.61
4. Which of the following statements correctly describes the signs of q and w for the following exothermic process at $P = 1 \text{ atm}$ and $T = 370 \text{ K}$?
$$\text{H}_2\text{O}(g) \rightarrow \text{H}_2\text{O}(l)$$

(A) q and w are negative. (B) q is positive, w is negative.
(C) q is negative, w is positive. (D) q and w are both positive.
(E) q and w are both zero.
5. Which of the following atoms would have the largest second ionization energy?
(A) Mg (B) Cl (C) S (D) Ca (E) Na
6. What is the correct order of the following bonds in terms of decreasing polarity?
(A) N-Cl, P-Cl, As-Cl (B) P-Cl, N-Cl, As-Cl (C) As-Cl, N-Cl, P-Cl
(D) P-Cl, As-Cl, N-Cl (E) As-Cl, P-Cl, N-Cl
7. According to VSEPR theory, which of the following species has a square planar molecular structure?
(A) TeBr_4 (B) BrF_3 (C) IF_5 (D) XeF_4 (E) SCl_2
8. The hybridization of the central atom in XeF_5^+ is:
(A) sp (B) sp^2 (C) sp^3 (D) dsp^3 (E) d^2sp^3
9. How many of the following: F_2 , B_2 , O_2 , N_2 , are paramagnetic?

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- (A) 0 (B) 1 (C) 2 (D) 3 (E) 4
10. If the reaction $2\text{HI} \rightarrow \text{H}_2 + \text{I}_2$ is second order, which of the following will yield a linear plot?
(A) $\log [\text{HI}]$ vs time (B) $1/[\text{HI}]$ vs time (C) $[\text{HI}]$ vs time
(D) $\ln [\text{HI}]$ vs time (E) None of these.
11. Which of the following nuclides is the most stable one?
(A) ^{56}Fe (B) ^{18}O (C) ^{235}U (D) ^2H .
12. The 2 most abundant elements in the earth's crust, oceans and atmosphere are:
(A) O and H (B) Si and Fe (C) Ca and Mg (D) O and Si.
13. The boiling points for HF, HCl, HBr, HI should be:
(A) -85, -67, -35 and 20°C , (B) 20, -85, -67 and -35°C ,
(C) -35, -67, -85 and 20°C , (D) -67, -85, 20 and -35°C , respectively.
14. Which of the following belongs to the first row transition metals on the periodic table?
(A) Al (B) K (C) Li (D) Co.
15. Which one of the following boranes is unstable?
(A) BH_3 (B) B_2H_6 (C) B_5H_9 (D) B_4H_7 .
16. Which of the following belongs to the group 3A elements on the periodic table?
(A) Na (B) Mg (C) P (D) C.
17. When hard water is passed over a resin column, Ca^{2+} and Mg^{2+} ions bind to the resin and can be removed from water. What kind of resin is used in this process?
(A) anion-exchange (B) cation-exchange (C) molecular weight filtering (D) acid-base titration.
18. The bond order of nitric oxide (NO) is
(A) 1.0 (B) 1.5 (C) 2.0 (D) 2.5.
19. Which of the following nuclides is not radioactive?
(A) ^{14}C (B) ^{238}U (C) ^{131}I (D) ^{16}O .

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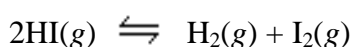
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20. Hybridization of the central atom in ion PF_6^- is:

- (A) sp^3 (B) d^2sp^3 (C) sp^2 (D) dsp^3 .

二. 計算與簡答 (40%)

1. In which direction will the position of the equilibrium be shifted for each the following changes?



- (1) $\text{H}_2(g)$ is added. (2%)
(2) In a rigid reaction container, some $\text{Ar}(g)$ is added. (2%)
(3) The temperature is decreased (the reaction is exothermic). (2%)

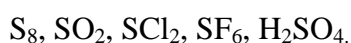
2. Although no currently known elements contain electrons in g orbitals in the ground state, it is possible that these elements will be found or that electrons in excited states of known elements could be in g orbitals. For g orbitals, the value of l (angular momentum quantum number) is 4.

- (1) What is the lowest value of n (principal quantum number) for which g orbitals could exist? (2%)
(2) What are the possible values of m_l (magnetic quantum number)? (2%)
(3) How many electrons could a set of g orbitals hold? (2%)

3. The table below lists the cell potentials for the 10 possible galvanic cells assembled from the metals A, B, C, D, and E, and their respective 1.00 M M^{2+} ions in solution. The standard reduction potential for A^{2+} ion is 0.00 V. When metal $\text{C}(s)$ is added to $\text{D}^{2+}(aq)$ solution, metal $\text{D}(s)$ comes out of solution. Using the information described above, calculate the standard reduction potential for each metal ion (B^{2+} , C^{2+} , D^{2+} , and E^{2+}). (8%)

	A(s) in $\text{A}^{2+}(aq)$	B(s) in $\text{B}^{2+}(aq)$	C(s) in $\text{C}^{2+}(aq)$	D(s) in $\text{D}^{2+}(aq)$
E(s) in $\text{E}^{2+}(aq)$	0.28 V	0.81 V	0.13 V	1.00 V
D(s) in $\text{D}^{2+}(aq)$	0.72 V	0.19 V	1.13 V	
C(s) in $\text{C}^{2+}(aq)$	0.41 V	0.94 V		
B(s) in $\text{B}^{2+}(aq)$	0.53 V			

4. Give the oxidation states for sulfur in the following compounds. (10%)



5. The half-life for the decay of strontium-90 is a constant 28.8 years. How many years will it take for a 6.0 g sample to decay to 0.75 g? (10%)