

國立臺灣大學九十三年學年度轉學生入學考試試題

科目：普通化學(B)

題號 :35

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※ 請在答案卷上標明題號依序作答

I. 選擇題 (單選題 12 題, 每題 4 分)

48%

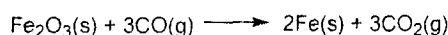
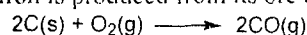
1. Which element does not belong to the family or classification indicated?

- (a) Br, halogen      (b) He, noble gas      (c) Fe, transition metal  
(d) K, alkali metal      (e) Se, Lanthanide

2. Which of the following is NOT the correct chemical formula for the compound named?

- (a) hydrocyanic acid      HCN      (b) calcium sulfate       $\text{CaSO}_4$   
(c) beryllium oxide      BeO      (d) nickel (II) peroxide       $\text{Ni}_2\text{O}$   
(e) ammonium chromate       $(\text{NH}_4)_2\text{CrO}_4$

3. Iron is produced from its ore by the reactions:



How many moles of  $\text{O}_2(\text{g})$  are needed to produce 1 mole of  $\text{Fe}(\text{s})$ ?

- (a) 0.5 mole  $\text{O}_2$       (b) 0.75 mole  $\text{O}_2$       (c) 1 mole  $\text{O}_2$   
(d) 1.5 mole  $\text{O}_2$       (e) none of above

4. Balance the reaction below in acidic solution.



What volume of 0.352 M HCl is needed to produce  $2.48 \times 10^{-3}$  moles of iodine,  $\text{I}_2$ , with an excess of  $\text{KIO}_3$  and  $\text{KI}$ ?

- (a) 2.48 mL      (b) 4.96 mL      (c) 7.05 mL      (d) 14.1 mL      (e) none of these

5. Which of the following relations is correct?

- (a)  $H = E - PV$       (b)  $H = G - TS$       (c) for a irreversible change  $dS_{\text{surr}} < dq/T$   
(d) for a reversible change  $dS_{\text{sys}} = dH_{\text{sys}}$   
(e) for an irreversible change  $\Delta S_{\text{sys}} + \Delta S_{\text{surr}} = 0$   
(f) at the phase transition  $\Delta S_{\text{sys}} = \Delta H/T$ .

6. Oxygen gas, generated by the reaction  $2\text{KClO}_3(\text{s}) \longrightarrow 2\text{KCl}(\text{s}) + 3\text{O}_2(\text{g})$ , is collected over water at 27 °C in a 2.00-L vessel at a total pressure of 760. torr. (The vapor pressure of  $\text{H}_2\text{O}$  at 27 °C is 26.0 torr.) How many moles of  $\text{KClO}_3$  were consumed in the reaction?

- (a) 0.0790 moles      (b) 0.119 moles      (c) 0.0527 moles  
(d) 0.0813 moles      (e) none of these

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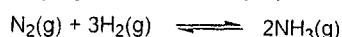
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7. Green light has a wavelength of  $5.50 \times 10^2$  nm. The energy of a photon of green light is

- (a)  $3.64 \times 10^{-38}$  J, (b)  $2.17 \times 10^5$  J, (c)  $3.61 \times 10^{-19}$  J, (d)  $1.09 \times 10^{-27}$  J, (e)  $5.45 \times 10^{12}$  J

8. Ammonia is prepared industrially by the reaction:



For the reaction,  $\Delta H = -92.2$  kJ and  $K$  (at  $25^\circ\text{C}$ ) =  $4.0 \times 10^8$ . When the temperature of the reaction is increased to  $500^\circ\text{C}$ , which of the following is true?

- (a)  $K$  for the reaction will be larger at  $500^\circ\text{C}$  than at  $25^\circ\text{C}$ ,  
(b) At equilibrium, more  $\text{NH}_3$  is present at  $500^\circ\text{C}$  than at  $25^\circ\text{C}$ ,  
(c) Product formation (at equilibrium) is not favored as the temperature is raised,  
(d) The reaction of  $\text{N}_2$  with  $\text{H}_2$  to form ammonia is endothermic.  
(e) None of the above is true.

9. Which of the following compounds has the lowest solubility in mol/L in water?

- (a)  $\text{Al}(\text{OH})_3$        $K_{\text{SP}} = 2 \times 10^{-32}$       (b)  $\text{CdS}$        $K_{\text{SP}} = 1.0 \times 10^{-28}$   
(c)  $\text{PbSP}_4$        $K_{\text{SP}} = 1.3 \times 10^{-8}$       (d)  $\text{Sn}(\text{OH})_2$        $K_{\text{SP}} = 3 \times 10^{-27}$   
(e)  $\text{MgC}_2\text{O}_4$        $K_{\text{SP}} = 8.6 \times 10^{-5}$

10. Which of the following will **NOT** make a buffered solution?

- (a) 100 mL of 0.1 M  $\text{Na}_2\text{CO}_3$  and 50 mL of 0.1 M HCl.  
(b) 100 mL of 0.1 M  $\text{NaHCO}_3$  and 25 mL of 0.2 M HCl.  
(c) 100 mL of 0.1 M  $\text{Na}_2\text{CO}_3$  and 75 mL of 0.2 M HCl.  
(d) 50 mL of 0.2 M  $\text{Na}_2\text{CO}_3$  and 5 mL of 1.0 M HCl.  
(e) 100 mL of 0.1 M  $\text{Na}_2\text{CO}_3$  and 50 mL of 0.1 M NaOH.

11. What is the probability of finding a particle in a one-dimensional box in energy level  $n = 4$  between  $x = L/4$  and  $x = L/2$ ? ( $L$  is the length of the box.)

- (a) 12.5%      (b) 25%      (c) 33%      (d) 37.5%      (e) 50%

12. For a particle in a cubic box, how many degenerate energy levels have energy equal to  $14h^2/8mL^2$ , in which  $L$  is the length of the cubic box.

- (a) 1, (b) 3, (c) 6, (d) 8, (e) 12

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II. 單選題，每題 3 分，答錯倒扣 1 分；共 10 題。 30%

- All fats are:  
(a) acids (b) alcohols (c) esters (d) ketones
- Which of the following pairs has the correct order of boiling point?  
(a)  $\text{HCl} > \text{HF}$  (b)  $\text{HCl} > \text{F}_2$  (c)  $\text{C}_3\text{H}_8 > \text{CH}_3\text{OCH}_3$  (d)  $\text{CH}_3\text{OCH}_3 > \text{C}_2\text{H}_5\text{OH}$
- Calcium (atomic weight = 40) crystallizes in a face-centered cubic lattice. The length of a unit cell edge is 556 pm. What is the density of calcium?  
(a) 0.39 (b) 0.77 (c) 1.55 (d) 2.32
- Which of the following is not a colligative property of solution?  
(a) density (b) boiling point (c) vapor pressure (d) osmotic pressure
- Pick the most basic oxide in aqueous solution.  
(a)  $\text{BeO}$  (b)  $\text{BaO}$  (c)  $\text{SO}_3$  (d)  $\text{Al}_2\text{O}_3$
- Choose the element that is the strongest reducing agent in aqueous solution.  
(a) Li (b) Na (c) K (d) Cs
- Which of the following species is diamagnetic? ( $\text{CN}^-$  is strong field)  
(a)  $[\text{Ti}(\text{CN})_6]^{3-}$  (b)  $[\text{Cr}(\text{CN})_6]^{3-}$  (c)  $[\text{Co}(\text{CN})_6]^{3-}$  (d)  $[\text{Ni}(\text{CN})_6]^{4-}$
- An element common to brass and bronze is  
(a) Pb (b) Sn (c) Ni (d) Cu
- Electron capture transforms  ${}^7_4\text{Be}$  into what nuclide?  
(a)  ${}^6_4\text{Be}$  (b)  ${}^7_5\text{B}$  (c)  ${}^6_5\text{B}$  (d)  ${}^7_3\text{Li}$
- Which of the following yields a primary alcohol upon reduction?  
(a) a ketone (b) an amine (c) an ether (d) an aldehyde

III. Answer the following questions for  $\text{XeO}_3$ . 10%

- Draw its Lewis structure with the least formal charges
- Assign the formal charges to each atom
- Give the hybrid-orbital used for the central atom.
- What is its geometric shape?

IV. If the initial rate for the second-order reaction:  $2\text{A} \rightarrow \text{B}$  is  $1.0 \times 10^{-6} \text{ M}\cdot\text{s}^{-1}$  for  $[\text{A}]_0 = 0.01 \text{ M}$  at  $25^\circ\text{C}$ , answer the following questions. 12%

- Find the rate constant and the half-life for this reaction.
- What is the concentration of B after 10 minutes?
- If the activation energy is  $40 \text{ kJ}\cdot\text{mol}^{-1}$ , what will be the initial rate at  $50^\circ\text{C}$  for the same reaction? (gas constant  $R = 8.314 \text{ J}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}$ )

試題必須隨卷繳回