

2009年度日本政府(文部科学省)奨学金留学生選考試験

QUALIFYING EXAMINATION FOR APPLICANTS FOR JAPANESE  
GOVERNMENT (MONBUKAGAKUSHO) SCHOLARSHIPS 2009

学科試験 問題

EXAMINATION QUESTIONS

(学部留学生)

UNDERGRADUATE STUDENTS

化 学

CHEMISTRY

注意 ☆試験時間は60分。

PLEASE NOTE : THE TEST PERIOD IS 60 MINUTES.

CHEMISTRY

Nationality		No.		Marks	
Name	(Please print full name, underlining family name)				

I Write the reference number of the correct answer in the answer box.

(Atomic weights : H : 1.0, C : 12.0, N : 14.0, O : 16.0, and S : 32.0)

(1) In the solid state which of the following substances 1) to 5) forms a molecular crystal?

- 1) sodium chloride      2) carbon dioxide      3) silicon dioxide  
4) iron                      5) diamond

(2) Give the name of the gas formed by adding concentrated hydrochloric acid to manganese(IV) oxide and heating.

- 1) chlorine      2) hydrogen      3) oxygen      4) ozone

(3) There is an aqueous solution containing  $\text{Cu}^{2+}$  and  $\text{Pb}^{2+}$  ions. The most suitable reagent to precipitate one of the two ions from the solution is

- 1) nitric acid                      2) sodium carbonate  
3) sulfuric acid                      4) hydrogen sulfide

(4) A mixed gas of 4.0 l composed of gas A (molecular weight 4.0) and gas B (molecular weight 20) at  $0^\circ\text{C}$  and 1-atm pressure has a mass of 3.0 g. What is the molar ratio (gas A) : (gas B) in this mixture?

- 1) 1:4      2) 1:3      3) 1:2      4) 1:1      5) 2:1      6) 3:1      7) 4:1

(5) In the electrolysis of an aqueous solution of sodium nitrate using platinum electrodes, 0.50 faradays of electrical charge was passed through the solution. How many grams of gas evolved at the anode?

- 1) 1.0                      2) 2.0                      3) 4.0                      4) 8.0  
 5) 16                        6) 23                        7) 32                        8) 46

(6) Which of the aqueous solutions of the compounds 1) to 5) is acid?

- 1)  $K_2CO_3$       2)  $KCl$       3)  $Na_2SO_4$       4)  $NH_4Cl$       5)  $NaHCO_3$

(7) There are three metals A, B, and C. Read a) and b), and arrange A, B, and C in order of decreasing ionization tendency.

- a) A dissolves in dilute nitric acid, but B does not.  
 b) C reacts with water at room temperature, but A and B do not.

- 1)  $A > B > C$                       2)  $A > C > B$                       3)  $B > A > C$   
 4)  $B > C > A$                       5)  $C > A > B$                       6)  $C > B > A$

(8) The addition of aqueous solutions of (a) ammonia, (b) ammonium sulfide, and (c) potassium hexacyanoferrate(II) to an aqueous solution containing  $Fe^{3+}$  each produce precipitate. What is the color of the precipitate?

- 1) white      2) black      3) green      4) light blue      5) dark blue  
 6) dark reddish-brown      7) purple      8) yellow

(1)	(2)	(3)	(4)	(5)
(6)	(7)	(8)		
		(a)	(b)	(c)

II Calculate the pH of the solution that results upon mixing 10 ml of HCl solution with a pH of 1.0 with 40 ml of

- (a) 0.15 mol/l HCl solution.
- (b) 0.15 mol/l AgNO<sub>3</sub> solution.
- (c) 0.15 mol/l NaOH solution.

If necessary, use  $\log 2 = 0.30$ ,  $\log 3 = 0.48$ , and  $\log 7 = 0.85$ .

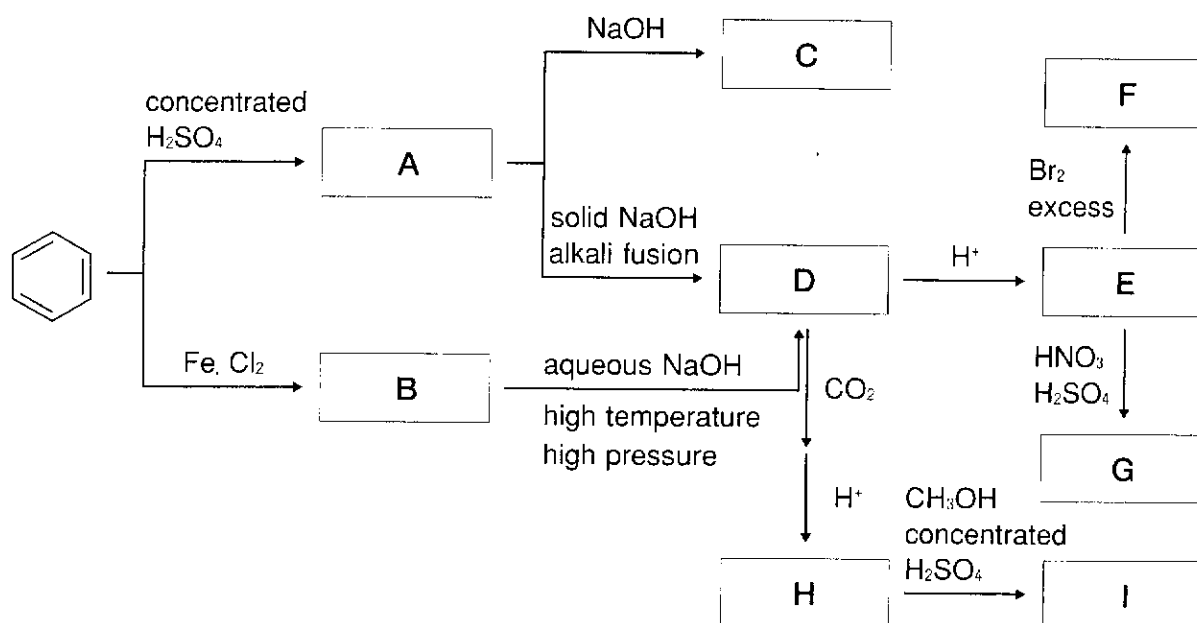
(a)		(b)		(c)	
-----	--	-----	--	-----	--

III The solubility of sodium sulfite (Na<sub>2</sub>SO<sub>3</sub>) is 27 (g/100 g-water) at 20°C. Answer the following questions (1) and (2). (Atomic weights : H : 1.0, O : 16.0, Na : 23.0, and S : 32.0)

- (1) What is the mass percent concentration of the saturated solution of Na<sub>2</sub>SO<sub>3</sub> at 20°C?
- (2) How many grams of Na<sub>2</sub>SO<sub>3</sub> · 7H<sub>2</sub>O is soluble in 50 g water at 20°C?

(1)		%	(2)		g
-----	--	---	-----	--	---

IV Outlined here are synthetic processes of some aromatic compounds. Select the structural formulas for the compounds **A** to **I** from ①~⑳.



- ①
- ②
- ③
- ④
- ⑤
- ⑥
- ⑦
- ⑧
- ⑨
- ⑩
- ⑪
- ⑫
- ⑬
- ⑭
- ⑮
- ⑯
- ⑰
- ⑱
- ⑳
- ㉑

A	B	C	D	E
F	G	H	I	

V Answer the questions (1) to (3).

(1) Which is correct as the nature of phenol? Select two from 1) to 6).

- 1) soluble in water, and neutral                      2) insoluble in water  
3) soluble in water, and acidic                      4) soluble in water, and basic  
5) undergoes silver mirror reaction  
6) shows blue and purple when treated with iron(III) chloride aqueous solution

(2) Which is correct as the nature of ethanol? Select one from 1) to 6).

- 1) soluble in water, and neutral                      2) insoluble in water  
3) soluble in water, and acidic                      4) soluble in water, and basic  
5) undergoes silver mirror reaction  
6) shows blue and purple when treated with iron(III) chloride solution

(3) What happens when phenol is treated with NaOH aqueous solution?

- 1) The product is soluble in water.                      2) The product is precipitated.  
3) Nothing happens.                      4) It turns blue.                      5) It turns yellow.

(1)	(2)	(3)

VI Which compound has geometrical isomers (*cis-trans* isomer)? Choose one from 1) to 6).

- 1)  $\text{CH}_2=\text{CH}-\text{COOCH}_3$                       2)  $\text{CH}_3-\text{CH}(\text{OH})-\text{COOCH}_3$   
3)  $\text{H}_3\text{COOC}-(\text{CH}_2)_3-\text{COOCH}_3$                       4)  $\text{CH}_2=\text{C}(\text{COOCH}_3)_2$   
5)  $\text{H}_3\text{COOC}-\text{CH}=\text{CH}-\text{COOCH}_3$                       6)  $\begin{array}{l} \text{H}_3\text{C} \\ \diagdown \\ \text{C}=\text{CH}_2 \\ \diagup \\ \text{H}_3\text{C} \end{array}$

- VII How many structural isomers does dichloropropane  $C_3H_6Cl_2$  have?
- VIII When propene  $C_3H_6$  undergoes addition of bromine  $Br_2$ , how many mol of  $Br_2$  can react with 1 mol of propene?
- IX A certain organic compound 8.96 g contains C 1.14 g, H 0.19 g, Br 7.63 g. What is the empirical equation of the compound? Use the following values for atomic weights : H : 1.00, C : 12.0, Br : 79.9.
- X Calculate the ratio of the weight of oxygen required for the complete combustion of 1 g of propane  $C_3H_8$  to that of 1 g of methane  $CH_4$ ?
- XI Nitration of 50 g of benzene gave 55 g of nitrobenzene. Calculate the yield.

VI	VII	VIII	IX	X	XI