

2006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 2006

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, O=16.0, and Na=23.0)

(1) The atom $^{13}_6\text{C}$ has

- | | | |
|----------------|-----------------|----------------|
| 1) 7 electrons | 2) 13 electrons | 3) 7 protons |
| 4) 13 protons | 5) 7 neutrons | 6) 13 neutrons |

(2) Which is the acid salt of which the aqueous solution is basic?

- | | | |
|-----------------------------|-----------------------------|-----------------------------|
| 1) NaHSO_4 | 2) Na_2SO_4 | 3) NaHCO_3 |
| 4) Na_2CO_3 | 5) $\text{Mg}(\text{OH})_2$ | 6) $\text{MgCl}(\text{OH})$ |

(3) Arrange the ions H^+ , OH^- , and Na^+ in order of decreasing molar concentration in the solution that results when 200ml of 0.1mol/l sodium hydroxide solution is mixed with 100ml of 0.1mol/l hydrochloric acid.

- | | | |
|---|---|---|
| 1) $\text{H}^+ > \text{OH}^- > \text{Na}^+$ | 2) $\text{H}^+ > \text{Na}^+ > \text{OH}^-$ | 3) $\text{OH}^- > \text{H}^+ > \text{Na}^+$ |
| 4) $\text{OH}^- > \text{Na}^+ > \text{H}^+$ | 5) $\text{Na}^+ > \text{H}^+ > \text{OH}^-$ | 6) $\text{Na}^+ > \text{OH}^- > \text{H}^+$ |

(4) In the solid state the combination of molecular crystals is

- 1) sodium chloride, carbon dioxide
- 2) carbon dioxide, diamond
- 3) diamond, naphthalene
- 4) sodium chloride, diamond
- 5) carbon dioxide, naphthalene
- 6) sodium chloride, naphthalene

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

- 1) aqueous ammonia
- 2) aqueous hydrogen sulfide
- 3) aqueous sodium hydroxide
- 4) hydrochloric acid
- 5) nitric acid

(6) Give the name of the gas formed by adding dilute sulfuric acid to iron sulfide FeS and heating.

- 1) hydrogen
- 2) hydrogen sulfide
- 3) sulfur dioxide
- 4) sulfur trioxide

(7) A sample of pure rubidium metal weighing 3.000g was quantitatively converted to 3.280g of pure rubidium oxide Rb_2O . What is the atomic weight of rubidium?

- 1) 85.7
- 2) 93.7
- 3) 171
- 4) 187
- 5) 343
- 6) 375

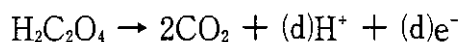
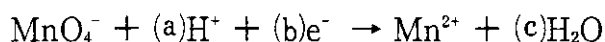
(8) The solubility of sodium carbonate in 100g water is 25.0g at 22°C . How many grams of the hydrate $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ can be dissolved in 100g of water at 22°C ?

- 1) 0.556g
- 2) 0.762g
- 3) 9.27g
- 4) 67.5g
- 5) 81.7g
- 6) 117g

(1)		(2)		(3)		(4)	
(5)		(6)		(7)		(8)	

II Answer the following questions (1) and (2).

(1) Balance the following reactions. Put the figures into the boxes (a) to (d).

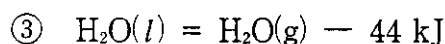
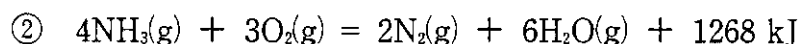
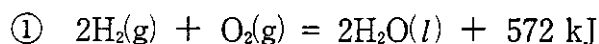


(2) A 0.320g sample of calcium oxalate CaC_2O_4 was dissolved in dilute sulfuric acid. Titration of the liberated $\text{H}_2\text{C}_2\text{O}_4$ required 20.0ml of a KMnO_4 solution. What is the concentration of the KMnO_4 solution? (Atomic weights; H=1.0, C=12.0, O=16.0, K=39.1, Ca=40.0, and Mn=54.9)

	a	b	c	d		
(1)					(2)	mol/l

III Answer the following questions (1) and (2).

(1) Calculate the heat Q (kJ) in the thermochemical reaction (A) using the equations ① to ③.



(2) If a mixture of the three components in the reaction; $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$ were in equilibrium, what would be the effect on the amount of NH_3 if (a) the temperatures were raised, keeping the pressure constant; (b) the mixture were compressed, keeping the temperature constant? Write the reference number of the correct answer in the answer box.

1) increase

2) decrease

3) no change

			(a)	(b)
(1)		(2)		

IV Answer the following questions concerning the molecular formula $C_4H_{10}O$.

- (1) How many constitutional isomers (structural isomers) have the molecular formula $C_4H_{10}O$?
- (2) How many alcohols have the molecular formula $C_4H_{10}O$?
- (3) How many ethers have the molecular formula $C_4H_{10}O$?
- (4) How many alcohols are active in the iodoform reaction?
- (5) How many alcohols do not react with $K_2Cr_2O_7$?

(1)	(2)	(3)	(4)	(5)

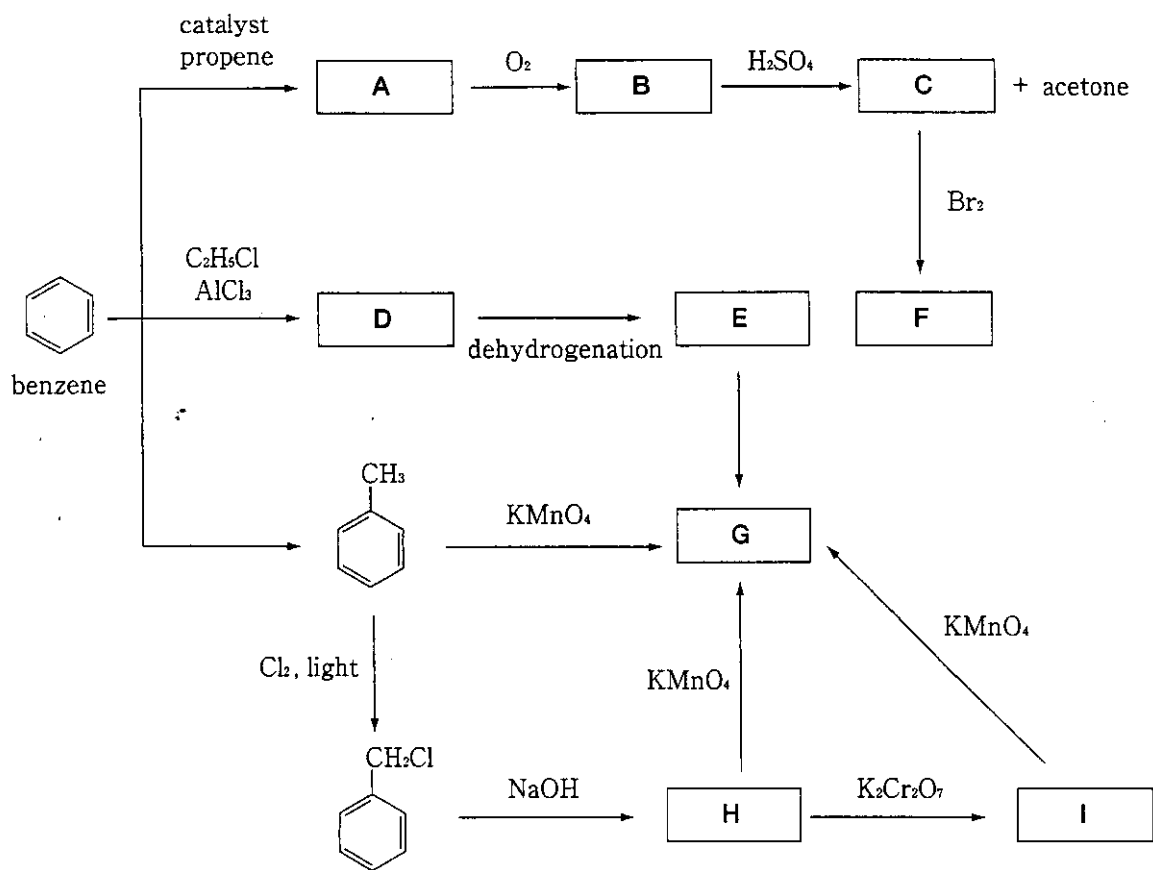
V Select the most appropriate reagent to distinguish each compound. The same answer cannot be used twice.

- (1) alcohols, ethers
- (2) aldehydes, ketones
- (3) carboxylic acids, esters

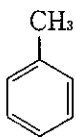
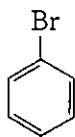
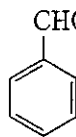
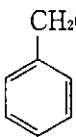
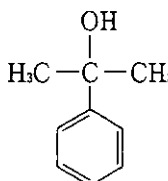
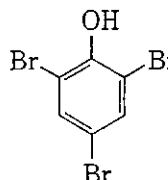
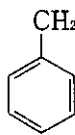
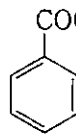
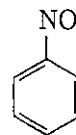
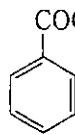
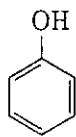
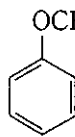
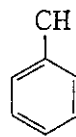
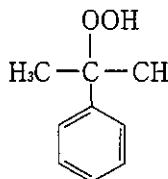
- | | | |
|------------------------|------------------------------|-------------------|
| a . glucose | b . sodium hydrogencarbonate | c . acetylene |
| d . sodium | e . ethylene | f . sulfuric acid |
| g . Fehling's solution | h . methane | i . ethanol |

(1)	(2)	(3)

VI Outlined here are synthetic processes of organic compounds. Select the structural formulas for the compounds **A** to **I** from (1)–(15).



A	B	C	D	E
F	G	H	I	

- (1)  (2)  (3)  (4)  (5) 
- (6)  (7)  (8)  (9)  (10) 
- (11)  (12)  (13)  (14)  (15) 