共/3 頁,第/頁 編號: 113. 國立成功大學九十八學年度碩士班招生考試試題 系所組別: 材料科學及工程學系 考試科目: B科目 考試日期:0307·節次:2 ※ 考生請注意:本試題 ☑可 □不可 使用計算機 B卷:普通化學(30 題[1-30], 每題 1 分)、材料熱力學(20 題[31-50], 每題 1.5 分)、有機化 學(20 題[51-70], 每題 1.5 分)。滿分 90 分。倒扣至零分為止。 科目名稱: 普通化學 每題為4選1,每一題答對得1分,答錯倒扣0.25分。 1. Which substance of the following reaction is oxidizing agent?  $2H_2O_2(1) \rightarrow 2H_2O(1) + O_2(g)$ none of the above  $\mathbb{C}$  H<sub>2</sub>O<sub>2</sub> (i)  $\mathfrak{B}$   $O_2(g)$  $\mathbb{A}$  H<sub>2</sub>O (1) 2. Which substance of the following reaction is reducing agent?  $SiCl_4(1) + 2H_2O(1) \rightarrow 4 HCl(aq) + SiO_2(s)$ none of the above © HCl(aq) A SiCl<sub>4</sub>(1) (B)  $H_2O(1)$ 3. A piece of Cu metal (1.06g) is placed in 250ml of 0.20M AgNO<sub>3</sub> solution. What would you expect to happen? A No reaction (B) produce brown precipitate D produce yellow gas © the Cu metal disappears 4. Rust stains (Fe<sub>2</sub>O<sub>3</sub>) can be removed by washing the surface with a dilute solution of oxalic acid (H<sub>2</sub>C<sub>2</sub>O<sub>4</sub>). Which of the following statements is correct? (A) This reaction is an oxidation-reduction reaction (B) The rust stains are reduced © The oxalic acid is oxidized ① There is no change in oxidation number of any element 5. The correlation between the equilibrium constant and the reaction rate is, A larger equilibrium constant gives rise to higher reaction rate B higher equilibrium constant gives rise to slower reaction rate © equilibrium constant and reaction rate are irrelevant D reaction rate is influenced by the equilibrium constant only at high temperature

6. The K<sub>a</sub> values are given in parenthesis for the following acids. HF (7.2×10<sup>-4</sup>), HNO<sub>2</sub> (4.0×10<sup>-4</sup>), HCN (6.2×10<sup>-10</sup>), NH<sup>4+</sup> (5.6×10<sup>-10</sup>). Which of the following sequence is correct?
 A Base strength F < NO<sub>2</sub> < H<sub>2</sub>O < CN<sup>-10</sup>

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	<b>B</b>	Base strength F	$> NO_2^- > H_2O > CN^-$		
	C		$I_2O < F^- < NO_2^- < CN^- <$	< NH₁	
	<b>©</b>		$1 < NO_2^- < H_2O < CN^- < 1$	<del>-</del>	
<b></b> (	7. Whi	ch of the followin	g electron configuration	es is correct?	
			B Cu <sup>+</sup> : [Ar]4s <sup>2</sup> 3d <sup>8</sup>		© V: [Ar]4s <sup>1</sup> 3d <sup>4</sup>
. 8			= 5.6×10 <sup>-10</sup> , K <sub>a</sub> (HCN) =	= 6.2×10 <sup>-10</sup> , the aqueo	ous solution of NH4CN will
	be,				
	A	) basic	® neutral	© acidic	not known
9	). Cons	sidering the reaction	on. CH <sub>1</sub> CO <sub>2</sub> H(aq) + H <sub>2</sub> t	$O(1) = CH_3CO_2^{-1}(aq) -$	$+ H_3O^+(aq) K_a=1.8\times10^{-5}$
			ng statements is incorrec		TIJO (uq) Isa 1.0010
			$O_2$ are competing for pro-		
			ger base than CH <sub>3</sub> CO <sub>2</sub>		
			er base than CH <sub>3</sub> CO <sub>2</sub>		
			competing for proton.		
1	0. Wh	ich of the followir	ng orbital designs is inco	orrect?	
		ls 1s	B lp	© 3d	<b>(1)</b> 4f
1	1. Reg	arding the chemic	al bonding, which of the	e following statement	ts is incorrect?
			volves sharing of electro		
			ves sharing of electron p	_	
			is the ability of an atom	•	ract electron
			and involves unequal sh		
1:	2. Whi	ich of the followin	gs is disproportional to	intermolecular force	7
	_	surface tension	® viscosity	© boiling point	vapor pressure
1:	3. The	glucose solution i	n water may exhibit		
	<b>(A)</b>	higher billing poin	nt than water		
	₿	lower boiling poin	nt than water		
	<b>©</b>	same boiling poin	ıt as water		
	<b>(</b>	lower boiling poi	int than water at < 1% c	concentration	
1/	∕ The	Lalamand annualism	0 4 2 0		
17	i. The	oalanced equation	for the reaction of gase	ous nitrogen dioxide	and fluorine is: 2NO <sub>2(g)</sub> +

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Face > 2NO.Fc	The experimentally determined rate law is: Rate=kINO	I(Fa) Which of the

 $F_{2(g)} \rightarrow 2NO_2F_{(g)}$ . The experimentally determined rate law is: Rate=k[NO<sub>2</sub>][F<sub>2</sub>]. Which of the following suggestion mechanism for this reaction is acceptable?

- (A)  $NO_2 + F_2 \rightarrow NO_2F + F$  (slow);  $F + NO_2 \rightarrow NO_2F$  (fast)
- **®** NO<sub>2</sub> + F<sub>2</sub> → NO<sub>2</sub>F + F (fast); F + NO<sub>2</sub> → NO<sub>2</sub>F (slow)
- $\bigcirc$  NO<sub>2</sub>+ F<sub>2</sub>  $\rightarrow$  NOF + OF (fast); NOF + OF + NO<sub>2</sub> $\rightarrow$  2NO<sub>2</sub>F (slow)
- $\bigcirc$  NO<sub>2</sub>+ F<sub>2</sub>  $\rightarrow$  NF<sub>2</sub> + O<sub>2</sub> (slow); NF<sub>2</sub> + O<sub>2</sub> + NO<sub>2</sub>  $\rightarrow$  2NO<sub>2</sub>F (fast)
- 15. Which one of the following descriptions is CORRECT?
  - A AgNO<sub>3(aq)</sub> + KCI<sub>(aq)</sub>  $\rightarrow$  AgCl<sub>(s)</sub> + KNO<sub>3(aq)</sub> is a precipitate reaction
  - (B)  $NaOH_{(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O$  is a oxidation-reduction reaction
  - $\bigcirc$  2Na<sub>(s)</sub> + Cl<sub>2(g)</sub>  $\rightarrow$  2NaCl<sub>(s)</sub> is an precipitate reaction
  - $\bigcirc$  CH<sub>4(g)</sub> +2O<sub>2(g)</sub>  $\rightarrow$  CO<sub>2(g)</sub> + 2H<sub>2</sub>O<sub>(g)</sub> is an acid-base reaction
- 16. Which one of the following descriptions about chemical bonds is CORRECT?
  - A Bonds are defined as forces that hold groups of molecules together and make the molecules functions as a unit.
  - B The energy that are required to break the bond is called the ionization energy.
  - © Ionic bond are formed when an atom that loses electrons relatively easily reacts with an atom that has low affinity for electrons.
  - © Covalent bond are formed in the hydrogen molecule and in many other molecules in which electrons are shared by nuclei.
- 17. Which one of the following hybrid orbital is NOT possible for carbon atom in a molecule?
  - A sp hybridization

B sp² hybridization

© sp<sup>3</sup> hybridization

- D dsp<sup>3</sup> hybridization
- 18. The infrared spectrum of gaseous CH<sub>4</sub>, CO<sub>2</sub>, C<sub>2</sub>H<sub>2</sub> and H<sub>2</sub>O shows the υ=0 to υ=1 transition at 2850 cm<sup>-1</sup>, 1690 cm<sup>-1</sup>, 1640 cm<sup>-1</sup> and 3610 cm<sup>-1</sup>, respectively. Which one of the following sequence of force constant for the corresponding bond is CORRECT?
  - $\triangle$  C-H > C=O > C=C > O-H
- © C=C > C-O > C-H > O-H
- © C=C > C-O > O-H > C-H
- 19. Consider the following elements, which one of the following sequences of first ionization energy is NOT correct?
  - $\triangle$  He > Ne > Ar > Kr

B N > C > B > Be

© Ne > Mg > Na

H > Li > Na > K

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·	20.3	Which one of	the following m	antonulo in oum	acted to have a di-	ala a a+0	
	20.	CCl <sub>4</sub>			ected to have a di	_	
		W CC14	® SC		© CO₂		
	21. 1	In the reaction	n: CH <sub>4</sub> (g) + 2O <sub>2</sub>	$_{2}(g) \rightarrow CO_{2}(g)$	) + 2H <sub>2</sub> O (g), whi	ich of the followi	ng statement is
	i	incorrect?			•		
		A The oxid	ation state of O	changed from	0 to -2		
		B The oxid	ation state of C	changed from	-4 to +4		
		© CH <sub>4</sub> is th	e oxidizing age	nt			
		① Oxygen	s reduced				
	22. /	About the pro	perties of H <sub>2</sub> O,	which of the fo	ollowing is <b>incorr</b>	ect?	
		A It is amp			<del>-</del>	nds forms an ang	gle of 120°
		© Its IUPA	C name is oxida	ne	① It's a polar r	_	
	23. 7	Γhe pH value	of a 2.0 M solut	tion of CH <sub>1</sub> NH	$k_2$ is $(k_b = 4.38 \times 10^{-5})$	) <sup>-4</sup> ):	
		(A) 12.17	<b>®</b> 13		© 10.28	① 1.68	
			0		© 10. <b>2</b> 0	<b>©</b> 1.00	
	24. <i>A</i>	About atomic	radius, which of	f the following	is true?		
		A Be < C	B Si	> Na	© Mg > Ca	$\bigcirc$ Al > C	SI .
	25. V	Which one of	the following de	escriptions on t	the galvanic cells	is <b>correct</b> ?	
					ons or a decrease i		per.
		_			zing agent to the		i
		© A galvani	c cell is a device	e in which che	mical energy is ch	nanged to electric	al energy.
			occurs at the ca		<b></b>	J	3,
	26. V	Which one of	the following de	escriptions on a	acids and bases is	correct?	
					s solution, and ac		oxides ions.
					mains of the acid		
					ated in aqueous so		•
					dissociation at eq		
	27 V	Which one of	the following de	escriptions on s	icid strength (for a	a week enid HA a	and its
		· made one of	are rouse as and	seribaons on c	era anerikni (101 s	a wear acid life a	uru 1tə

® For weak acid, equilibrium concentration of H<sup>+</sup> is comparable with original

conjugate base A') is **correct**?

(A) For weak acid,  $K_a$  is large.

concentration of HA.

113 共 /3頁,第4頁 國立成功大學九十八學年度碩士班招生考試試題 系所組別: 材料科學及工程學系

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- © For weak acid, the strength of conjugate base is much weaker base than H<sub>2</sub>O.
- ① The value of  $K_a$ , HSO<sub>4</sub> > NH<sub>4</sub><sup>+</sup>.
- 28. Which one of the following descriptions on the electrochemical cells is correct?
  - A The thermodynamic driving force is defined in terms of a cell potential difference between two points in the circuit.
  - B) When current flows, some energy is inevitably wasted through frictional heating, so the maximum work is obtained.
  - © The entropy of the universe must decrease in any spontaneous process.
  - D We can never achieve the maximum work through the actual discharge of a galvanic cell, so we cannot measure the maximum potential.
- 29. A species with an unpaired electron is called
  - (A) a dissociated ion

- (B) a negatively charged particle
- © a covalently bonded species
- (D) a free radical
- 30. Which one of the following chemical properties is not from metals?
  - A To lose electron(s) to become cations
  - B to react with non-metals to form ionic compounds
  - © to react with non-metals to form covalent compounds
  - ① to mix with other metals to form solid solutions (alloys).

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	科目名稱: 材料熱力學				
	每題為4選1,每一題答對得1.5分,答錯倒	1 <del>1</del>	1375 △ 。		
	Acronyms: R=gas constant, T=temperature, V=v	•	• •	enerav	
	H=enthalpy; G=Gibbs free energy; A=Helmholt:			= :	
	C <sub>p</sub> =heat capacity at constant pressure; C <sub>v</sub> =heat c			i, w work,	
	Gas constant: R= 8.314 J/mol-K=0.082 l-atm/mol-K		ily at tolibalit volume.		
	31. The number of ways in which the particles ca	an h	digtributed in gness is rele	tad ta tha	
•	concept of the thermodynamic property:	all U	distributed in space is reta	ied to the	
	thermal entropy	(B)	degree of mixed-up-ness		
	© enthalpy	_	configuration entropy		
	32. The internal energy of two moles of ideal gas	e ie a	function of		
	A pressure	_	volume		
	© heating history	_	product of pressure and vol	lume	
	•		•		
	33. In a reversible process, what is commonly ob	serv	ed		
	A heat flow is not needed	₿	work done may vary		
	© process is slow	<b>(</b>	all of above is correct		
	34. A gas in a container was freely expanded who	en co	onnected to a vacuum cham	ber. Then, the	
	free expansion process of this gas			,	
	(A) is highly irreversible	₿	results in no work done		
	© results in significant increase in entropy	<b>D</b>	all of above is correct		
	35. When a process is described as very irrevers	sible	means the process		
	(A) is very exothermic		is very endothermic		
	© is very reactive		results the significant incre	ase of entropy	
	36. Two identical gases (labeled A and B) with sa	ame o	conditions (temperature, vol	lume and	
	pressure) have gone through isothermal (for				
	pressure is the same. Then, compare the final		· · · · · · · · · · · · · · · · · · ·		
	A has larger volume and higher temperat				

(B) A has larger volume and lower temperature(C) B has larger volume and higher temperature

編號: 113 國立成功大學九十八學年度碩士班招生考試試題 共13頁,第7頁 系所組別: 材料科學及工程學系 考試科目: B科目 考試日期:0307,節次:2 ※ 考生請注意:本試題 ☑可 □不可 使用計算機 D B has larger volume and lower temperature 37. When a piece of steel A with temperature of 30 °C and a piece of aluminum B with temperature of 50 °C were put in contact side by side, which of the following is true A the Al atom will diffuse into steel A ® configuration entropy will not increase © total entropy will not be affected (1) thermal entropy will not increase 38. In the diagram of enthalpy versus temperature, the discontinuity at certain temperature usually means A overheating B the phase change © supercooled state © oxidation 39. When pressure is constant, enthalpy is equivalent to A heat (B) internal energy © entropy D work 40. Which activity coefficient is an indication of a eutectoid solid solution? A 0 B 0.5 © 1.0 (D) 1.5 41. Which property cannot be derived from the first law of thermodynamics alone? work © internal energy A free energy (D) heat 42. At constant pressure, when temperature increases, Gibbs free energy A always increases B always decreases © does not change (1) increases following by decreasing Consider the phase diagram for the system Cd-Zn at 1 atm pressure, answer the following questions (Q43-Q45) 400 300 temperature, o

(背面仍有題目,請繼續作答)

0.50

mole fraction Zn

0.75

0.25

100

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國立成功大學九十八學年度碩士班招生考試試題

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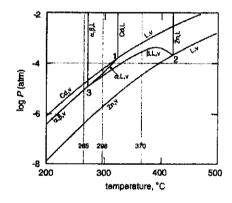
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考試科目: B科目

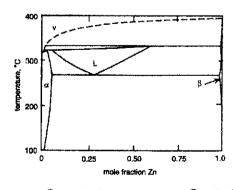
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- 43. Which of the following is true?
  - A The maximum solubility of Zn in Cd is 0.0435
  - B The eutectic melt happens between 266 °C and 321 °C
  - © The maximum solubility of Cd in Zn is 0.9875
  - All of the above
- 44. The P-T projection of the system Cd-Zn is shown below. Which of the following is incorrect?



- A State 1 is a triple point of the system
- The invariant 4-phase equilibrium occurs at State 2
- © The 3-phase equilibrium  $\beta$ -L-v has a maximum at T= 380-390 °C, and approximately  $4\times10^{-4}$  atm
- ① At 350 °C and 10<sup>-3</sup> atm, the system has no vapor phase
- 45. The isobaric section of the binary system Cd-Zn at P=10<sup>-4</sup> atm is showed below. Which of the following is **not** an equilibrium?



- ©α-L-β
- $\bigcirc$  v- $\alpha$ - $\beta$
- 46. In a binary solution A-B, which of the following is true?

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- (A) The molar Gibb's free energy of formation is  $\Delta G^M = RT(X_B \ln a_A + X_A \ln a_B)$
- B For equilibrium between phase  $\alpha$  and phase  $\beta$ :  $a_A$  (in  $\alpha$ ) =  $a_B$  (in  $\beta$ )
- $\bigcirc$  In a regular solution, when  $\alpha = 2$ , immiscibility is likely to happen
- ① The A-liquidus composition are given by  $-\Delta G^{o}_{m(A)} = RT \ln X_A$
- 47. Consider a system of water and vapor at the uniform temperature T contained in a cylinder fitted with a frictionless piston, and let the cylinder be placed in thermal contact with a heat reservoir which is also at the constant temperature T. When the compression of the water-vapor is performed,
  - A spontaneous evaporation of water occurs
  - ® entropy remains unchanged in the water-vapor system;
  - © heat is transferred from the heat reservoir to the water-vapor system.
  - ① When a complete reversibility is approached, the process becomes infinitely slow.
- 48. Which one of the following descriptions on entropy is correct?
  - A Entropy is a not state function.
  - B The entropy of a system increases when the system undergoes a reversible process.
  - The entropy change decreases when a process of phase change is completed.
  - ① Entropy is independent of reaction paths when the system conducted reversibly.
- 49. Which one of the following descriptions on the reversible heat transfer is correct?
  - A Reversible heat flow is degraded as a maximum work performed in a system.
  - B The heat transfer is so fast that the system remains in equilibrium throughout the process.
  - © The process from an initial state to a final state can be returned when a maximum work is performed.
  - ① The system or the surroundings suffer an overall change.
- 50. Which one of the following descriptions on the heat of fusion and vaporization at normal melting and boiling temperatures is **correct**?
  - A The temperatures correspond to low temperature.
  - ® For fusion, the volume change is much higher than for vaporization.
  - © The difference between the change of internal energy and the change of enthalpy is very small.
  - ① A vapor pressure is attained when the rates of evaporation and condensation are not equal.

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科目名稱: 有機化學

毎題為4選1,每一題答對得1.5分,答錯倒扣0.375分。

- 51. Which group is ortho- and para-directing activator in electrophilic aromatic substitution?
  - (A) -C1
- (B) -CN
- © -NO2
- (D) -OH
- 52. The molecules which contain chirality centers and a plane of symmetry are:
  - A meso compound B racemates
- © enantiomers
- diastereomers

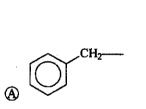
53. What is the structure of tetrahydrofuran (THF)?

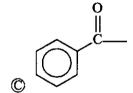


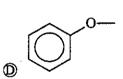


- 54. Which one is the poorer leaving group in  $S_N$ 2 reaction?
  - ♠ F⁻
- ® I
- © Cl
- D OH

55. What is the benzoyl group?







- 56. What is the most common reaction of carboxylic acids?
  - A nucleophilic addition

B nucleophilic substitution

© electrophilic addition

- (1) electrophilic substitution
- 57. Acid chlorides react with amines to yield:
  - A ester
- (B) acetal
- © nitrile
- (D) amide

- 58. Aldehydes and ketones are easily reduced to yield:
  - (A) alcohols
- (B) esters
- © acid
- (D) alkane

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60. The intermediate in the reaction is:

- 61. The configuration of each chiral carbon in a molecule can be designated in terms of the symbol R and S. Which of the following description is **not** correct?
  - A There must be four different ligands covalently bonded to this chiral carbon atom.
  - B The configuration of R can be switched to configuration S by consecutive rotation around single bonds.
  - © R configuration can not superimpose with the S configuration.
  - This difference in configurations can cause the molecular behavior and reactivity to be very different.
- 62. Compare physical and chemical properties of enantiomers, which of the following description is correct?
  - A Their chemical properties are the same toward achiral solvent
  - B Enantiomers are not optical active
  - The racemic form is optical active
  - ① The melting point of enantiomers usually is different.
- 63. Which of the following description is **not** considered as the aromatic characters of benzene molecules?.
  - A Thermal stability
  - ® Substitution rather than addition reactions with polar reagents

## (背面仍有題目,請繼續作答)

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<b>編號: 1</b>	13	8	<b>国立成功大學</b> 力	1.十八學年度碩士班‡	四生考試試題	共 /3頁 · 第/2頁
系所組別:	材料	科學及工程學	系			
<b>学試科目:</b>	B科	目			·	考試日期:0307・節次:2
	意主	: 本試題 ②可	□不可 使用	計算機		
	©	Easy to be oxid	·			
	Ø	Unique nuclear	magnetic resor	nance spectra.		
64	. Ab	out the name an	d molecular for	mula, which of the fol	lowing pairs is <b>not</b>	proper?
	<b>(A)</b>	ethyl alcohol: C	CH₃CH₂OH		halide: CH <sub>3</sub> CH <sub>2</sub> X	
	O	Borane: H <sub>2</sub> BH		Sulfurice	acid: HOSO <sub>3</sub> OH	
65.	. Con	sidering the reve	ersible reaction.	RCH₂CH₂OH <del>←</del>	RCH=CH <sub>2</sub> + H <sub>2</sub> O	which of the
	follo	wing description	n is <b>not</b> correct	?		
	A	High H <sub>2</sub> O conc	entration and te	mperature favor alken	e formation by deh	ydration.
	₿	Hydration of a	kene occurs at	low temperature and	with dilute acid w	hich provides a
		high concentrat	ion of $H_2O$ .			
	O	The reverse pro	ocess proceeds	through the same inte	rmediates and trans	sition states, but
		in the opposite				
	0	This is a reaction	on about the del	ydration of alcohols a	nd hydration of alk	enes.
66.	. Con	paring the relati	ve reactivities	of HX to alkene, which	n of the following d	escription is not
	corr					
	A	The relative rea	ction rate depe	nds on the ability of H	IX to donate an H <sup>+</sup>	to form an R <sup>+</sup> in
		th rate controlli	ng step			
	₿	HI is an stronge				
	O	The reactivity of				
	0	The reactivities	are direct relate	ed to the stabilities of	the intermediate R <sup>+</sup>	
67.	. Con	paring the solub	ility and boilin	g point of alkane with	those of correspond	ling alkene,
	whic	ch of the following	ng description i	s <b>not</b> correct?		
	A	Both of them ar	e nonpolar com	pounds.		
	₿	Both of them ar	e not soluble in	water.		
	©	The $\pi$ bond of a	lkene is strong	er and less reactive tha	in the σ bond.	
	0	Boiling points increments per		e close to those of	alkanes and simil	arly have 20°C
68.	. Whi	ch of the followi	ng compound i	s NOT nucleophile?		
- ***		NH <sub>3</sub>	® OH.	© Cl <sup>-</sup>	$\bigcirc$ Br <sub>2</sub>	
	_					
69.	. Whi	ch of the followi	ng description	regarding Markovniko	ov's rule is NOT cor	rect?

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國立成功大學九十八學年度碩士班招生考試試題

共 13頁 第3頁

系所組別: 材料科學及工程學系

考試科目: B科目

考試日期:0307·節次:2

## ※ 考生請注意:本試題 ☑可 □不可 使用計算機

- (A) In the addition of HX to an alkene. The H attaches to the carbon with fewer alkyl substituents, and the X attaches to the carbon with more alkyl substituents.
- The reason that H attaches on the carbon with fewer alkyl substituents is to stabilize the carbon cation intermediate.
- ©Thus, the product of 1-Methylcyclohexene + HBr reaction is 1-Bromo-1-methylcyclohexane.
- Thus, the product of 1-Methylcyclohexene + HBr reaction is 1-Bromo-2-methylcyclohexane.
- 70. What is the product of the addition reaction of alkenes and H<sub>2</sub>O?
  - (A) alkane
- alkyne
- © alcohol
- (D) acid