國立中興大學 114 學年度學士後醫學系招生考試試題

科目：化學　　系所：學士後醫學系甲、乙組

本科目不可以使用計算機　　本科目試題共 10 頁

單選題，每題 2 分，共 40 題 80 分，不倒扣。

1. Which equation correctly describes the change in Gibbs free energy for a reaction at non-standard conditions?
   (A) $\Delta G = \Delta G^\circ + RT \ln(Q)$
   (B) $\Delta G = \Delta H - T\Delta S$
   (C) $\Delta G = -RT \ln(K)$
   (D) $\Delta G = RT \ln(Q/K)$
   (E) $\Delta G = \Delta G^\circ - RT \ln(K)$

2. In a system at equilibrium, how are ΔG and the equilibrium constant K related?
   (A) $\Delta G = 0$; $K = 1$
   (B) $\Delta G^\circ = -RT \ln(Q/K)$
   (C) $\Delta G > 0$; $K < 1$
   (D) $\Delta G = RT \ln(K)$
   (E) $\Delta G^\circ = -RT \ln(K)$

3. What is the primary effect of adding a catalyst to a reversible reaction at equilibrium?
   (A) Increases the forward rate only.
   (B) Shifts the equilibrium constant.
   (C) Alters the reaction enthalpy.
   (D) Increases the activation energy required for the reaction.
   (E) Increases the rates of both forward and reverse reactions equally.

4. Who did not contribute the Atomic Theory?
   (A) John Dalton
   (B) Emil Fischer
   (C) Ernest Rutherford
   (D) James Chadwick
   (E) J. J. Thomson

5. Indicate which of the following sets of quantum numbers (n, l, m_l, m_s) in an atom is acceptable:
   (A) $(1, 0, 2, -1)$
   (B) $(3, 0, 0, -\frac{1}{2})$
   (C) $(2, 2, 1, -\frac{1}{2})$
   (D) $(4, 3, \frac{1}{2}, -\frac{1}{2})$
   (E) $(3, 2, 1, 1)$

6. Phenyl Grignard reagent reacts with 2-methylpropanal to form a secondary alcohol. The ^{1}H NMR spectrum of 2-methylpropanal displays the two methyl groups as equivalent (a single doublet at δ 1.1). However, in the product alcohol (a racemic mixture, the ^{1}H NMR now shows two distinct 3H doublets, one at δ 0.75 and one around δ 1.0. Why do the two methyl groups in the product have different NMR chemical shifts? What is the term applied to such protons?
   (A) The presence of the hydroxyl group creates an asymmetric center, making the methyl groups homotopic.

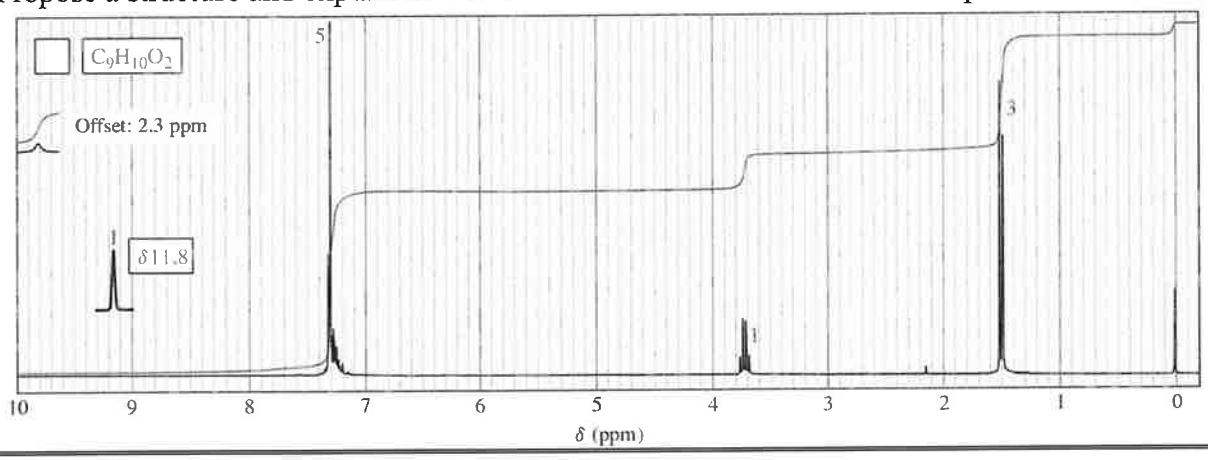
(B) The formation of a chiral center in the product makes the two methyl groups diastereotopic, meaning they experience different chemical environments.
(C) The hydroxyl group participates in hydrogen bonding, causing different splitting patterns for the methyl groups, which are now homotopic.
(D) The two methyl groups in the product remain chemically equivalent, and the observed difference in NMR chemical shifts is due to rotational averaging.
(E) The steric hindrance of the bulky phenyl group shields one methyl group, making them enantiotopic rather than diastereotopic.

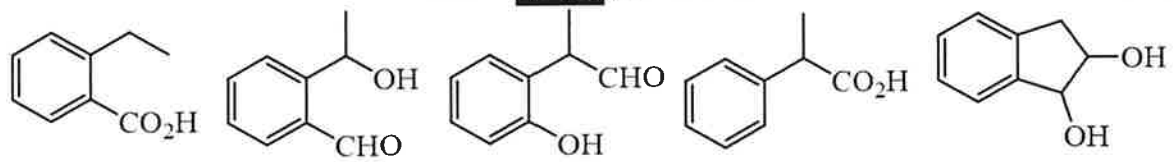
7. What does the pre-exponential factor in the Arrhenius equation represent?
(A) Activation energy.
(B) Reaction probability.
(C) Temperature dependence.
(D) Molecular orientation during collisions.
(E) Frequency of collisions.

8. How does enzyme turnover number (k_{cat}) relate to reaction velocity?
(A) Determines the maximum reaction velocity when the enzyme is saturated with substrate.
(B) Reflects the enzyme's catalytic efficiency relative to substrate concentration.
(C) Is directly proportional to the rate constant for enzyme-substrate binding.
(D) Indicates the fraction of substrate molecules converted to product per second.
(E) Describes the maximum catalytic rate normalized by the enzyme's molecular weight.

9. A researcher is studying an enzyme-catalyzed reaction and observes that adding a certain compound decreases the reaction rate without affecting the substrate binding at the active site. Which mechanism most likely explains this observation?
(A) The compound increases substrate affinity.
(B) The compound stabilizes the enzyme's active form.
(C) The compound induces a conformational change, reducing enzyme activity.
(D) The compound decreases the reaction rate by irreversibly inhibiting the enzyme.
(E) The compound physically blocks the active site, preventing substrate binding.

10. The following NMR spectrum corresponds to a compound with the molecular formula $C_9H_{10}O_2$. Propose a structure and explain how it is consistent with the observed absorptions.

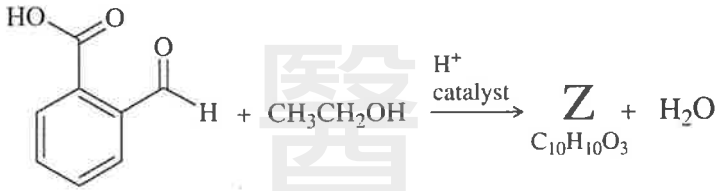




I　II　III　IV　V

(A) **I**
(B) **II**
(C) **III**
(D) **IV**
(E) **V**

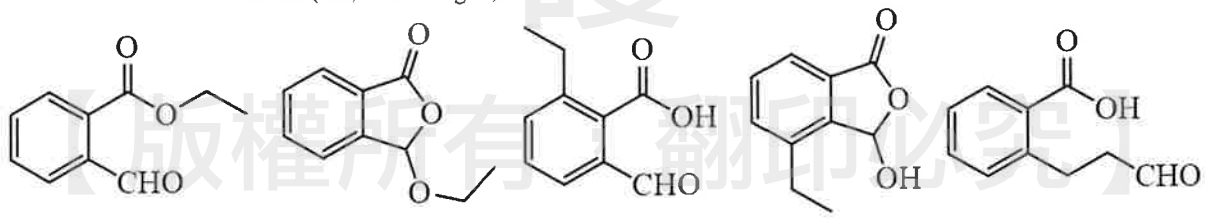
11. A chemist attempted to synthesize the ethyl ester of 2-formylbenzoic acid, but the spectral data of the product did not match her expectations. The IR spectrum of product Z showed an ester carbonyl absorption, but no aldehyde absorption and no OH absorption. The ^{1}H NMR data are provided. What is the structure of Z?



2-formylbenzoic acid
$C_8H_6O_3$

HNMR chemical shifts:
δ 8.0 to 8.4 (4H, complex)
δ 10.4 (1H, sharp singlet)
δ 13.3 (1H, broad singlet)

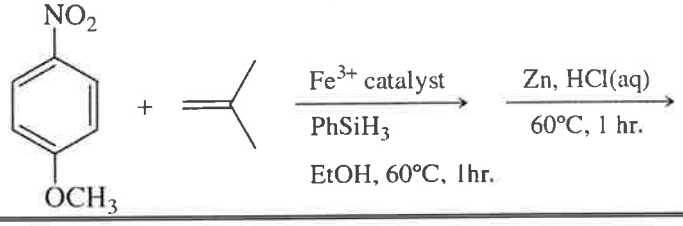
HNMR chemical shifts:
δ 7.5 to 7.8 (4H, complex)
δ 6.6 (1H, sharp singlet)
δ 3.9 (2H, quartet)
δ 1.1 (3H, triplet)



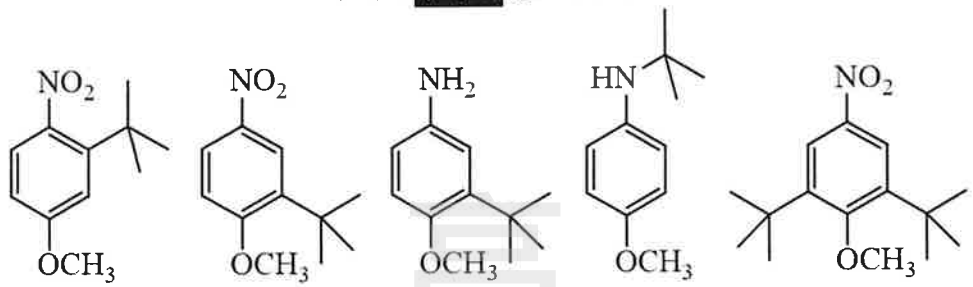
I　II　III　IV　V

(A) **I**
(B) **II**
(C) **III**
(D) **IV**
(E) **V**

12. Please predict the final product of the following reactions.



背面有題，請繼續作答。



(A) **I**
(B) **II**
(C) **III**
(D) **IV**
(E) **V**

13. Which statement best describes the thermodynamic principle related to the entropy of a perfect crystal at absolute zero?
(A) The internal energy of the system remains constant.
(B) The entropy of a system approaches a constant minimum as the temperature approaches absolute zero.
(C) A perfect crystal at absolute zero has zero entropy.
(D) Heat cannot spontaneously flow from a colder body to a hotter body.
(E) The molecular motion of the system ceases completely at absolute zero.

14. Which condition is maintained during a reversible isothermal expansion of an ideal gas?
(A) Internal energy is constant, and heat equals work.
(B) Enthalpy increases, and heat is absorbed.
(C) Gibbs free energy increases, and work is done.
(D) Entropy decreases, and heat is released.
(E) The pressure of the system remains constant throughout the process.

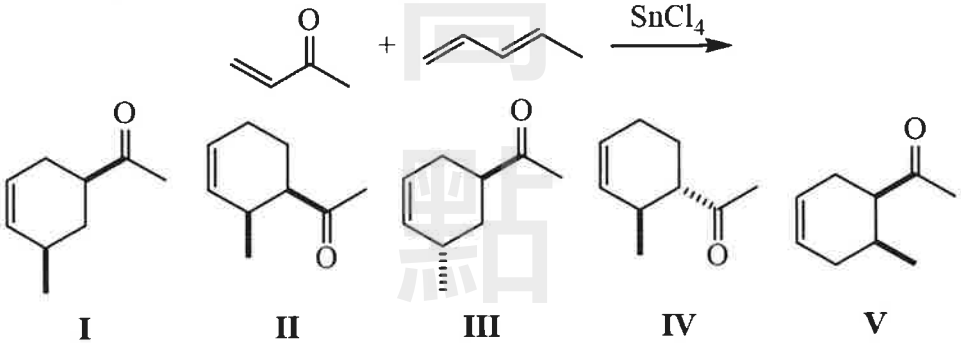
15. What is the shape of the PV graph for a constant-volume process?
(A) Parabolic.
(B) Horizontal line.
(C) Vertical line.
(D) Exponential curve.
(E) Linear with a positive slope.

16. What adjustments does the van der Waals equation make to the ideal gas law?
(A) Accounts for temperature effects.
(B) Corrects for non-ideal gas behaviors by including terms for intermolecular forces and finite molecular size.
(C) Modifies heat capacity to account for variable energy distribution.
(D) Introduces terms to describe deviations in the compressibility factor.
(E) Includes a proportionality constant to relate pressure and volume more accurately.

17. What determines the half-life of a first-order reaction?

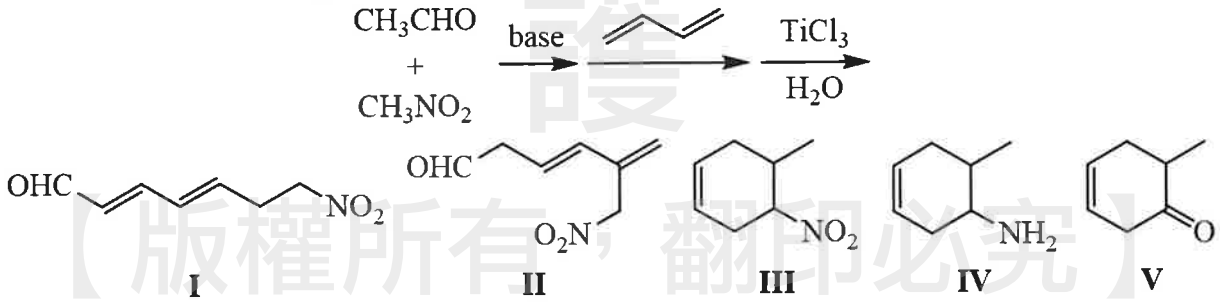
(A) Reactant concentration.
(B) Temperature.
(C) Activation energy.
(D) Both temperature and activation energy.
(E) Molecular size of the reactant.

18. Please predict the product of the following reaction.



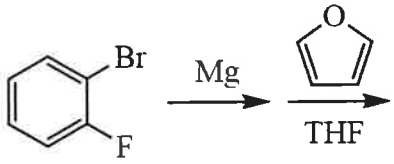
(A) **I**
(B) **II**
(C) **III**
(D) **IV**
(E) **V**

19. Please indicate the final product of the following reactions.

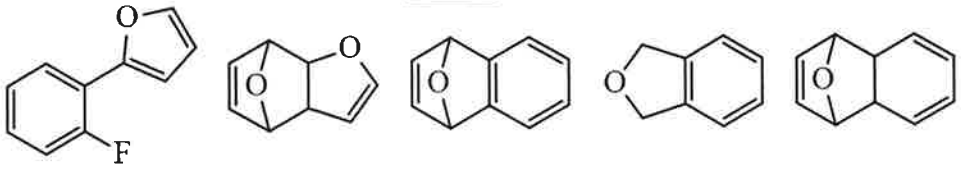


(A) **I**
(B) **II**
(C) **III**
(D) **IV**
(E) **V**

20. Please provide the product of the following reaction.



背面有題，請繼續作答。



I　II　III　IV　V

(A) **I**
(B) **II**
(C) **III**
(D) **IV**
(E) **V**

21. How does increasing the ionic strength of a solution affect the activity coefficient of ions?
(A) Decreases for all ions.
(B) Increases for all ions.
(C) Depends on ion size and charge.
(D) Remains constant.
(E) Becomes negligible at very high ionic strengths.

22. In mass spectrometry, what is the primary function of a quadrupole?
(A) Fragment molecules.
(B) Separate ions based on mass-to-charge ratio.
(C) Ionize neutral molecules.
(D) Detect ions.
(E) Focus ion beams for improved resolution.

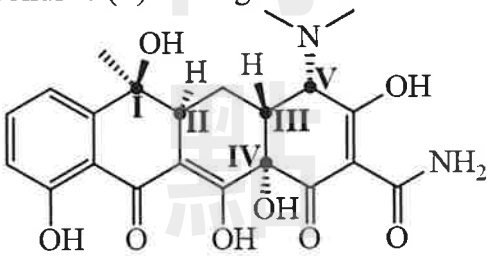
23. What is the Beer-Lambert law limitation for high concentrations?
(A) Absorbance decreases linearly.
(B) Stray light causes deviations.
(C) Band broadening occurs.
(D) Nonlinear absorbance-concentration relationship.
(E) Path length variations amplify errors.

24. Which type of enzyme inhibition can be reversed by adding more substrate?
(A) Non-competitive.
(B) Competitive.
(C) Uncompetitive.
(D) Irreversible.
(E) Mixed.

25. Which of the following rules corresponds to the statement: "No two electrons in the same atom can have the same four quantum numbers"?
(A) Hund's rule
(B) Pauli exclusion principle
(C) Bohr's model
(D) quantum theory
(E) photoelectric effect

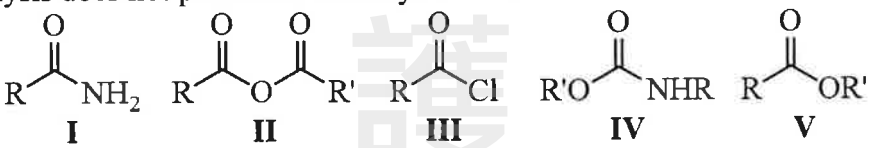
26. Which orbital is correct?
(A) 3*f*
(B) 2*d*
(C) 2*p*
(D) 1*p*
(E) 1*d*

27. Which configuration corresponds to (*R*) in the given molecule



(A) **I**
(B) **II**
(C) **III**
(D) **IV**
(E) **V**

28. Which hydrolysis does not produce a carboxylic acid?



(A) **I**
(B) **II**
(C) **III**
(D) **IV**
(E) **V**

29. What principle underlies chromatography's separation of compounds?
(A) Partitioning between phases.
(B) Absorption of light.
(C) Electrochemical redox reactions.
(D) Differential molecular interactions.
(E) Mass-to-charge ratio differences.

30. In UV-Vis spectroscopy, the absorbance of light is proportional to:
(A) Wavelength.
(B) Concentration and path length.
(C) Temperature.
(D) Molecular weight.
(E) Molar extinction coefficient.

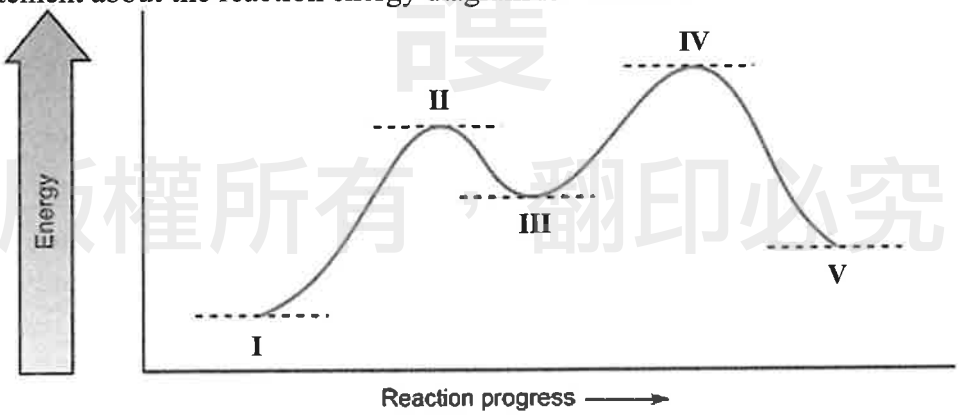
背面有題，請繼續作答。

31. A protein mixture contains three proteins with molecular weights of 15 kDa, 50 kDa, and 120 kDa. You need to separate them effectively based on molecular weight for downstream analysis. Which chromatographic technique would be the most appropriate?
(A) Ion exchange chromatography.
(B) Size-exclusion chromatography.
(C) Affinity chromatography.
(D) Gas chromatography.
(E) Reverse-phase chromatography.

32. How does entropy change during the mixing of two different ideal gases?
(A) Decreases due to uniformity.
(B) Increases due to increased randomness.
(C) Increases due to heat spontaneously flowing into the system from the surroundings.
(D) Remains constant at equilibrium.
(E) Depends on both the molar ratio and initial pressure of the gases.

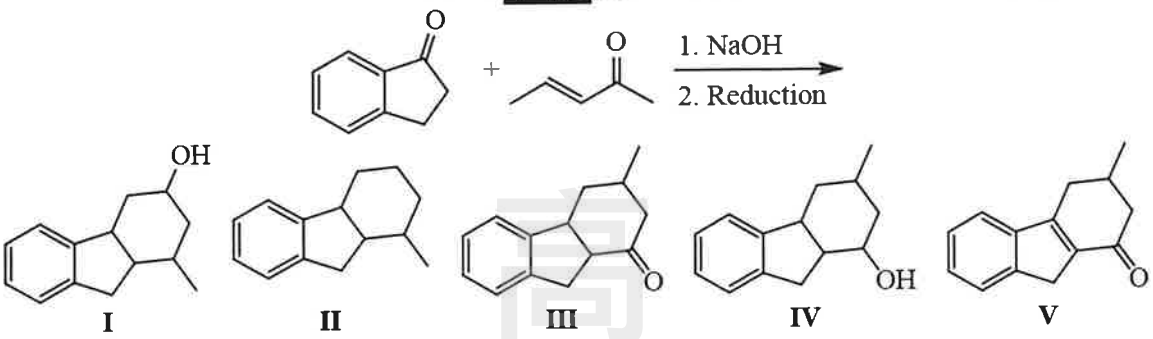
33. What is the relationship between the equilibrium constant (K) and temperature for an exothermic reaction?
(A) K decreases with increasing temperature.
(B) K increases with increasing temperature.
(C) K remains constant regardless of temperature.
(D) K depends only on activation energy.
(E) K is inversely proportional to the enthalpy change.

34. Which statement about the reaction energy diagram is incorrect?



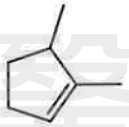
(A) **I:** Reactants
(B) **II:** Transition state
(C) **III:** Activated complex
(D) **IV:** Transition state
(E) **V:** Products

35. Please predict the final product of the following reactions.



(A) **I**
(B) **II**
(C) **III**
(D) **IV**
(E) **V**

36. Please provide the IUPAC name for the given molecule.



(A) 1,2-dimethylcyclopentene
(B) 2,3-dimethylcyclopentene
(C) 1,2-dimethylcyclopent-2-ene
(D) 1,5-dimethylcyclopentene
(E) 1,5-dimethylcyclopent-4-ene

37. Which molecule is most likely to undergo an S_N2 substitution reaction?
(A) *tert*-Butyl bromide
(B) Isopropyl chloride
(C) Methyl iodide
(D) Phenyl chloride
(E) Chloroform

38. Which of the following is a typical 1,2-addition reaction?
(A) Diels-Alder reaction
(B) Grignard reagent reaction with aldehydes
(C) Friedel-Crafts alkylation
(D) Esterification
(E) Amide hydrolysis

39. Which compound does not react with Tollens' reagent?
(A) Formaldehyde
(B) Benzaldehyde
(C) Formic acid
(D) Acetic acid
(E) D-Glucose

40. Which statement is true about the S_N1 reaction mechanism?
(A) The reaction rate is proportional to the nucleophile concentration.
(B) A carbocation intermediate is formed.
(C) It favors primary alkyl halides.
(D) The reaction occurs in a coplanar manner.
(E) A strong base is required.

複選題，每題 4 分，共 5 題 20 分。答錯倒扣 0.8 分，未作答，不給分亦不扣分，倒扣至本大題 0 分為止。

41. Which factors influence the equilibrium constant (K) of a chemical reaction?
(A) Temperature.
(B) Pressure (for gas-phase reactions; real gas).
(C) Concentration of reactants and products.
(D) Catalyst presence.
(E) Reaction enthalpy.

42. Under which conditions will real gases deviate most from ideal gas behavior?
(A) High temperature and low pressure.
(B) Low temperature and high pressure.
(C) Presence of significant intermolecular forces.
(D) Low molar volume of the gas.
(E) Large molecular size of gas particles.

43. In an enzymatic reaction, which factors can alter the reaction velocity at saturating substrate concentrations?
(A) Enzyme concentration.
(B) Temperature.
(C) Presence of competitive inhibitors.
(D) pH changes outside the enzyme's optimal range.
(E) Presence of non-competitive inhibitors.

44. Under which conditions is an enzyme most likely to exhibit maximum catalytic efficiency?
(A) At its optimal temperature.
(B) At its optimal pH.
(C) In the absence of allosteric regulators.
(D) In the presence of competitive inhibitors.
(E) At saturating substrate concentrations.

45. When performing high-performance liquid chromatography (HPLC), what factors can lead to tailing peaks?
(A) Use of low-pressure mobile phase delivery.
(B) Strong interaction between analyte and stationary phase.
(C) Use of a non-polar solvent with a polar stationary phase.
(D) Insufficient column temperature control.
(E) Overloading the sample injection volume.

國立中興大學 114 學年度醫學院學士後醫學系招生考試

選擇題參考答案

科目：化學

題號	答案	題號	答案	題號	答案	題號	答案	題號	答案	題號	答案	題號	答案
1.	A	16.	B	31.	B	46.		61.		76.		91.	
2.	E	17.	D	32.	B	47.		62.		77.		92.	
3.	E	18.	B	33.	A	48.		63.		78.		93.	
4.	B	19.	E	34.	C	49.		64.		79.		94.	
5.	B	20.	C	35.	A	50.		65.		80.		95.	
6.	B	21.	C	36.	D	51.		66.		81.		96.	
7.	E	22.	B	37.	C	52.		67.		82.		97.	
8.	A	23.	D	38.	B	53.		68.		83.		98.	
9.	C	24.	B	39.	D	54.		69.		84.		99.	
10.	D	25.	B	40.	B	55.		70.		85.		100.	
11.	B	26.	C	41.	AB	56.		71.		86.			
12.	D	27.	C	42.	BCE	57.		72.		87.			
13.	C	28.	D	43.	ABDE	58.		73.		88.			
14.	A	29.	A	44.	AB	59.		74.		89.			
15.	C	30.	B	45.	BCE	60.		75.		90.			

國立中興大學114學年度學士後醫學系招生考試
試題參考答案疑義釋疑公告

科目	題號	疑義答覆	釋疑結果
化學	01	$\Delta G = \Delta G^{\circ} + RT \ln(Q) = -RT \ln(K) + RT \ln(Q) = RT \ln(Q/K)$ 因此，選項D亦為正確答案	答案更改為(A)或(D)
	02	$\Delta G=0$; $K=1$ 僅在 $\Delta G^{\circ}=0$ 時成立，非一般情況。	維持原答案(E)
	07	在Arrhenius方程式中，pre-exponential factor代表的是有效碰撞頻率，即碰撞頻率與立體因子相乘後，反映能夠成功發生反應的碰撞數量，而不是單純描述分子碰撞的方向或幾何構型。	維持原答案(E)
	14	“heat equals work”，熱與功等值(equal in magnitude)，為本題的正確選項。	維持原答案(A)
	29	Although chromatography employs various mechanisms, the use of “underlies” implies the fundamental one—the differential partitioning of compounds between the stationary and mobile phases.	維持原答案(A)
	30	在一般UV-Vis分析中，ε 被視為在特定條件(固定波長、溶劑等)下的常數。	維持原答案(B)
	41	選項B說明在非理想氣體條件下，壓力會影響反應成分的 fugacity，因此壓力會間接影響平衡常數的數值。此外，題目未特別假設反應物與產物的熱力學狀態保持不變，因此選項E也應視為影響平衡常數的因素之一	答案更改為(A)(B)(E)
	42	選項 D 代表氣體分子間距離接近，通常為低溫高壓的情形，然而D也構成偏離理想行為的條件。	答案更改為(B)(C)(D)(E)
	44	選項 E 確實為酵素達到最大催化效率的重要條件之一。當substrate濃度達到飽和時此時酵素的催化效率才能充分展現	答案更改為(A)(B)(E)

化　學

梁傑(梁家榮)老師提供

3. What is the primary effect of adding a catalyst to a reversible reaction at equilibrium?
   (A) Increases the forward rate only.
   (B) Shifts the equilibrium constant.
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   (E) Increases the rates of both forward and reverse reactions equally.

(E)

催化劑能加速正、逆反應，更快達到平衡狀態

4. Who did not contribute the Atomic Theory?
   (A) John Dalton
   (B) Emil Fischer
   (C) Ernest Rutherford
   (D) James Chadwick
   (E) J. J. Thomson

(B)

Emil Fischer在科學上主要貢獻的領域是糖類(sugar chemistry)與嘌呤類(purine chemistry)研究

6. Phenyl Grignard reagent reacts with 2-methylpropanal to form a secondary alcohol. The ^{1}H NMR spectrum of 2-methylpropanal displays the two methyl groups as equivalent (a single doublet at δ 1.1). However, in the product alcohol (a racemic mixture, the ^{1}H NMR now shows two distinct 3H doublets, one at δ 0.75 and one around δ 1.0. Why do the two methyl groups in the product have different NMR chemical shifts? What is the term applied to such protons?
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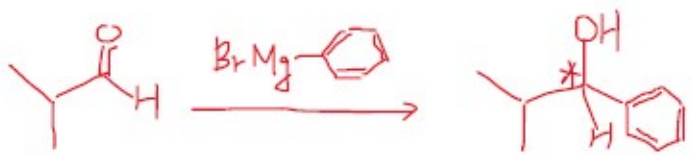
   (E) The steric hindrance of the bulky phenyl group shields one methyl group, making them enantiotopic rather than diastereotopic.

(B)



(2個甲基的關係屬於diastereotopic)

8. How does enzyme turnover number (k_{cat}) relate to reaction velocity?
(A) Determines the maximum reaction velocity when the enzyme is saturated with substrate.
(B) Reflects the enzyme's catalytic efficiency relative to substrate concentration.
(C) Is directly proportional to the rate constant for enzyme-substrate binding.
(D) Indicates the fraction of substrate molecules converted to product per second.
(E) Describes the maximum catalytic rate normalized by the enzyme's molecular weight.

(A)

當substrate濃度很高，enzyme的活性位置被佔滿，此時反應速率達到最大值(V_{max})
依據Michaelis Menten kinetic推導的結論
V_{max}、$[E]_0$ 和 k_{cat} 有以下關係：

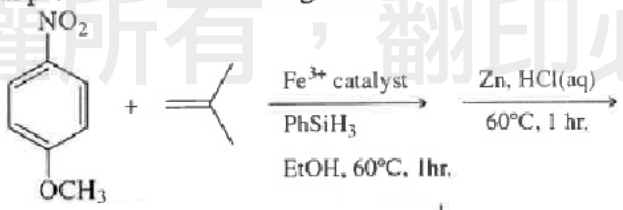
$$\frac{V_{max}}{[E]_0} = k_{cat} \Rightarrow V_{max} = k_{cat} \times [E]_0$$

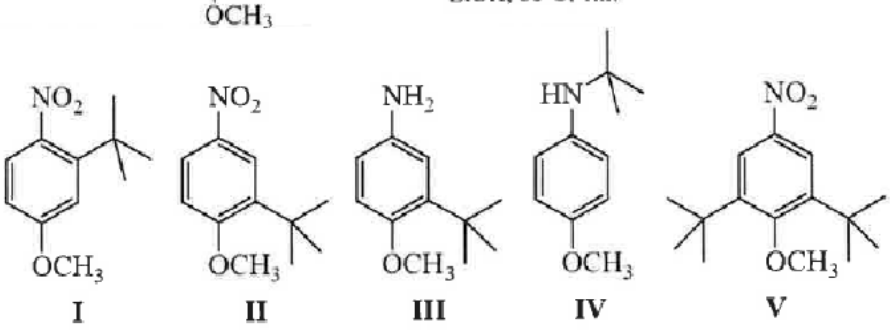
9. A researcher is studying an enzyme-catalyzed reaction and observes that adding a certain compound decreases the reaction rate without affecting the substrate binding at the active site. Which mechanism most likely explains this observation?
(A) The compound increases substrate affinity.
(B) The compound stabilizes the enzyme's active form.
(C) The compound induces a conformational change, reducing enzyme activity.
(D) The compound decreases the reaction rate by irreversibly inhibiting the enzyme.
(E) The compound physically blocks the active site, preventing substrate binding.

(C)

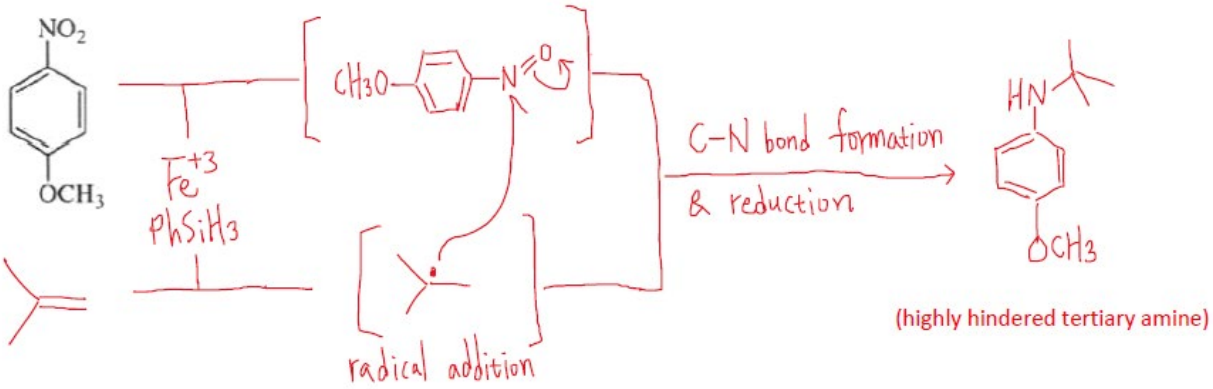
依據題目敘述，額外添加的物質屬於non-competitive inhibitor
當non-competitive inhibitor 與enzyme 結合會影響enzyme 結構，造成enzyme活性受到影響

12. Please predict the final product of the following reactions.





(D)



14. Which condition is maintained during a reversible isothermal expansion of an ideal gas?
(A) Internal energy is constant, and heat equals work.
(B) Enthalpy increases, and heat is absorbed.
(C) Gibbs free energy increases, and work is done.
(D) Entropy decreases, and heat is released.
(E) The pressure of the system remains constant throughout the process.

(A)

恆溫的理想氣體膨脹過程：

$\Delta E = q + W = nC_v\Delta T \xrightarrow{\Delta T = 0} q + W = 0$

$q = -W$

雖然q和w不完全相等，而是等值異號
但也沒有其他更適合的答案了，因此選(A)

16. What adjustments does the van der Waals equation make to the ideal gas law?
(A) Accounts for temperature effects.
(B) Corrects for non-ideal gas behaviors by including terms for intermolecular forces and finite molecular size.
(C) Modifies heat capacity to account for variable energy distribution.
(D) Introduces terms to describe deviations in the compressibility factor.
(E) Includes a proportionality constant to relate pressure and volume more accurately.

(B)

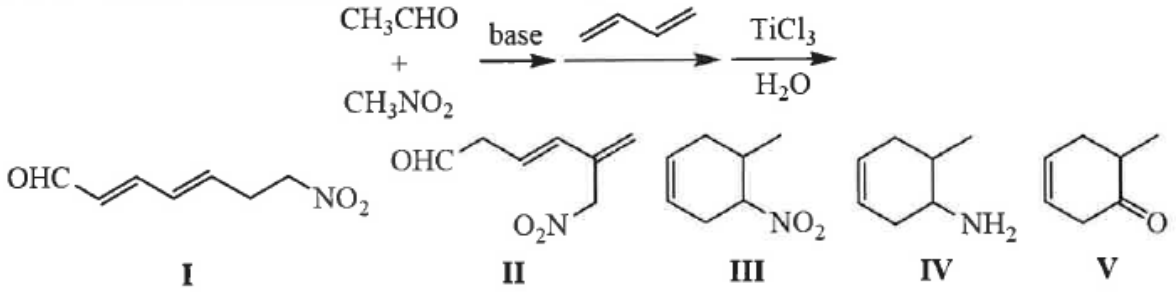
van der Waals equation：

$PV = nRT \longrightarrow \left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$

Correction for molecular attraction

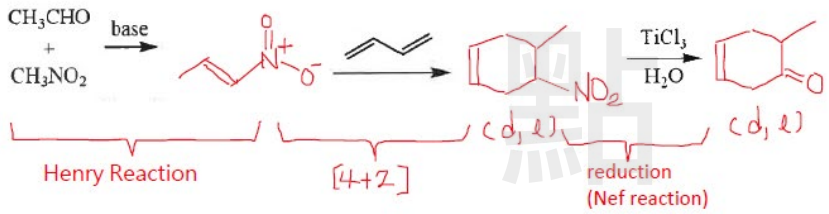
Correction for volume of molecules

19. Please indicate the final product of the following reactions.

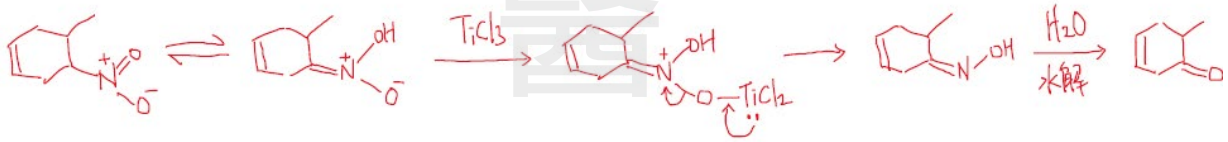


(A) I
(B) II
(C) III
(D) IV
(E) V

(D)



還原步驟的反應機構：



24. Which type of enzyme inhibition can be reversed by adding more substrate?
(A) Non-competitive.
(B) Competitive.
(C) Uncompetitive.
(D) Irreversible.
(E) Mixed.

(B)

抑制類型	增加substrate是否可抵消抑制	原因
Non-competitive	X	抑制劑結合的位置是non-active site 不受substrate濃度影響
Competitive	O	抑制劑與substrate競爭相同active site 加入更多substrate可以取代抑制劑，產生逆轉
Uncompetitive	X	抑制劑只會與E-S complex結合 加入更多substrate反而讓更多抑制劑結合
Mixed	X	抑制劑可與enzyme結合或與E-s complex結合 作用複雜，增加substrate無法完全抵消抑制效果

29. What principle underlies chromatography's separation of compounds?
(A) Partitioning between phases.
(B) Absorption of light.
(C) Electrochemical redox reactions.
(D) Differential molecular interactions.
(E) Mass-to-charge ratio differences.

(A)

層析法是利用物質與固定相和移動相有不同作用傾向的原理，達到分離物質的效果

30. In UV-Vis spectroscopy, the absorbance of light is proportional to:
(A) Wavelength.
(B) Concentration and path length.
(C) Temperature.
(D) Molecular weight.
(E) Molar extinction coefficient.

(B)

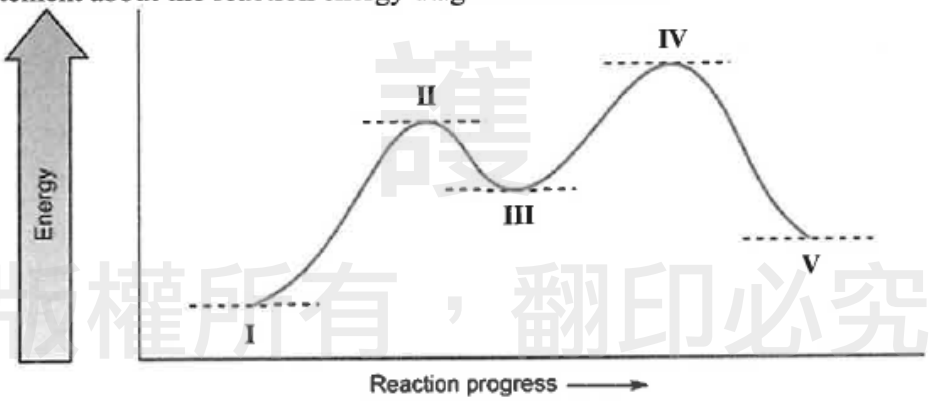
依照Beer-Lambert Law：

$$A = \varepsilon \times C \times l$$

特定物質的消光係數
(molar extinction coefficient)

濃度和光徑長
(特定物質的吸光度與這兩項變數有關)

34. Which statement about the reaction energy diagram is incorrect?



(A) **I:** Reactants
(B) **II:** Transition state
(C) **III:** Activated complex
(D) **IV:** Transition state
(E) **V:** Products

(C)

一般而言，activated complex = transition state
因此(C)選項錯誤，III = intermeditate = 中間物

41. Which factors influence the equilibrium constant (K) of a chemical reaction?
(A) Temperature.
(B) Pressure (for gas-phase reactions; real gas).
(C) Concentration of reactants and products.
(D) Catalyst presence.
(E) Reaction enthalpy.

(A)(B)(E)

如果是ideal gas，則平衡常數只受溫度和反應本質(影響ΔH)的影響，(A)(E)都可以選

但是(B)選項特別強調是real gas，則其apparent equilibrium constant 受壓力影響，(B)也可以選但

就算是real gas，其true equilibrium constant 依然不變

42. Under which conditions will real gases deviate most from ideal gas behavior?
(A) High temperature and low pressure.
(B) Low temperature and high pressure.
(C) Presence of significant intermolecular forces.
(D) Low molar volume of the gas.
(E) Large molecular size of gas particles.

高溫低壓且作用力小、體積小的真實氣體會有接近理想氣體的行為

低溫高壓且作用力大、體積大的真實氣體會與理想氣體有很大偏差，(B)(C)(D)(E)都符合

44. Under which conditions is an enzyme most likely to exhibit maximum catalytic efficiency?
(A) At its optimal temperature.
(B) At its optimal pH.
(C) In the absence of allosteric regulators.
(D) In the presence of competitive inhibitors.
(E) At saturating substrate concentrations.

出題老師釋疑說明：答案更改為(A)(B)(E)

選項 E 確實為酵素達到最大催化效率的重要條件之一。當 substrate 濃度達到飽和時此時酵素的催化效率才能充分展現

梁傑說明：維持原始公告答案(A)(B)

要達到最佳催化效率，(A)溫度、(B)pH一定要符合要求

但出題老師這裡弄錯了catalytic efficiency和catalytic rate的差異了

如果題目問的是maximum catalytic 「rate」

則達到saturating substrate concentration才會達到最大催化速率(Vmax)

但題目問的是maximum catalytic 「efficiency」

則應該要看的是K_{cat}/K_M 的比值，而兩者皆為速率常數，其比值不受substrate濃度影響

答案不應該選(E)