國立中山大學 106 學年度碩士暨碩士專班招生考試試題

科目名稱：有機化學及無機化學【化學系碩士班甲組】　　題號：422001

※本科目依簡章規定「可以」使用計算機（廠牌、功能不拘）（混合題）　共 3 頁第 1 頁

(一) 選擇題 (30%)

There is only one correct answer for each question. (3%×10 = 30%)

1. What are the correct configurations for Cr and Zr elements, respectively?
   (A) $[Ar]4s^1 3d^5$, $[Kr]5s^2 4d^2$　(B) $[Ar]4s^2 3d^4$, $[Kr]5s^2 4d^2$
   (C) $[Ar]4s^2 3d^4$, $[Kr]5s^1 4d^3$　(D) $[Ar]4s^1 3d^5$, $[Kr]5s^1 4d^3$

2. What is the coordination number of $BeCl_2$ in a crystal phase?
   (A) 2　(B) 3　(C) 4　(D) 5

3. For *trans* $[RuX_2(CO)_2L_2]$ complex, what are the irreducible representation for experimentally observed IR stretching bands?

D_{2h}	E	$C_2(z)$	$C_2(y)$	$C_2(x)$	i	$\sigma(xy)$	$\sigma(xz)$	$\sigma(yz)$		
A_g	1	1	1	1	1	1	1	1		x^2, y^2, z^2
B_{1g}	1	1	−1	−1	1	1	−1	−1	R_z	xy
B_{2g}	1	−1	1	−1	1	−1	1	−1	R_y	xz
B_{3g}	1	−1	−1	1	1	−1	−1	1	R_x	yz
A_u	1	1	1	1	−1	−1	−1	−1		
B_{1u}	1	1	−1	−1	−1	−1	1	1	z	
B_{2u}	1	−1	1	−1	−1	1	−1	1	y	
B_{3u}	1	−1	−1	1	−1	1	1	−1	x	

   (A) A_g　(B) B_{1u}　(C) B_{2u}　(D) B_{3u}

4. What are the bond orders of $[Mo_2(SO_4)_4]^{4-}$?
   (A) 2.5　(B) 3　(C) 3.5　(D) 4

5. Which metal ion has largest hydrated metal ion acidity?
   (A) Al^{3+}　(B) Fe^{3+}　(C) Cr^{3+}　(D) Sc^{3+}

6. Which binary compound could has the same overall geometry of diamond?
   (A) NaCl　(B) CsCl　(C) ZnS　(D) CaF_2

7. How many microstates dose O atom has in $(1s)^2(2s)^2(2p)^4$ configuration ?
   (A) 9　(B) 12　(C) 15　(D) 18

8. What is the ligand-field stabilization energy of $[Fe(CN)_6]^{4-}$?
   (A) -12/5 Δ_o　(B) -9/5 Δ_o　(C) -6/5 Δ_o　(D) -3/5 Δ_o

9. Which of the following two orbitals are the HOMO and LUMO of $[Ni(CN)_4]^{2-}$?
   (A) d_{xz}, d_{yz}　(B) d_{xy}, d_{z^2}　(C) $d_{z^2}, d_{x^2-y^2}$　(D) $d_{xy}, d_{x^2-y^2}$

10. Which of the following step is included in the Fischer-Tropsch process?
    (A) Insertion via metallocyclbutane　(B) Splitting of the C–O bond
    (C) C–N bond formation　(C) 1, 2-insertion

(二) 非選擇題 (70%)

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國立中山大學106學年度碩士暨碩士專班招生考試試題

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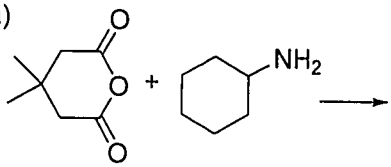
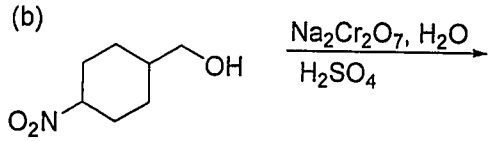
※本科目依簡章規定「可以」使用計算機（廠牌、功能不拘）（混合題）　

1. Please predict the products of the following reactions. (12 points)

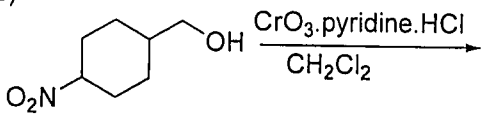
(a)



(b)



(c)



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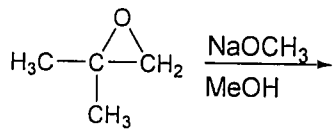
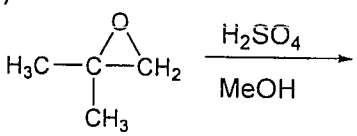
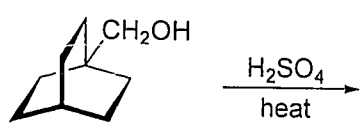


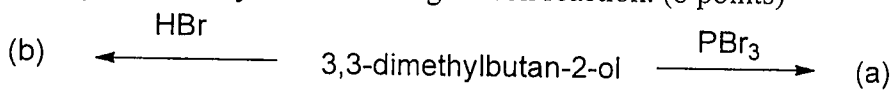
(e)



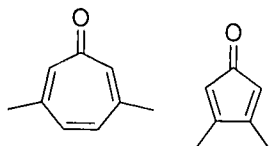
(f)



2. Halogenation of alcohols has been accepted as one of the most important and commonly used transformations in organic synthesis. Please predict reasonable products according to halogenating agents used in the transformation (a) and (b), respectively, as well as explain the reasonable mechanism and its regioselectivity for each halogenation reaction. (8 points)



3. 3,6-Dimethylcyclohepta-2,4,6-trienone (**I**) is very stable. On the contrary, 3,4-dimethylcyclopenta-2,4-dienone (**II**) is unstable and rapidly undergoes a self Diels-Alder reaction. Please answer the following two questions. (10 points)
   (a) Propose an explanation for the different stabilities between **I** and **II**.
   (b) Draw the chemical structure of self Diels-Alder adduct of 3,4-dimethylcyclopenta-2,4-dienone (**II**).


(I)

(II)

4. (a) Please give all stereoisomers of 2,3-dibromobutane in **Fischer projections** with correct assignments of stereochemistry (R or S) at each chirality carbon atom. Please define the relationship of all the stereoisomers in terms of enantiomers and diastereomers ? (b) Please determine the dehalogenation product, resulting from the reaction of iodine and 2,3-dibromobutane, for each isomer with reasonable explanation. (10 points)

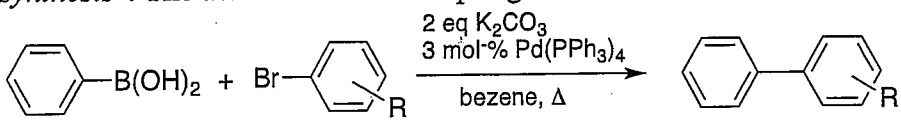
5. Please predict three hydration products while 3,3-dimethylbut-1-ene is treated with (a) H_2SO_4, H_2O. (b) $Hg(OAc)_2$; then $NaBH_4$. (c) BH_3.THF; then H_2O_2, NaOH. (10 points)

6. Cisplatin is a prescription chemotherapy drug for treating various malignant cancers. Please answer the following question regarding Cisplatin.
   (a) Draw the chemical structure of cisplatin. (3%)
   (b) Using fundamental knowledge of coordination chemistry to rationalize the selective dissociation of

coordinated ligands from cisplatin inside cancer cells. (4%)

(c) Explain why Cisplatin is capable of killing cancer cells.(3%)

7. The Nobel Prize in Chemistry 2010 was warded "*for palladium-catalyzed cross couplings in organic synthesis*". The awarded Suzuki coupling reaction can be formulated as follows:



(a) Please draw the full catalytic cycle (5%)

(b) Explain reaction mechanism for each step (5%).

國立中山大學106學年度碩士暨碩士專班招生考試試題

科目名稱：物理化學及分析化學【化學系碩士班】　　題號：422002

※本科目依簡章規定「可以」使用計算機（廠牌、功能不拘）（混合題）　　

物理化學(單選題，每題兩分，共二十五題)

1. Which statement about hydrogen atom is wrong?
   (A) The ground state energy is -13.6 eV.
   (B) The ground state wave function has no node.
   (C) The energy depends on the principal quantum number only.
   (D) The atom contains an electron moving around nucleus in a circular orbit.
   (E) The motion of the electron can be treated as a wave.

2. For a free particle of mass m moving in one dimensional box $(0 \le x \le 2a)$, the energy of the particle in its first excited state is
   (A) $\dfrac{h^2}{8ma^2}$
   (B) $\dfrac{h^2}{4ma^2}$
   (C) $\dfrac{h^2}{2ma^2}$
   (D) $\dfrac{h^2}{16ma^2}$
   (E) none is correct.

3. The wave function of a moving particle confined within $0 \le x \le 1$ is $\psi(x) = N \cdot x \cdot (x-1)$. What is N?
   (A) $\sqrt{2}$
   (B) $\sqrt{30}$
   (C) $\sqrt{6}$
   (D) $1/\sqrt{2}$
   (E) $\dfrac{\sqrt{3}}{2}$

4. The infrared spectrum of HCl shows an intense peak around 2938 cm^{-1}. The corresponding spectrum of DCl shows a peak in
   (A) 2380 cm^{-1}
   (B) 1469 cm^{-1}
   (C) 2105 cm^{-1}
   (D) 2077 cm^{-1}
   (E) Can't predict.

5. Which of the following statement is wrong?
   (A) The vibration of a diatomic molecule is Harmonic oscillation.
   (B) The vibration energies of harmonic oscillator are equally spaced.
   (C) The wave functions of harmonic oscillator are orthogonal.
   (D) The average kinetic energy of harmonic oscillator is half of its total energy.
   (E) The vibration frequency of a harmonic oscillator is related to its force constant.

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6. The quantum mechanical angular momentum operators are $\hat{L}_x$, $\hat{L}_y$ and $\hat{L}_z$, and $\hat{L}^2 = \hat{L}_x^2 + \hat{L}_y^2 + \hat{L}_z^2$. Which of the following statement is correct?

(A) The eigenvalues of $\hat{L}^2$ are equally spaced.

(B). $\left[\hat{L}_y, \hat{L}_z\right] = 0$

(C) $\hat{L}_x$, $\hat{L}_y$ and $\hat{L}_z$ are (r, θ, ϕ) dependent

(D) The measured values of $\hat{L}_z$ are 0, $\hbar$, $2\hbar$, ...,

(E) $\left[\hat{L}^2, \hat{L}_x\right] = 0$

7. The commuter $\left[\hat{p}_x^{\,2}, x^2\right] =$

(A) 0

(B) $-2\hbar^2 \dfrac{d}{dx}$

(C) $-\hbar^2(2 + 4x\dfrac{d}{dx})$

(D) $-\hbar^2$

(E) $2\hbar^2$

8. Given below are equilibrium bond lengths (in units of Å) of some diatomic molecules. Which of them has the largest rotation constant?

HCl: 1.27;　N_2: 1.09　　CO: 1.13　　D_2: 0.74　　C_2: 1.31

(A) D_2

(B) N_2

(C) HCl

(D) C_2

(E) CO

9. The wave functions of hydrogen atom with $n = 2$, $\ell = 1$ and $m = \pm 1$ can be combined to yield a new wave function $\psi_{new} = \dfrac{1}{\sqrt{2}}\left(\psi_{2,1,+1} + \psi_{2,1,-1}\right)$. What is the energy of this state?

(A) -9.6166 eV

(B) − 13.6 eV

(C) − 4.4 eV

(D) -8.32 eV

(E) None of above.

10. Which statement about isotopic diatomic molecules is not correct?

(A) They have similar structures.

(B) They have same vibration force constants.

(C) They have same vibration frequencies.

(D) They have same potential energy curves.

(E) They have different dissociation energies.

11. Given the wave function of the state, $Y_{\ell m}(\theta, \phi)$, which of the following statement is wrong?

(A) The measured value of L_z of the state is $m\hbar$.

(B) The measured value of L is $[\ell(\ell+1)]^{1/2}\hbar$.

(C) The L and L_z can be simultaneously measured.

(D) The magnitude of $L_x^2 + L_y^2$ can be determined experimentally.

(E) The average value of L_x is zero.

12. Given wave function of a harmonic oscillator $\psi_n(q) = N_q H_n(q) e^{-\frac{1}{2}q^2}$, where N_q is normalization constant and $H_n(q)$ is Hermite polynomial of degree n. The Hermite polynomial satisfies the recursion relation

$$qH_n(q) = nH_{n-1}(q) + \frac{1}{2}H_{n+1}(q)$$

What is the average value of q^2 for the state $\psi_3(q)$?

(A) 0

(B) $\frac{7}{2}$

(C) $\frac{5}{4}$

(D) $\frac{4}{3}$

(E) $\frac{1}{4}$

13. The ground state wave function of helium ion, He^+, is

$$\psi = \frac{1}{\pi^{1/2}}\left(\frac{2}{a}\right)^{3/2} e^{-2r/a}$$

The maximum probability of finding the electron of the ground sate helium ion is at $r = ?$

(A) a

(B) $2a$

(C) $3a/2$

(D) $a/2$

(E) None is correct.

14. According to the Maxwell relations, $\left(\frac{\partial V}{\partial T}\right)_P = ?$

(A) $-\left(\frac{\partial P}{\partial S}\right)_V$

(B) $\left(\frac{\partial S}{\partial V}\right)_T$

(C) $\left(\frac{\partial V}{\partial S}\right)_P$

(D) $-\left(\frac{\partial S}{\partial P}\right)_T$

(E) $\left(\frac{\partial G}{\partial T}\right)_H$

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15. A mole of ideal monoatomic ideal gas initially at temperature T_1 and with volume V_1. If the gas is compressed adiabatically and reversible to the volume of $V_1/2$ and final temperature is T_2, then, what is the possible relation between T_1 and T_2?

(A) $\ell nT_2 = \frac{3}{2}\ell nT_1$

(B) $\left(\frac{T_1}{T_2}\right) = \left(\frac{1}{2}\right)^{5/3}$

(C) $\ell nT_2 = \ell nT_1 + \frac{2}{3}\ell n2$

(D) $\ell n\left(\frac{T_1}{T_2}\right) = \frac{3}{2}\ell n\left(\frac{1}{2}\right)$

(E) None is correct.

16. One mole of CO_2 expands reversibly and at constant temperature of 127 °C from 5 liters to 10 liters. Which of the following is correct?

(A) $\Delta G > 0$, $\Delta S > 0$

(B) $\Delta G < 0$, $\Delta E > 0$

(C) $Q = W > 0$, $\Delta S < 0$

(D) $\Delta H > 0$, $\Delta S > 0$

(E) $\Delta S > 0$, $\Delta G < 0$

17. The change of Gibbs free energy (in J/mol) of a certain process at constant pressure was found to be

$\Delta G = 4321 + 20T - 5320/T$

where T is absolute temperature. The changes in entropy of such process at 300 K is

(A) 20.059 J/mol

(B) -43.2 J/mol

(C) 328 J/mol

(D) -82.4 J/mol

(E) 52.67 J/mol

18. A gas obeying the following relation

$\frac{P\overline{V}}{RT} = 1 + B\overline{V}$

The change of Hemlholtz energy, ΔA, of one mole of such gas for the isothermal expansion from V to $2V$ is

(A) $-RT\ell n2$

(B) $-\frac{RTB}{2V}$

(C) $RT\ell n2 - \frac{RTB}{2V}$

(D) $\frac{RT}{2V}B\ell n2$

(E) $RTB\ell n2$

19. A linear least square fit of ℓnP against $1/T$ for vapor pressures of liquid aluminum gives slope = -31200 K and intercept = 20.04. The ΔH_{vap} of the material is which of the following? (Gas constant $R = 8.3154 J \cdot K^{-1} \cdot mol^{-1}$)

(A) -61994 J mol^{-1}
(B) 259400 J mol^{-1}
(C) – 74820 J mol^{-1}
(D) 56784 J mol^{-1}
(E) None is correct

20. Given below are the measured Joule-Thomson coefficients, μ_{J-T} (in units of K/MPa), of some gases at 273 K and 1 ATM. Which of the statement is correct?

Gas	Ne	N_2	CH_4	H_2
μ_{J-T}	-0.62	2.15	4.38	-0.34

(A) Among the given gases, CH_4 is more closed to ideal gas than others.
(B) Cooling the temperature of N_e can be achieved by expansion.
(C) For the isenthalpic expansion, the cooling rate of CH_4 is larger than N_2.
(D) The isothermal expansion of H_2 gas leads the decreasing of enthalpy.
(E) None is correct.

21. Let μ represents chemical potential. A solution contains 2 moles of A and 1 mole of B. Which of the following statement is correct?

(A) μ_A (solution) = μ_B (solution)
(B) μ_A (solution) < μ_A (pure)
(C) μ_B (solution) > μ_B (vapor)
(D) $\mu_A : \mu_B = RT\ell n2$
(E) None is correct.

22. For unimolecular reaction $A \rightarrow P$, Lindemann proposed mechanism is

$A + A \xrightarrow{k_1} A^* + A$

$A^* + A \xrightarrow{k_{-1}} A + A$

$A^* \xrightarrow{k_2} P$

In which A^* is activated reactant. At high reactant concentration ($[A]$ very large), what is the possible expression for the reaction rate?

(A) $\frac{d[P]}{dt} = k_1[A]^2$

(B) $\frac{d[P]}{dt} = \frac{k_1 k_2}{k_{-1}}[A]$

(C) $\frac{d[P]}{dt} = \frac{k_1[A]^2}{1 + k_{-1}[A]}$

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(D) $\frac{d[P]}{dt} = \frac{k_1[A]^2}{k_2 + k_{-1}}$

(E) None is correct

23. Assuming the distribution of speed is

$F(v)dv = Av^2 \exp(-Mv^2/2RT)dv$

For $\int_0^\infty x^{2n} e^{-bx^2} dx = \frac{1 \cdot 3 \cdots (2n-1)}{2^{n+1}} \left(\frac{\pi}{b}\right)^{1/2}$,the uncertainty of measured speed is

(A) $\sqrt{0.45}\left(\frac{RT}{M}\right)^{1/2}$

(B) $\sqrt{2.54}\left(\frac{RT}{M}\right)^{1/2}$

(C) $\sqrt{2}\left(\frac{RT}{M}\right)^{1/2}$

(D) $\left(\frac{RT}{M}\right)^{1/2}$

(E) None is correct

24. Given the radii of some gas particles:

Species	$r(nm)$	$M(g/mol)$
He	0.13	4.0
Ar	0.17	40.0
CO_2	0.20	44.0
N_2	0.19	28.0
O_2	0.18	32.0

At same temperature, among the following equal molar gas mixtures which one has the largest collision frequency?

(A) He and Ar
(B) CO_2 and N_2
(C) O_2 and He
(D) Ar and CO_2
(E) He and N_2

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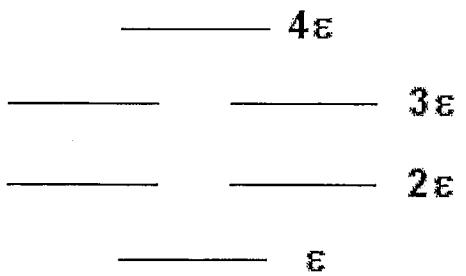
25. Given below is the energy diagram of a molecule:



The ratio of the molecule populated on the ground state to its first excited state is

(A) $\exp\left(\frac{2\varepsilon}{kT}\right)$

(B) $\frac{1}{2}\exp\left(\frac{\varepsilon}{kT}\right)$

(C) $\exp\left(\frac{\varepsilon}{2kT}\right)$

(D) $\frac{1}{2}\exp\left(\frac{2\varepsilon}{kT}\right)$

(E) $\frac{\ell n2}{kT}$

分析化學(單選題，每題兩分，共十五題)

26. To determine whether two analytical methods are significantly different from each other, which of the following tests should be conducted?
(A) Student's t test
(B) F test
(C) Q test
(D) Y test

27. Which of the following statements is INCORRECT?
(A) 207 ppb Pb^{2+} = 1 μM Pb^{2+} (Atomic mass of Pb is 207 amu).
(B) The number 1.2500×10^4 has three significant figures.
(C) 0.01 (± 0.02) + 0.01 (± 0.02) + 0.01 (± 0.01) = 0.03 (± 0.03).
(D) 60% w/w nitric acid = 60 g of HNO_3 per 100 g of solution.

28. Which of the following statements concerning random and systematic error is INCORRECT?
(A) Random error is always present in a measurement.
(B) Random error can be evaluated through statistical analysis.
(C) Systematic error can be reduced by averaging several trials.
(D) Systematic error can be detected using different analytical methods for the analysis of the same analyte.

29. Seawater containing K^+ produced a signal of 4.0 mV in an atomic absorption analysis. Then 5.00 mL of 2.00 M KCl was added to 95.0 mL of seawater. This spiked seawater produced a signal of 8.00 mV. What is the original concentration of K^+ in seawater?

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(A) 0.095 M.
(B) 0.085 M.
(C) 0.075 M
(D) 1.095 M

30. Which of the following statements concerning titration is INCORRECT?
(A) EDTA forms strong 1:1 complexes with most metal ions.
(B) In argentometric titrations, silver nitrate is used as a titrant.
(C) An acid-base titration is useful to determine the pK_a of the unknown acid.
(D) The most common approach for quantifying organic carbon is the Kjeldahl method, which is based on a neutralization titration.
(E) Iodometric titration of vitamin C is an example of a redox titration.

31. Which of the following statements concerning voltammetry is INCORRECT?
(A) In polarography, the working electrode is the unique dropping mercury electrode.
(B) Removal of dissolved oxygen from water is usually the first step in amperometric procedures.
(C) The rotating ring-disk electrode is a modified rotating disk electrode that is useful for the screening of oxygen reduction reaction (ORR) catalyst.
(D) Compared to differential-pulse voltammetry, square-wave voltammetry provides the advantages of faster scan rate and increased sensitivity.
(E) The charging current is caused by reduction or oxidation of analyte at the working electrode.

32. Which of the following statements concerning capillary electrophoresis is INCORRECT?
(A) In capillary zone electrophoresis, there is no stationary phase.
(B) Micellar electrokinetic chromatography allows uncharged analytes to be separated.
(C) Electroosmotic flow is relatively large at high pH as compared to low pH.
(D) Electroosmotic flow increases with an increase in electric field strength.

33. Which of the following statements concerning surface spectroscopic methods are INCORRECT?
(A) X-Ray photoelectron spectroscopy provides information about the energy levels of core electrons.
(B) Auger electron spectroscopy provides the principle advantage of high spatial resolution (< 1 micron).
(C) X-Ray photoelectron spectroscopy is a method for detecting element composition on the surface of solid samples.
(D) Electrons ejected from a solid will generally undergo multiple scattering events and lose energy in the form of collective electron density oscillations called Photon.
(E) An Electron from higher shell comes to the core by releasing X-ray photon, that photon strikes the valance electrons and knocked out. Such electron is called Auger electron.

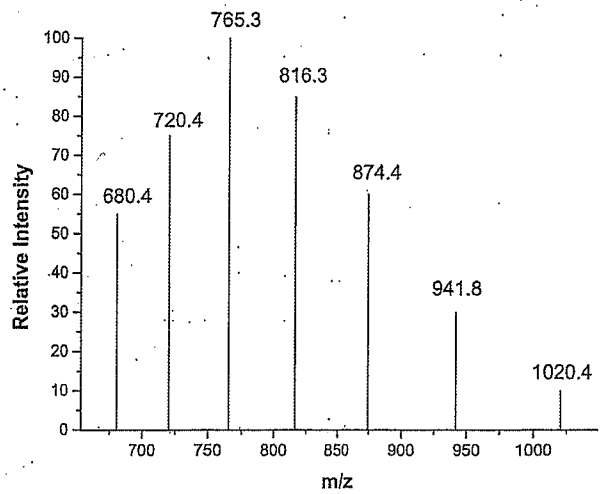
34. Which of the following statements concerning inductively coupled plasma mass spectrometry (ICP-MS) are INCORRECT?
(A) Flow injection analysis coupled to ICP-MS is powerful for the separation and detection of a mixture of Hg^{2+}, CH_3Hg^+, and $CH_3CH_2Hg^+$.
(B) Dynamic reaction cell in ICP-MS is used for eliminating isobaric interferences.
(C) The plasma used in an ICP-MS is made by partially ionizing argon gas.
(D) The advantages of the ICP-MS technique above AAS (Atomic Absorption Spectroscopy) or ICP-OES (inductively coupled plasma optical emission spectrometry) include low detection limits, a large linear range, and possibilities to detect isotope composition of elements.

35. The activity coefficients of H^+ and OH^- are 0.83 and 0.76 when the ionic strength is 0.1. The pH of water containing 0.1 M KCl at 25°C is
(A) 7.00.
(B) 7.02.
(C) 6.98.
(D) 6.96.

36. Which of the following techniques is the best for accurate determination of molecular weight of protein?
(A) Matrix-assisted laser desorption/ionization time-of-flight mass spectrometry.
(B) 2-D polyacrylamide gel electrophoresis.
(C) Gel permeation chromatography.
(D) Dynamic light scattering.

37. Which of the following conditions is the best for eluting proteins from an affinity chromatography?
(A) High salt concentrations.
(B) Adding a soluble ligand which interacts with proteins.
(C) High-polarity solvent.
(D) Washing buffer.

38. Determine the mass of the protein whose electrospray ionization mass spectrum is shown as follows.



(A) 12230
(B) 22230
(C) 32230
(D) 42230

39. Which of the following statements concerning luminescence is INCORRECT?
(A) Fluorescence and phosphorescence are examples of luminescence.
(B) Absorbance is more sensitive than luminescence for the detection of low concentration of analyte.
(C) The emission spectrum is a mirror image of the absorption spectrum.
(D) Emission spectra are typically independent on the excitation wavelength.

40. Which of the following conditions is the best for enhancing Raman scattering signal?
(A) Analytes adsorbed on roughened silver electrode surfaces.

背面有題

(B) Analytes adsorbed on roughened carbon electrode surfaces.
(C) Analytes adsorbed on smooth silver electrode surfaces.
(D) Analytes adsorbed on smooth carbon electrode surfaces.

問答 (請於答案卷中標示題號並依續作答，每題四分，共五題)

41. Describe the strategies for the detection and elimination of matrix effects in the developed method.

42. Describe the working principle of photomultiplier tube.

43. Describe the working principle of pH meter.

44. Describe the theory of band broadening in chromatographic processes.

45. Describe the advantages of Fourier Transform Infrared spectroscopy.

國立中山大學 106 學年度碩士暨碩士專班招生考試試題

科目名稱：英文【化學系碩士班乙組】　　題號：422003

※本科目依簡章規定「不可以」使用計算機(混合題)　　

一、 單選選擇題 (每題三分):

1. Many people often _____outside the restrooms of an office area to gossip about their coworkers. Therefore, it is often the most crowded area of an office.
(A) congregate (B) combine (C) leverage (D) emerge

2. The vast range of makeup products that women find commonplace is instead very often _____ and confusing for men.
(A) beginning (B) brainstorming (C) bewildering (D) compelling

3. Our native language is often called our mother _____ .
(A) home (B) land (C) tongue (D) nature

4. Wearing uniforms is still _____ in most schools in Taiwan.
(A) tertiary (B) mandatory (C) sanctuary (D) stationary

5. I have only gone scuba diving once before, so I would consider myself a _____ .
(A) naive (B) professional (C) novice (D) native

6. Aa part of their _____ routine, the mechanical department conducts maintenance inspections on factory equipment.
(A) normality (B) normally (C) normal (D) normalize

7. Gift certificates will be given to those _____ complete Oriang Health Spa's service survey by July 18.
(A) who (B) they (C) what (D) theirs

8. The company has grown so much that it is running out of _____ and will need to move to a bigger office.
(A) area (B) land (C) room (D) location

9. Many students at the institute have complained that they find it challenging _____ their tests within the given time limits.
(A) finishing (B) finished (C) to finish (D) have finished

10. Winners of this year's literary contest will be announced _____ in both the print and online versions of the publication *Literatura*.
(A) persuasively (B) officially (C) truthfully (D) exceedingly

11. Upon close inspection, the two patterns are indeed _____, but the differences are so minute that they are hardly noticeable at first.
(A) analytical (B) asymmetrical (C) ambidextrous (D) analogue

12. _____ has recently become a disease with young children as now many of them eat fast foods and unhealthy snacks often.
(A) Obesity (B) Diabetes (C) Parkinson's (D) High-blood pressure

13. The torrential rain, which lasted nearly a week, caused _____ damage to the countryside of Essex.
(A) impossible (B) expediential (C) irresistible (D) preliminary

14. It is not surprising that it took me so long to discover the extent of my own miseducation, because the last thing an elite education will teach you is its own _____ .

背面有題

(A) mitigation (B) distinction (C) calibre (D) inadequacy

15. _____ -- the interaction of the student with learning courses on a computer -- will accelerate education.
(A) Self-directed learning (B) Self-directing learning
(C) Self-directed learned (D) Self-directing learned

16-18
Subject: Bread and cupcake orders
Date: April 1

Dear Mr. Yang,

We have received the follow-up letter about your orders for next week. I sent an e-mail to our main branch to inform them about the __16__ you made. They will supply you with all the baked items you required for your business. The main branch verified your orders on Sunday and notified us that they__17__ them on Monday morning. We are confident __18__ your customers will be more than satisfied once they sample our products. We look forward to continuing to serve you.

Sincerely,

Tristan Beach

16. (A) policies (B) requests (C) improvements (D) presentations
17. (A) delivered (B) has delivered (C) will deliver (D) was delivering
18. (A) what (B) which (C) them (D) that

19-20
Date: December 1

Hello everyone,

The finance department is completing a budget proposal for next year. The proposal will be discussed at ADT Bank's yearly planning meeting in January. In connection with this, we request that you submit the budget estimates for your respective branches within the week.

In particular, we need your recommended salary adjustments as well as your estimated expenses for supplies and equipment. As agreed in the last meeting, your budget proposals should meet the standards provided by the finance department. Please turn in the documents no later than December 8.

19. What is the e-mail mainly about?
(A) A proposed project
(B) A submission deadline
(C) The schedule of conference activities
(D) The promotion of an employee

20. According to the e-mail, what is the finance department's role in budget planning?
(A) Assigning accounting consultants to branches
(B) Updating the shareholders on company income
(C) Soliciting price quotations from suppliers
(D) Setting guidelines for estimating expenses

國立中山大學 106 學年度碩士暨碩士專班招生考試試題

科目名稱：英文【化學系碩士班乙組】　　題號：422003

※本科目依簡章規定「不可以」使用計算機(混合題)　　

二、 翻譯題 (英翻中):

1. Circulating tumor cells (CTC) are key early indicators of metastasis, which is the process by which cancer cells move from one organ group in the body to another. Once cancer spreads, the prognosis is generally not good. So, early identification of CTCs can help prevent them from creating new colonies of malignant cells. Researchers at Worcester Polytechnic Institute (WPI) in Massachusetts have developed a new approach to microfluidics to detect CTCs in blood. The WPI researchers believe that their technique could form the basis of a simple lab test for quick detection of early signs of metastasis and help physicians select treatments targeted at the specific cancer cells identified. (15 分)

2. Healing of cutaneous wounds involves regeneration of surface epidermis and repair of connective tissues. Re-epithelialization precedes repair in the dermis and accelerates the process of wound healing. It also provides early re-establishment of a functional barrier, which is vital in the prevention of excessive transepidermal water loss and infection. Therefore, re-epithelialization is considered a primary step in cutaneous wound healing. Various types of tissue engineered scaffolds have been developed and used for engineering epidermis. Ideally, these scaffolds should exhibit certain biological features (i.e., to support keratinocyte adhesion, proliferation, and differentiation) and possess appropriate mechanical and degradation properties. Mechanical properties of the scaffolds have been identified as a key modulator in keratinocyte behavior with increased cell adhesion and proliferation on stiffer substrates with compressive moduli of around 100 kPa. The scaffolds should also be sufficiently strong and elastic for facile handling during surgery and for supporting natural movements of the tissues. Additionally, such scaffolds should ideally degrade only after adequate healing, which could take more than 8 weeks. Furthermore, for some clinical applications, the scaffolds are required to be rapidly crosslinked in situ, allowing for optimal molding toward the wound contour. (10 分)

3. The U.S. Food and Drug Administration (FDA) has approved a genetically engineered virus to treat patients with advanced melanoma. Among innovative treatments for cancer therapy, virotherapy represents a class of promising cancer therapeutics, with viruses from several families currently being evaluated in clinical trials. Most clinical trials of virotherapy have treated patients via intratumoral injection. However, one of the most important technical solutions needed for clinical virotherapy is enhanced systemic delivery. Achieving efficacious and accurate systemic delivery will greatly broaden opportunities in virotherapy. Significant developments in technological solutions improving delivery, potency, and purity for virotherapy have given rise to recent success. Specificity in viral delivery however will greatly enhance therapeutic gains. (15 分)

國立中山大學106學年度碩士暨碩士專班招生考試試題

科目名稱：分析化學【化學所生物醫學暨化學生物學組】　　題號：422004

※本科目依簡章規定「可以」使用計算機（廠牌、功能不拘）（混合題）　　共3頁第1頁

一、單選題，每題五分，共十五題。

01. To determine whether the precision between two analytical methods are significantly different from each other, which of the following tests should be conducted?
(A) F test
(B) Student's t test
(C) Y test
(D) Q test

02. 207 ppb Pb^{2+} is _____. (Atomic mass of Pb is 207 amu)
(A) 10 μM Pb^{2+}.
(B) 1 μM Pb^{2+}.
(C) 100 nM Pb^{2+}.
(D) 10 nM Pb^{2+}.

03. Which of the following statements concerning random and systematic error is CORRECT?
(A) Systematic error is always present in a measurement.
(B) Systematic error can be evaluated through statistical analysis.
(C) Random error can be reduced by averaging several trials.
(D) Random error can be detected using different analytical methods for the analysis of the same analyte.

04. Drinking water containing Na^+ produced a signal of 8.0 mV in an atomic emission analysis. Then 5.00 mL of 2.00 M NaCl was added to 95.0 mL of seawater. This spiked drinking water produced a signal of 16.00 mV. What is the original concentration of Na^+ in seawater?
(A) 0.095 M.
(B) 0.085 M.
(C) 0.075 M
(D) 1.095 M

05. Which of the following statements concerning titration is CORRECT?
(A) EDTA forms strong 1:4 complexes with most metal ions.
(B) In argentometric titrations, potassium nitrate is used as a titrant.
(C) A redox titration is useful to determine the pK_a of the unknown acid.
(D) The most common approach for quantifying organic nitrogen is the Kjeldahl method, which is based on a neutralization titration.
(E) Iodometric titration of vitamin C is an example of an acid-base titration.

06. Which of the following statements concerning voltammetry is CORRECT?
(A) In polarography, the working electrode is the gold electrode.
(B) Removal of dissolved nitrogen from water is usually the first step in amperometric procedures.
(C) The rotating ring-disk electrode is a modified rotating disk electrode that is useful for the screening of hydrogen evolution reaction catalyst.
(D) Compared to square-wave voltammetry, differential-pulse voltammetry provides the advantages of faster scan rate and increased sensitivity.
(E) The faradaic current is caused by reduction or oxidation of analyte at the working electrode.

背面有題

07. Which of the following statements concerning capillary electrophoresis is CORRECT?
(A) Capillary zone electrophoresis contains a stationary phase.
(B) Micellar electrokinetic chromatography allows charged analytes to be separated.
(C) Electroosmotic flow is relatively large at low pH as compared to high pH.
(D) Electroosmotic flow remains constant with an increase in electric field strength.

08. Which of the following statements concerning surface spectroscopic methods are CORRECT?
(A) X-Ray photoelectron spectroscopy provides information about the energy levels of valence shell electrons.
(B) Auger electron spectroscopy provides the principle advantage of low spatial resolution.
(C) X-Ray photoelectron spectroscopy is a method for detecting molecular composition on the surface of solid samples.
(D) Electrons ejected from a solid will generally undergo multiple scattering events and lose energy in the form of collective electron density oscillations called Plasmon.
(E) An Electron from higher shell comes to the core by releasing X-ray photon, that photon strikes the valance electrons and knocked out. Such electron is called Gold electron.

09. Which of the following statements concerning inductively coupled plasma mass spectrometry (ICP-MS) are CORRECT?
(A) Reversed-phase high-performance liquid chromatography coupled to ICP-MS is powerful for the separation and detection of a mixture of Hg^{2+}, CH_3Hg^+, and $CH_3CH_2Hg^+$.
(B) Dynamic reaction cell in ICP-MS is used for increasing isobaric interferences.
(C) The plasma used in an ICP-MS is made by partially ionizing nitrogen gas.
(D) The advantages of the ICP-MS technique above AAS (Atomic Absorption Spectroscopy) or ICP-OES (inductively coupled plasma optical emission spectrometry) include low detection limits, a small linear range, and possibilities to detect isotope composition of elements.

10. The ionic strength of 0.1 M NaCl is _____.
(A) 0.05.
(B) 0.2.
(C) 0.1.
(D) 0.4.

11. Which of the following techniques is NOT suitable for the determination of molecular weight of protein?
(A) Reversed-phase high-performance liquid chromatography.
(B) Matrix-assisted laser desorption/ionization time-of-flight mass spectrometry.
(C) 2-D polyacrylamide gel electrophoresis.
(D) Gel permeation chromatography.
(E) Dynamic light scattering.

12. Which of the following method is the best for the purification of proteins?
(A) Capillary zone electrophoresis.
(B) Affinity chromatography.
(C) Ion-exchange chromatography.
(D) Reversed-phase high-performance liquid chromatography.

13. 0.1 (± 0.01) − 0.1 (± 0.02) + 0.2 (± 0.02) = _____
(A) 0.2 (± 0.03)
(B) 0.2 (± 0.04)
(C) 0.2 (± 0.05)
(D) 0.2 (± 0.01)

14. Which of the following statements concerning luminescence is CORRECT?
(A) Raman scattering and phosphorescence are examples of luminescence.
(B) Absorbance is less sensitive than luminescence for the detection of low concentration of analyte.
(C) The emission spectrum fully overlaps the absorption spectrum.
(D) Emission spectra are typically dependent on the excitation wavelength.

15. One method to _____ Raman signals is to employ surface-enhanced Raman scattering (SERS)?
(A) amplify.
(B) increase.
(C) decrease
(D) prevent

二、問答 (請於答案卷中標示題號並依續作答，每題五分，共五題)

16. Comparison of standard addition method and internal standard method

17. Describe the working principle of matrix-assisted laser desorption/ionization time-of-flight mass spectrometry

18. Describe the working principle of ion selective electrode.

19. Describe the theory of band broadening in capillary electrophoresis.

20. Describe the advantages of Fourier transform-based mass spectrometry.