每題只有一個正確答案，共40題，各題2.5分

1. Which of the following types of nuclear decay results in an increase in the nuclear charge?
A) positron emission B) gamma emission
C) electron capture D) beta emission
E) alpha emission

2. What is the best answer to report for $\frac{2.521 \times 13.51}{2.78} + 0.31$?
A) 12.6 B) 12.5613 C) 13
D) 12.561 E) 12.56

3. Sparkling wine is bottled under a CO_2 pressure of 4.0 atm. The solubility of CO_2 at 4.0 atm is 0.68 g/100 g H_2O. What is its solubility after the bottle is opened if the partial pressure of CO_2 is 4.0×10^{-4} atm?

A) 5.8×10^{-4} g/100 g H_2O B) 6.8×10^{-5} g/100 g H_2O
C) 5.1×10^{-6} g/100 g H_2O D) 2.72×10^{-5} g/100 g H_2O
E) 1.35×10^{-5} g/100 g H_2O

4. A ligand is
A) a Lewis base. B) a chelate. C) an ion.
D) a Lewis acid. E) bidentate.

5. For an ideal gas, which pairs of variables are directly proportional to each other (if all other factors remain constant)?

1. P, T
2. P, V
3. V, T
4. n, V

A) 1 and 2 only B) 1 and 3 only
C) 3 and 4 only D) 2 only
E) 1, 3, and 4 only

6. Which of the following statements is not a characteristic of acids in aqueous solution?
A) They have a slippery feeling.
B) They are electrolytes.
C) They taste sour.
D) They react with a base to yield a salt.
E) They react with $CaCO_3$ to produce CO_2.

7. If the rate law for a reaction is

$$R = k[ClO_3^-][I^-][H^+]^2$$

What are the units of k when time is in seconds and the concentration is in moles per liter?

A) $\frac{mol}{L \cdot s}$ B) $\frac{L^2}{mol^2 \cdot s}$ C) $\frac{L^3}{mol^3 \cdot s}$ D) $\frac{L \cdot s}{mol}$ E) $\frac{mol^2}{L^2 \cdot s}$

8. A given mass of gas occupies a volume of 4.00 L at 60°C and 550 mmHg. Which of the following mathematical expressions will yield its pressure at 3.00 L and 30°C?

A) $550 \times \frac{4.00}{3.00} \times \frac{303}{333}$ B) $550 \times \frac{3.00}{4.00} \times \frac{303}{333}$

C) $550 \times \frac{3.00}{4.00} \times \frac{333}{303}$ D) $550 \times \frac{4.00}{3.00} \times \frac{30}{60}$

E) $550 \times \frac{3.00}{4.00} \times \frac{30}{60}$

9. How many electrons does the ion $^{56}_{26}Fe^{3+}$ have?

A) 53 B) 56 C) 23 D) 29 E) 26

10. A 0.0100-mol sample of urea, NH_2CONH_2, contains

A) 4.82×10^{22} atoms. B) 4.82×10^{23} atoms.

C) 6.02×10^{23} molecules. D) 4.82×10^{24} atoms.

E) 6.02×10^{22} molecules.

11. The atomic mass of Ga is 69.72. There are only two naturally occurring isotopes of gallium, ^{69}Ga and ^{71}Ga. The natural abundance of the ^{69}Ga isotope must be approximately

A) 50%. B) 60%. C) 30%. D) 40%. E) 70%.

12. One can show that gasoline is a mixture of compounds by

A) measuring its temperature during distillation.
B) measuring its freezing point.
C) measuring its density.
D) measuring its molecular mass.
E) measuring its specific gravity.

13. Which of the following equations represents roasting?

A) $WO_3 + 3H_2 \longrightarrow W + 3H_2O$

B) $2Al(OH)_3 \longrightarrow Al_2O_3 + 3H_2O$

C) $Al(OH)_3 + OH^- \longrightarrow Al(OH)_4^-$

D) $2ZnS + 3O_2 \longrightarrow 2ZnO + 2SO_2$

E) $ZnO + C \longrightarrow Zn + CO$

14. The numerical value of the Faraday constant is given as 96,500. This value represents

A) the number of electrons corresponding to one coulomb of charge.
B) the number of ions discharged by the passage of one mole of electrons.
C) the number of electrons corresponding to one mole of electric charge.
D) 96,500 $\frac{amp}{sec}$.
E) the number of coulombs carried by one mole of electrons.

15. The pH of 0.1 M NH_3 is approximately

A) 1. B) 3. C) 11. D) 13. E) 7.

16. A mixture of NO and O_2 at a fixed temperature reacts according to the equation

$$NO(g) + \tfrac{1}{2}O_2(g) \rightleftharpoons NO_2(g)$$

When equilibrium is established, which of the following ratios is constant, regardless of the initial concentrations of NO and O_2?

A) $\dfrac{[O_2][NO]}{[NO_2]}$ B) $\dfrac{[NO_2]}{\frac{1}{2}[O_2][NO]}$ C) $\dfrac{[NO]^2[O_2]}{[NO_2]^2}$

D) $\dfrac{[NO_2]}{[NO][O_2]}$ E) $\dfrac{[NO_2]}{[\frac{1}{2}O_2][NO]}$

17. The radiation that has the greatest penetration power is
A) positron. B) x-ray. C) beta.
D) alpha. E) gamma.

18. $N_2O_4(g) \rightleftharpoons 2NO_2(g)$

At 25°C and one atmosphere pressure, one mole of N_2O_4 forms an equilibrium mixture with NO_2. At equilibrium there is 0.815 mol N_2O_4 and 0.370 mol NO_2. At 55°C and one atmosphere pressure, one mole of N_2O_4 forms an equilibrium mixture containing 0.50 mol N_2O_4 and 1.0 mol NO_2.

Therefore, we can conclude that
A) heat is evolved when N_2O_4 goes to NO_2.
B) NO_2 reacts faster at 25°C than at 55°C.
C) the equilibrium constant for the reaction above will increase with temperature.
D) the reaction above is exothermic.
E) NO_2 molecules are colliding with each other more frequently at 25°C than at 55°C.

19. The geometry of the SO_3 molecule is best described as
A) trigonal planar. B) bent.
C) trigonal pyramidal. D) tetrahedral.
E) linear.

20. Which of the following has the lowest boiling point?
A) HI B) H_2O C) HCl D) HBr E) HF

21. Calculate the molarity of a solution that contains 64.0 g of HCl in 315 mL of solution. (MW HCl = 36.5 g/mol.)
A) 5.57 M B) 7.55 M C) 8.21 M D) 9.15 M E) 9.75 M

22. Consider the following specific heats of metals.

Metals	Specific Heat
copper	0.385 J/(g • °C)
magnesium	1.02 J/(g • °C)
mercury	0.138 J/(g • °C)
silver	0.237 J/(g • °C)
lead	0.129 J/(g • °C)

If the same amount of heat is added to 25.0 g of each of the metals, which are all at the same temperature, which metal will have the highest temperature?

A) mercury B) silver C) magnesium
D) copper E) lead

Question 23 refers to the following:

	K_{sp}
$BaSO_4$	1.0×10^{-10}
AgCl	1.6×10^{-10}
$BaCO_3$	9.1×10^{-9}
CuBr	4×10^{-8}
$PbSO_4$	1.1×10^{-8}

23. Which of the following compounds is the most soluble in water?

A) AgCl B) $PbSO_4$ C) $BaCO_3$ D) $BaSO_4$ E) CuBr

24. The empirical formula of a salt consisting of Mg^{2+} and N^{3-} ions is

A) MgN. B) Mg_2N_3. C) $Mg^{2+}N^{3-}$.
D) Mg_2N. E) Mg_3N_2.

25. Which of the following compounds would be expected to have the lowest boiling point?

A) $CH_3\underset{\displaystyle OH}{\underset{|}{C}}HCH_3$ B) $CH_3CH_2CH_2OH$ C) CH_3CH_2COOH
D) $CH_3CH_2CH_2NH_2$ E) $CH_3CH_2CH_2F$

26. The concentration of H_3O^+ in a solution is 2×10^{-4} M.

What is its OH^- concentration?

A) 2×10^{-4} M B) 1×10^{-10} M C) 5×10^{-11} M
D) 5×10^{-10} M E) 2×10^{-10} M

27. Which of the following is a strong acid in water?

A) HF B) $HClO_2$ C) H_3PO_4 D) H_2CO_3 E) HI

28. All of the following processes are exothermic except

A) $NH_3(aq) + HCl(aq) \longrightarrow NH_4Cl(aq)$.
B) $H_2(g) + Cl_2(g) \longrightarrow 2HCl(g)$.
C) $Na^+(g) + e \longrightarrow Na(s)$.
D) $Cl^-(g) \longrightarrow Cl(g) + e$.
E) $H_2O(g) \longrightarrow H_2O(l)$.

29. Which of the following is an example of a chemical change?
A) dry ice sublimating
B) sucrose dissolving
C) hydrogen burning
D) sodium chloride melting
E) alcohol boiling

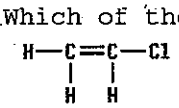
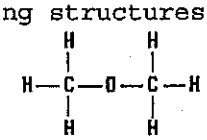
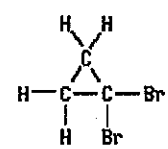
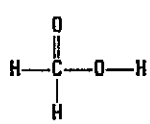
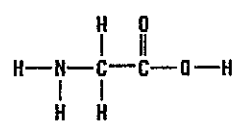
30. Consider the following information for four sulfides:

	K_{sp}
CdS	3.6×10^{-29}
ZnS	4.9×10^{-18}
CuS	8.7×10^{-36}
PbS	8.4×10^{-28}

To saturated 1.0-L solutions of all the sulfides above, 100 mL of 0.01 M sodium sulfide is added. Which one of the following ions exists in lowest concentration at 25° C?

A) Cu^{2+} B) S^{2-} C) Pb^{2+} D) Zn^{2+} E) Cd^{2+}

31. How many isomeric alcohols have the molecular formula $C_4H_{10}O$?
A) 3
B) 5
C) 4
D) 2
E) some other number

32. Which of the following structures is incorrect?
A) 
B) 
C) 
D) 
E) 

33. From a consideration of electronic configurations, which of the elements indicated below would be classified as a <u>transition</u> element?
A) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^5, 4s^2$
B) $1s^2, 2s^2, 2p^6, 3s^2, 3p^5$
C) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^{10}, 4s^2, 4p^6$
D) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2$
E) $1s^2, 2s^2, 2p^2$

34. All of the following statements about silicon are true <u>except</u>
A) It appears free in nature.
B) It is a nonmetal.
C) It is extremely abundant in the earth's crust.
D) It forms a crystal structure similar to that of diamond.
E) It is used as a semiconductor.

35. What is the frequency of light that has a wavelength of 432 nm?

A) 1.44×10^{3} Hz B) 1.44×10^{-15} Hz
C) 1.30×10^{20} Hz D) 8.39×10^{11} Hz
E) 6.94×10^{14} Hz

36. Which of the following sets of the four quantum numbers n, ℓ, m_ℓ, and m_s correctly describes an electron occupying a spherical orbital of the fourth energy level?

A) 4, 1, 1, $+\frac{1}{2}$ B) 4, 0, 0, $-\frac{1}{2}$ C) 4, 3, 3, $-\frac{1}{2}$
D) 4, 2, 0, $+\frac{1}{2}$ E) 4, 4, 4, $-\frac{1}{2}$

37. All of the following reactions are called combination reactions except

A) $CuSO_4(s) + 5H_2O(\ell) \longrightarrow CuSO_4 \cdot 5H_2O(s)$.
B) $3H_2(g) + N_2(g) \longrightarrow 2NH_3(g)$.
C) $C_2H_4(g) + Br_2(\ell) \longrightarrow C_2H_4Br_2(\ell)$.
D) $Cl_2(g) + H_2O(\ell) \longrightarrow HOCl(aq) + HCl(aq)$.
E) $MgO(s) + CO_2(g) \longrightarrow MgCO_3(s)$.

38. Polymers of two to ten simple-sugar units are called
A) polysaccharides. B) peptides.
C) oligosaccharides. D) monosaccharides.
E) polypeptides.

39. A sample of ammonium phosphate, $(NH_4)_3PO_4$, contains 2.15 mol of hydrogen atoms. The number of moles of oxygen atoms in the sample is
A) 6.45. B) 1.43. C) 2.15. D) 0.717. E) 1.73.

40. Consider the equilibrium $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ at a certain temperature. An equilibrium mixture in a 4.00-L vessel contains 1.60 mol NH_3, 0.800 mol N_2, and 1.20 mol H_2. What is the value of K_c?
A) 3.37 B) 17.1 C) 7.41 D) 29.6 E) 9.00

— end —

一、解釋下列名詞或說明其原理　50%

1. Ionic strength (5%)
2. Partition (Distribution) coefficient (5%)
3. Standard addition method (5%)
4. Precision and accuracy (5%)
5. Gas chromatography (5%)
6. X-ray diffraction (5%)
7. 繪一典型的極譜圖 (Polarogram) 並註明其(i) residual current (ii) half-wave potential (iii) limiting current (5%)
8. 說明下列物品之用途 (15%)
   (i) Certified (Reference) material
   (ii) pH buffer solution
   (iii) Reference electrode
   (iv) Volumetric flask, ion exchange resin, syringe
   (v) Electronic balance, fume hood, freeze dryer

二、(I)固態 $CaCO_{3(s)}$ 與其飽和溶液達平衡時, Ca^{2+} 之離子強度爲何? (5%)　$\log K_{so} = -8.48$

(II)於上述飽和溶液中分別加入 (i) KOH (ii) $(NH_4)_2SO_4$ (iii) $FeCl_3$ (iv) Na_2CO_3 (v) H_2O 時, Ca^{2+} 之濃度變化各爲何? (5%)

三、爲測定沉積物中銅的濃度，秤取乾燥且磨細的沉積物 0.2 g 於微波消化瓶中，加入 HCl-HNO_3-HF 共 10 ml 進行加熱分解，於沉積物分解後加入去離子水稀釋至 100 ml 後，利用原子吸收光譜儀測得銅的濃度爲 25 μg/L，請問沉積物中銅的濃度爲何？ 並請說明原子吸收光譜儀測定的原理爲何？ (15%)

四、假設仁愛河沉積物間隙水之 pH 爲 8.0，而汞 [Hg(II)] 的濃度係由 $HgS_{(s)}$之溶解所控制〔亦即 Hg(II) 與 $HgS_{(s)}$達平衡〕。已知 Hg(II)在間隙水中極易形成硫化汞錯合物種(complexes)，而間隙水中硫化物總濃度爲 10^{-5}M [$S(II)_{total} = 10^{-5}$M]，請問間隙水中 [Hg^{2+}], [HgS_2^{2-}], [$HgHS_2^-$], [$Hg(HS)_2°$], 以及總汞 [$Hg(II)_{total}$] 濃度各爲何？ (15%)

$$Hg^{2+} + 2HS^- \rightleftharpoons Hg(HS)_2^\circ \qquad \log K = 37.7$$

$$Hg^{2+} + 2HS^- \rightleftharpoons HgHS_2^- + H^+ \qquad \log K = 31.5$$

$$Hg^{2+} + 2HS^- \rightleftharpoons HgS_2^{2-} + 2H^+ \qquad \log K = 23.2$$

$$H_2S \rightleftharpoons HS^- + H^+ \qquad \log K = -7.0$$

$$HS^- \rightleftharpoons S^{2-} + H^+ \qquad \log K = -19$$

$$HgS_{(s)} + H^+ \rightleftharpoons Hg^{2+} + HS^- \qquad \log K'_{so} = -37.11$$

五、(I)若地表水(湖水或河水)之 pH 介於 7 - 8 之間，那麼地表水中主要可中和酸雨中 H+ 的化學物種爲何？ (5%)

(II)以 pH 測定儀量測雨水或湖水中 pH 值時之原理及方法爲何？ (5%)

(橫書式) 國立中山大學八十七學年度碩博士班招生考試試題

科 目：普通地質學(海地化所一乙、丙) 共 一 頁 第 頁

一. 試解釋下列諸詞：(60%)

1. uniformitarianism
2. aquifer
3. Darcy's law
4. fumarole
5. evaporite
6. Curie point
7. hypocenter
8. turbidite
9. stalagmite
10. pahoehoe lava
11. radiolaria
12. orogeny
13. calcareous ooze
14. offshore bar
15. travertine
16. pelagic sediment
17. isotope
18. guyot
19. geyser
20. craton

二. 試列舉五類主要之造岩礦物.(5%)

三. 何謂 sea floor spreading？有何証据？(5%)

四. Coral reef 如何形成？有那幾種？(5%)

五. 試解釋 porosity 與 permeability 以及兩者間之相関性或不相関性.(5%)

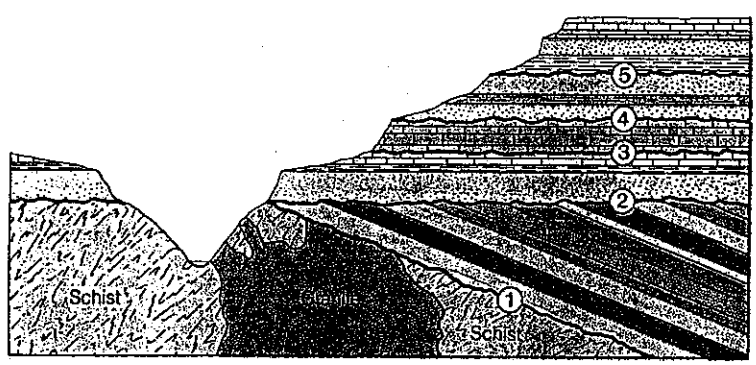
六. 大陸地殼中的主要元素(重量百分比>1%)有那些？請依其重量百分比排序並列出其大致百分比.(10%)

七. 何謂 isomorphism？又何謂 polymorphism？試舉例說明之.(10%)

1. (a). Cyclostratigraphy, (b). Oxygen isotope stratigraphy,
   (c). Magnetostratigraphy, (d). Biostratigraphy, (e). Lithostratigraphy,
   (f). Chronostraigraphy.
   請就以上六種地層學中任選四種，詳細描述其地層劃分及對比的依據與所使用的單位.（各 15 %、共 60 %）

2. 野外觀察露頭時，我們如何判斷地層層序正常(normal)或倒轉(overturned)？（10 %）

3. 如下圖中的①②③④⑤各是何種不整合 ？ 請同時列出中英文名稱.（10 %）



4. 對於火成岩、沈積岩和變質岩三種不同岩層，如何各自進行地層對比？（10 %）

5. 你可以列舉兩種放射性定年的方法及其應用的原理嗎 ？（10 %）

(橫書式) 國立中山大學八十七學年度碩　士班招生考試試題

科　目：構造地質學(海地化所乙組)選考　　共 1 頁 第 1 頁

1. 畫圖並比較下列名詞的異和同。（每小題 4 分，畫圖佔一半分數，共 16 分）

(1) 正斷層 (Normal fault) 和生長斷層 (Growth fault)

(2) 逆斷層 (Reverse fault) 和逆衝斷層 (Thrust fault)

(3) 力 (Force) 和應力 (Stress)

(4) 走向斷層 (Strike-slip fault) 及轉形斷層 (Transform fault)

2. 蓬萊造山運動屬於薄層 (Thin-skinned) 還是厚層 (Thick-skinned)，目前有不少討論。列舉這兩種看法的 (1) 代表人物 (2) 証據 (3) 弱點及 (4) 重要論點。(16 分)

3. 畫圖說明如何利用

(1) Drag fold 和 Major fold 間的關係來判斷地層的上下。

(2) Slaty cleavage 和地層間的關係來決定背斜及向斜的位置。(12 分)

4. 台灣南部及西南海域有些什麼構造？成因？(10 分)

5. 畫圖顯示衝頂構造 (Diapir) 頂部及周圍可能出現的構造，及發生原因。(10 分)

6. 台灣島的重力測量值結果及其意義。(10 分)

7. 畫圖並說明形成正斷層的所有可能原因。(10 分)

8. 畫圖並說明下列構造的成因。(16 分)

(1) Klippe (2) Window (Fenster) (3) Parallel folding (4) Closed folds

海洋學概論試題

1. Please 1) explain in detail what El Nino is, and 2) describe all the oceanographic and meteorological phenomenon associated with El Nino worldwide. If you can, draw diagrams and use examples to illustrate your points. (15%)

2. Why Japan Islands, Taiwan, and the Philippine Islands are easily subject to earthquakes? Please draw diagrams to explain your answers. (15%)

3. What is a T-S diagram, and what can it tell us. Please give some examples. (10%)

4. What is tide? What are the most important tide-generating forces and their related tide forms? (10%)

5. Please give brief descriptions and draw diagrams if possible, to explain the following terminologies: (50%)

(1). photic zone
(2). storm surge
(3). primary productivity
(4). Ekman spiral
(5). sigma-T (σ_t)
(6). Snell's law
(7). subduction zone
(8). transform fault
(9). rip current
(10). red tide