

科目：化學【海地化所碩士班甲組】 V

本科目准許考生攜帶簡單計算機

- 一、何謂同位素? 請列舉碳、氮、氧同位素組成並說明各元素同位素在自然界中相對組成(大約)?就你所知舉一例說明同位素在地球科學研究上的應用?(10%)

- 二、假設飲用水中汞的含量不得高於 6.02×10^{-4} g/kg, 若水的密度為 1.00 g/ml, 請問汞的含量上限為多少 molarity? 【Hg】=200.6 g/mole (10%)

- 三、何謂固液相的 partition coefficient (ratio) (K_d)? 如何定義? 並請說明 K_d 在層析(chromatography)原理上的應用?(10%)

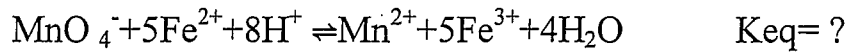
- 四、請寫出下列化學式英文名稱 (10%)
(i) $\text{Na}_2\text{S}_2\text{O}_3$ (ii) KIO_3 (iii) $\text{K}_2\text{Cr}_2\text{O}_7$ (iv) $\text{CaCO}_3/\text{Mg}(\text{OH})_2$
(v) BaSO_4

- 五、何謂準確度 (accuracy)及精確度 (precision), 當你進行任一化學分析時, 如何確保準確度和精確度? 以及如何表示準確度及精確度的高低?(10%)

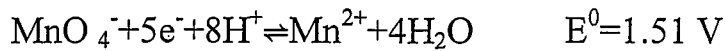
- 六、酸雨的成因為何? 以及如何利用 pH 值判斷酸雨? 你如何以玻璃電極量測雨水 pH 值?(10%)

科目：化學【海地化所碩士班甲組】

七、計算下列反應之平衡常數 (equilibrium constant) (10%)



半反應之標準電位如下：



八、解釋或簡答下列各題：(30%)

- (1) 何謂三鹵甲烷？自來水中三鹵甲烷的成因為何？寫出任二種自來水中三鹵甲烷有機物。(6%)
- (2) 火焰與石墨爐式原子吸收光譜儀有何差別？優缺點為何？(6%)
- (3) 氣相層析儀(GC)以及高效能液態層析儀(HPLC)之分析原理有何差異？(6%)
- (4) 在實驗室中如何配置特定pH之緩衝溶液？該緩衝溶液pH值與弱酸pK值關係為何？(6%)
- (5) 螢光光譜 (Fluorescence)如何產生？什麼是原子螢光光譜 (Atomic Fluorescence)? (6%)

科目：科學英文【海地化所碩士班】 ✓

Part 1. Multiple Choices. There is only ONE correct or best answer to each question. (5 points for each question, total 75 points)

第一部份、單選題。每一題僅有一個正確或最佳答案；請於答案卷作答。

Answer questions 1-5 according to the following article by David Biello in 60-Second Science Blog of Scientific American Magazine.

The undisturbed tropical forests of Africa—like the rainforest in Congo—remove 1.2 billion metric tons of carbon dioxide from the atmosphere every year. For the last few decades, that rate of removal has increased by 0.6 metric tons per hectare per year—simply because the trees are getting bigger and bigger in size, according to an analysis published in Nature today.

That's good news for those who are looking for ways to sequester carbon, which many say is necessary to curb global warming. "We are receiving a free subsidy from nature," said study co-author Simon Lewis of the University of Leeds, in a statement. He and his co-authors measured the girths of tropical trees in Africa—and hence CO₂ absorption.

All told, the world's tropical forests absorb some 4.8 billion metric tons (annually), or 18 percent of manmade CO₂ from fossil fuel burning and only a little less than the entire emissions of the U.S. In effect, tropical trees are getting bigger globally, perhaps because the CO₂ is acting to promote growth as has been shown in other studies.

Based on current prices for metric tons of CO₂, all that avoided greenhouse gas is worth some \$18 billion, according to Lee White, chief climate change scientist of Gabon and a co-author on the research.

Some policymakers and scientists have argued that countries with tropical forests should be paid to preserve them. That could somehow translate into healthier economies in those countries, and jobs to replace those previously created by cutting timber or clearing forest.

Ultimately, however, the trees can't do that much more than they already are to save us. "Even if we preserve all remaining tropical forest," Lewis said, "these trees will not continue getting bigger indefinitely."

1. According to the article, tropical forests in Africa uptake (a) 0.6×10^6 tons; (b) 1/4; (c) 4.5%; (d) 1/2; (e) 18% of anthropogenic CO₂ from the atmosphere every year.
2. Growth of trees in tropical forests leads to (a) higher biomass burning; (b) more global warming threat; (c) lowered anthropogenic CO₂ in the atmosphere; (d) job losses in developed countries; (e) better weather.
3. It is indicated that (a) fossil fuel burning; (b) wastewater treatment; (c) cutting trees; (d) plant photosynthesis; (e) paying African countries money is responsible for the absorption of carbon by the forest trees.
4. What would you suggest, by the action of choice, which may help to slow down global warming?
(a) Keep the atmospheric CO₂ content high so that forest trees will grow faster; (b) Pay the countries that have tropical forests; (c) Create more job opportunities for cutting timbers or clearing forests; (d) Better maintenance and management of forest sizes; (e) Stop using paper products.

科目：科學英文【海地化所碩士班】

5. What time period of data did Simon Lewis and his coworkers collect and analyze to reach their conclusion in this study? (a) 2 years; (b) 5 years; (c) 10 years; (d) 20 years; (e) more than 20 years.

Answer questions 6-10 according to abstract of the following article.

Raymond, P.A., Oh, N.-H., Turner, R.E., Broussard, W., 2008. Anthropogenically enhanced fluxes of water and carbon from the Mississippi River. *Nature*, 451(7177), 449-452.

The water and dissolved inorganic carbon exported by rivers are important net fluxes that connect terrestrial and oceanic water and carbon reservoirs¹. For most rivers, the majority of dissolved inorganic carbon is in the form of bicarbonate. The riverine bicarbonate flux originates mainly from the dissolution of rock minerals by soil water carbon dioxide, a process called chemical weathering, which controls the buffering capacity and mineral content of receiving streams and rivers². Here we introduce an unprecedented high-temporal-resolution, 100-year data set from the Mississippi River and couple it with sub-watershed and precipitation data to reveal that the large increase in bicarbonate flux that has occurred over the past 50 years (ref. 3) is clearly anthropogenically driven. We show that the increase in bicarbonate and water fluxes is caused mainly by an increase in discharge from agricultural watersheds that has not been balanced by a rise in precipitation, which is also relevant to nutrient and pesticide fluxes to the Gulf of Mexico. These findings demonstrate that alterations in chemical weathering are relevant to improving contemporary biogeochemical budgets. Furthermore, land use change and management were arguably more important than changes in climate and plant CO₂ fertilization to increases in riverine water and carbon export from this large region over the past 50 years.

6. What country was studied in this report? (a) Mexico; (b) Mississippi; (c) Taiwan; (d) United States of America; (e) Brazil.
7. According to the article, what is unique about the data set analyzed in this study? (a) Covering vast area; (b) Having high sampling frequency; (c) Being connected to the Gulf of Mexico; (d) Being related to global environmental changes; (e) Having very long study period.
8. Which region should have the highest bicarbonate concentrations in its streams and rivers? (a) Polar region; (b) Arid grassland; (c) Tropical coastal plain; (d) High-altitude mountains; (e) Sahara Desert.
9. Which term best describes the authors' argument that caused elevated bicarbonate levels in Mississippi River waters in the last 50 years? (a) Human stressor; (b) Weathering; (c) Natural disaster; (d) Hurricanes; (e) El Nino.
10. What is the best unit to describe the "carbon flux" in this study? (a) g/cm³; (b) m/s; (c) mole/day; (d) mg/L; (e) cm²/s.

Answer questions 11-15 according to abstract of the following article.

Feely, R.A., Sabine, C.L., Hernandez-Ayon, J.M., Ianson, D., Hales, B., 2008. Evidence for upwelling of corrosive "acidified" water onto the continental shelf. *Science*, 320(5882), 1490-1492.

The absorption of atmospheric carbon dioxide (CO₂) into the ocean lowers the pH of the waters.

科目：科學英文【海地化所碩士班】

This so-called ocean acidification could have important consequences for marine ecosystems. To better understand the extent of this ocean acidification in coastal waters, we conducted hydrographic surveys along the continental shelf of western North America from central Canada to northern Mexico. We observed seawater that is undersaturated with respect to aragonite upwelling onto large portions of the continental shelf, reaching depths of ~40 to 120 meters along most transect lines and all the way to the surface on one transect off northern California. Although seasonal upwelling of the undersaturated waters onto the shelf is a natural phenomenon in this region, the ocean uptake of anthropogenic CO₂ has increased the areal extent of the affected area.

11. Which ocean/sea is the investigated region in this study located? (a) Gulf of Mexico; (b) Atlantic Ocean; (c) Southern Ocean; (d) Indian Ocean; (e) Pacific Ocean.
12. According to the paper, what material is depleted in the upwelling water under study? (a) CaCO₃; (b) NaCl; (c) MgCO₃; (d) FeS₂; (e) CaSO₄.
13. What causes ocean acidification? (a) Excess atmospheric CO₂ entering the ocean; (b) World ocean circulation; (c) Biodiversity; (d) Overfishing; (e) Ocean dumping.
14. What latitude is in the vicinity of the location where the strongest upwelling was observed in this study? (a) 40°S; (b) 40°N; (c) 20°S; (d) 20°N; (e) 10°N.
15. How many people are credited for the contribution toward publication of this paper? (a) 1; (b) 2; (c) 3; (d) 4; (e) > 4.

Part 2. Translation. Give a summary in Mandarin Chinese for each of the following paragraphs of text. (25 points)

第二部份、英翻中。將下列段落文字以大意（非逐字）方式翻寫為中文；文中專有名詞若無法利用已知中文俗名，則以原始英文字取代。評分以理解及文句通順程度為標準。

Submarine canyons that directly receive sediment from rivers near and far have rapid deposition of fluvial sediment, are effective temporary traps of fluvial sediment during the flood season; and have high mass fluxes. In recent years there have been numerous particle flux studies in submarine canyons and on open continental margins. Their findings are similar that most particle fluxes increase with depth and suspended particles are predominantly lithogenic, whose percentage also increases with depth. Common nonlithogenic constituents measured in the particle fluxes/dynamics studies include (not exclusively) calcium carbonate, organic carbon, biogenic opal, organic matter, and some stable isotopes such as $\delta^{13}\text{C}$, $\delta^{15}\text{N}$ and radioisotopes such as $^{210}\text{Pb}_{\text{ex}}$.

As the particles settle through the water column, biogeochemical transformation such as degradation, decomposition, and remineralization of organic and biogenic matter takes place. The result is the decreasing percentage/flux of organic matter and increase C/N ratio with depth. As the particles settle, organic matter could be diluted by lithogenic particles as well. Near the canyon or shelf floor, a benthic nepheloid layer (BNL) often exists in which the particles could come from downward settling, rebound material in the water column and resuspended material from the floor. Bottom nepheloid layers are involved in the supply of significant fraction of sediment to the deep and they could be related to the breaking of internal waves.

科目：普通地質學【海地化所碩士班乙組】 V

一、解釋名詞（20%）

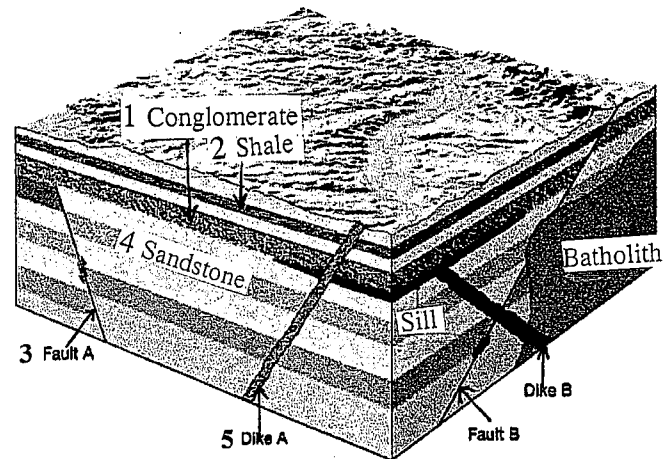
1. uniformitarianism (3%)
2. fault (3%)
3. weathering (3%)
4. barrier island (3%)
5. unconformity (2%)
6. diagenesis (2%)
7. turbidite (2%)
8. eolian (2%)

二、試說明板塊構造（plate tectonics）學說的內涵，並解釋大陸地殼（continental crust）與海洋地殼（oceanic crust）的差異之處。（20%）

三、試說明地球內部的構造為何？並以地球物理研究的角度出發，描述有哪些研究方法可以應用在探知地球的內部組成。（20%）

四、試以地質學的角度出發，討論（圖一）中各地質構造的先後順序，並說明有哪些地質學的原理（principles）可以幫助你釐清圖中各地質事件發生的順序。（20%）

- 1 Conglomerate
- 2 Shale
- 3 Fault A
- 4 Sandstone
- 5 Dike A



（圖一）

五、請僅就您所了解的部份，闡述「全球暖化及氣候變遷」的意義。並依您的認知，嘗試討論京都議定書（Kyoto Protocol）的施行所可能造成的影響。（20%）