

國立中山大學 105 學年度碩士暨碩士專班招生考試試題

科目名稱：科學英文【海科系碩士班甲組、乙組、丙組】

題號：458001

※本科目依簡章規定「不可以」使用計算機(混合題)

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A. Reading comprehension. Read the following reports and answer the multiple-choice questions accordingly. Choose one correct or "best" answer for each question. (60 points, 3 point each question).

Answer questions 1-5 according to abstract of the following report:

Excerpts from American Geophysical Union's (AGU) Earth and Space Science News, Dec. 1, 2015.

Tropical forests, sometimes referred to as the Earth's lungs, are having trouble breathing. Woody vines, known as lianas, are slowly outcompeting trees in tropical forests, making it harder for those forests to inhale the vast quantities of carbon dioxide that humans pump into the atmosphere every year. In a study published 12 October in the Proceedings of the National Academy of Sciences of the United States of America, scientists estimate that without the lianas, tropical forests could soak up 4 times as much carbon dioxide as they do now. The vines have grown more widespread in recent decades—increasing in some forests by as much as 75%, said Geertje van der Heijden, the study's lead author and a tropical ecologist at the University of Nottingham in the United Kingdom. No one knows for certain why lianas are proliferating, she noted, but one explanation could be that they thrive under higher concentrations of carbon dioxide or drier conditions. Another theory is that because trees are dying faster, lianas can quickly move into the resulting gaps in the canopy, she said.

The Amazon forest—which is the largest tropical forest in the world—absorbs more carbon than it releases, making it a significant global carbon sink. It sequesters just under 1 billion metric tons of carbon every year through photosynthesis and stores it in the woody tissues of trees. However, climate change and other human influences are taking their toll on the Earth's forests, especially the tropical ones. Since 1990, the world has lost 129 million hectares to deforestation, predominately in tropical South America and Africa, according to a recent report from the Food and Agriculture Organization of the United Nations. A study in Nature published in March reported that Amazon trees have been dying at higher rates in the past few decades—possibly because of the atmosphere's increasing carbon dioxide concentrations. The increasingly abundant lianas are also outcompeting tropical forests' trees, van der Heijden said. Their extensive root systems more efficiently take up water, and their leaves blanket the canopy, blocking out sunlight. The more lianas there are, the faster trees die, allowing the lianas to spread further. Most important, compared to trees, lianas produce less woody tissue—where carbon is stored in the long term—and more leaves. In other words, what lianas make up for in total biomass, they lack in carbon storage. "Lianas, on the forest level, make sure that the carbon taken up from the atmosphere is less and that the carbon released back to the atmosphere is higher," said van der Heijden. By JoAnna Wendel, Staff Writer

1. Why are tropical forests considered the Earth's lungs? (A) They absorb and store carbon dioxide; (B) They release carbon dioxide; (C) They fix oxygen; (D) They breathe like human being.
2. Who is the leading author of the article on vine carbon uptake? (A) JoAnna Wendel; (B) Geertje van der Heijden; (C) multiple authors; (D) unknown.
3. What is the main difference between woody trees and lianas that affect CO₂ uptake? (A) Trees grow more leaves; (B) Lianas grow more roots; (C) Trees block sunlight more effectively than lianas; (D) Trees produce more carbon-storing tissues.
4. Which continent is the largest carbon sink that is contributed by its tropical forest? (A) Africa; (B) Asia; (C) South America; (D) North America.
5. What is the major issue this article identifies? (A) lianas outgrow trees; (B) lianas uptake more CO₂; (C) tropical forests grow more trees in the last few decades; (D) more lianas growth helps reduce atmospheric CO₂ globally.

Answer questions 6-12 according to abstract of the following report by McCauley, D.J., et al., Science, 347(6219): 1255641 (2015).

Comparing patterns of terrestrial and marine defaunation helps to place human impacts on marine

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fauna in context and to navigate toward recovery. Defaunation began in earnest tens of thousands of years later in the oceans than it did on land. Although defaunation has been less severe in the oceans than on land, our effects on marine animals are increasing in pace and impact. Humans have caused few complete extinctions in the sea, but we are responsible for many ecological, commercial, and local extinctions. Despite our late start, humans have already powerfully changed virtually all major marine ecosystems.

Humans have profoundly decreased the abundance of both large (e.g., whales) and small (e.g., anchovies) marine fauna. Such declines can generate waves of ecological change that travel both up and down marine food webs and can alter ocean ecosystem functioning. Human harvesters have also been a major force of evolutionary change in the oceans and have reshaped the genetic structure of marine animal populations. Climate change threatens to accelerate marine defaunation over the next century. The high mobility of many marine animals offers some increased, though limited, capacity for marine species to respond to climate stress, but it also exposes many species to increased risk from other stressors. Because humans are intensely reliant on ocean ecosystems for food and other ecosystem services, we are deeply affected by all of these forecasted changes. Three lessons emerge when comparing the marine and terrestrial defaunation experiences: (i) today's low rates of marine extinction may be the prelude to a major extinction pulse, similar to that observed on land during the industrial revolution, as the footprint of human ocean use widens; (ii) effectively slowing ocean defaunation requires both protected areas and careful management of the intervening ocean matrix; and (iii) the terrestrial experience and current trends in ocean use suggest that habitat destruction is likely to become an increasingly dominant threat to ocean wildlife over the next 150 years.

Wildlife populations in the oceans have been badly damaged by human activity. Nevertheless, marine fauna generally are in better condition than terrestrial fauna: Fewer marine animal extinctions have occurred; many geographic ranges have shrunk less; and numerous ocean ecosystems remain more wild than terrestrial ecosystems. Consequently, meaningful rehabilitation of affected marine animal populations remains within the reach of managers. Human dependency on marine wildlife and the linked fate of marine and terrestrial fauna necessitate that we act quickly to slow the advance of marine defaunation.

6. What is the most probable title of this article? (A) The history of animal extinctions; (B) How to protect animals; (C) What stops marine defaunation; (D) Animal loss in the ocean?
7. To classify the content of each paragraph, what is the most likely type the second paragraph fits into? (A) abstract; (B) observations; (C) advances; (D) conclusions.
8. What field of study should this article be classified? (A) fishery; (B) marine conservation; (C) human impact in the ocean; (D) defaunation on Earth.
9. According to the article, how are the events of defaunation in the ocean and on land compared? (A) It occurred in the ocean earlier; (B) It is more severe in the ocean; (C) It is more severe on land; (D) It is comparable in the ocean and on land.
10. What is the likely impact on marine defaunation from human activities? (A) increase the rate of defaunation; (B) lead to several marine mammal extinctions; (C) no effect on ecological structures; (D) impact starts from the ocean to the land.
11. Which following statement correctly reflects the outlook of marine defaunation? (A) Human impact can be managed to reduce the effects; (B) It is already too late; (C) Many marine animal extinctions have occurred; (D) We need to look at the impact on land first.
12. According to the article, which statement is correct? (A) The experience of animal extinctions on land does not help our knowledge on their marine counterparts; (B) Marine defaunation occurred in the ocean earlier than terrestrial ones; (C) It is helpless to manage human impact on marine defaunation; (D) The extent of human influence on marine ecology is increasing.

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Answer questions 13-15 according to abstract of the following abstract by Hu et al., *Nature*, 522: 299-308 (2015).

Pacific Ocean western boundary currents and the interlinked equatorial Pacific circulation system were among the first currents of these types to be explored by pioneering oceanographers. The widely accepted but poorly quantified importance of these currents—in processes such as the El Niño/Southern Oscillation, the Pacific Decadal Oscillation and the Indonesian Throughflow—has triggered renewed interest. Ongoing efforts are seeking to understand the heat and mass balances of the equatorial Pacific, and possible changes associated with greenhouse-gas-induced climate change. Only a concerted international effort will close the observational, theoretical and technical gaps currently limiting a robust answer to these elusive questions.

13. What is the main subject of this article? (A) ocean currents in the Pacific; (B) climate patterns in the Pacific; (C) effects of ocean currents on climate; (D) international collaboration on ocean current research.
14. Which continent or land is closer to the currents mentioned in the article? (A) Greenland; (B) Hawaii; (C) Easter Island; (D) Taiwan.
15. Which parameter is key component of the studies required for answering the questions raised in this article? (A) rainfall rate; (B) temperature; (C) partial pressure of carbon dioxide; (D) current velocity.

Answer questions 11-15 according to abstract of the following abstract by Resing et al., *Nature*, 523: 200-203 (2015).

Hydrothermal venting along mid-ocean ridges exerts an important control on the chemical composition of sea water by serving as a major source or sink for a number of trace elements in the ocean. Of these, iron has received considerable attention because of its role as an essential and often limiting nutrient for primary production in regions of the ocean that are of critical importance for the global carbon cycle. It has been thought that most of the dissolved iron discharged by hydrothermal vents is lost from solution close to ridge-axis sources and is thus of limited importance for ocean biogeochemistry. This long-standing view is challenged by recent studies which suggest that stabilization of hydrothermal dissolved iron may facilitate its long range oceanic transport. Such transport has been subsequently inferred from spatially limited oceanographic observations. Here we report data from the US GEOTRACES Eastern Pacific Zonal Transect (EPZT) that demonstrate lateral transport of hydrothermal dissolved iron, manganese, and aluminium from the southern East Pacific Rise (SEPR) several thousand kilometres westward across the South Pacific Ocean. Dissolved iron exhibits nearly conservative (that is, no loss from solution during transport and mixing) behaviour in this hydrothermal plume, implying a greater longevity in the deep ocean than previously assumed. Based on our observations, we estimate a global hydrothermal dissolved iron input of three to four gigamoles per year to the ocean interior, which is more than fourfold higher than previous estimates. Complementary simulations with a global-scale ocean biogeochemical model suggest that the observed transport of hydrothermal dissolved iron requires some means of physicochemical stabilization and indicate that hydrothermally derived iron sustains a large fraction of Southern Ocean export production.

16. In terms of Fe in the ocean, hydrothermal vents act as (A) localized source; (B) sources of long-range transport; (C) sinks as Fe deposits near the vents; (D) a predominant source?
17. Where was the field measurements done in the paper? (A) South Pacific Ocean; (B) Southern Ocean; (C) North Pacific; (D) Equatorial Pacific.
18. What is the most important significance of Fe in the ocean? (A) behaving conservatively; (B) providing mineral resource; (C) being an essential and bio-active element; (D) having limited effects on marine biogeochemistry.
19. Results of biogeochemical model in this study reveal (A) hydrothermal derived Fe originate from the Southern Ocean; (B) Fe precipitates during long-range transport; (C) Fe reacts with Mn and Al; (D)

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hydrothermal sources provide significant Fe requirement for biomass in the ocean interior.

20. Nutrients mean (A) chemical discharged out of hydrothermal vents; (B) chemicals required by organisms; (C) material important in the Pacific; (D) chemicals having conservative behavior.

B. Vocabulary: translate the following words into Chinese (10 points, 1 point each).

(1) speculation, (2) investigation, (3) transparency, (4) emission, (5) absorption,
(6) distinction, (7) hydrology, (8) cyanobacteria, (9) momentum, (10) divergence.

C. Vocabulary: translate the following words into English words or phrases (all nouns) (10 points, 1 point each).

(1) 地幔 (2) 大洋環流 (3) 假說 (4) 分子(化學) (5) 全球化
(6) 實驗 (7) 生產力 (8) 當代人 (9) 絕種(絕跡) (10) 管理

D. Translation: translate the following paragraph of English report into Chinese. Points will be awarded based on the completeness and fluency of the translation. (20 points)

Most undergraduates give high ratings to research experiences. Studies report that these experiences improve participation and persistence, often by strengthening students' views of themselves as scientists. Yet, the evidence for these claims is weak. More than half the 60 studies reviewed rely on self-report surveys or interviews. Rather than introducing new images of science, research experiences may reinforce flawed images especially of research practices and conceptual understanding. The most convincing studies show benefits for mentoring and for communicating the nature of science, but the ideas that students learn are often isolated or fragmented rather than integrated and coherent. Rigorous research is needed to identify ways to design research experiences so that they promote integrated understanding. These studies need powerful and generalizable assessments that can document student progress, help distinguish effective and ineffective aspects of the experiences, and illustrate how students interpret the research experiences they encounter. To create research experiences that meet the needs of interested students and make effective use of scarce resources, we encourage systematic, iterative studies with multiple indicators of success.

國立中山大學 105 學年度碩士暨碩士專班招生考試試題

科目名稱：普通生物學【海科系碩士班甲組】

題號：458005

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問答題(每題 10 分)

1. Please define polymerase chain reaction (PCR) and describe how it works.
2. Describe the seven types of learning.
3. Giraffes have a long neck because they have to stretch their necks to reach leaves on the tree. After stretching over and over again, their necks grow longer. What is wrong about this description? And how would you describe it in the perspective of evolution?
4. Define photosynthesis and describe its chemical reactions.
5. Define countercurrent exchange, and how it benefits marine species?
6. What is a homologous structure? Name two examples.
7. What is a keystone species?
8. Why sexual reproduction can increase genetic variability?
9. How global climate change affects ecosystems in terms of biodiversity?
10. How ocean acidification threatens the environments?

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科目名稱：化學【海科系碩士班乙組選考】

題號：458002

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1. 名詞解釋(30%)
 - 1) pH
 - 2) Diffusion
 - 3) Half-time ($t_{1/2}$) (for radio isotope)
 - 4) Aerobic oxidation
 - 5) Anion
 - 6) Stable isotope
 - 7) Heat capacity
 - 8) Henry's law
 - 9) Stoichiometry
 - 10) Nuclear chain reaction
2. 過去六十年間大氣中二氧化碳分壓逐漸升高，使海洋逐漸酸化，請列出化學方程式描述上述現象(20%)。
3. 假設實驗室中的有機物質成分為 $(\text{CH}_2\text{O})_{106}(\text{NH}_3)_{16}(\text{H}_3\text{PO}_4)$ ，在有氧環境下分解成二氧化碳水硝酸以及磷酸，試寫出完整反映式並平衡該式(20%)。
4. 簡述光譜儀以及質譜儀的原理(10%)。
5. 何謂準確度(Accuracy)，何謂精準度(Precision)，如何表示精準度以及準確度的高低(10%)?
6. 何謂理想氣體定律(10%)?

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科目名稱：普通地質學【海科系碩士班乙組選考】

題號：458006

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一、單選題 (10%，每題 2%)

1. 下列何者不是礦物？ (a) 石英 (b) 鐘乳石 (c) 橄欖石 (d) 磷灰石
2. 下列何者不是變質岩？ (a) 板岩 (b) 大理岩 (c) 安山岩 (d) 硬頁岩
3. 下列何者不是中生代的地質時間名稱？ (a) 白堊紀 (b) 三疊紀 (c) 二疊紀 (d) 侏羅紀
4. 下列何者不具有生物性碳酸鹽？ (a) 放射蟲 (b) 有孔蟲 (c) 鈣板藻 (d) 珊瑚
5. 下列何者不在板塊邊界？ (a) 大西洋中洋脊 (b) 夏威夷群島 (c) 喜馬拉雅山脈 (d) 加勒比海群島

二、名詞解釋 (24%，每題 2.4%)

1. 彈性回跳學說 (elastic rebound theory)
2. 化學風化作用 (chemical weathering)
3. 濁流岩 (turbidite)
4. 超基性岩石 (ultramafic rock)
5. 地震波的陰影帶 (shadow zone of seismic waves)
6. 不整合 (unconformity)
7. 均變說 (uniformitarianism)
8. 節理 (joint)
9. 地殼均衡說 (isostasy)
10. 沖積扇 (alluvial fan)

三、申論題 (66%)

1. 請敘述臺灣島的地體構造，內容須包含西南海域（南海北部）與東北海域（沖繩海槽）。請繪圖說明之。（20%）
2. 請敘述碳 14 定年法的原理。（15%）
3. 請說明包溫氏反應系列。（15%）
4. 請繪製地球內部的示意剖面圖，並說明地核、地函、海洋地殼與大陸地殼大致的組成。（16%）

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科目名稱：微積分【海科系碩士班丙組選考】

題號：458007

※本科目依簡章規定「不可以」使用計算機(問答申論題)

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1. 求極限

(a) $y = \sqrt{x \tanh x}$, 求 $\lim_{x \rightarrow 0} \frac{\left(\frac{dy}{dx}\right)}{\left(\frac{y}{x}\right)}$ 。 (10%)

(b) $\lim_{x \rightarrow 0} \frac{(x+5)^3 - 125}{x}$ (5%) 。

2. 計算以下的積分

(a) $\int \sin^2 x \, dx$ (5%)

(b) $\int (x+1)^3 \, dx$ (5%)

(c) $\int \sin^8 x \cos x \, dx$ (5%)

3. (a) 以 Taylor Series 將 $\sqrt[3]{1+x}$ 對 x 展開至 x 階 (5%)

(b) 利用以上結果求 $\sqrt[3]{65}$ 的近似值 (10%)

4. 在時間 t 時，一質點的位置為 $\vec{r} = 3e^{3t} \vec{i} + \cosh(2t) \vec{j} + 2t^3 \vec{k}$ ，求該質點在時間 t 時的速度與加速度。(各 5%)

5. 旋度與散度

$\vec{F}(x, y, z) = x^2 z^3 \cos y \vec{i} + y \sinh z \vec{j} + 2x^3 \vec{k}$ ，求 $\nabla \wedge \vec{F}$ 與 $\nabla \cdot \vec{F}$ 。(各 5%)

6. 設 $f(x) = \int_x^{x^2} \frac{1}{t} dt$ ，求導數 $f'(2)$ 之值。(10%)

7. 假設 $x=0$ 公里處產生波動，以每小時 \sqrt{x} 公里的速度向 $+x$ 方向傳播，求(a)在 x 公里處，波經過 dx 距離需要多少小時? (5%)

(b) 多少小時後，波會抵達座標 $x=300$ 公里處? (10%)

8. 求由點 $(5, 3, 1)$ 到平面 $3x+y+2z=3$ 的最短距離。(10%)

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科目名稱：流體力學【海科系碩士班丙組選考】

題號：458003

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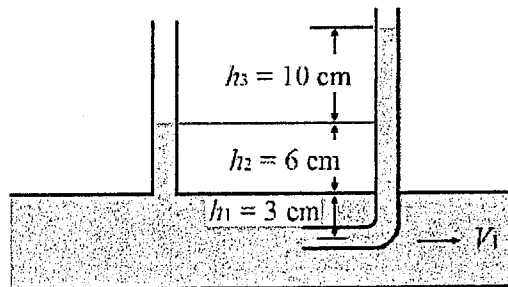
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一、解釋名詞 (每小題 5 分，共計 50 分)

1. Newtonian fluid 牛頓流體
2. dimensional analysis 因次分析
3. continuity equation 連續方程式
4. vorticity 渦度
5. Bernoulli equation 伯努利方程式
6. flow separation 流動分離
7. Navier-Stokes equation 那維爾-史托克方程式
8. Reynolds number 雷諾數
9. hydraulic jump 水躍
10. lift and drag of airfoil 機翼的昇力與阻力

二、計算題 (每小題 10 分，共計 50 分)

1. 某工程師利用皮托管(Pitot Tube)來量測一水平管流中水的流速，其裝置量測之結果如圖所示，計算水平管中心之流速 V_1 。(水的密度 $\rho = 1000 \text{ kg/m}^3$; $g = 9.81 \text{ m/s}^2$)



2. 下列速度場何者為無旋性流動(irrotational flow):

$$(a) V = 2xy\mathbf{i} + (x^2 - y^2)\mathbf{j}$$

$$(b) V = -(2xy + x)\mathbf{i} + (y^2 + y - x^2)\mathbf{j}$$

並求出其速度位(velocity potential)和流函數(stream function)。

3. 為了預測原型船在航行速度為 5 m/s 時的受力情形，以 $1/10$ 比例之模型船進行水槽試驗。

(a) 為了達到動力相似，模型船的航行速度應該設為多少？

(b) 若水槽試驗中模型船的阻力為 5 N ，則原型船所承受的阻力為多少？

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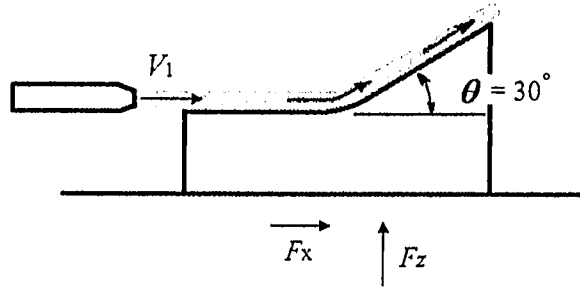
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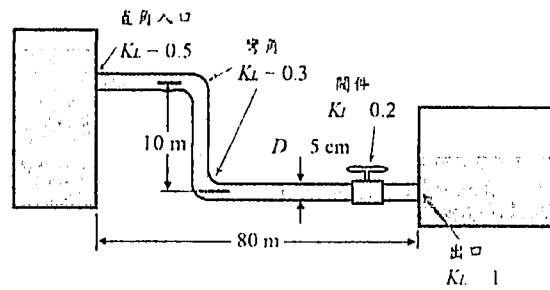
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4. 一截面積為 0.005 cm^2 之水管將一水流以均勻流速 $V_1 = 2 \text{ m/s}$ 射向一導流平台，水流以同 V_1 流速且 $\theta = 30^\circ$ 之角度離開平台。試計算地面對導流平台之作用力 F_x 及 F_z 。



5. 在下列供水系統中，管內平均流速為 3 m/s ，已知管內摩擦因子為 0.03 。求出下列供水系統之總壓損(head loss)



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科目名稱：海洋物理學【海科系碩士班丙組選考】

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選擇題 (7 題、每題 6 分共 42 分、單選、不倒扣)

- () 牛頓平衡潮理論的要義是講海面因受天體運動所引發的週期性水面升降現象，主要係因何力的平衡? (A)離心力與引力 (B)引力與科氏力 (C)科氏力與壓力梯度力 (D)離心力與科氏力。
- () 高水位和相鄰低水位之差值稱為潮差，潮差有週期性，會由小變大，再由大變小，請問大潮-小潮(spring-neap tide)之週期約為(A)12 小時(B)15 天(C)24 小時 (D)28 天。
- () 潮波在台灣海峽傳遞時會受到地理環境的影響，台灣海峽潮差最大之處約在? (A)淡水 (B)澎湖(C)烏坵(D)台南。
- () 同一頻率之波浪傳播時，波速在深水較快，淺水較慢，導致波射線發生彎曲稱為折射，其作用在沙質海岸容易形成? (A)凹形海灣(B)凸形海岸(C)平直海灘(D)以上皆非。
- () 風浪大小與風力有關，風浪成熟度又受吹風距離與吹風延時所控制，台灣附近冬季東北季風盛行時何處風浪會較小? (A)澎佳嶼(B)小琉球(C)蘭嶼 (D)澎湖。
- () 代表波高亦有人稱為有義波高(Significant wave height)，係海面上某點長時間連續觀測，所得波高中選取最大的多少組平均後所得到的數值? (A)1/2 (B)1/3 (C)1/4 (D)1/7。
- () 波浪共振會使波高倍增，颱風波浪常使台灣何處造成港池振盪，致船舶無法繫纜? (A)花蓮港(B)高雄港(C)台中港(D)基隆港。

解釋名詞 (4 題、每題 7 分共 28 分)

8. Thermocline
9. Ekman transport
10. Internal wave
11. Ocean acidification

申論題 (1 題共 30 分)

12. 下圖為在小琉球附近觀測到海水之溫度(x 上軸)及鹽度(x 下軸)隨深度(y 軸)之變化，圖中重疊之兩條線為儀器下放及上收之記錄。請問(a)溫度及鹽度隨深度有何種變化? (b)溫鹽深資料說明海水有何種垂直分層結構?

