

選擇考題 (每題 2 分, 共 50 分): ※ 注意: 請於試卷內之「選擇題作答區」依序作答。

- 1) Who was the first chemist to realize clearly that the bitter taste of seawater was due to the presence of  $MgSO_4$  and  $MgCl_2$ ? (a) Antoine Lavoisier, (b) Michael Pilson, (c) John Riley, (d) Wallace Broecker, (e) John Murray
- 2) Which gases have the highest average concentration in the ocean? (a) He (b) O, (c) N, (d)  $CO_2$ , (e) Ar
- 3) What is the residence time of the water in the ocean which estimated by simple flux balance box model? (a)  $\sim 1,500$  years, (b)  $\sim 37,000$  years, (c)  $\sim 3,700$  years, (d)  $\sim 150$  years, (e)  $\sim 1.5 \times 10^4$  years
- 4) What is the acronym of "AOU" used in marine science stands for? (a) Additional Oxygen Uptake, (b) Apparent Oxygen Uptake, (c) Actual Oxygen Utilization, (d) Additional Oxygen Utilization, (e) Apparent Oxygen Utilization
- 5) Who reported and published the first scientific paper on measurements of seawater composition? (a) Robert Boyle, (b) William Dittmar, (c) Joseph Louis Gay-Lussac, (d) Alexander Marcet, (e) Alfred C. Redfield
- 6) What is the metal centered in chlorophyll-a structure? (a) Ca (b) Cu (c) Mn (d) Cd (e) Mg
- 7) Opal in marine sediment is produced and input primarily by which type of organisms? (a) diatom (b) cyanobacteria (c) coccolithophores (d) foraminiferan (e) ciliate
- 8) Which element listed have the "nutrient type" distribution in the north Pacific Ocean? (a) Lead, (b) Strontium, (c) Thorium, (d) Sodium, (e) Germanium
- 9) What is the average temperature of North Atlantic Deep Water (NADW)? (a)  $\sim 0.3^\circ C$ , (b)  $\sim 0.8^\circ C$ , (c)  $\sim 5^\circ C$ , (d)  $\sim 1^\circ C$ , (e)  $\sim 3^\circ C$ ,
- 10) What is the age of the seawater found at north Atlantic Ocean by  $\Delta C14$  method? (a)  $\sim 1,500$  years, (b)  $\sim 37,000$  years, (c)  $\sim 3,700$  years, (d)  $\sim 400$  years, (e)  $\sim 1.5 \times 10^4$  years
- 11) Which of the listed open ocean surface water is saltiest? (a) North Atlantic Ocean, (b) North Pacific Ocean, (c) South Pacific Ocean, (d) Indian Ocean, (e) Southern Ocean
- 12) What is the ionic strength of 0.025 mol/L of  $MgSO_4$  solution? (a) 0.1, (b) 0.8, (c) 0.5, (d) 0.05, (e) 0.06
- 13) The thermocline is the depth in the ocean where (a) the salinity changes rapidly, (b) the temperature changes rapidly, (c) the density changes rapidly, (d) the density remain constant, (e) calcium carbonate dissolve rapidly
- 14) Which major class of biomolecules have highest content of carbon? (a) lipid (b) carbohydrate (c) protein (d) nucleic acid (e) amino acid
- 15) What is the average concentration range of dissolved silicate in north pacific deep waters? (a) 20~40 nM, (b) 40~80 nM, (c) 250~300  $\mu M$ , (d) 150~160  $\mu M$ , (e) 190~200  $\mu M$
- 16) What is the major radionuclide introduced to Pacific Ocean during Japan's Fukushima Daiichi power plant accident in year of 2011? (a)  $^{222}Rn$ , (b)  $^{238}U$ , (c)  $^{210}Pb$ , (d)  $^{89}Sr$ , (e)  $^{137}Cs$
- 17) What is the average concentration of dissolved organic carbon (DOC) in open ocean below 3000 m depth? (a) 150 $\mu M$  (b) 40 $\mu M$  (c) 250 $\mu M$  (d) 3 $\mu M$  (e) 800 $\mu M$
- 18) Which of the following seawater properties/contents or methods cannot be used for salinity measurement? (a) Density, (b) pH, (c) Conductivity, (d) Evaporation, (e) Refractometer
- 19) What is the average density of marine sediments? (a) 2.1 g/cm<sup>3</sup> (b) 5 g/cm<sup>3</sup> (c) 0.3 g/cm<sup>3</sup> (d) 28 g/cm<sup>3</sup> (e) 1.3 g/m<sup>3</sup>
- 20) What is the pH in a  $5 \times 10^{-4}$  mol/L solution of boric acid ( $B(OH)_3$ )? (Hint:  $H_2O \leftrightarrow H^+ + OH^-$ ,  $K_w = 10^{-14}$ ;  $B(OH)_3 + H_2O \leftrightarrow B(OH)_4 + H^+$ ,  $K_a = 7 \times 10^{-10}$ )? (a) 5.92, (b) 8.39, (c) 6.21, (d) 5.32, (e) 7.56
- 21) What is the pore size of most commonly used filters for separating particles and dissolved substances in marine waters? (a) 0.45 $\mu M$ , (b) 0.45mm, (c) 0.45cm, (d) 0.45 $\mu m$ , (e) 0.2mm
- 22) Which hard part of certain planktonic particle can affect the alkalinity of seawater? (a) diatom (b) cyanobacteria (c) dinoflagellate (d) coccolithophorid (e) ciliate

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- 23) What is the method used for measuring seawater Chlorinity Cl‰ ? (a) Molybdenum Blue method, (b) Hydride Generation method, (c) Argentometric Titration method, (d) Methylene Blue method, (e) Ferrozine method
- 24) What is the average ionic strength of open ocean waters? (a) 1.0, (b) 0.1, (c) 0.7, (d) 2.0, (e) 0.2
- 25) What is the pH of a  $10^{-3}$  M  $H_3PO_4$  solution ( $K_1 = 10^{-2.1}$ ,  $K_2 = 10^{-7.0}$ ,  $K_3 = 10^{-12.2}$ )? (a) 4.08, (b) 3.05, (c) 4.71, (d) 2.35, (e) 5.28

問答與計算考題 (每題 10 分, 共 50 分): ※ 注意: 請於試卷內之「非選擇題作答區」標明題號依序作答。

1. Describe "solubility pump" and "biological pump" in the ocean?
2. Explain what is marine "Dead Zone".
3. Describe at least 5 different ways (i.e., tools or techniques) of collecting marine suspended/sinking particles.
4. Calculate the residence time of Chloride (Cl) in the ocean, given the volume of the ocean is  $1.37 \times 10^9$  km<sup>3</sup> with average Chlorinity of 19 Cl‰, and the river flux is  $3.7 \times 10^4$  km<sup>3</sup>/yr with an average chloride concentration of 6 mg/kg.
5. Describe and draw out the different types of vertical concentration distribution patterns for elements in the ocean?

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