

OLLSCOIL NA hÉIREANN**NATIONAL UNIVERSITY OF IRELAND, GALWAY**

SUMMER EXAMINATIONS, 2004

Second Year (Denominated B.Sc. Degree in Marine Science)*MR 201 Fundamental Oceanography and Meteorology***Prof. M.J. Dring
and the internal examiners****Time allowed: *Three hours.*****Students answer 4 questions, at least **one** from each section****Use a **SEPARATE** answer book for each section****SECTION A**

1. Using the T-S diagram explain the process of cabelling which may mix two different water types.

Three water masses have distinct source temperatures and salinity and mix to form a 4th water mass. Show how a T-S diagram can be used to graphically determine the percentage contribution of each of the 3 water masses that have mixed together.

2. Describe the Ekman theory for wind driven circulation including the character of the mass transport predicted by the theory. Explain how the theory can explain the sea level characteristics in the middle of the main North Atlantic gyre.
3. Describe the equilibrium theory for the generation of ocean tides. Use the theory to explain the monthly variations of tidal range that might be expected.

P.T.O.

SECTION B

4. Answer all parts.

- a. Briefly explain two of the following terms
 - i. Halocline
 - ii. Lysocline
 - iii. Pycnocline
- b. Complete the following chemical equation for chemosynthesis
$$n(\text{CO}_2 + \text{H}_2\text{S} + \text{O}_2 + \text{H}_2\text{O}) \rightarrow$$
- c. Most of the dissolved salts in seawater come from continental weathering, and are brought in by rivers. Where does the chlorine come from? What other sources of dissolved constituents are there?

5. Answer all parts.

- a. What is the CCD? Would you expect the CCD to be deeper or shallower below an area of high primary productivity compared to low productivity? Why?
- b. Calculate the residence time of calcium in seawater, given the following:
River concentration: $0.33 \times 10^{-3} \text{ mol L}^{-1}$
Seawater concentration: $10 \times 10^{-3} \text{ mol L}^{-1}$
River discharge: $3.6 \times 10^{16} \text{ L yr}^{-1}$
Ocean volume: $1.37 \times 10^{26} \text{ L}$
- c. Explain what is meant by nutrient limitation. How might primary productivity be affected by stratification of the water column?

6. Answer all parts.

- a. Name 5 of the 7 principal ions found in seawater.
- b. Complete the following equation for the formation of calcite
$$\text{Ca}^{2+}_{(\text{aq})} + 2\text{HCO}_3^{-}_{(\text{aq})} \rightleftharpoons$$
- c. The average salinity of seawater is 35. What processes might cause the salinity of surface waters to vary in different parts of the ocean?

P.T.O.

SECTION C

7. Explain what is meant by the following terms;
Lapse rate, hectopascal, triple point of water, planetary short wave albedo, radiative forcing.

Give a brief account of solar radiation, to include maximum emission, and its distribution with respect to wavelength.

What parameters does the rate of emission of radiation from an object depend on?

Describe briefly emission of radiation from the earth's surface.

Determine the equilibrium radiative temperature at which a balance occurs between incoming solar radiation and outgoing terrestrial radiation, neglecting absorption by greenhouse gases.

Irradiance at the top of the atmosphere = 1367 W m^{-2}

Planetary short wave albedo = 0.31

Stefan-Boltzmann constant = $5.67 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$

8. Explain what is meant by the following terms:
Moist air, deposition, saturation water vapour pressure, specific humidity, relative humidity.

Explain briefly:

- a) why evaporation leads to cooling;
- b) why a person feels warmer in conditions of high humidity than a person at a lower relative humidity at the same temperature.

9. Draw a typical cross section of a continental margin, clearly label and explain the continental shelf, slope, rise and abyssal plains. What are submarine canyons and how do they form? Briefly comment on why continental shelves are of economic importance?