CHECK POINTS – GEF2610

Pickard and Emery:
Excerpts from Descriptive Physical Oceanography

Chapter 2 Ocean Dimensions, Shapes and Bottom Materials

1. From a geographic point of view it is natural to distinguish between different regions of the ocean by the land masses surrounding them. From an oceanographic point of view other criteria may be more convenient. What are these criteria?
2. How can the following concepts be defined and characterized: the *shore*, the *continental shelf*, the *continental slope*, the *deep-sea basins*, the *seamounts*, the *island arcs and ridges*, the *trenches*, the *sills*?
3. Why are the geological concepts in point 2 above important in physical oceanography?
4. Why is information about the bottom material of interest to the physical oceanographer?

Chapter 3 Physical Properties of Sea-Water

1. Pure freshwater has several unique properties, compared to other fluids. What are these properties?
2. What are the most important differences between pure freshwater and pure sea-water?
3. How is salinity defined?
4. How was salinity determined before the conductivity method was developed? On which principle was this earlier method based?
5. How are $\sigma_{s,t,p}$ and $\sigma_{s,t,0} = \sigma_t$ defined? Why is the latter quantity often used instead of $\rho(s,t,p)$?
6. What is an *adiabatic* process? What is a *potential temperature*? What is a *potential density*? Is a potential temperature higher or lower than the *in situ* temperature? Is a potential density higher or lower than the *in situ* density?
7. To which extent can salinity and temperature be regarded as conservative properties in the sea? How can conservative properties be used in physical oceanography?
8. What is the velocity of sound in the sea? How do temperature, salinity and pressure influence this velocity?
9. What is a SOFAR channel, and why do they occur?
10. How much of the incident light energy from sun and sky is absorbed within the first meter in the clearest ocean water? And in coastal water?
11. Why is clear ocean water blue, and coastal water greener?

Chapter 4 Typical Distributions of Water Characteristics in the Oceans

1. What are the mean values of temperature and salinity for the world ocean?
2. What are the typical ranges of temperature and salinity for 75% of the world ocean?
3. How do the surface temperature, salinity and density vary with latitude, - averaged for all oceans?
4. What is the pycnocline, and at which depths do we find it in the oceans?

5. What do vertical profiles of density, typical for low and high latitude regions respectively, look like?
6. What do the vertical profiles of temperature and salinity, corresponding to the profiles in point 5, look like?
7. What is meant by *stable* and *unstable* density stratification?
8. Which processes in the ocean require unstable conditions?
9. Why are observations of dissolved oxygen and nutrients of interest to the physical oceanographer?

Chapter 5 Water, Salt and Heat Budgets of the Oceans
1. The principle of the conservation of mass is used in two different forms in physical oceanography. Which forms? How are the corresponding budgets?
2. What are *Knudsen's relations*, and which assumptions are they based upon?
3. What are the fundamental differences between the inflow and outflow patterns of the Mediterranean Sea and the Black Sea, and what is the cause of these differences?
4. What does the heat budget for a water body look like?
5. What is the average percentage of the incoming short-wave radiation from the sun that is finally absorbed by the world ocean, and what are the average magnitude of the different other terms in the heat budget, expressed by the same percentages?
6. Which environmental factors influence the magnitude of the different terms in the heat budget?
7. How do the different terms in the heat budget vary with latitude in the world ocean?

Chapter 7 Circulation and Water Masses of the Oceans
1. What is the ultimate source of energy for the surface circulation and the thermohaline circulation?
2. What are the processes creating the formation of deep water and bottom water in the oceans? Which physical force is driving the thermohaline circulation?
3. Where are the deep water and bottom water of the Atlantic formed?
4. What are the estimated transports of the deep water and bottom water in the Atlantic?
5. What are the typical horizontal speeds in these transports? (See the additional figures presented on the web site for GEF1600).
6. What is the estimated speed of the upward movement of deep water towards the upper layers in the Atlantic?
7. What is an Ekman current, and which forces are neglected in the model for the Ekman spiral?
8. What are typical depths of the Ekman layer at different latitudes?
9. It is possible to divide the Southern Ocean into three zones. Which ones?
10. What are the characteristic features of the Southern Ocean circulation?
11. What is the estimated transport of the Antarctic Circumpolar Current?
12. There are four characteristic water masses in the Subantarctic zone. Which ones?
13. What are the characteristic features and names of currents in the North Atlantic and South Atlantic surface circulations?
14. What are typical transports of the Gulf Stream and the Brazil Current?
15. Mediterranean water contributes to the thermohaline circulation within the Atlantic Ocean. What are the features of this contribution?

16. How is the influence of the thermohaline circulation in the Mediterranean Sea on the current pattern in the Strait of Gibraltar?
17. How is the general current pattern in the straits between the Baltic Sea and the Kattegat, as compared with that of the Strait of Gibraltar?
18. What are the temperatures and salinities of the bottom water in the Greenland Gyre?
19. What are the three characteristic water masses of the Arctic Sea, and what are their temperatures and salinities?
20. Where is the origin of these water masses?
21. What different types of circulation do we find in adjacent seas?
22. What are the names and directions of the surface currents of the Pacific Ocean?
23. What are El Niño, ENSO and La Niña?
24. What are the names and directions of the surface currents of the Indian Ocean?
25. Where have the deep and bottom waters of the Pacific and Indian Ocean been formed?

Chapter 8 Coastal Oceanography
1. When do we get upwelling at a coast?
2. From which depths will the upwelling come?
3. How do Cameron and Pritchard define an estuary?
4. Which main types of estuaries do we have, and what are their characteristics?
5. What is the estuarine circulation?

Sælen and Aas:
Lecture notes in physical oceanography

Chapter 1-5 overlap similar chapters in P&E, but may have different angles and supplementing information. The term *the Norwegian Sea* will today sometimes be called *the Nordic Seas*, which include: *the Greenland Sea, the Iceland Sea* and *the Norwegian Sea.* North Americans may call this *the GIN Sea*.

Chapter 6. Equations of motion in the sea
1. Which ones are the 5 forces we usually are dealing with in physical oceanography?
2. Which two forces are balancing each other in the vertical when we have hydrostatic pressure, and how is the equation describing this case on differential and integral forms?
3. Which two forces are balancing each other in the horizontal plane when we have a geostrophic current?
4. Which two forces are balancing each other in the horizontal plane when we have an Ekman current?

Chapter 7. Currents in the sea

The chapter overlaps to a great extent Chapter 7 in P&E.

1. At which times of the year will the depth of the upper mixed layer on Station M obtain its maximum and minimum?
2. What are the mean values for the maximum and minimum of this mixed layer?
3. Which factors are causing this seasonal variation?
4. How does the thickness of the upper mixed layer in the Norwegian Coastal Current vary with season and latitude?
5. Which surface currents do we have in the Nordic and Barents Seas?
6. On which coasts do we find upwelling on a large scale?
7. What is the cause of this upwelling?
8. Which biological consequences are usually resulting from such upwellings?
9. What is the typical depth of origin for the upwelling water?

Chapter 8. Waves

1. What is the difference between wind waves and swells?
2. How will the water particles in a sinus shaped surface wave be moving?
3. How can the ratio between the trajectory speed of the water particle and the propagation (phase) speed of the wave be expressed?
4. What do we mean by *short* and *long* waves?
5. What is the expression for the phase velocity of short and long waves, respectively?
6. What is *dead water*?

Chapter 9. Tides

1. What is the average period between two successive high waters at most places on the globe?
2. When do we obtain spring and nip tides, respectively?
3. Why are two successive high waters (or low waters) usually somewhat different?
4. The tip of the velocity vector for a tidal current in the open sea will usually describe a geometrical figure during a tidal period. Which figure?

Chapter 10. Fjords and estuaries

1. At which time of the year and why can some fjords cease to be an estuary?
2. What are the physical and biological effects of the sill in a fjord?
3. Where in Norway can we find fjords without a sill?
4. At which time of the year will the renewal of the deep water usually take place in the fjords on the Norwegian West Coast, and why?
5. At which time of the year will the renewal of the deep water usually take place in the inner Oslofjord, and why?

Chapter 11. Ice in the sea

1. Which two main types of ice do we find in the sea?
2. When seawater freezes, what happens to the salts?
3. What is *ice sludge, pack ice, hummock, pan cake ice*?
4. How old will the pack ice in the Polar Sea become before currents will transport it out of the area?
5. What is the density of ice relative to seawater, and how much of the ice volume will reach above the surface?