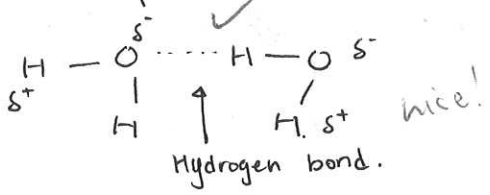
Properties of seawater test – December 2019

Name: Maggie.

1. Describe how the structure of a water molecule affects three different properties of water. [3] 3

Because H-bond requires a lot of energy to break!

The structure of water molecule:



nice!

The effects.

① Cohesion (adherence) because of strong H-bond. so there is surface tension and organisms like water strider can walk on it.

② High specific heat capacity it can absorb more heat than land and maintain a relatively constant temperature in the ocean.

③ (Almost) "universal" solvent. It can dissolve most substances because of its strong H bond. it attracts other ions and dissolve them.

2. a) State the temperature at which water is most dense. 4 °C [1] 1

b) Explain why solid water (ice) has a lower density than liquid water. [2] 2

Because in liquid water, water molecules can move around freely, and take up free spaces as much as possible. So the molecules are closer together and thus higher density; however, in ice, molecules stay roughly at the same fixed position, the space between them are bigger, thus lower density.

3. Describe the effects of temperature, salinity and pressure on water density. [3] 3

As temperature increases ↑, density decreases ↓

As salinity ↑, density ↑.

As pressure ↑, density ↑

4. During the water cycle there are many changes in energy and temperature. The table shows the heat energy absorbed as 10 grams of ice at –5 °C are warmed and change to water vapour at +10 °C.

Sequence	Heat energy required for the change	Mass / g	Temperature change / °C	Heat energy for 10 g (cal)
Step 1: warm ice (–5 to 0 °C)	0.5 cal g^{-1} $°C^{-1}$	10	5	25
Step 2: melt ice at 0 °C	80 cal g^{-1}	10	0	800
Step 3: warm liquid water 0 to 10 °C	1.0 cal g^{-1} $°C^{-1}$	10	10	10
Step 4: evaporate water at 10 °C	540 cal g^{-1}	10	0	5400

0.5 cal g^{-1} $°C^{-1}$

(a) Identify the change in temperature and the heat energy values for **step 4** by writing the missing values in the spaces in the table. [2] 2

(b) Explain how melting ice can absorb 800 calories of heat without a change in temperature. because of hydrogen bond [2] 1

Because water has high specific heat capacity which means it takes a lot of energy to break the chemical structure of ice (hydrogen bond) before it can go from ice to water. The 800 cal are use to change the structure, so the temperature doesn't rise.

5. Describe and evaluate TWO methods to measure water salinity at 100 m. [4] 4

① use a bottle to collect water sample at 100 m. Take a sample of a certain amount and evaporate the water in the lab. Calculates the ratio of salt remaining and initial water volume. Hence get the salinity.

② Use an ARGO float. It is sent down automatically and it can collect the data for water salinity at 100 m. it then sends the data to satellite and people can access the data.

① accurate, easy to do

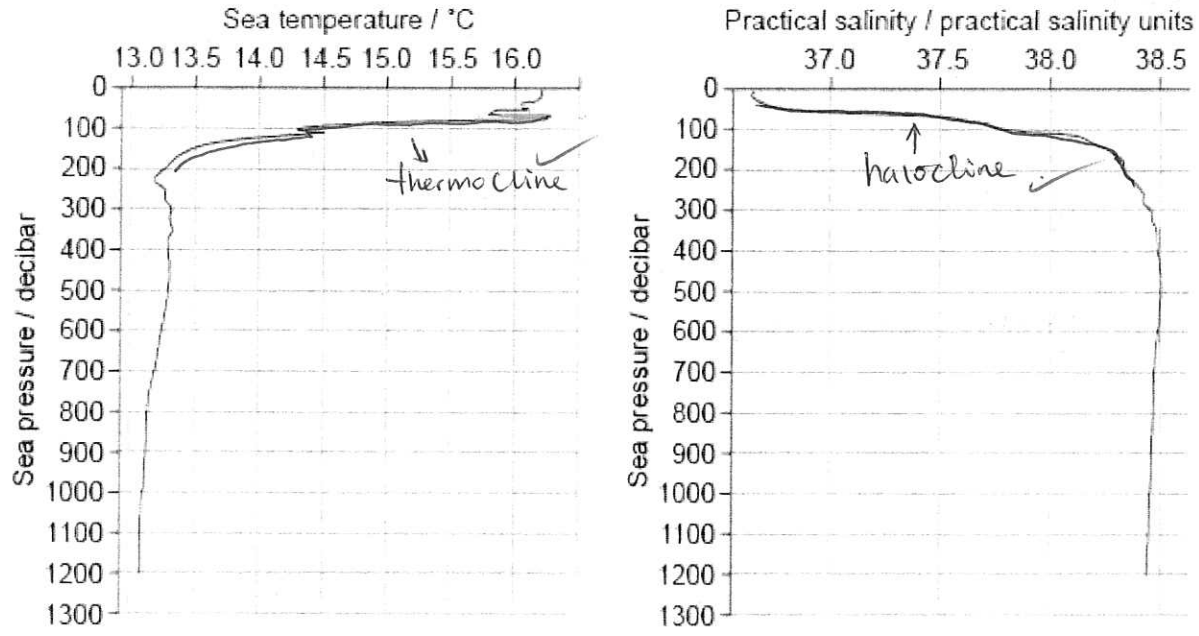
② too slow and time-consuming good.

② It's accurate and can collect sample from multiple sites with many ARGO floats; people don't need to go there by themselves.

② It's expensive. and after it cannot work, it will sink to the seafloor and become a waste and pollution.

6.

Ocean profiles from the Argo float that surfaced in the Mediterranean on 24 December 2013 are shown.



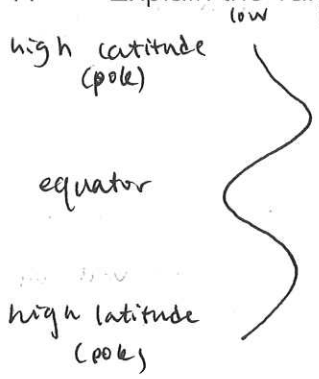
(a) Label the thermocline and the halocline on the ocean profile. [2] 2

③ below the pycnocline, the water is very stable. Because for 1000 m, water temperature remains constant at around 13.2°C. and salinity around 38.4 - 38.5 ppt. (I misunderstood the question!)

(b) Determine, with reasoning, whether this column of water is vertically stable. [2] 2

Yes. At the surface, the temperature is high and the salinity is low, both makes water density at surface very low. At depth, the temperature is lower and salinity is higher, both mems that the density is higher.
Since the density at surface is lower that depth, the water will stay stable.

7. Explain the variation in salinity with **latitude**. [3] 3



(the graph)

- At low latitude (equator), the salinity is ~~low~~ low because there's a lot of rainfall / precipitation that dilute the salinity. ↑ a lot of rainforests
- At a bit higher latitude (tropics), the salinity is high because of little precipitation and high evaporation rate.
- At the highest latitude (poles), the salinity is low again because of a lot of precipitation and the melting of ice also dilutes the seawater.

8. List the six most abundant ions in sea water in order of abundance. [3] 3

Chloride (Cl^-) > Sodium (Na^+) > Sulphate (SO_4^{2-}) >
Magnesium (Mg^{2+}) > Calcium (Ca^{2+}) > Potassium (K^+).

9. a) Describe the cause of ocean acidification. [2] 2

The major cause is ~~CO_2~~ too much CO_2 emission as a result of burning fossil fuels. The CO_2 in the atmosphere is absorbed by the ~~ocean~~ sea water and because of the process $CO_2 + H_2O \leftrightarrow H_2CO_3 \leftrightarrow H^+ + HCO_3^-$. and H^+ decrease water pH, CO_2 makes ocean more acid.

Besides, the intake of anthrogenic (CO_2 (breathing) makes it more acid.

b) Explain why ocean acidification is occurring to a greater extent in polar oceans (at high latitudes). [2] 2

At higher latitudes, the water temperature is much lower. As temperature decreases, CO_2 dissolves more in the water.

Also, because ice is melting because of global warming, there is more open water and more CO_2 is absorbed.

Since more CO_2, more H^+, and thus more ocean acidification.

c) Describe three impacts of ocean acidification on marine organisms. [3] 3

① Acid will dissolve their shells & skeleton.
ex. pteropods, coccolithephores, urchis, barnacle will lose their shell. fish's skeleton will be dissolved.

② As it's harder for them to build shells, they will have less energy for forage and reproduction, lead to decrease in population

③ As organisms are dying, the food web is destroyed, and animals don't have enough food to eat. Ex salmon is indirectly influenced.

d) Discuss three solutions to ocean acidification. [3] 3

① To increase resiliance,
we can (i) build more ocean protected areas
(ii) control fishing ✓
(iii) reduce nutrient pollution.

② Use renewable energy ~~to reduce~~ like solar, tidal, wind energy. to be more efficient. ✓

③ Stop burning fossil fuels !!! ✓ yes!

10. Suggest two possible sources of the water that now makes up earth's oceans. [2] 2

① Off-gasing of igneous rocks ✓ in volcanos. it is followed by condensation, precipitation and accumulation of water, which is now ocean.

② Comets ✓ brought ice & rock. and thus there is water on Earth.

11. Write one question you wish had been on this test and answer your question. [2] 2

Describe and evaluate 2 methods to measure water temperature. ✓

① Acoustic Tomography ✓
Because sound travels at different speed in water of different temperatures, by measuring the speed sound travels ~~after~~ in the ocean, we can determine the temparature.
☺: it's accurate and can measure at depth.
☹: It's inaccessible for most people and can disturb marine organisms.

② ~~Satte~~ Ocean surface topography. great!
Because water volume ↑ as temperature increases. by measuring the variation of ~~height~~ water height, we can deduce the water temperature, Do to so. satelite sends microwave signals to collect information and thus obtain ocean temperature.
☺ It can measure a large range.
☹ It can only measure at surface.

40/41 = 98% Wow! Excellent!