**Year 12 ATAR Chemistry Units 3 and 4**

**Task 2: Extended Response Question on Ocean Equilibria**

**ANSWERS**

Part 1: Research Project. Weighting 1%.

Part 2: Validation Test including one calculation question on stoichiometry.

Weighting 4%.

You are to research the questions on Ocean Equilibria. This research is due on Monday Week 6 of Term 1, 2021. To present this research in sufficient detail is likely to require at least a 1000-word type-written report, plus diagrams. A reference list containing at least 5 sources of information from reliable sources is also required.

A validation test on the same topics will be held on Wednesday Week 6 of Term 1, 2021.

Part 1: Research project. Use a variety of sources to find answers to these questions.

1. List as many possible reasons as you can to explain why the concentration of atmospheric carbon dioxide is rising as the result of human activities. Where appropriate, use equation/s to show how this carbon dioxide is generated.

**1 mark for each reason, maximum 2 marks. Reasons must be distinct from each other. Any reasonable answer at the teacher’s discretion e.g.**

* **Fossil fuel combustion for electricity production.**
* **Fossil fuel combustion for transport.**
* **Deforestation.**

**1 mark for any correct, relevant equation at the teacher’s discretion e.g.**

**CH4 + 2O2 🡪 CO2 + 2H2O**

1. Identify other greenhouse gases that are increasing in concentration in the atmosphere because of human activities. Also identify the human activities that are producing these greenhouse gases.

**1 mark each for any 3 greenhouse gases – named and a human activity that produces that greenhouse gas.**

**Examples**

**Methane – livestock enteric fermentation, paddy rice farming, landfill emissions etc.**

**Nitrous oxide (N2O) - the use of fertilisers leading to higher nitrous oxide concentrations.**

**Ozone – as the result of automobile use and industrial processes.**

**Chloroflurocarbons (or specific examples) - use in refrigeration systems and use in fire suppression.**

**Hydrofluorocarbons – refrigeration, air conditioning equipment, propellants, foam blowing, solvent cleaning and in fire extinguishers.**

**Water vapour is also a greenhouse gas but it may be difficult for students to name the human activity producing this gas.**

1. Explain why the rising level of atmospheric level carbon dioxide is causing sea-level rise.

**For 2 marks students are to provide 2 different mechanisms by which rising CO2 is causing sea-level rise. Both points need to be properly explained, at the teacher’s discretion.**

**Examples**

**Rising atmospheric carbon dioxide levels are increasing the amount of infrared radiation trapped by the atmosphere, causing increased Earth surface temperatures, causing…**

* **Sea-level rise due to the loss of polar ice-caps.**
* **Sea-level rise due to thermal expansion of the oceans.**

1. Explain in terms of the principles of equilibria why the oceans are becoming more acidic.

**Students can answer by referring to (and explaining only as much as necessary) the following 3 reactions for 1 mark each, or they can explain the same concept in words. Student should explain that because of increasing CO2(g) the first three reactions are being pushed to the right. (The fourth reaction is being pushed to the left).**

**CO2(g) ⇌ CO2(aq)**

**CO2(aq) + H2O(l) ⇌ H2CO3(aq)**

**H2CO3(aq) ⇌ H+(aq) + HCO3-(aq)**

**HCO3-(aq) ⇌ H+(aq) + CO3-(aq)**

**OK to combine the last two reactions. OK to write Brønsted-Lowry reactions.**

1. Explain how ocean acidification can impact humans, and how it can affect a variety of marine organisms, including those with shells and those without. Also explain how ocean acidification can affect organisms at the bottom of food chains, and at the top of food chains.

**How it can impact humans**

**Any 2 reasonable points at the teacher’s discretion for 1 mark each e.g. human life lost due to increased number or intensity of bushfires, loss of arabable land due to salt-water poisoning.**

**How it can affect marine life without shells**

**Oceanic food chains often begin with calcareous plankton (which are calcifying organisms).**

**The increase in H+ and decrease in CO32- concentrations is devastating for marine calcifying species such as oysters, clams, sea urchins, corals and calcareous plankton, as it forces these animals to use more energy to make their shells and may even dissolve their shells. Calcareous plankton is the basis of many food chains.**

1. Ocean pH has fallen from 8.2 to 8.1. Calculate the % change in hydrogen ion concentration that this represents.

**At pH 8.2 [H+] = 10-pH = 10-8.2 = 6.3096 x 10-9 mol L-1**

**At pH 8.1 [H+] = 10-pH = 10-8.1 = 7.9432 x 10-9 mol L-1 (1)**

**% change**

**= ((6.3096 x 10-9 - 7.9432 x 10-9) / 6.3096 x 10-9) x 100**

**= -26 % OK without the negative sign.(1)**

1. Give two examples of positive-feedback cycles that are exacerbating global warming and/or ocean acidification.

**As the level of atmospheric carbon dioxide increases, the oceans become warmer because of trapped infrared radiation. As the temperature of the oceans increases the solubility of carbon dioxide in the ocean decreases, causing more carbon dioxide to be released into the atmosphere, causing further global warming etc.**

**At global warming occurs due to increasing atmospheric carbon dioxide levels, permafrost melts and decays, releasing carbon dioxide and methane into the atmosphere, causing further global warming, causing further permafrost to melt etc.**

**Other answers may be correct.**

1. Explain why fuel from crops, such as bioethanol and biodiesel, do not contribute to global warming, even though when they are burnt in car engines they produce carbon dioxide.

**The carbon dioxide released into the atmosphere by the combustion of bioethanol and biodiesel, is taken back from the atmosphere when the crop is regrown.**

1. Determine whether or not ’prescribed burning’ of native bushland by the Department of Parks and Wildlife contributes to global warming. Justify your answer.

**No. The carbon dioxide released by prescribed burning is taken back out of the atmosphere when the bushland regrows.**

1. Some groups of people, sometimes for political or business reasons, argue that either climate change is not real or that climate change is not the result of human activities. Below are some of the arguments that these people have used. Analyse each argument and decide if the argument is reasonable. Justify your response.
2. Very large volcanic eruptions worldwide together release far more carbon dioxide than even all the factories of entire countries and therefore to say that the increase in atmospheric carbon dioxide level is the result of human activities is unreasonable.

**The argument is not reasonable. The release of carbon dioxide by volcanoes is part of a large-scale naturally-occurring process that is countered in the long-term by subduction of oceanic plates containing organic matter.**

1. Water vapour, which is a naturally-occurring greenhouse gas, is a much more potent greenhouse gas and is present in higher concentrations than carbon dioxide. Therefore, carbon dioxide is not the major cause of global warming.

**The argument is not reasonable. Before the industrial revolution a delicate balance existed that kept the earth at a constant temperature. The water vapour in the atmosphere was part of that delicate balance and it contributed to the naturally-occurring greenhouse effect that kept the Earth’s surface at the correct temperature for life to be possible. Because of the industrial revolution and the addition of more greenhouse gases into the atmosphere this delicate balance has been upset.**

1. Carbon dioxide is necessary for life and is present in the atmosphere in only very tiny concentrations, therefore carbon dioxide cannot have any appreciable effect on the climate or on the pH of the oceans.

**This argument is not reasonable. Although present in only a tiny concentration, before the industrial revolution a delicate balance existed so that the amount of energy entering and leaving the Earth was constant. This delicate balance has been upset by the large relative increase in atmospheric carbon dioxide.**

1. Despite claims that the world is getting hotter, cold days, blizzards and snowstorms still occur. Therefore, global warming is not real.

**This argument is not reasonable. Cold days will continue to exist as global warming progresses, however the number of cold days will decrease and the number of warmer days will increase.**

Part 2: A validation test on the same topics as part 1 will be held on Wednesday Week 6 of Term 1, 2021. One stoichiometry calculation question will be there.