Ocean acidification

The following diagram shows how carbon dioxide can flow from the atmosphere into the ocean.

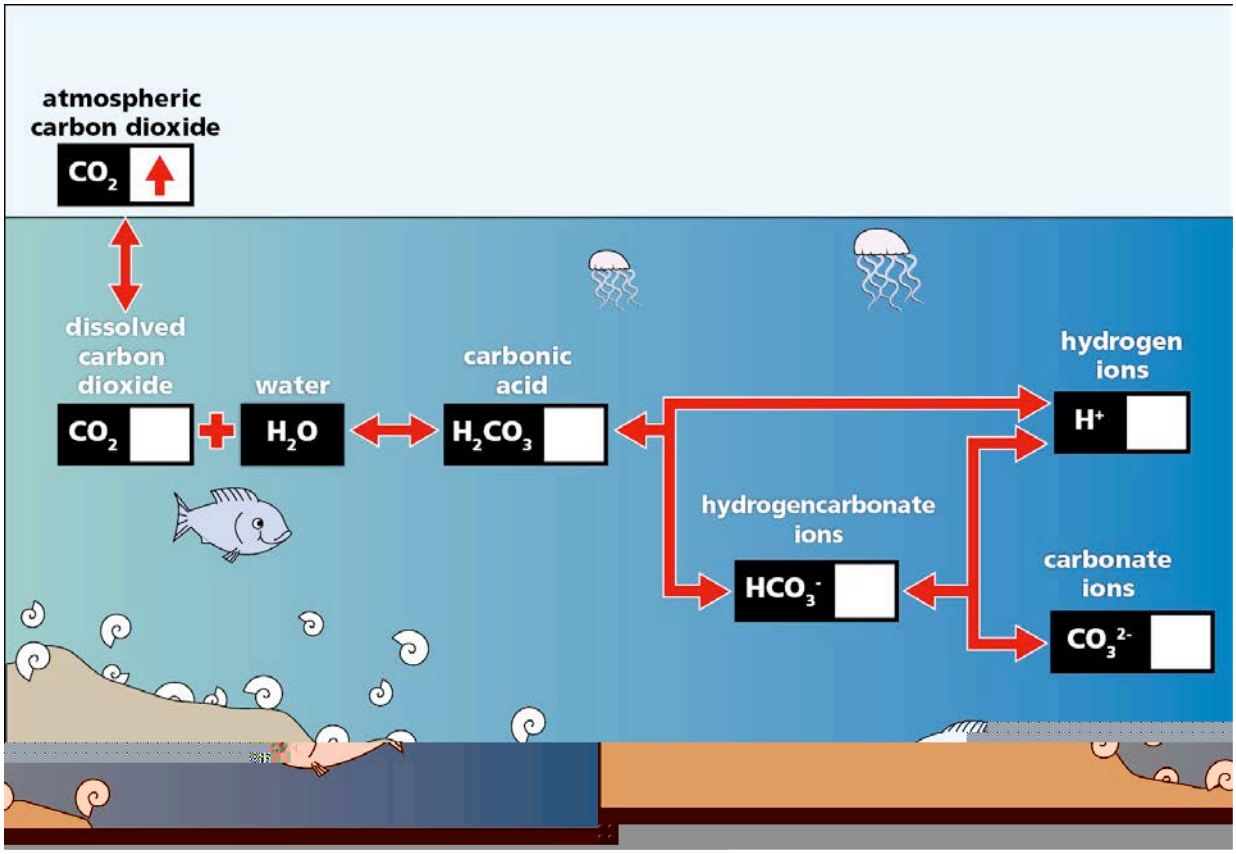

Figure 1: the flow of carbon dioxide from atmosphere to ocean

1. Draw arrows (↑ increase or ↓ decrease) next to each species on the diagram to show what will happen to the concentration of that species when more CO_2 is released into the atmosphere by human activities. The first one has been done for you.

2. Use your knowledge of buffering and Le Chatelier's principle, as well as the diagram above, to explain why there is a change in the ocean's concentration of H^+ ions and CO_3^{2-} ions as more carbon dioxide is released into the atmosphere by human activities.

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- Figures 2 and 3 are based on information collected from Hawaii. CO_2 levels were collected from Mauna Loa (a volcano in Hawaii) at an altitude of 3400m. Data collected from high altitudes is more reliable as the air has had the opportunity to mix. Air quality closer to sea level is influenced by local industry or plant life and the data collected is not as reliable.

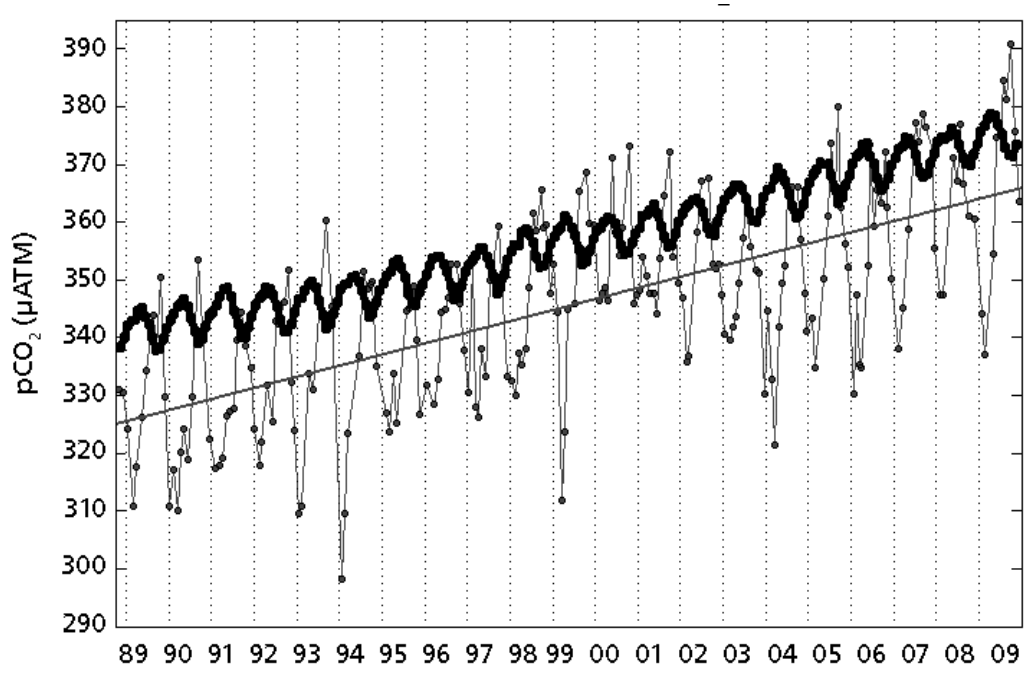

Figure 2: partial pressure of carbon dioxide measured at two locations between 1989 and 2009: Moana Loa (thick line) and surface seawater (thin line)

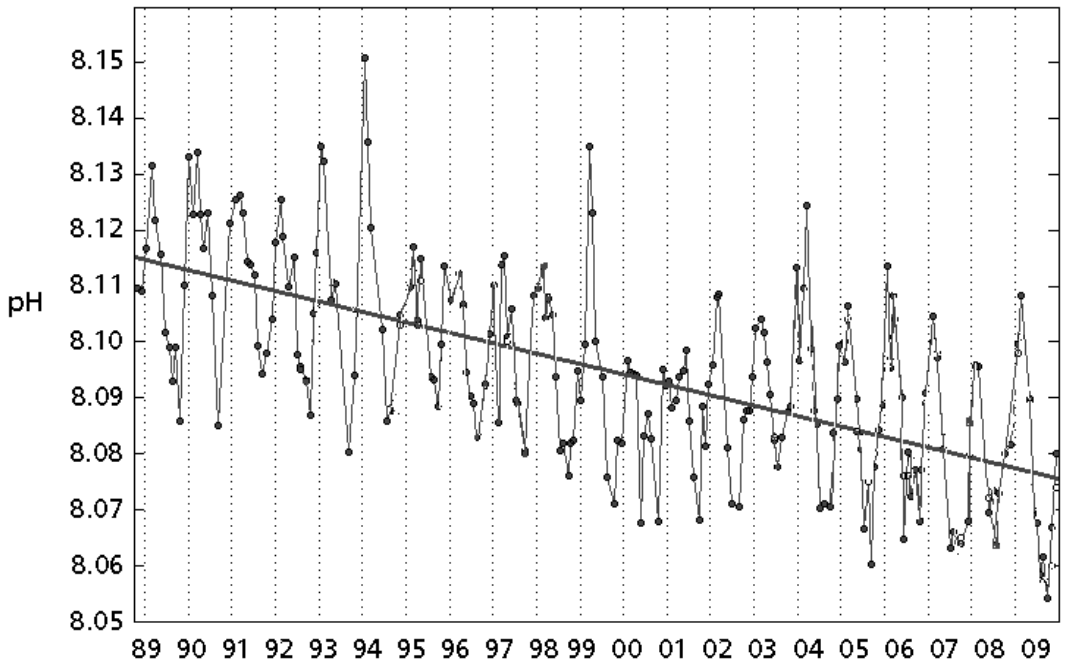

Figure 3: ocean pH from samples taken near Moana Loa between 1989 and 2009

3. Examine the two graphs above. Do these results support your answer from question 1? Explain your answer.

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4. Extrapolate both graphs and predict the partial pressure of CO_2 and ocean pH for the year 2050.

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- Figures 4 and 5 show predictions scientists have made about how the ocean will change over the next 150 years.

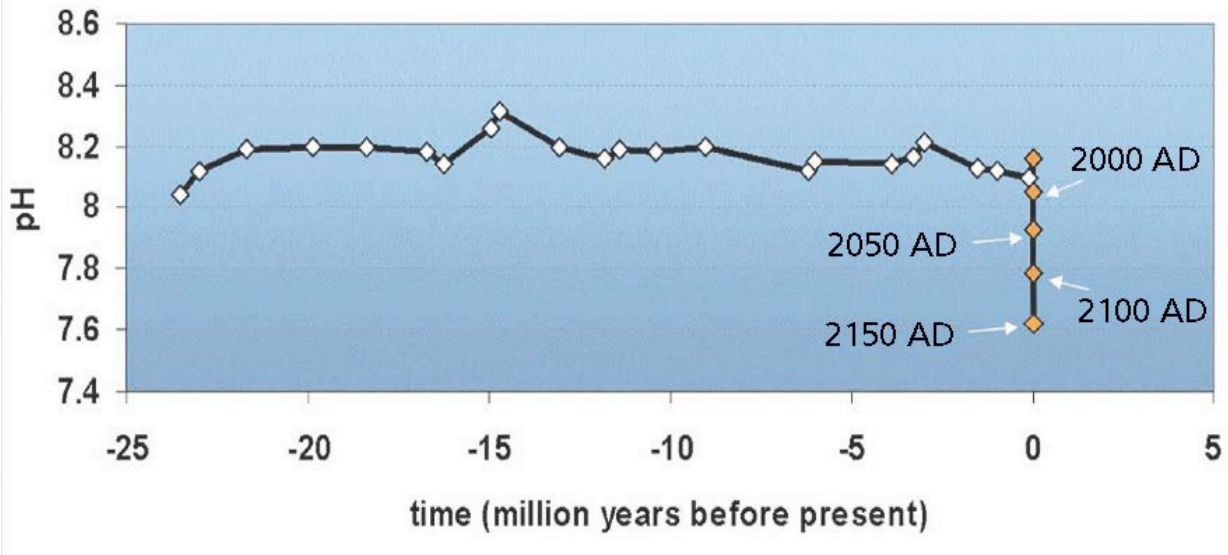

Figure 4: historic values of ocean pH and predicted changes over the next 150 years

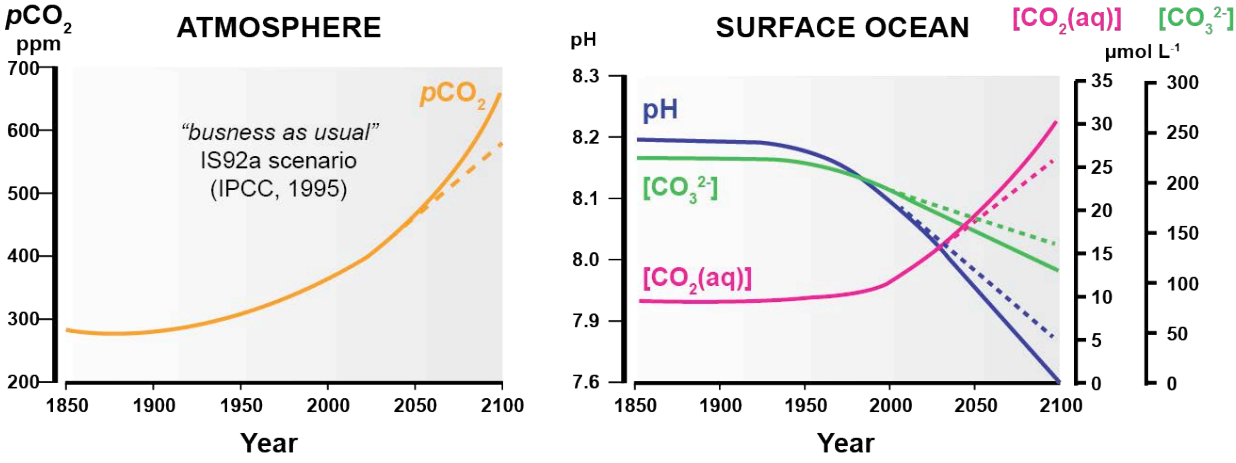

Figure 5: predicted changes in atmospheric and surface ocean concentration of carbon dioxide

5. Compare the predictions you made in question 4 with the graphs shown in Figures 4 and 5. Do you think the data collected up to the present time supports scientists predictions? Explain why or why not.

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6. Scientists predict that pH will suddenly drop. Explain how this could occur with reference to the diagrams and the term 'buffering capacity', despite the equilibrium occurring in an open system.

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Reference

European Project on Ocean Acidification (2009). *Ocean acidification, the other CO_2 problem: how far will life resist?* http://www.carboeurope.org/education/epoca-july2009_single_pages.pdf