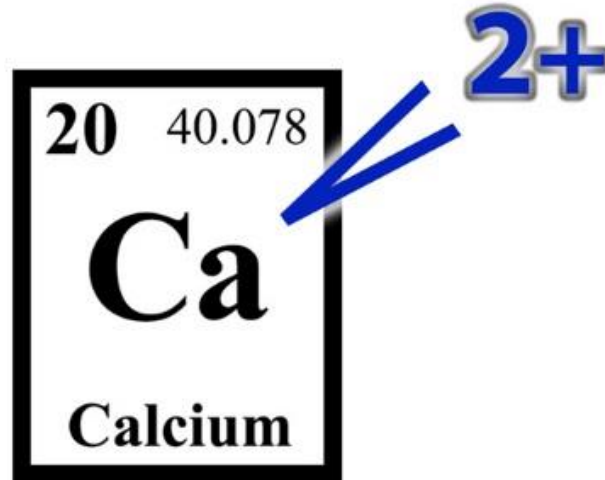


# Calcium ions: equilibrium in water from calcium carbonate





**For 42 years, the Great Barrier Reef (Australia) has been protected under the Great Barrier Reef Marine Park Act 1975.**



# What is a coral reef made of?

A coral reef is made of thin layers of **calcium carbonate**



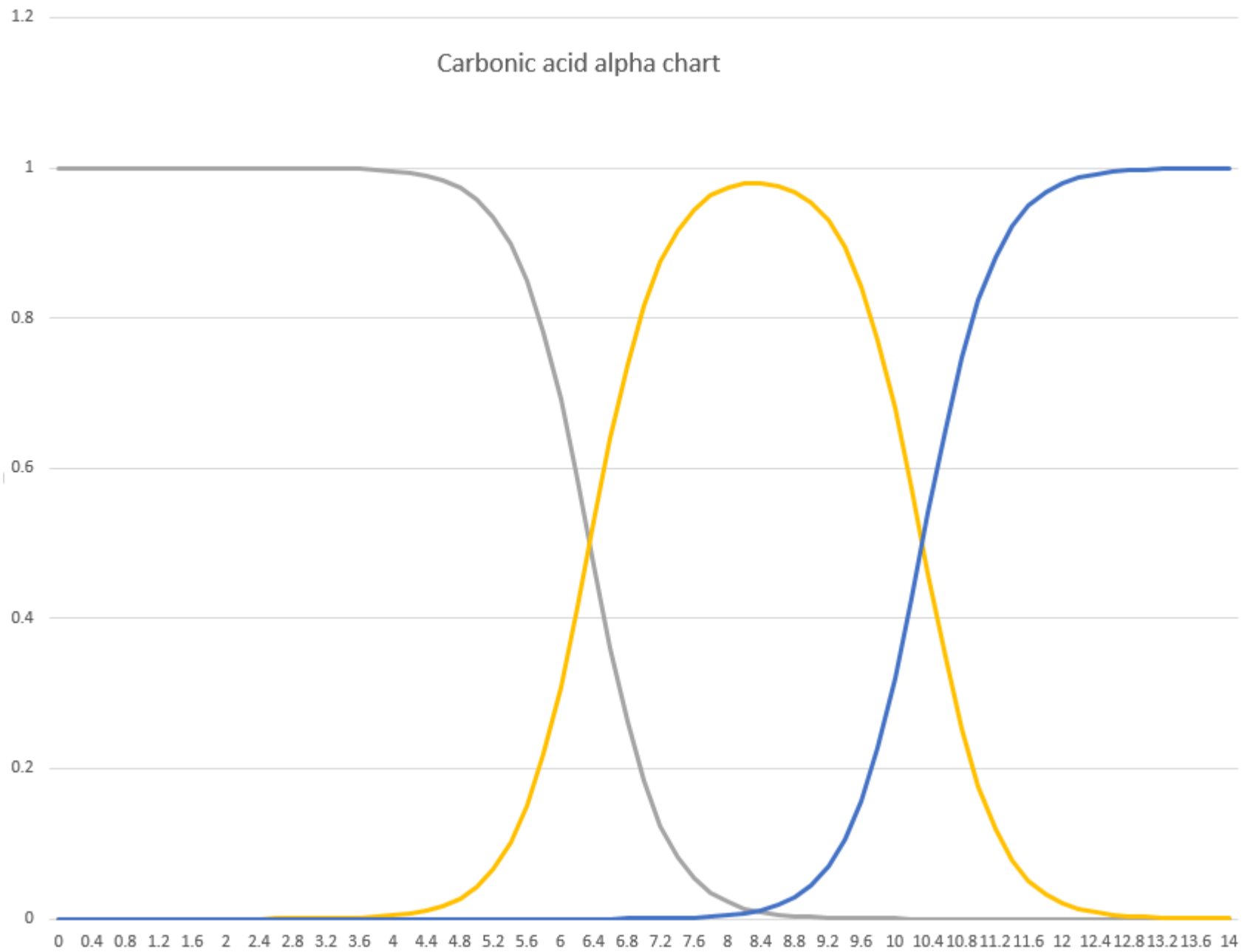
**Coral polyps form a living mat over a calcium carbonate skeleton.**

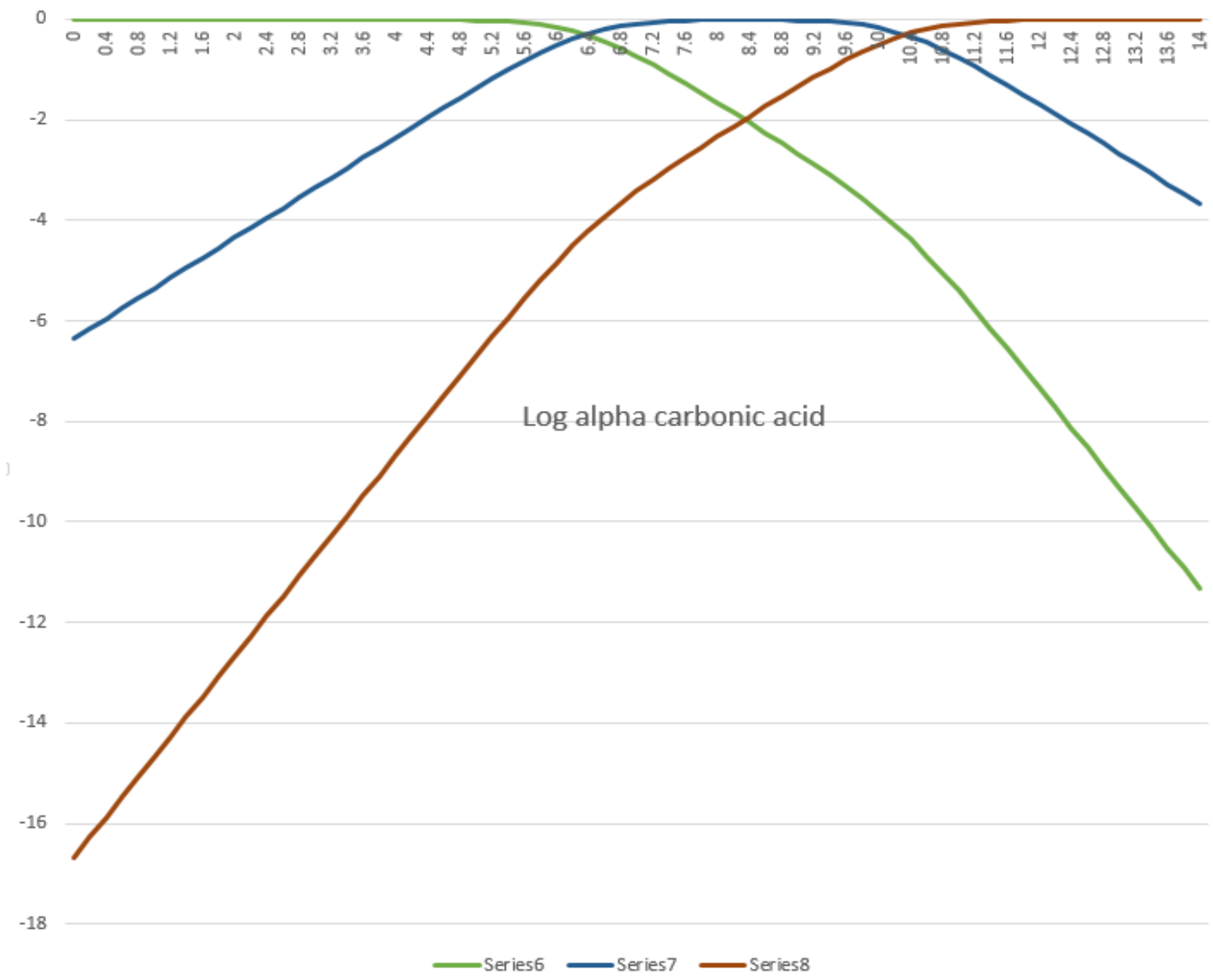
Stony corals (or scleractinians) are the corals primarily responsible for laying the foundations of, and building up, reef structures. Massive reef structures are formed when each individual stony coral organism—or polyp—secretes a skeleton of calcium carbonate.



<http://news.mit.edu/2015/why-seashell-mineral-forms-differently-in-seawater-0302>

Carbonic acid alpha chart



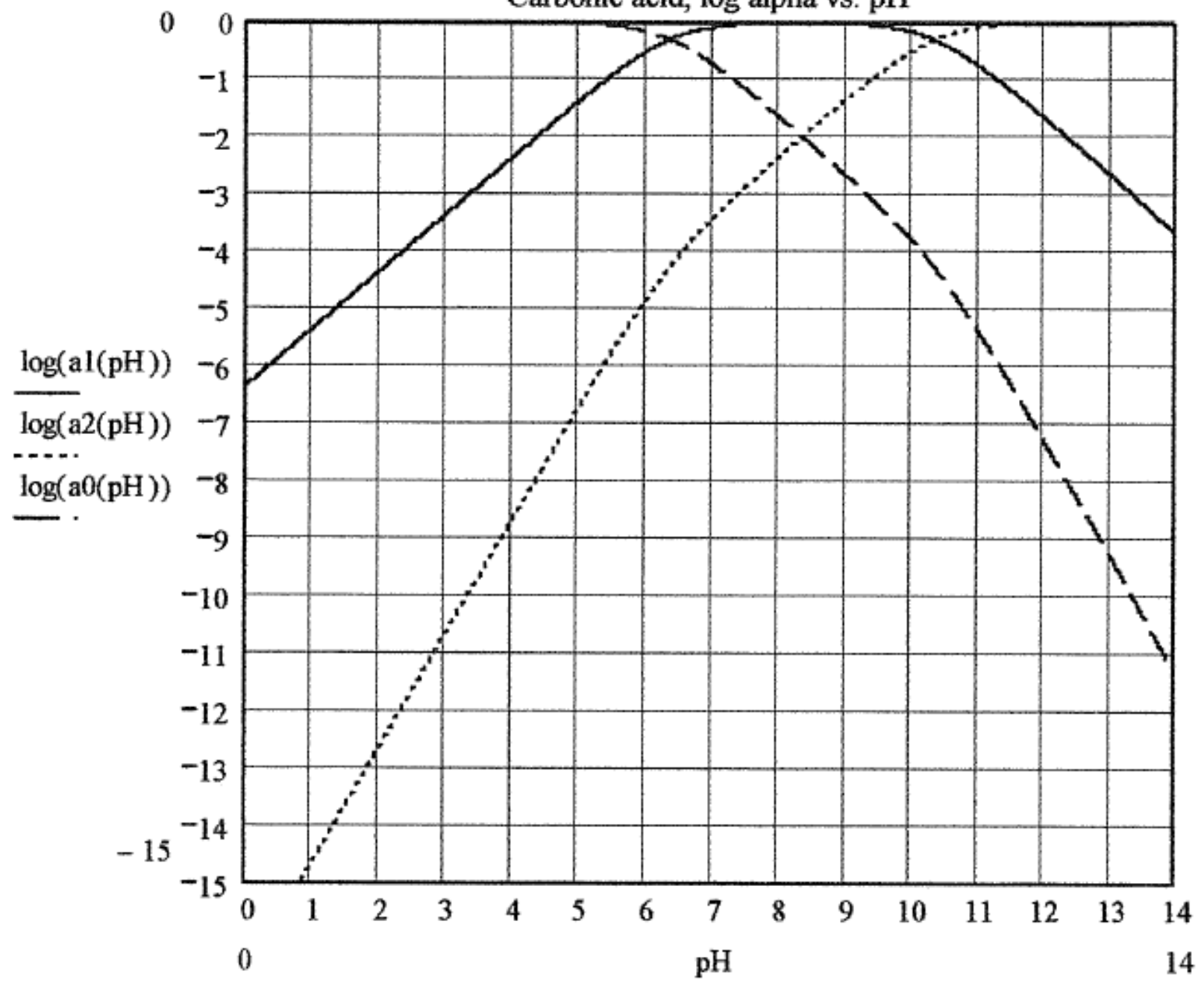


## Question

Coral reefs are made of at least 90% (w/w) of calcium carbonate,  $\text{CaCO}_3$ . Acidity in oceans is known to be a threat to their preservation.

a) Determine the pH value required to dissolve 100 kg of coral reef in 6000 L of water. Justify and use the graph below if required.

Carbonic acid, log alpha vs. pH





b) What pH value would be safe in order to keep 99% (w/w) of the same coral reef reasonably intact in 6000 L of water? Justify. Use graph if needed. Environmentally, does this make sense?

c) Write the mass and charge balance equations for the [calcium carbonate - carbonic acid] systems found at the pH values found in a) and b). Your answer should include four (4) equations, mass balance + charge balance for both a) and b). Do not include items of negligible concentrations.

d) In general, are carbonate salts more or less soluble at high pH? Justify.

For calcium carbonate,  $K_{sp} = 5.6 \times 10^{-9} \text{ M}^2$ , M.W. = 100.087 g/mol

For carbonic acid,  $K_1 = 4.45 \times 10^{-7} \text{ M}$ ,  $K_2 = 4.69 \times 10^{-11} \text{ M}$ .