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Year 11 Chemistry 2017
Comprehension Extended Response Assessment
Ocean Acidification Validation Test

Name : Marking Key

Time Allowed : 55 minutes

Materials Allowed ;

- Articles on Ocean Acidification - highlighting key points is allowed but there should be no notes written onto the articles.
- Chemistry Data Sheet
- No extra notes allowed
- Pens, pencils, calculator, etc

Answer All Questions in the spaces provided

Good Luck

1. (a) Which gas is the major cause of ocean acidification. CO₂ (1)

(b) Why are the levels of this gas in the atmosphere increasing? (1)

Burning of fossil fuels
Deforestation

(c) Write a chemical equation showing how this gas produces an acid when it dissolves in water. (1)



(d) The acid produced in the equation above is a weak acid. Explain the difference between a weak acid and a strong acid. (2)

Weak acid partially ionises in water

Strong acid fully ionises

In weak acid some molecules remain

(e) Write another equation to show how this weak acid ionises in water. (1)



2. What is pH?

(2)

pH is a measure of acidity or alkalinity
It is a measure of the concentration
of H^+ ions

$$pH = -\log_{10} C$$

3. The current pH of our oceans is about 8.1.

(a) What does this number mean in terms of acids and bases?

(1)

It is slightly basic

(b) Given your answer to 3.(a), why is this problem called ocean "acidification"?

(1)

It is becoming less basic over time.

3. (a) What is the relationship between the CO_2 levels in the atmosphere and the pH levels in the ocean?

(1)

As CO_2 levels rise, pH levels fall.

(b) According to the graph, by how much is ^{the pH} it expected to change ^{from now to} by the end of this century?

(1)

8.1 \rightarrow 7.75
drop of 0.35

(c) How has the ocean's pH changed since the industrial revolution?

(1)

8.2 \rightarrow 8.1
dropped by 0.1

5. The drop in pH doesn't seem like it is very significant. However, one of the articles states that this corresponds to a 26% increase in ocean acidity.

Explain how a small change in pH can be a large increase in acidity.

(2)

pH is on a logarithmic scale

A change of 1 is an increase of 10 times

6. Calcium carbonate is a very important compound for many organisms in our oceans.

(a) Give 3 examples of organisms living in the ocean that need calcium carbonate.

Calcifying algae
molluscs
Corals

varieties of plankton

(1)

(b) Why is calcium carbonate so important for these organisms?

(1)

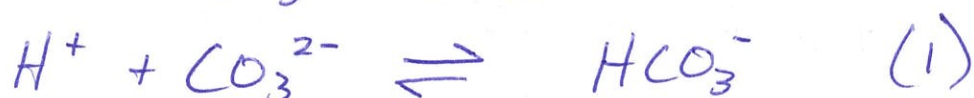
Shells or hard structures that these organisms use for support or shelter are made from CaCO_3 .

(c) Explain why the higher levels of acid in the water make it more difficult for the organisms to get calcium carbonate. You must include a chemical equation in your answer.

(3)

These organisms need Ca^{2+} ions and CO_3^{2-} ions dissolved in water to produce CaCO_3 . (1)

The H^+ ions from ocean acidification joins with free CO_3^{2-} ions to form bicarbonate ions.



This locks up the CO_3^{2-} ions making it more difficult for the organisms to produce CaCO_3 . (1)

7. Some organisms can be advantaged by the increased acidity of sea water.
According to the articles, which living thing is most advantaged?

(1)

Fleshy Algae

8. Small fish may not be directly affected by the lowering pH levels, but they may be indirectly affected. Explain.

(1)

Affects their habitat (shelter)
and
Less Food supply - eg. plankton

9. As the ocean gets more and more acidic, how will the affect CO_2 levels in our atmosphere?
Explain your answer.

(2)

For the ocean to get more acidic, a lot of CO_2 is dissolved.

It becomes more difficult for more CO_2 to dissolve

With less CO_2 dissolving, if we continue at the current rate of production of CO_2 , the levels of CO_2 will increase more.

- Won't be absorbed as fast by the ocean.

10. Not everyone in our society trusts scientists.

So here are a few statements taken from the opinion page of The Australian newspaper about the Great Barrier Reef and ocean acidification.

- Ocean acidification was “invented” in 2005 by climate scientists because global warming wasn’t bad enough.
- Because corals and shellfish have been around for millions of years they’ll be fine if the ocean keeps soaking up all the extra CO_2 .
- The oceans have a built-in natural “buffer” that stops the water from swinging around the pH scale (the scale used to measure acid and alkaline states).
- People who keep saltwater aquariums at home sometimes add CO_2 to the water to make plants grow – therefore, CO_2 is great for the oceans.

Write your own argument for or against ocean acidification.

(4)

You must present a set of “evidence”, logical points or scientific method to back up your argument.

Four good points

Examples

- Increasing CO_2 levels in atmosphere are well documented
 - Oceans have absorbed between $\frac{1}{3}$ to $\frac{1}{2}$ of the CO_2 released into atmosphere since 1850.
 - Acidity of oceans has increased by 26% since 1850 - measurement of pH
 - Experiments on shells placed in seawater of increased acidity shows they dissolve
 - Details of biological impacts are not well documented - only started in 2003, so more studies, observations need to take place.
- etc.