

# Australian Islamic College 2020

## ATAR Chemistry Units 3 and 4

### Task 2

**(Weighting: 1% for Holiday Homework;  
4% for this Validation Test)**

### Ocean Equilibrium

Test Time: 40 minutes

Please do not turn this page until instructed to do so.

First Name	Surname
ANSWERS	

Teacher

Mark / 28	Percentage

Equipment allowed: Pens, pencils, erasers, whiteout, rulers and non-programmable calculators permitted by the Schools Curriculum and Standards Authority.

**Special condition:** 2 marks will be deducted for failing to write your full name on this test paper.

Teacher help: Your teacher cannot help you during the test. Do not ask the teacher questions about the questions.

Questions must be answered in this booklet, in the spaces provided.

Special conditions regarding questions involving calculations.

- For all questions involving calculations, final answers must be stated to the correct number of significant figures, unless otherwise stated. 1 mark will be subtracted for failing to do this.
- For all questions involving calculations, final answers must be stated with the correct units. 1 mark will be subtracted for failing to do this.
- Follow-on marks will not be paid for calculations.
- For all questions involving calculations, calculations must be shown. Calculations must be explicit and logically set-out in the opinion of the marker. Marks will not be awarded for calculations that are not set out in a manner that can not be easily followed by the marker.

Total marks: 28

1. The average pH of the oceans in preindustrial times was about 8.16. It is estimated that the hydronium ion concentration of the oceans could be as much as 2.09 times higher than in preindustrial times by the end of this century. What pH will the oceans be in 2100 if this eventuates?

(3 marks)

$$[\text{H}_3\text{O}^+] \text{ (when pH} = 8.16) = 10^{-8.16} = 6.9183 \times 10^{-9} \text{ mol L}^{-1}$$

(1 mark)

$$[\text{H}_3\text{O}^+] \text{ (in 2100)} = 6.9183 \times 10^{-9} \times 2.09 = 1.4459 \times 10^{-8} \text{ mol L}^{-1}$$

(1 mark)

$$\text{pH (in 2100)} = -\log[\text{H}_3\text{O}^+] = -\log(1.4459 \times 10^{-8}) = 7.84 \text{ (3sf)}$$

(1 mark)

2. Diesel is derived from fossil fuels and is used for transport, for instance in trucks and in some trains and cars, and for electricity production in some power stations. Biodiesel can be used for the same purposes as diesel but can be manufactured from vegetable oils.

Explain why the use of diesel as a fuel for electricity production contributes to global warming but the use of biodiesel for the same purpose does not.

(5 marks)

**When diesel is used as a fuel it is burnt/combusted (1) which produces carbon dioxide (1) which causes global warming / is a greenhouse gas (1).**

**When biodiesel is used as a fuel (it is also burnt and) carbon dioxide is produced (1) however the carbon dioxide is used up again / taken back out of the atmosphere when the next crop (of plants used to make vegetable oil) is grown (1).**

3. Scientists differentiate the naturally-occurring greenhouse effect from the enhanced greenhouse effect. The naturally-occurring greenhouse effect, which has existed for millions of years, describes how the Earth's atmosphere keeps the Earth's surface warm enough for life to exist. The enhanced greenhouse effect, which has only existed since the industrial revolution, involves an increase in the surface temperature of the Earth due to the increased concentration of greenhouse gases in the atmosphere resulting from human activities.

- a. Volcanic eruptions release enormous quantities of carbon dioxide into the atmosphere. Do volcanic eruptions contribute to the enhanced greenhouse effect?

(2 marks)

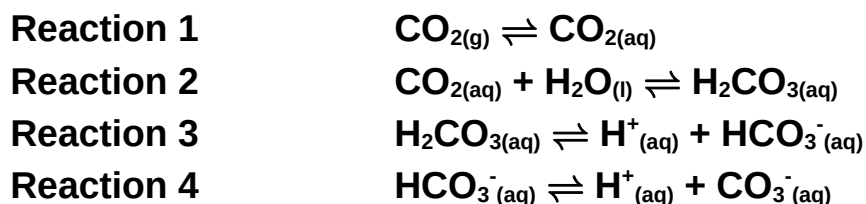
**No. The release of carbon dioxide into the atmosphere by volcanoes is part of a natural cycle that is countered by the loss of the same amount of carbon (1) from the Earth's surface by subduction (1).  
*No points just for saying 'no'.***

- b. Water vapour is a naturally-occurring greenhouse gas that contributes to the naturally-occurring greenhouse effect. Explain how water vapour is involved in a positive-feedback cycle that is exacerbating the enhanced greenhouse effect.

(4 marks)

**Global warming is increasing the temperature of the oceans (1)  
which is causing more water to evaporate from the oceans (1)  
which is resulting in more water vapour in the atmosphere (1)  
(Water vapour is a greenhouse gas so) this is increasing global warming (1).**

4. The following sequence of reactions summarise ocean acidification.



- a. Given that the first three reactions in this sequence are being pushed to the right by the increasing concentrations of carbon dioxide in the atmosphere, explain why reaction 4 is being pushed to the left.

(2 marks)

**(Although the molar amount of  $\text{H}^+$  and  $\text{HCO}_3^-$  produced by reaction 3 is identical)  
the factor increase in  $\text{H}^+$  is much greater than the factor increase in  $\text{HCO}_3^-$  (1)  
Because the initial concentration of  $\text{H}^+$  is much lower than the initial concentration of  $\text{HCO}_3^-$  (1)  
(therefore reaction 4 is pushed to the left).**

- b. Explain how reaction 4 being pushed to the left could indirectly adversely affect an animal at the top of a food chain, such as a blue whale.

(5 marks)

**(When reaction 4 is pushed to the left) the concentration of  $\text{CO}_3^{2-}$  in the ocean decreases (1)  
which means there is less  $\text{CO}_3^{2-}$  available for calcifying species/organisms that build shells / calcifying species must expend more energy to build their shells (1)  
Many organisms at (or near) the bottom of food chains are calcifying species (1)  
e.g. calcareous plankton / any correct example (1)  
Animals at the top of food chains suffer from lack of food available lower down the food chain (1).**

5. The recent unprecedented spate of large bushfires in Australia has been widely attributed to global warming. These same bushfires have resulted in the release of an enormous amount of carbon dioxide into the atmosphere due to the combustion of plants and trees. Is the release of these enormous quantities of carbon dioxide into the atmosphere likely to contribute to a positive-feedback cycle that will exacerbate global warming?

(4 marks)

**No (1)**

**because there will be no permanent increase in atmospheric carbon dioxide levels due to these fires (1)**

**because the carbon dioxide released from the combustion of trees and plants will be absorbed again when this bush regrows (1) and**

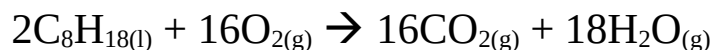
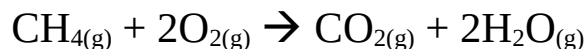
**the dead plants and trees that were combusted in the bushfires will have been broken down by natural processes into the same products (H<sub>2</sub>O and CO<sub>2</sub>) that are produced by their combustion (1).**

*No marks for saying 'no' without a correction explanation.*

*Other answers (saying 'yes' or 'no') with proper justification may be accepted at the teacher's discretion. For instance, the student may argue 'yes' because the recent fires have been so devastating that some bush will not regenerate, or the regeneration will be delayed by a considerable time etc etc.*

6. Which will contribute more moles of greenhouse gas to the atmosphere – the complete combustion of 8 moles of methane gas ( $\text{CH}_4$ ) or the complete combustion of 1 mole of liquid octane ( $\text{C}_8\text{H}_{18}$ )?

The equations for the complete combustion of methane and octane are given below.



*(It is not necessary to follow significant figure rules for this question).*

(3 marks)

**The combustion of 8 moles of  $\text{CH}_{4(g)}$  results in the production of 24 moles of greenhouse gas. (1)**

**The combustion of 1 mole of  $\text{C}_8\text{H}_{18(g)}$  results in the production of 17 moles of greenhouse gas. (1)**

**The combustion of 8 moles of  $\text{CH}_{4(g)}$  will contribute more moles of greenhouse gas to the atmosphere. (1)**

***No mark for correctly stating ' $\text{CH}_{4(g)}$ ' unless both calculations are correct.***

END OF TEST