**Practice Case study on desalination**

**Instructions and Advice**

* Use your own words, rather than simply repeating those used in the sources, to show your understanding of the points being made.
* Section A: Questions on your appreciation and understanding of the case study material. You are expected to demonstrate an understanding of ideas about How Science Works in answering these questions.
* Section B: Questions that ask you to demonstrate your ability to write an appropriate explanation for a given audience and to write an argued opinion on an issue raised by the case study material. You are expected to make extensive use of the information in the sources in answering both these questions.

**Source A:** Australia turns to Desalination Amid Water Shortage

<http://www.npr.org/templates/story/story.php?storyId=11134967>

**Source B:** Desalination no solution to water crisis: WWF

<http://www.reuters.com/assets/print?aid=USL1834918020070619>

**Source C:** Large scale desalination: is there enough energy to do it?

<http://lightbucket.wordpress.com/2008/04/04/large-scale-desalination-is-there-enough-energy-to-do-it/>

**Source D:** Preliminary results of the monitoring of the brine discharge produced by the SWRO desalination plant of Alicante (SE Spain)

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[www.desline.com/articoli/6678.pdf](http://www.desline.com/articoli/6678.pdf)

**Source E:** Impacts of desalination plant discharges on the marine environment: a critical review of published studies

<http://ipac.kacst.edu.sa/eDoc/2011/191463_1.pdf>

You may find the following glossary useful when reading Source D.

**psu** is a unit of salt concentration. It is very nearly the same as parts per thousand.

**Benthic** organisms are those that live on or close to the sea bed

***Posidonia oceanica*** is a sea grass that lives in meadows on the sea floor and provides an important ecosystem.

**Echinoderms** are a group of species that include star fish and sea urchins

**Section A**

1. Give two reasons cited in **Source A** for the shortage of water in Perth.

(1 mark)

2. **Source B** claims that greenhouse gas emissions make desalination an unsustainable solution to water shortages. Why might the managers quoted in Source A claim that this does not apply to the Perth plant?

(1 mark)

3. Some people, however, are not convinced that setting up a wind farm makes the process sustainable. What points can be made to support this position?

 (2 marks)

4. **Source C** uses two scenarios to calculate the worldwide energy that might be used for desalination. Explain why scenarios are used in this way to forecast future situations.

(3 marks)

5. In Africa the average annual fresh water consumption is only 25m3, this includes industry and agriculture. Is it reasonable for the author of **Source C** to have used the figure for Denmark, rather than Africa value in making the “low” predictions? Explain your answer.

(2 marks)

6. **Source C** ends with the sentence ‘We may end up “drinking energy”’. Explain what this means.

(2 marks)

**Figure 1 Outline of sea water desalination plant**

storage tank

Pre-treatment

Reverse osmosis desalination

**The Sea**

7. This question relates to the issues discussed in **Sources D** and **E**. **Figure 1** shows the main features of a modern desalination plant. The water is pumped at high pressure through very fine membranes.

 (i) What is the main chemical waste product that is returned to the sea?

(1 mark)

(ii) Why does a desalination plant produce this waste chemical?

(1 mark)

 (ii) Why might this waste present a risk to the local ecosystem?

(2 marks)

Questions 8 and 9 are about **Source D**.

8. What do the data in Figure 6 suggest about the effect of the desalination plant on the echinoderms. Explain your answer.

(3 marks)

9. The third diagram in Figure 7 shows the balance between new growth and the death of shoots of *Posidonia oceanica,* a sea grass, an important indicator of the health of the plants.

 (i) Over which period was this balance studied?

(1 mark)

 (ii) Do these data confirm that the discharges from the desalination plant have harmed the sea grass?

(3 marks)

The remaining questions in this section relate mainly to **Source E**. You do not need to read Results 3.1 on salinity, temperature and contaminants or 3.3 on impact minimisation.

10. The list of references for Source E shows that all the papers appear to be written in English. The journal Desalination in which Source D is published requires its authors to write in English. Comment on the advantages and disadvantages of the use of English by all the scientists involved.

(2 marks)

11. Source E says that it summarises information obtained from laboratory and field-based experiments, and ecological monitoring studies. Explain the difference between a field-based experiment and a monitoring study.

(2 marks)

12. In the second paragraph of their conclusion the authors of Source E say; “The one area where evidence is clearly lacking is in field-based ecological monitoring. Unfortunately, many of the published ecological monitoring programs do not appear to be scientifically defensible assessments of impacts.”

 Explain two features of a monitoring program on the effects of desalination that are required for it to be *scientifically defensible*. You may find recommendation 2 in the Discussion useful.

(4 marks)

13. In the abstract the authors of source E say ‘Many of the monitoring studies lacked sufficient detail with respect to study design’.

 Explain why the scientific community expects scientists to publish the details of the study design.

(2 marks)

14. Desalination is providing an increasing proportion of water all over the world. However the authors found only a small number of papers on ecological monitoring that they considered worth including in their summary in Table 3.

 Suggest some reasons why which might explain why there are so few good papers published on the subject.

(4 marks)

(total for this section 36)

**Section B**

15. Imagine that students in a city such as Perth are to be asked to volunteer to help in an ecological monitoring program before and after the opening of a new water desalination plant.

 Write an information leaflet to encourage the students’ participation. It should explain the environmental issue, why this new research is necessary and how the information will be gathered. It should be about one page long.

(12 marks)

16. The WWF says, “Desalination no answer to water crisis”.

 The author of source C says, “there are no fundamental showstoppers to desalination on a massive scale”.

 Give your opinion on the role of desalination in meeting the world’s need for fresh water, supporting your argument with evidence from this case study or other sources.

(12 marks)