OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary GCE

SCIENCE   **2843/01**

Interpreting Scientific Information

| Friday | **10 JUNE 2005** | Morning | 1 hour |

Candidates answer on the question paper.
Additional materials:
    Electronic calculator

Candidate Name	Centre Number	Candidate Number

TIME   1 hour

INSTRUCTIONS TO CANDIDATES

- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- There are **four** questions in this paper. Answer **all** parts of the questions.
- Write your answers in the spaces provided on the question paper.
- Read each question carefully and make sure you know what you have to do before starting your answer.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- The questions in this paper are based on the abridged version of a scientific article, which is printed in the insert to this question paper.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	9	
2	14	
3	11	
4	11	
TOTAL	45	

This question paper consists of 8 printed pages and an insert.

Answer **all** the questions.

All of the questions in this paper refer to the article 'The Worm that Earned'. This is abridged from an article by Douglas Fox which first appeared in New Scientist (15 September 2001).

A copy of the article is provided as an insert to this paper.

Read the article carefully before you answer the questions.

1 The author states that worm-based sewage recycling on a small scale is a well-established process.

(a) What type of worm is used in sewage recycling?

.... [1]

(b) Explain briefly, and in terms of biological processes, how the worms convert sewage sludge to vermicompost.

....

....

.... [3]

(c) What is meant by the term *pathogen*?

....

.... [2]

(d) Traditional composting prior to worm treatment is one way of ensuring that pathogens are removed.

(i) What is added to the sewage sludge in the traditional composting method?

.... [1]

(ii) In this method of composting, what causes the pathogens to die?

.... [1]

(e) State **one** reason why the combination of traditional composting and worm treatment has so far proved unprofitable on a large scale.

.... [1]

[Total: 9]

2 The Australian company, Vermitech, has developed an economically viable process for worm-based sewage recycling. The vermicompost, made in special worm beds, is safe to spread onto food plants.

(a) Draw a labelled diagram showing the dimensions and layered structure of one of these worm beds. The diagram need not be drawn to scale.

[4]

(b) Explain why 40 days is chosen as the residence time for the sewage sludge within the worm bed.

....

.... [2]

(c) Explain how pathogens are reduced to safe numbers

    (i) in the top third of the worm bed;

....

.... [2]

    (ii) in the lower part of the worm bed.

....

.... [2]

[Turn over

(d) State **two** ways in which Vermitech check that sufficient numbers of pathogens are removed from the sewage sludge during the process.

....

....

.... [2]

(e) Suggest why more pathogens are killed in Vermitech's worm beds than when worms are simply added to a pile of sewage sludge.

....

....

.... [2]

[Total: 14]

3 Initial trials indicate that Vermitech's vermicompost is highly beneficial to plants, giving higher yields and less plant disease.

(a) Explain why plant pathologist, Peter Stephens, suspects that part of the increased yield may be due to plant hormones in the compost.

....

.... [2]

(b) What evidence has soil ecotoxicologist, Clive Edwards, been able to add to reinforce this argument?

....

.... [2]

(c) Why does Vermitech's compost contain so many more soil microbes than traditional compost?

.... [1]

(d) What explanation has been suggested for the decrease in plant disease when Vermitech's compost is applied to plants?

....

.... [2]

(e) Explain, in your own words, how the use of Vermitech's compost could help farmers keep within environmental limits on heavy metals in the soil.

....

....

....

....

....

.... [4]

[Total: 11]

[Turn over

4   The Vermitech process is being trialled at the Redlands Shire water treatment works in Queensland, Australia. From information given in the article, it is possible to estimate the size of such a treatment works.

(a)   From the dimensions given in the article, calculate the approximate volume in m^3 of each worm bed.

volume = ... m^3 [1]

(b)   The mass of 1 m^3 of sewage sludge is approximately 0.9 tonnes. Calculate the mass in tonnes of sewage sludge that can be contained in one worm bed.

mass = ... tonnes [1]

(c)   It takes about 40 days for sewage sludge to move through the worm bed.
Show that the mass, in tonnes, of sewage sludge that can be processed in one worm bed in one year is approximately 575 tonnes.

[3]

(d)   Given that 15 000 tonnes of sewage sludge is being processed each year, estimate the number of worm beds present at the Redlands Shire water treatment works.

[2]

(e) How many **water treatment works** of this size would be needed to treat the million tonnes of sewage produced in New York City each year?

[1]

(f) What recent environmental regulations have made sewage disposal more problematical in the USA?

....

.... [1]

(g) Suggest **one** advantage and **one** disadvantage of adopting worm-based sewage recycling in New York City.

advantage ....

....

disadvantage ....

.... [2]

[Total: 11]

END OF QUESTION PAPER