

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

SCIENCE

2844

Science and Environmental Management

Wednesday **26 JANUARY 2005** Morning 1 hour 30 minutes

Candidates answer on the question paper.

Additional materials:

Electronic calculator

Candidate Name	Centre Number	Candidate Number												
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TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- Answer **all** 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.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- 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	11	
2	8	
3	12	
4	19	
5	9	
6	13	
7	18	
TOTAL	90	

This question paper consists of 14 printed pages and 2 blank pages.

Answer **all** the questions.

1 One of the problems of raising livestock is getting rid of animal waste. A common practice is to use water to wash the raw waste out of barns into lagoons. A lagoon is a big pit in the earth, sometimes lined with clay or a plastic liner. When a lagoon is full, the mixture is pumped out and sprayed onto fields as fertiliser.

(a) Name **two** plant nutrients in animal waste that make it a good fertiliser.

.....
..... [2]

Lagoons can leak. Animal waste can then find its way into surface waterways, killing fish and causing environmental damage.

(b) Leakage from the lagoons causes eutrophication.

(i) What initial effect does eutrophication have on the growth of plant life in the waterways? Explain your answer.

.....
.....
..... [2]

(ii) Explain how eutrophication results in the death of fish.

.....
.....
.....
..... [3]

(c) Name **two** abiotic factors, other than nutrient availability, that can affect the growth of plant life in waterways.

.....
..... [2]

(d) Application of **synthetic** fertilisers onto crops can also cause eutrophication.

(i) State **one** way in which synthetic fertilisers can enter surface waterways.

.....

..... [1]

(ii) State how pollution of surface waterways by these synthetic fertilisers can be reduced.

.....

..... [1]

[Total: 11]

2 Synthetic pesticides can contaminate underground water stores used to provide drinking water. An infrared spectrometer can be used to measure the amount of pesticides in water. A beam of infrared radiation is passed through a cell containing the sample being investigated. The intensity of this beam is compared with that of another beam of infrared radiation (the reference beam), which is passed through a reference cell.

(a) When an infrared spectrometer is used to measure the amount of pesticides in water, what is likely to be contained in the reference cell?

..... [1]

(b) When infrared radiation of certain wavelengths passes through the sample, the molecules in the sample absorb some of the radiation. What happens to the molecules in the sample, when infrared radiation is absorbed?

.....
.....
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..... [3]

(c) Draw a labelled diagram to show how an infrared spectrometer works.

[4]

[Total: 8]

- 3 Chemical changes involve energy transfers. In most cases, the energy transfer is between chemical energy stored in bonds, and thermal energy. The combination of the chemical energy and thermal energy of a substance is called enthalpy, and is given the symbol H .

(a) Chemical reactions that lead to heating are called exothermic.

What happens to the chemical energy in an exothermic reaction?

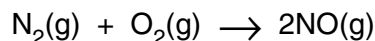
.....
..... [1]

(b) Reactions can be carried out in a way that keeps temperature constant. In this way, the enthalpy change is equal to the change in chemical energy.

(i) What happens to the thermal energy of the substances involved in a chemical reaction when it is carried out at constant temperature?

..... [1]

(ii) The equation for a reaction between nitrogen and oxygen is shown below.



The change in enthalpy (ΔH), at constant temperature, for this reaction is $+90 \text{ kJ mol}^{-1}$. Draw and label an enthalpy level diagram for this reaction.

[3]

(iii) What information does the positive value of ΔH provide about the change in **bonding** that occurs in this reaction?

.....
.....
.....
..... [3]

(c) Dissolving is accompanied by a change in enthalpy. This can be thought of as a combination of a number of more specific enthalpy changes, each associated with a particular step in the dissolving process.

(i) Describe **two** of these steps when an ionic compound is dissolved in water.

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.....
.....
..... [2]

(ii) Calcium chloride is an ionic compound, which dissolves exothermically in water. Explain this enthalpy change.

.....
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..... [2]

[Total: 12]

4 Improved varieties of the world's most important crops, such as rice, wheat, maize and potatoes, have helped to feed the world's increasing population.

(a) Suggest **two** improvements that have been made in varieties of crops, which help them to feed more people.

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.....
..... [2]

(b) Plant breeders sometimes combine desirable properties of two varieties of plant to produce hybrids. Explain how a plant breeder would do this, without the use of genetic engineering techniques.

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..... [3]

(c) Fears have grown that wild or local strains of crop plants, no longer used for agriculture, might disappear through neglect. Why is it undesirable that wild varieties of crop plants disappear?

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..... [2]

(d) Sorghum is a cereal crop, which is grown in parts of Africa and India, because it can grow in hot, dry conditions. Drought resistant varieties of sorghum possess characteristics that allow them to survive periods without rain. Suggest **two** characteristics that would help such plants to resist periods of drought.

.....
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..... [2]

(e) When there is plenty of water and light available, plants increase their rate of photosynthesis. Explain how water and light are used in the light-dependent stage of photosynthesis.

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..... [3]

(f) In which cells in the leaf does the light-dependent stage of photosynthesis take place?

..... [1]

(g) In conditions of very high temperature and light intensity, the productivity of a plant may be reduced by photorespiration. Explain what is meant by *photorespiration*.

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..... [3]

(h) Describe how some plants are adapted to overcome the problem of photorespiration.

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..... [3]

[Total: 19]

5 Sexual reproduction in plants involves the production of gametes. Gametes are produced by a process known as meiosis.

(a) Explain the meaning of the following terms, which are connected with meiosis.

gametes

.....

.....

homologous pair

.....

independent assortment

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..... [4]

(b) (i) Explain how genes can be exchanged between chromosomes during meiosis.

.....

.....

.....

..... [2]

(ii) Explain the effect that this may have on variation.

.....

.....

..... [2]

(c) Plants may breed asexually as well as sexually. State **one** disadvantage to a plant of **asexual** reproduction.

.....

..... [1]

[Total: 9]

6 Scientists who carry out research into genetic modification of crops claim that there are benefits.

(a) Explain briefly how each of the following benefits is achieved.

(i) Reduction in famine
.....
..... [2]

(ii) Improved nutritional value
.....
..... [1]

(iii) Reduction in the use of pesticides
.....
..... [2]

(b) Describe **one** possible disadvantage of growing genetically modified (GM) crops.

.....
..... [2]

(c) The steps involved in transferring a gene from one organism into the genome of another may involve the following:

restriction enzymes bacterial plasmids DNA ligase

Explain briefly the part played by each of these.

- Restriction enzymes
.....
.....
- Bacterial plasmids
.....
.....
- DNA ligase
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..... [6]

[Total: 13]

- 7 On April 25 1953, the journal *Nature* published the paper by James Watson and Francis Crick that first described the double helical structure of DNA. With some understatement they noted that the structure 'suggests a possible copying mechanism for the genetic material'.

Fig. 7.1 is a copy of a diagram that they included in their original article.

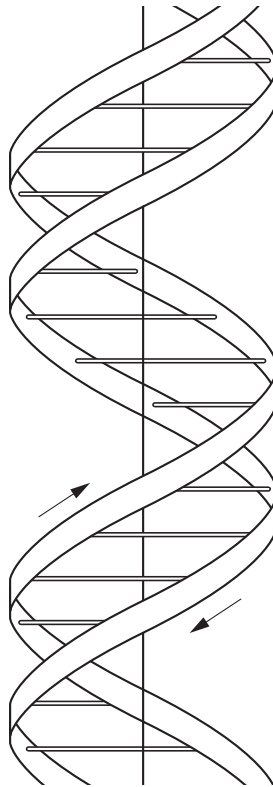


Fig. 7.1

- (a) In this question, four marks are available for the quality of written communication.

Describe the structure of DNA, and explain how this structure allows the genetic material to be copied.

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[7]

Quality of Written Communication [4]

(b) Watson and Crick also noted in their paper that it was probably impossible to build this structure with ribose instead of deoxyribose, because the double helix would be distorted. The nucleic acid containing ribose is called RNA.

State **two** differences between RNA and DNA.

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[2]

- (c) The information stored in DNA in genes provides instructions for the synthesis of proteins. Explain how the sequence of bases in DNA is linked to the sequence of amino acids in proteins.

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[5]

[Total: 18]

END OF QUESTION PAPER

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