

**ADVANCED GCE  
 SCIENCE**

**2844**

Science and Environmental Management

**FRIDAY 25 JANUARY 2008**

Morning

Time: 1 hour 30 minutes

Candidates answer on the question paper.

**Additional materials:** Electronic calculator  
 Ruler



Candidate Forename

Candidate Surname

Centre Number

Candidate Number

**INSTRUCTIONS TO CANDIDATES**

- Write your name in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Do **not** write outside the box bordering each page.
- Write your answer to each question in the space provided.

**INFORMATION FOR CANDIDATES**

- The number of marks for each question is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **90**.
- 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	10	
2	19	
3	8	
4	12	
5	18	
6	8	
7	15	
<b>TOTAL</b>	<b>90</b>	

This document consists of **14** printed pages and **2** blank pages.

Answer **all** the questions.

1 Gregor Mendel was a monk who studied the genetic inheritance of various factors in peas.

The pea plants can be either short-stemmed or long-stemmed. A pair of alleles controls the stem length. The allele T for long-stemmed is dominant.

(a) (i) What is an *allele*?

..... [1]

(ii) Complete the table below (Fig. 1.1) to show the phenotypes of peas. Include an explanation for your answer.

Genotype	Phenotype	Explanation
TT	Long-stemmed	Two dominant alleles present, so long-stemmed
Tt		
tt		

Fig. 1.1

[4]

(b) A plant with the genotype TT is cross-bred with a plant with genotype tt . All of the plants produced are long-stemmed. Explain why.

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

(c) A pea plant with the genotype Tt self-pollinates. Predict the percentages of the offspring which are long-stemmed and short-stemmed?

Show your working in the space below.

long-stemmed .....% short-stemmed .....% [3]

[Total: 10]



(d) The algal blooms produced in the drainage ditches in Holland are also found to be associated with high concentrations of nitrates.

(i) Suggest **two** sources of the nitrates in these ditches.

1. ....

2. .... [2]

(ii) Suggest a reason for the link between nitrate concentration and algal blooms.

..... [1]

(iii) Algal blooms can trigger changes in the relative populations of fish species. Suggest an explanation for this.

.....

.....

.....

.....

..... [4]

[Total: 19]

3 Ionisation is the removal or addition of electrons in atoms.

(a) Sodium can be ionised by electromagnetic radiation.

A sodium ion has ten electrons.

Using the electron shell model draw a diagram of a sodium ion.

In your diagram, show clearly the nucleus as well as the number and relative positions of the electrons in the ion.

Label the electron shell with the highest energy value.

[4]

(b) The sodium atom is ionised by incoming electromagnetic radiation with an energy of  $8.221 \times 10^{-19}$  J.

Calculate the minimum frequency required to do this.

Use the equation

$$E = hf.$$

Planck constant ( $h$ ) =  $6.63 \times 10^{-34}$  Js.

.....

.....

.....

.....

..... [4]

[Total: 8]

- 4 Pesticides are designed to break down fairly rapidly to prevent the problem of build-up in the food chain. The break down process is complete in three months. Samples of soil are analysed at regular intervals to monitor this break down. One way of analysing the soil is to use thin-layer chromatography (t.l.c.).

Some results are shown in Fig. 4.1.

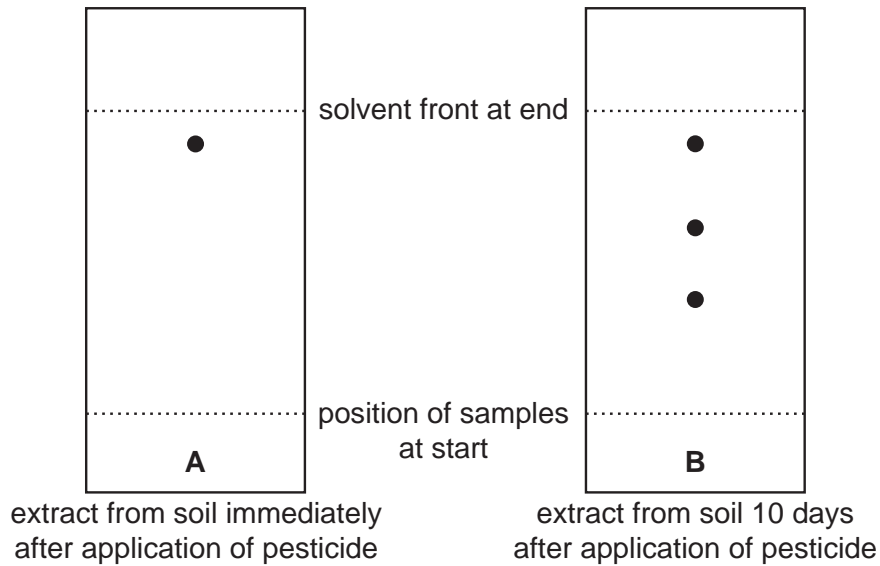


Fig. 4.1

- (a) (i) Explain why there are 3 spots shown on the chromatogram from sample B.

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

- (ii) What would you expect to see on the chromatogram taken after three months? Explain your answer.

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

(iii) A compound can be identified from a chromatogram by its  $R_f$  value.

The  $R_f$  value is calculated using

$$R_f = \frac{\text{distance travelled by compound}}{\text{distance travelled by solvent}}$$

By measuring on Fig. 4.1 calculate the  $R_f$  value of the compound in sample **A**.

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

(b) DDT is an illegal pesticide which does not break down. If someone had been illegally using DDT, how could thin-layer chromatography be used to show this?

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

(c) Gas – liquid chromatography (g.l.c.) is another method of analysis. Give **three** differences between g.l.c. and t.l.c.

1. ....  
.....  
2. ....  
.....  
3. ....  
..... [3]

[Total: 12]

- 5 A student investigated the solubility of various compounds in water. The temperature of the water was taken before and after the compound was dissolved. The temperature change was noted.

Fig. 5.1 shows the results of this investigation.

compound	temperature change (°C)	type of reaction	enthalpy of solution (kJ mol <sup>-1</sup> )
sodium fluoride (NaF)	none detected		
calcium chloride (CaCl <sub>2</sub> )	+ 10.8		
ammonium nitrate (NH <sub>4</sub> NO <sub>3</sub> )	- 4.4		

**Fig. 5.1**

- (a) (i) Insert the following descriptions into the appropriate place in the type of reaction column.

**EXOTHERMIC**

**ENDOTHERMIC**

**ENERGETICALLY NEUTRAL**

[1]

- (ii) The enthalpy of solution at 25°C is an indication of the temperature change that will take place on dissolving for a particular compound.

The following are enthalpy of solution values for the above compounds. Add them to the correct places in the table.

**-82.9**

**+0.3**

**+26.8**

[2]





- (c) In a similar investigation the students also measured the total volume of water and ammonium hydroxide before they were mixed and after dissolving. They compared the volume before and after the solution was made and found that the total volume had decreased.

Explain how dissolving a compound in water can lead to a decrease in total volume.

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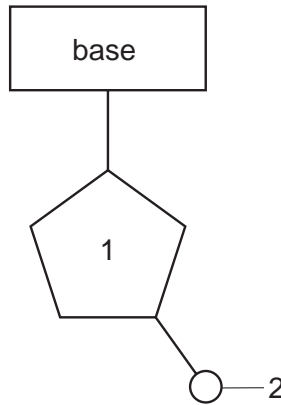
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..... [3]

[Total: 18]

- 6 DNA is an extremely complex biological molecule. It is made up from relatively simple sub-units such as the ones shown below.



**Fig. 6.1**

- (a) Name parts 1 and 2.

1 ..... 2 ..... [2]

- (b) A section of DNA was analysed using electrophoresis. It was found that 31% of the bases were guanine.

Complete the following table by naming the other three bases stating the percentage of each present in this sample. [6]

name of base	amount present (%)
guanine	31

**Fig. 6.2**

[Total: 8]

- 7 (a) This question is about genetic engineering.  
Fill in the missing words in the passage that follows.  
The words may be used once, more than once or not at all.

<b>characteristic</b>	<b>ligase</b>	<b>plasmid</b>
<b>chromosome</b>	<b>lipase</b>	<b>protein</b>
<b>DNA</b>	<b>modified</b>	<b>restriction</b>
<b>expression</b>	<b>organelles</b>	<b>vector</b>

Genetic engineering involves splicing an area of a .....  
called a gene, that controls a desirable ..... of the organism.

For example, the gene may be responsible for producing an antiviral

.....

A ..... enzyme is used to split a .....  
sequence and remove the gene from the chromosome.

This gene is then placed into a bacterial ..... where it is  
sealed into the DNA chain using ..... forming recombinant  
DNA.

The recombinant DNA acts as a ..... for transferring the gene.  
The practice of genetic engineering has been widely used in the production of genetically  
..... crops.

[9]

(b) People have different opinions about genetic engineering.

(i) Give **three disadvantages** to the use of genetic engineering.

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..... [3]

(ii) Give **three advantages** to the use of genetic engineering.

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..... [3]

[Total: 15]

**END OF QUESTION PAPER**

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