OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
Advanced GCE

SCIENCE 2845

Synthesis of Scientific Concepts

Monday **19 JUNE 2006** Afternoon 1 hour 30 minutes

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

Candidate Name	Centre Number	Candidate Number

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	**10**	
2	**10**	
3	**10**	
4	**10**	
5	**28**	
6	**22**	
TOTAL	**90**	

This question paper consists of 12 printed pages.

[Turn over

Answer **all** the questions.

1 Soils can be classified in terms of the proportions of sand, silt and clay that they contain. Information about the sizes of these three types of soil particle is shown in Fig. 1.1.

type of soil particle	size of particle / μm
sand	2000–20
silt	20–2
clay	<2

Fig. 1.1

(a) **(i)** What is the meaning of μ in the units μm?

..... [1]

(ii) What is the maximum size of a silt particle, in m? Give your answer in standard form.

size = ... m [2]

(b) Fig. 1.2 shows the masses of sand, silt and clay in a sample, **S**, of soil.

type of soil particle	mass in sample of soil / g
sand	0.28
silt	0.42
clay	0.70

Fig. 1.2

(i) Calculate the percentages of sand, silt and clay in sample **S** of soil.

% sand = ... % silt = ... % clay = ... [1]

(ii) Use Fig. 1.3 to sketch the composition of sample **S** in the form of a pie chart.

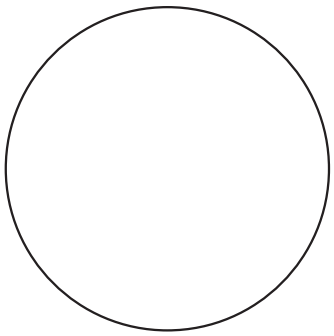

Fig. 1.3 [2]

The composition of a sample of soil can also be shown using a triangular graph.

The point, labelled **P**, on Fig. 1.4 represents a soil with a composition:

20% sand, 10% silt, 70% clay.

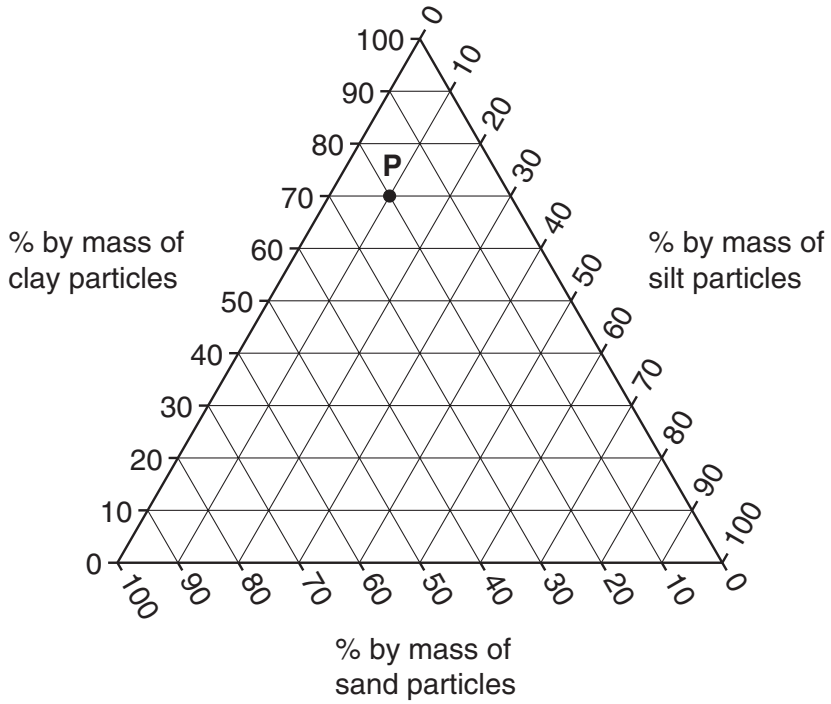

Fig. 1.4

(c) Mark on Fig. 1.4 a point, labelled **X**, to show the composition of sample **S** of soil from **(b)**. [1]

(d) **(i)** Loam is one class of soil. Loam soils are particularly good for the cultivation of crop plants.

Loam soils contain less than 30% clay, less than 90% silt and less than 90% sand.

Shade the area in Fig. 1.4 that corresponds to loam soils. [1]

(ii) Clay soils are poorly drained and plants can become waterlogged.

Sandy soils drain too quickly and plants can die from lack of water.

Suggest an explanation for this difference in behaviour between clay soils and sandy soils.

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..... [2]

[Total: 10]

2 In every breath you take there is, on average, one molecule from the last breath of Julius Caesar. This might sound unrealistic but can be shown to be true by the following calculation.

(a) The first step is to find how many breathfuls of air are contained in the atmosphere.

(i) Assume that the Earth is a sphere with radius, r.

The surface area, A, of a sphere is given by the equation: $A = 4\pi r^2$.

Calculate the surface area of the Earth.

($\pi = 3.14$; radius of the Earth = 6 400 km)

surface area of Earth = ... km^2 [2]

(ii) The volume, V, of the atmosphere is given by the equation:

$$V = Ah$$

where h is the height to which the atmosphere extends above the Earth's surface.

If all the atmosphere was at the pressure and temperature of the air breathed by Julius Caesar, its height, h, would be 6.0 km.

Calculate the volume of the atmosphere if it were all at this pressure and temperature.

Give your answer in standard form and to 2 significant figures.

volume of atmosphere = ... km^3 [2]

(iii) A breathful of air from a resting person has a volume of 3.6×10^{-13} km^3.

Julius Caesar's last breath would have had a similar volume.

How many breathfuls of air are contained in the atmosphere?

number of breathfuls in atmosphere = ... [1]

(b) The second step is to find how many molecules were in Caesar's last breath.

Under the temperature and pressure conditions of a breath, 1.0 km^3 of air contains 2.5×10^{34} molecules.

How many molecules were contained in Caesar's last breath, which had a volume of 3.6×10^{-13} km^3?

number of molecules in breath = ... [1]

(c) **(i)** Do your answers to **(a)** and **(b)** support the statement that in every breath you take there is, on average, one molecule from the last breath of Julius Caesar?

Explain your conclusion.

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(ii) Discuss **one** assumption, about the behaviour of molecules in the atmosphere, that must be made to reach your conclusion.

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[Total: 10]

3 Fig. 3.1 can be used to describe how an electric current passes through a metallic conductor, and the magnetic effect produced by the current.

A diagram has been removed due to third party copyright restrictions

Details:

A diagram showing how an electric current passes through a metallic conductor

Fig. 3.1

Complete the three labels on Fig. 3.1.

Summarise, on the lines below, the information contained in Fig. 3.1.

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[Total: 10]

4 Bracken is an invasive plant that has overgrown many areas of farmland and open land in the UK. Bracken has become widespread because organisms that graze on it do not occur naturally in the UK. A moth from South Africa, *Conservula cinisigna*, does feed on and destroy bracken. However, there may be no natural predators of the moth in the UK, and there are fears that populations of the moth could grow unchecked if it were released. Its use for bracken control has, therefore, been banned in the UK.

Discuss the science behind the spread of bracken in the UK, and the decision not to use the moth, *Conservula cinisigna*, in bracken control.

You may wish to include in your discussion ideas about

- the science of food chains
- the science of population growth.

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[Total: 10]

5 In this question, four marks are available for the quality of written communication.

Read the following extract about possible effects of climate change on agriculture.

One feature of climate change is that the average global temperature is likely to increase. The

An extract has been removed due to third party copyright restrictions

Details:

An extract about possible effects of climate change on agriculture.
It explains how the earth will be effected by an increase in temperature
which may mean some crops will no longer survive

the successful introduction of new crop species that were previously grown in regions at lower latitudes.

Discuss, as fully as you can, the science behind the aspects of climate and plant productivity, and possible changes to them, that are described in the extract above.

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For Examiner's Use

[24]

Quality of Written Communication [4]

[Total: 28]

[Turn over

6 In this question, four marks are available for the quality of written communication.

Some points about the role of the oceans in the carbon cycle are listed below.

- The oceans are a major store, or reservoir, of carbon. The carbon is present as dissolved carbon dioxide and related compounds. Carbon dioxide dissolves into the oceans from the atmosphere. Carbon dioxide itself consists of non-dipolar molecules; it is therefore not particularly soluble in water. Its concentration in seawater is low, but the volume of the oceans is so vast that a large quantity of carbon is held there.
- Once dissolved, carbon dioxide can be transported in the ocean deep water circulation system. This moves very slowly over large distances around the Earth. The carbon is 'locked up' for hundreds of years.
- The water in the ocean deep water circulation system is cold and under pressure. Both of these factors increase the solubility of carbon dioxide in water. Eventually, when water rises to the surface of the oceans again, its temperature rises and pressure falls. Some of the dissolved carbon dioxide is released back into the atmosphere.

Explain these points in greater scientific detail.

You may wish to organise your explanation in terms of the three areas listed below:

- molecular structure and solubility
- the ocean circulation system
- reversible processes.

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Quality of Written Communication [4]

[Total: 22]

END OF QUESTION PAPER