OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary GCE

SCIENCE   **2842**

Science and Human Activity

| Friday | **9 JUNE 2006** | 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.
- Answer **all** the questions.
- Write your answers in the spaces provided on the question paper.
- Read each question carefully and make sure that 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	9	
2	11	
3	14	
4	9	
5	17	
TOTAL	60	

This question paper consists of 12 printed pages.

Answer **all** the questions.

1 The climate at various points on the Earth's surface is affected by a number of factors, including air pressure.

Scientists have explained the variation in air pressure over the Earth's surface using models of the vertical and horizontal circulation of air.

Fig. 1.1 shows **part** of the Earth's surface and the major vertical and horizontal movements of air above it.

earth's surface
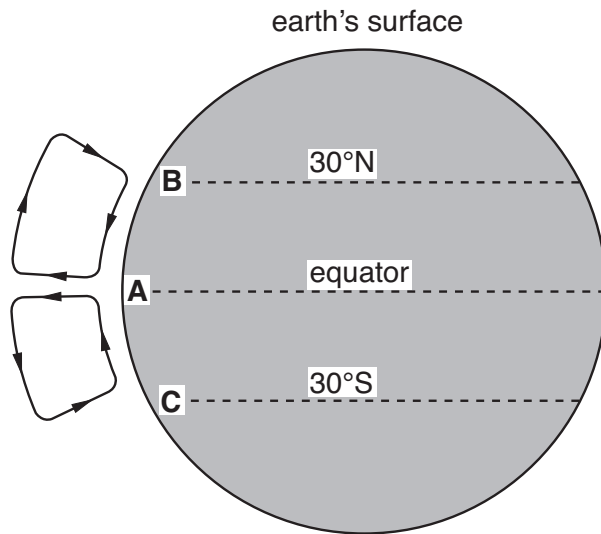
Fig. 1.1

(a) State the source of energy which causes this circulation of air.

.... [1]

(b) **(i)** Air rises at point **A**, close to the equator. State **two** reasons why air rises at this point.

1 ....

2 .... [2]

(ii) Complete Fig. 1.2 by writing "high" or "low" to show the likely air pressure at points **A**, **B** and **C**.

point on Earth	likely air pressure
A	
B	
C	

[1]

Fig. 1.2

(iii) A typical value for air pressure at the Earth's surface in a zone of high pressure is $1.03 \times 10^5 \, N \, m^{-2}$.

Calculate the force on an area of $20 \, m^2$ due to this air pressure.

Use the equation:

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

force = ... unit = ... [3]

(c) State **two** likely features of the climate at point **B** on Fig. 1.1.

1 ....

2 .... [2]

[Total: 9]

[Turn over

2 Acid rain, more correctly known as acid deposition, became a major problem for many countries in the 1960s and 1970s. Nitrogen oxides from car exhausts and sulphur oxides from power stations and factories were the main causes.

However, emissions of these gases from many countries have decreased in recent years. Strategies for dealing with the polluting effects of acid deposition have also been developed.

(a) Why is *acid deposition* a more accurate term than *acid rain*?

.... [1]

(b) Explain why sulphur oxides might be produced by power stations and factories.

....

.... [2]

(c) In this question, two marks are available for the quality of written communication.

Discuss some of the ways in which emissions of acidic gases, and their polluting effects, have been reduced in recent years.

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

.... [6]

Quality of Written Communication [2]

[Total: 11]

3 Several large-scale studies of people's health have been carried out in the past few years to discover whether there are any health problems associated with the use of mobile phones.

(a) What name is given to this type of study?

.... [1]

(b) Scientists have suggested that mobile phones could have an effect on cells in the brain because the phones emit radio waves. These waves consist of alternating electric and magnetic fields.

(i) Use the axes below to sketch a graph showing how the strength of a magnetic field varies over **one cycle** of an electromagnetic wave (such as a radio wave).

field
strength

time
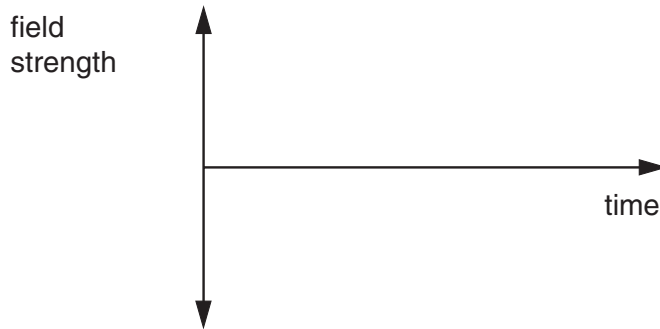
[2]

(ii) Mobile phones are considered to be low power devices. Explain the meaning of the term *power*.

....

.... [2]

(iii) Power to generate the radio waves comes from a low power d.c. circuit.

The power output from a d.c. electrical device is given by the equation:

power = voltage x current

Use this equation to show that a mobile phone with a power rating of 1 W, working off a 3.6 V battery, draws about 0.28 A of current.

[2]

(c) The relationship between current, charge and time is:

charge = current (in A) x time (in s)

(i) Calculate the charge which flows during a 50 second phone call made using a phone which draws 0.28 A of current.

charge = ... C [1]

(ii) The battery in the mobile phone is described as having a capacity of 670 mA hours. The charge stored in the battery is equivalent to the charge flowing in a current of 670 mA for 1 hour.

Calculate the charge stored in the battery of the mobile phone.

charge = ... C [1]

(iii) What percentage of the battery capacity is used by a 50 second phone call?

answer = ... [1]

(d) Scientists have also been concerned in the past about possible health effects caused by exposure to the alternating fields under electrical power lines. There is no agreement about whether mobile phones or power lines present the greater health risk, or if there is any health risk at all.

(i) Suggest why some scientists think that the fields from power lines present a greater risk.
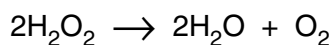
....

....

.... [2]

(ii) Suggest why some scientists think that the fields from mobile phones present a greater risk.

....

....

.... [2]

[Total: 14]

[Turn over

4 The enzyme catalase fulfils a vital purpose in many living cells by breaking down the toxic substance hydrogen peroxide.

The equation for the reaction can be written as:

$$2H_2O_2 \longrightarrow 2H_2O + O_2$$

(a) **(i)** Write down the formula for the **substrate** of the enzyme.

.... [1]

(ii) The enzyme works by providing a new mechanism for the reaction. Explain why this may result in a faster reaction than when no enzyme is present.

....

....

.... [2]

(b) **(i)** The structure of hydrogen peroxide is shown in Fig. 4.1.
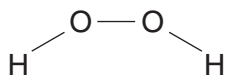
Fig. 4.1

The two oxygen atoms are held together by a covalent bond.

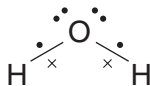Describe how a covalent bond holds two atoms together.

....

....

....

.... [3]

(ii) Water, formed in this reaction, has a "V-shaped" structure, with a bond angle of slightly less than 109°.

Fig. 4.2 shows both the shape of a molecule of water and the arrangement of its electrons.

Fig. 4.2

Explain why a water molecule has this shape.

....

....

....

.... [3]

[Total: 9]

[Turn over

5 A series of experiments was carried out to investigate the rate of breakdown of hydrogen peroxide solution by the enzyme catalase.

$5 cm^3$ of enzyme solution was added to $250 cm^3$ of hydrogen peroxide solution. The initial rate of reaction was measured and the experiment was repeated with fresh solutions of hydrogen peroxide at different concentrations.

concentration of hydrogen peroxide / g dm^{-3}	rate of reaction / g dm^{-3} s^{-1}
0	0.00
5	0.31
15	0.93
25	1.32
30	1.42
40	1.51
50	1.51

(a) Plot these data on the graph below, joining the points with a smooth curve.

rate of reaction / g dm^{-3} s^{-1}

concentration of H$_2$O$_2$ / g dm^{-3}
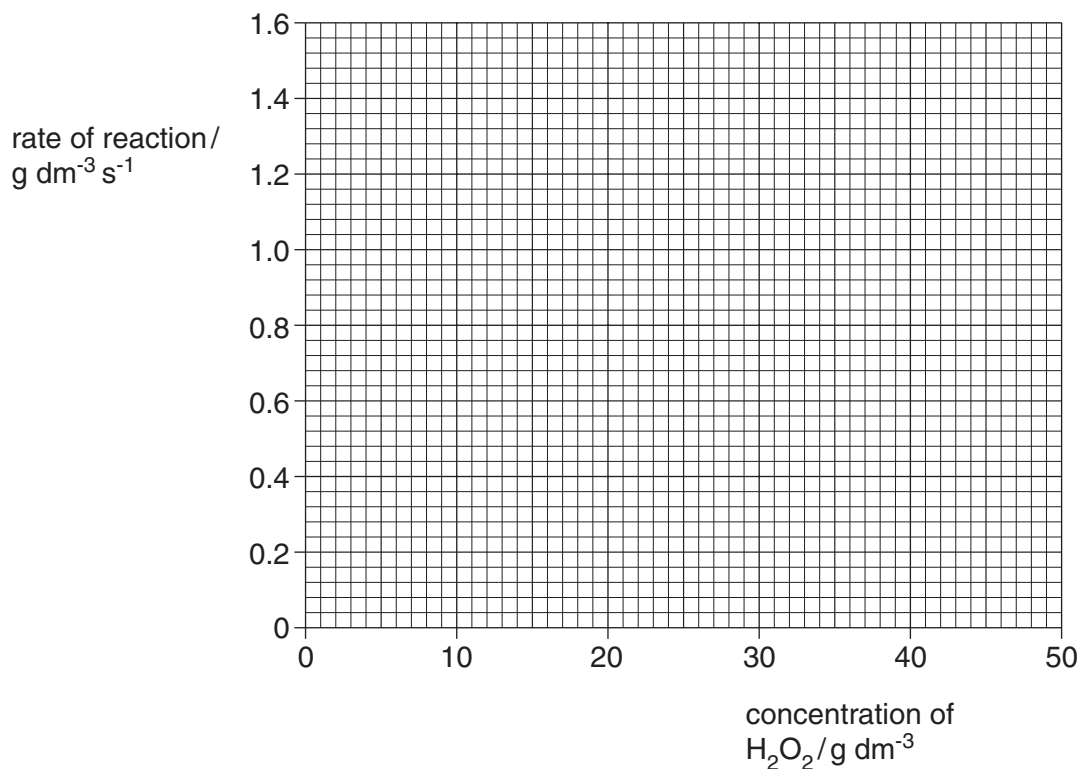
[2]

(b) Use the graph to find the rate of reaction when the concentration of hydrogen peroxide is:

(i) $8\,g\,dm^{-3}$

rate = ... $g\,dm^{-3}\,s^{-1}$ [1]

(ii) $16\,g\,dm^{-3}$

rate = ... $g\,dm^{-3}\,s^{-1}$ [1]

(iii) Explain how these results suggest that the reaction is first order for low concentrations of hydrogen peroxide.

....

.... [1]

(iv) Explain why increasing the concentration of reactants normally causes an increase in the rate of a reaction.

....

....

.... [2]

(v) State **one** other change which could be made to increase the rate of breakdown of hydrogen peroxide.

.... [1]

(c) An equation can be written to show the connection between rate and hydrogen peroxide concentration. At low concentrations, the equation is:

$$rate = k\,[H_2O_2]^1$$

(i) What name is given to an equation of this sort?

.... [1]

(ii) What name is given to the symbol k in this equation?

.... [1]

(d) (i) Use the graph in (a) to describe the effect on the rate of reaction when the hydrogen peroxide concentration is increased beyond $40\,g\,dm^{-3}$.

.... [1]

(ii) Suggest an explanation of this pattern.

....

....

....

.... [2]

[Turn over

(e) Enzymes have been used in the food industry for a long time. They are now used very widely in a range of industries.

(i) Describe one example of the use of an enzyme in the food industry.

....

....

....

.... [3]

(ii) State one industrial use of enzymes, apart from in the food industry.

.... [1]

[Total: 17]

END OF QUESTION PAPER