OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

SCIENCE 2846/01

Science and Global Processes

Tuesday **21 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.
- 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 may use an electronic calculator.
- You are advised to show all the steps in any calculations.

FOR EXAMINER'S USE		
Qu.	**Max.**	**Mark**
1	**13**	
2	**6**	
3	**15**	
4	**10**	
5	**16**	
TOTAL	**60**	

This question paper consists of 12 printed pages.

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[Turn over

Answer **all** the questions.

1 Fig. 1.1 illustrates the behaviour of tectonic plates.

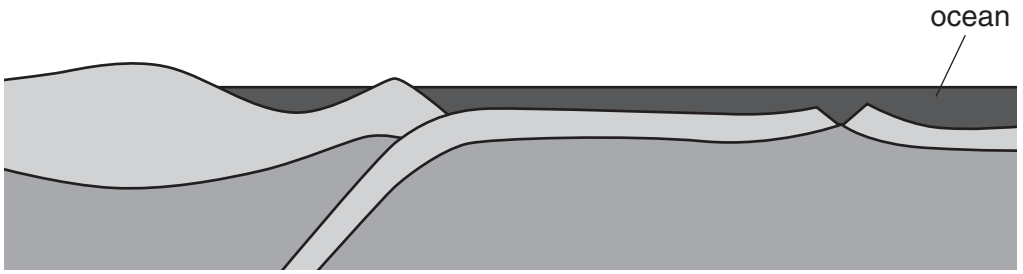

Fig. 1.1

(a) (i) Label Fig. 1.1 with the letters **A** to **E** to show

A a region of lithosphere

B a region of asthenosphere

C a destructive plate boundary

D a region of sea-floor spreading

E an oceanic plate. [5]

(ii) Draw an arrow on Fig. 1.1 to show an upwelling convection current that would drive plate movement. [1]

(b) The process of continental drift was proposed in the early 20th century to explain the apparent fit between areas of land that now form parts of different continents, for example, Africa and S. America. Explain how this continental fit can be understood in terms of plate tectonic theory.

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..... [3]

(c) People have always tried to understand the Earth. Plate tectonic theory replaced very different, earlier theories of the behaviour of the Earth's surface. But plate tectonic theory was not developed until the 1960s and 1970s. Discuss the reasons why plate tectonic theory only developed in such recent times.

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..... [4]

[Total: 13]

2 A mass, m, at the Earth's surface experiences a downward force, F, as a result of the Earth's gravitational field strength, g.

(a) Write down the equation that shows the relationship between these quantities.

..... [1]

(b) The Earth's gravitational field strength depends on the Earth's radius, r, and the Earth's mass, M. The relationship is

$$g = \frac{G\,M}{r^2}$$

where G, the gravitational constant, has the value $6.67 \times 10^{-11}\,\text{N m}^2\,\text{kg}^{-2}$.

The same equation can be used for all other planets.
Data for the planet, Venus, is given below.

mass of Venus $= 4.9 \times 10^{24}\,\text{kg}$
radius of Venus $= 6.1 \times 10^{6}\,\text{m}$

(i) Calculate the value of the gravitational field strength, g, of Venus, and note that it is less than the value of g on Earth.
The value of g, on Earth, is $9.8\,\text{N kg}^{-1}$.

g (on Venus) = ... N kg^{-1} [2]

(ii) Atmospheric pressure on Venus is about 100 times greater than on Earth. Suggest why Venus has a much higher atmospheric pressure.

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..... [3]

[Total: 6]

3 The Runnel Stone is an underwater reef off the SW coast of England. Because it is a danger to ships, its position is marked by a floating buoy. The buoy carries a flashing light and a whistle.

Fig. 3.1 is an illustration of the Runnel Stone buoy.

An image has been removed due to third party copyright restrictions

Details:

An image of a light house on top of a buoy

Fig. 3.1

(a) Suggest why the buoy carries both a light and a whistle.

.....

.....

..... [2]

(b) Light and sound are both waves. A wave is a travelling disturbance.

(i) Describe how a sound wave travels through air.

.....

.....

..... [2]

(ii) How does the direction of movement of the disturbed air compare with the direction of travel of the wave?

..... [1]

(iii) What do we call this type of wave?

..... [1]

(iv) Light waves and sound waves differ in some respects.
State **two** ways in which a light wave differs from a sound wave.

1 .....

.....

2 .....

..... [2]

(c) The tube that runs through the Runnel Stone buoy has a whistle at the top.
Air is forced through a reed in the whistle by the rise and fall of the seawater in the lower part of the tube.

The frequency, f, and wavelength, λ, of a wave are related to its speed, c, by the equation:

$$c = f\lambda$$

The speed of sound in the air above the sea is $332\,\text{m}\,\text{s}^{-1}$.

The note given out by a whistle depends on its length. The wavelength of the lowest pitch note (the fundamental note) is twice the length of the whistle.
The length of the whistle in the Runnel Stone buoy is 1 m.

(i) Calculate the wavelength of the fundamental note given out by the whistle.

wavelength = ... m [1]

(ii) Calculate the frequency of the fundamental note.

frequency = ... Hz [1]

(d) The Runnel Stone whistle was not designed to produce notes that correspond exactly to the pitch of musical notes. Fig. 3.2 illustrates part of a piano keyboard, showing the frequencies of different musical notes.

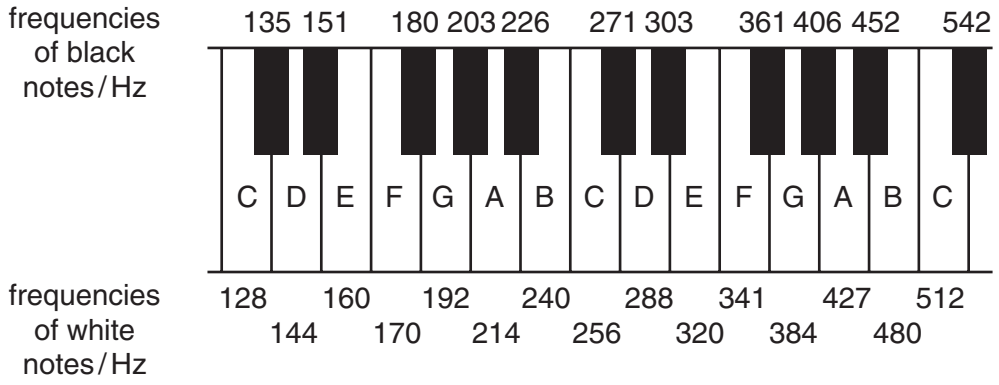

Fig. 3.2

(i) Using information from Fig. 3.2, describe the pitch of the fundamental note given out by the Runnel Stone whistle.

..... [1]

(ii) In rough seas, air is forced more quickly through the whistle's reed. The whistle can then produce other, higher pitch notes, called overtones. The first overtone has one-and-a-half wavelengths in the whistle.

How many times greater than the frequency of the fundamental note is the frequency of the first overtone?

..... [1]

(iii) Describe the pitch of the note given out as the first overtone by the Runnel Stone whistle. Explain your answer.

.....

..... [1]

(e) The movement of sea swell, as seawater rises and falls over time, resembles simple harmonic motion.

(i) Use Fig. 3.3 to draw a graph to show how the displacement in the level of seawater varies with time.

[1]

Fig. 3.3

(ii) Mark, with a letter **X**, on Fig. 3.3 a point at which seawater will be rising most rapidly. [1]

[Total: 15]

4 Over two thousand years ago, the Greek geographer and mathematician, Eratosthenes, made an estimate of the Earth's radius. It was surprisingly accurate.

The ancient Greeks measured distance in units of stadia.
Eratosthenes knew that the distance between Syene and Alexandria, two towns in Egypt, was approximately 5000 stadia.
By careful measurement of the angles of shadows cast by the Sun at these two towns, Eratosthenes estimated the angle at the Earth's centre between Syene and Alexandria to be approximately 7°, as shown in Fig. 4.1.

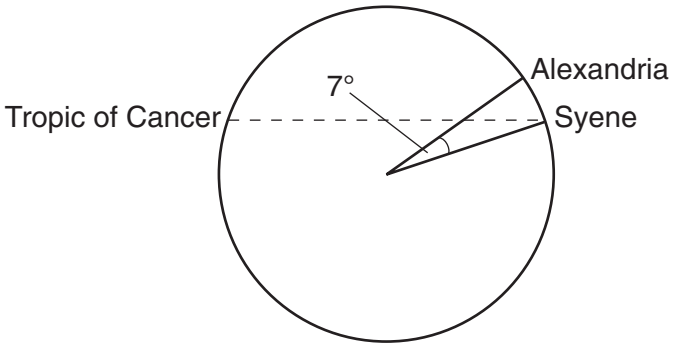

Fig. 4.1

An angle of 7° represents approximately $\frac{1}{50}$ of a complete revolution around the circumference of a circle.

(a) Calculate Eratosthenes' value for the circumference of the Earth.

circumference = ... stadia [1]

(b) The relationship between the circumference of a circle, L, and its radius, r, is given by the equation

$$L = 2\pi r \quad \text{(where } \pi \text{ has the value 3.14)}$$

Calculate Eratosthenes' value for the Earth's radius. Show your working.

radius = ... stadia [2]

(c) The currently accepted value for the Earth's radius is 6.4×10^3 km.
(1 km = 5.4 stadia)

(i) What is the currently accepted value for the radius of the Earth in stadia?
Give your answer to two significant figures and in standard form.

radius = ... stadia [2]

(ii) Suggest why Eratosthenes' value for the Earth's radius differs from the currently accepted value.

.....

..... [1]

(d) Eratosthenes measured the shadows at the two towns on mid-summer's day.
The Sun was directly overhead at mid-day in Syene, because Syene lay on the Tropic of Cancer. This is the most northerly latitude at which the Sun can be directly overhead.
Fig. 4.2 shows the positions of the Earth and Sun on mid-summer's day in the northern hemisphere.

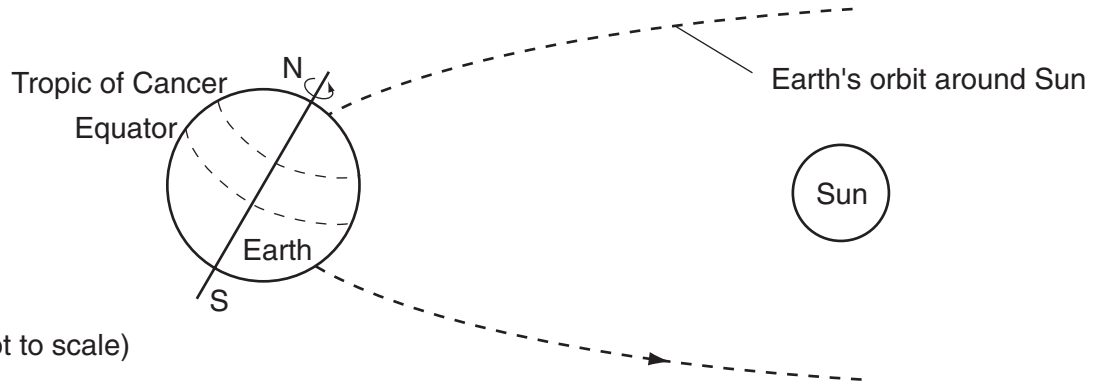

Fig. 4.2

Explain, using the information in Fig. 4.2, how the relative movement of the Earth and Sun gives rise to the season of summer.

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..... [4]

[Total: 10]

5 Fig. 5.1 shows some of the surface currents in the North Atlantic Ocean.

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Details:

A map of some of the surface currents in the North Atlantic Ocean

Fig. 5.1

(a) (i) Add arrows to Fig. 5.1 to show the directions of the following currents:

Gulf Stream
N. Atlantic Drift
Canaries Current.

[1]

(ii) Explain the direction of flow of the Canaries Current.

.....

.....

..... [2]

(b) What name is given to an area of ocean, such as Z, that lies within a system of surface currents?

..... [1]

(c) Explain why the presence of ocean currents can affect the climate of a region .

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..... [2]

(d) Describe the **global** contribution made by ocean currents to the distribution of thermal energy on Earth.

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..... [2]

(e) Water in the Norwegian Current sinks to form a deep-water current.
Name the other region where surface water sinks to form a deep-water current.

..... [1]

(f) The Labrador Current is a cold water current that brings icebergs floating along the east coast of N. America.

(i) State, in terms of its structure, why ice has a lower density than water.

.....

..... [1]

(ii) Which has the greater mass, 1 km^3 of ice or 1 km^3 of water?
Explain your answer.

.....

..... [1]

(g) The four types of structure into which substances can be classified are

metallic **molecular** **ionic** **giant molecular**.

Circle the type of structure shown by water. [1]

(h) **(i)** Name the type of bonding that holds neighbouring molecules together in **ice**.

..... [1]

(ii) Draw a labelled diagram to show the bonding around an oxygen atom of a water molecule in ice.

[3]

[Total: 16]

END OF QUESTION PAPER