

**ADVANCED GCE****SCIENCE**

Synthesis of Scientific Concepts

2845

Candidates answer on the Question Paper

OCR Supplied Materials:

None

Other Materials Required:

- Electronic calculator
- Ruler (cm/mm)

Thursday 17 June 2010**Afternoon****Duration:** 1 hour 30 minutesCandidate
ForenameCandidate
Surname

Centre Number

Candidate Number

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use 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.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- The number of marks 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.
- This document consists of **20** pages. Any blank pages are indicated.

Examiner's Use Only:

1			
2			
3			
4			
5			
6			
Total			



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Answer **all** the questions.

- 1** The honey bee pollinates a wide range of food crops. One such food crop is the apple.

Pollination occurs when pollen from one flower is transferred to the stigma of another.

- (a)** A typical apple orchard consists of two varieties of apple tree, a pollinator and a second variety which will form the fruit once it is pollinated.

- (i)** Suggest a reason why using two varieties may be an advantage to an apple grower.

.....
 [1]

- (ii)** Two possible layouts for an orchard are shown below. Suggest which layout is likely to be the most suitable for an apple grower, explaining your reasoning.

P = pollinator F = fruit-producing tree

Layout 1

F	F	P	F	F	F	F	P	F	F
F	F	P	F	F	F	F	P	F	F
F	F	P	F	F	F	F	P	F	F
F	F	P	F	F	F	F	P	F	F
F	F	P	F	F	F	F	P	F	F
F	F	P	F	F	F	F	P	F	F

Layout 2

P	F	F	F	F	F	F	F	F	P
P	F	F	F	F	F	F	F	F	P
P	F	F	F	F	F	F	F	F	P
P	F	F	F	F	F	F	F	F	P
P	F	F	F	F	F	F	F	F	P
P	F	F	F	F	F	F	F	F	P

most suitable layout:

justification:

.....
 [1]

- (b) In one orchard in England, the pollinator variety used is *Katy* which normally flowers between 04 May and 18 May.

The fruiting variety is *Gala* which flowers between 12 May and 23 May. One factor that affects the rate of pollination is the number of days when both varieties are in flower.

To ensure a satisfactory crop, 5% of flowers need to be pollinated.

- (i) Calculate the number of days on which both varieties are likely to be in flower.

number of days = [1]

- (ii) Suggest a reason why the dates of flowering may differ from year to year.

.....
 [1]

- (iii) One hectare of *Gala* trees produces approximately 2.2×10^6 flowers.

Calculate the minimum number of flowers that must be pollinated to produce a satisfactory crop.

minimum number of flowers pollinated = [2]

- (c) An average honey bee visits about 650 flowers per day.

- (i) How many days would it take **one** bee to pollinate the number of flowers required for satisfactory pollination of the orchard?

Give your answer to 2 significant figures.

number of days required = [3]

- (ii) Suggest reasons why the actual number of days may be significantly higher than this number.

.....

 [2]

- (iii) Use your answer to (b)(i) and (c)(i) to estimate the number of bees needed to produce a satisfactory crop in the one hectare orchard.

number of bees required = [1]

- (d) An average hive contains 2×10^4 worker bees (the bees responsible for pollination). Estimate how many hectares of orchard a single hive could pollinate.

number of hectares pollinated = [1]

- (e) The number of bees in the world is falling due to infectious diseases. It is thought that bees are particularly vulnerable to new diseases because most of the worker bees are genetically identical.

Explain how this might explain the vulnerability of bees to disease.

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

[Total: 15]

- 2 The production of nitrogen-based fertilisers is essential in allowing modern agriculture to produce high yields of crops.

The production of nitrogen-based fertilisers relies on the Haber process. In the Haber process, nitrogen and hydrogen are converted into ammonia, which can then be used to form nitrogen-based fertilisers such as ammonium nitrate.

- (a) The chemical equation for the Haber process is:



- (i) Natural gas is the raw material from which the hydrogen is produced.

Suggest a raw material that will supply the nitrogen.

..... [1]

- (ii) State the meaning of the \rightleftharpoons symbol.

.....

..... [1]

- (b) The **yield** of ammonia is a measure of the percentage of the reactants which are converted into ammonia.

Fig. 2.1 shows the yields of ammonia at different conditions of temperature and pressure.

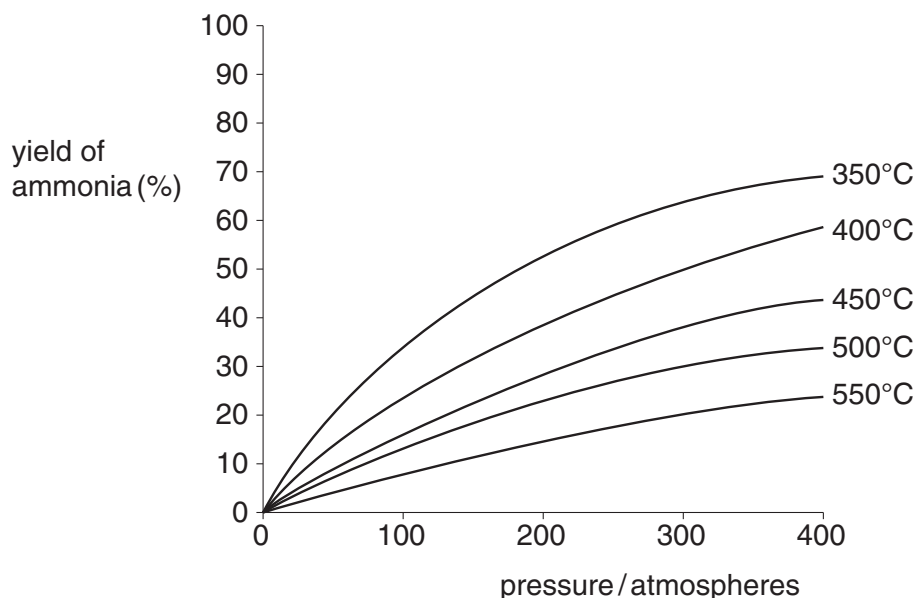


Fig. 2.1

- (i) Use the graph to estimate the yield of ammonia at 200 atm and 500°C.

yield = % [1]

- (ii) Using information from the graph, suggest two changes to the conditions that will **increase** the yield.

1.

.....

2.

..... [2]

- (iii) Le Chatelier's Principle states that 'the position of equilibrium will shift to oppose any change made in a system'.

For **one** of the changes you have suggested in (ii), describe how Le Chatelier's Principle can be used to explain why the yield increases when the conditions are changed in this way.

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..... [3]

- (iv) Industrial processes need to be fast and safe, as well as needing to produce a good yield.

In order to achieve this, suggest a reason why

1 temperatures lower than 355 °C are not used

.....

..... [1]

2 pressures higher than 400 atm are not used.

.....

..... [1]

- (c) In the past ten years there has been a great increase in the growing of biofuel crops, using fertilisers to produce high yields of crops rich in vegetable oils. These oils can then be used to produce diesel and other fuels.

Many people claim that these fuels are **carbon neutral** – that is they have no overall effect on the amount of CO₂ in the atmosphere.

- (i) Explain the reasoning behind this claim.

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..... [3]

- (ii) Outline an argument that could be used to support the view that the fuels may not, overall, be carbon neutral because they **do** in fact add extra CO₂ to the atmosphere.

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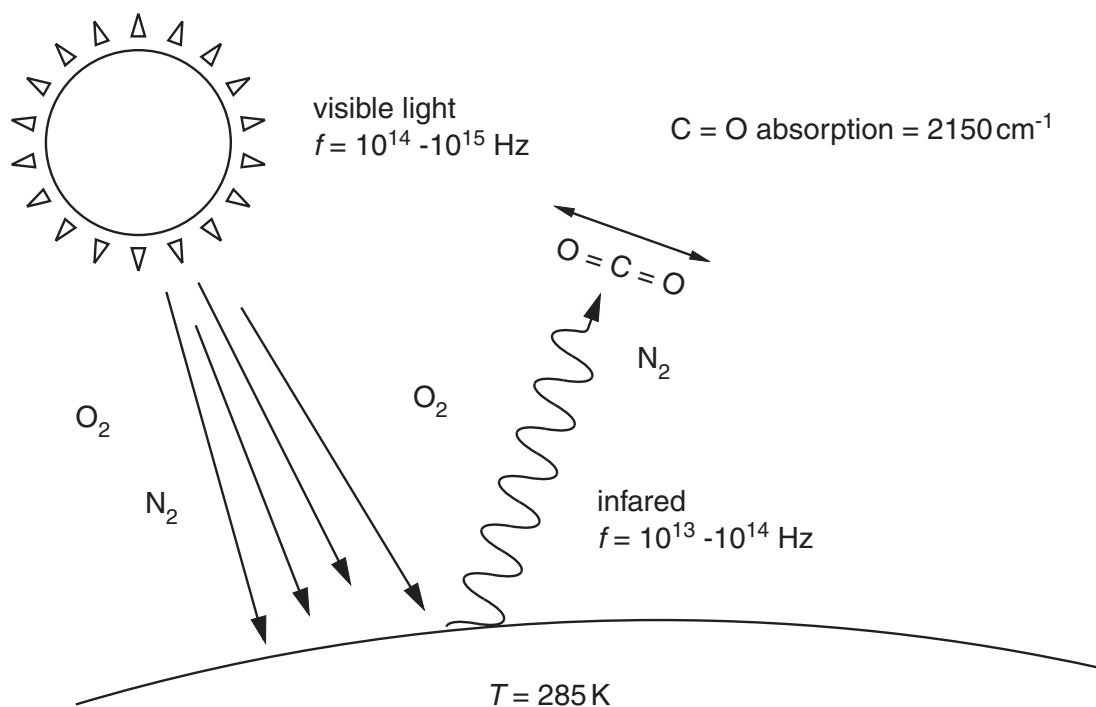
..... [2]

[Total: 15]

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- 3** The diagram below shows some of the processes that are involved in the greenhouse effect which causes the warming of the Earth's atmosphere.



Summarise the science shown in the diagram and hence explain how the greenhouse effect arises.

This image shows a full page of a handwriting practice worksheet. It consists of ten sets of horizontal dashed lines spaced evenly down the page, providing a guide for letter height and placement. The background is plain white, and there are no other markings or text present.

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..... [10]

[Total: 10]

- 4 The environment can be monitored by a range of techniques.

These can include remote sensing and instrumental analysis.

- (a) Remote sensing can be used to monitor environmental changes such as changes to sea-surface temperature, the health of vegetation in a rainforest or the depth of the ocean floor.

These applications include the use of active and passive remote sensing, as well as the use of different types of waves.

Use the terms below to complete Table 4.1 which summarises information about the different applications of remote sensing.

The words may be used more than once.

[3]

near infrared radiation

thermal infrared radiation

sound waves

passive remote sensing

active remote sensing

environmental application	type of radiation used	type of remote sensing used
monitoring sea-surface temperature		
assessing health of rainforest vegetation		
measuring depth of ocean floor		

Table 4.1

- (b)** Instrumental analysis take samples from the environment and analyses them using instrumental techniques in the laboratory.

Choose an example of instrumental analysis.

- Explain the principles behind the technique.
- Explain how the results may be displayed.
- Give an example of environmental information that the technique may provide.

..... [6]

[Total: 9]

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

Read the passage below which explains how the rock cycle may help to keep the temperature of the world constant.

The cycle begins with volcanoes spewing CO_2 into the atmosphere, which helps keep the planet warm, thanks to the greenhouse effect. This warmth allows seawater to evaporate, forming clouds and rain. As the rain contains dissolved CO_2 it is slightly acidic and so it reacts with surface rocks to dissolve carbon-containing minerals [such as calcium carbonate] into the water. This mixture is then washed out to sea where the minerals build up and eventually precipitate out to form new carbon containing rocks on the seabed. Sooner or later, plate tectonics carries these rocks into a subduction zone where CO_2 is 'baked' out of them by the heat of the Earth's interior and later returns to the atmosphere again through volcanic vents.

The cycle turns out to be an extremely effective thermostat. When the planet is warm, rainfall increases, speeding the rate at which CO_2 is removed from the atmosphere, cooling the planet. When it is cold, rainfall decreases, allowing volcanic gases to build up in the atmosphere, warming the planet.

Explain the scientific ideas mentioned in this passage.

You may wish to organise your answer in the following way:

- a description of the process of evaporation, explaining why the rate of evaporation is increased by high temperature
- an explanation of acidity and the effects of acidity on minerals
- a description of the processes in the rock cycle which lead to the formation of sedimentary rocks
- a description of the processes of plate tectonics that cause rocks to be subducted and volcanoes to form
- an explanation of why this cycle is an example of negative feedback

Do **not** discuss the mechanism of the greenhouse effect.

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..... [16]

Quality of Written Communication [4]

[Total: 20]

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

Read the following passage about the properties of water and its importance to life on Earth.

Water is one of the simplest molecules in the Universe and yet is essential to all living things. It is an excellent solvent and so all the molecules and ions present in cells can remain dissolved which allows them to diffuse around the cell or in the fluids around cells.

Water is also one of the raw materials in the process of photosynthesis which is the major way by which energy is trapped by ecosystems.

Only a small part of the Earth would be habitable as we know it, were it not for the ability of water to transport energy away from the equator by the system of ocean currents.

All of these features rely on water being a liquid at the average temperature of the Earth – around 285 K. This would not normally be the case for a molecule as small as water, but the hydrogen bonding between water molecules raises the boiling point enough to allow liquid water to exist in large quantities on Earth.

Explain the scientific ideas mentioned in this passage.

You may wish to organise your answer in the following way:

- the structure of water
- how the structure of water allows hydrogen bonding to form and allows water to act as a solvent
- the process of photosynthesis and how it allows energy to be trapped
- the energy transport system involving the oceans

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..... [17]

Quality of Written Communication [4]

[Total: 21]

END OF QUESTION PAPER

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