



ADVANCED SUBSIDIARY GCE
SCIENCE
 Science and Human Activity

G642

Candidates answer on the Question Paper

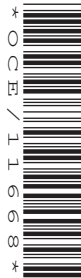
OCR Supplied Materials:
None

Other Materials Required:

- Electronic Calculator
- Ruler (cm/mm)

Wednesday 9 June 2010
Morning

Duration: 1 hour 45 minutes



Candidate Forename		Candidate 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. Additional paper may be used if necessary but you must clearly show your Candidate Number, Centre Number and question number(s).

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 **100**.
- You are advised to show all the steps in any calculations.
- Where you see this icon you will be awarded marks for the quality of written communication in your answer.
 This means, for example, you should:
 - ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear;
 - organise information clearly and coherently, using specialist vocabulary when appropriate.
- You may use an electronic calculator.
- This document consists of **20** pages. Any blank pages are indicated.

AS SCIENCE RELATIONSHIPS SHEET

pressure = force \div area

energy transferred = mass \times specific heat capacity \times temperature rise

density = mass \div volume

wavenumber = 1 / wavelength

speed = frequency \times wavelength

energy = Planck constant \times frequency

current = charge \div time

power = voltage \times current

power loss = (current)² \times resistance

Answer **all** the questions.

- 1 This question is about protein structure and function.

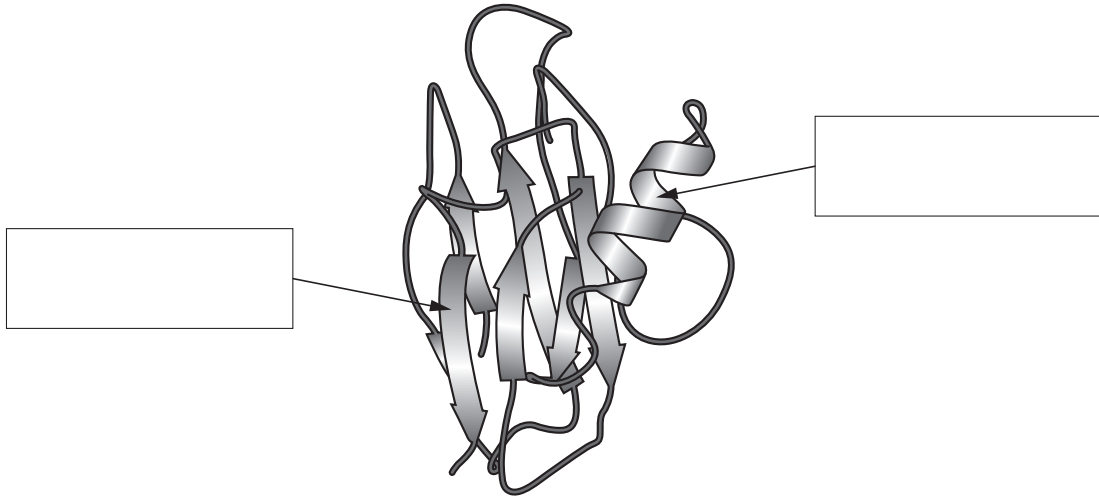
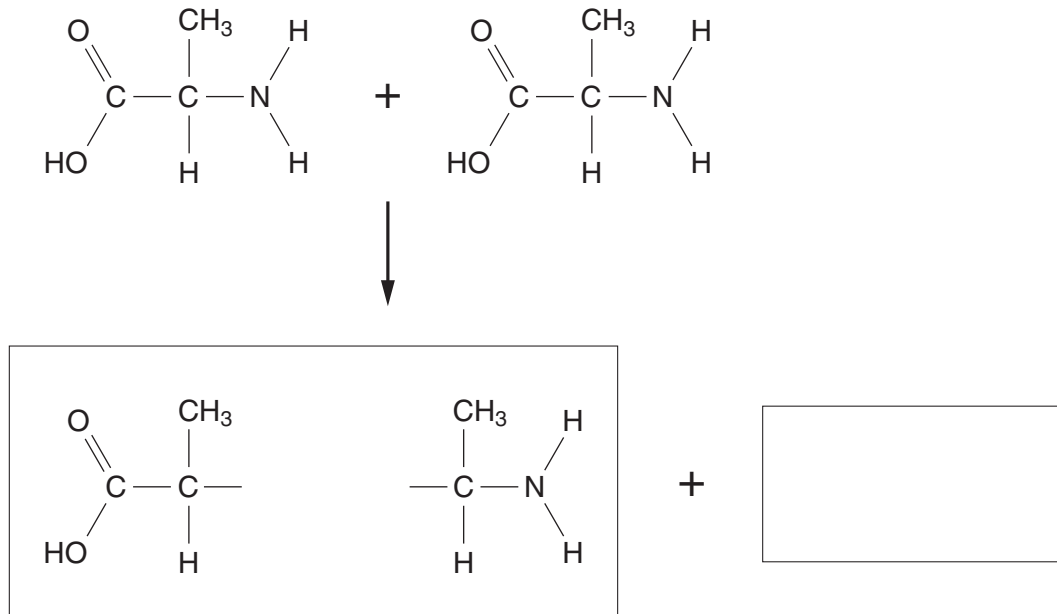


Fig. 1.1

- (a) (i) Fig. 1.1 shows a ribbon diagram of a protein. Label the **two** types of secondary structure in Fig. 1.1. [2]
- (ii) Two amino acids are shown below. Show the **two** products when the dipeptide is formed. [3]

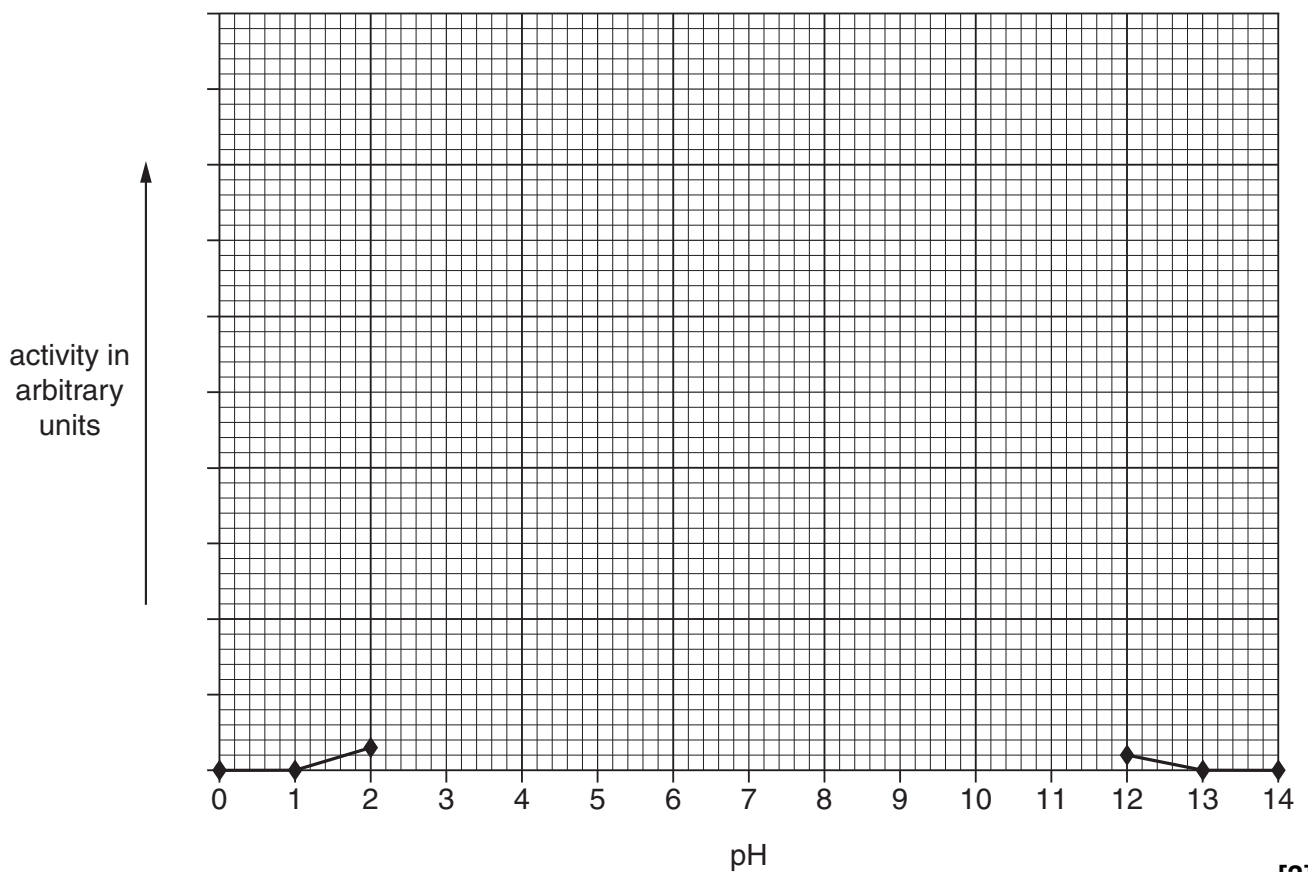


- (b) The activity of the enzyme chymotrypsin was measured over a range of pH values. The results are shown in Table 1.1.

Table 1.1

pH of solution	percentage activity of chymotrypsin
0	0
1	0
2	3
3	9
4	27
5	57
6	89
7	98
8	78
9	
10	21
11	8
12	2
13	0
14	0

- (i) Complete the graph below using Table 1.1. Some of the points have been plotted for you. Draw an appropriate line of best fit.



[3]

(ii) Use your graph to estimate the percentage activity of the enzyme at pH 9.

..... [1]

(c) (i) Explain what is meant by the *tertiary structure* of an enzyme.

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

(ii) The data shown suggests that the optimum activity for chymotrypsin is somewhere between pH 6.5 and 7. Explain in detail why the enzyme has zero activity at very high and very low pH.



In your answer, you should make clear how your explanation links with the evidence.

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
..... [6]

[Total: 17]

2 This question is about pressure.

(a) (i) Use the molecular kinetic theory of gases to explain how a gas exerts a pressure on the walls of a container.

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

(ii) The pressure of a gas in a sealed container is $100\,000\text{ N m}^{-2}$ at 20°C . Calculate the **total force** exerted by the gas on a wall of the container. This wall has a surface area of 0.5 m^2 .

total force = unit [3]

(iii) The temperature of the gas inside the container now increases. With reference to the kinetic theory of gases, describe **and** explain what happens to the pressure inside the sealed container. (Assume the volume of the container remains constant.)

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

(b) The pressure of air masses above the surface of the Earth influences the weather.

(i) Explain how the warming effect of the sun produces a low pressure region.

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

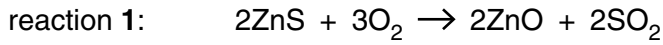
(ii) Explain why low pressure regions are often associated with wet weather.

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

[Total: 12]

- 3 This question concerns the causes and problems associated with acid rain. One of the causes of acid rain is the extraction of metals.

Zinc can be extracted from its ore in a **two step process** represented by the following reactions.



- (a) The oxidation number of sulfur in ZnS is -2 .

- (i) Calculate the oxidation number of sulfur in SO_2 .

oxidation number = [1]

- (ii) Explain how we know that sulfur dioxide is oxidised in reaction 1.

.....
 [1]

- (iii) Identify which substance is being **reduced** in reaction 2 and explain your choice.

.....

 [2]

- (b) Sulfur dioxide reacts in the atmosphere to form an acid.

- (i) Complete the equation below to show the formula of the other substance involved in the reaction.



- (ii) H_2SO_3 is an acid. Complete the equation below to show the dissociation of H_2SO_3 .



4 This question concerns the Earth's ozone layer.

(a) The formation of ozone in the upper atmosphere is a photochemical reaction that takes place in steps 1 and 2 as shown below.



followed by



(i) Explain what is meant by a *photochemical reaction*.

.....
 [1]

(ii) Ultraviolet light of wavelength 200 nm ($1 \text{ nm} = 1 \times 10^{-9} \text{ m}$) can cause an oxygen molecule to split into two oxygen atoms as shown in step 1.

Use a suitable equation to calculate the frequency of this ultraviolet light given that its speed is $3.0 \times 10^8 \text{ m s}^{-1}$. Show your working.

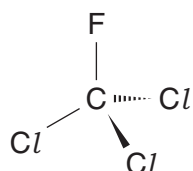
frequency = unit [4]

(b) Chlorofluorocarbons (CFCs) are thought to have been responsible for the depletion of the ozone layer in recent times. CFCs can react with sunlight to produce **radicals**.

(i) What is meant by the term *radical* in this context?

.....
 [1]

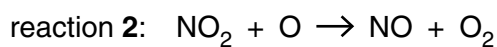
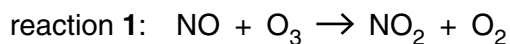
(ii) Give the formula of a radical that could be generated by the interaction of sunlight with a molecule of CFC-11.



CFC-11

formula = [1]

- (c) Another molecule that has been shown to contribute to ozone depletion is nitrogen monoxide (NO) which acts as a catalyst. The reactions are shown in the equations below.



- (i) Explain what is meant by a *catalyst*.

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

- (ii) Use the equations for the reactions 1 and 2 to explain why nitrogen monoxide is described as a **catalyst** in the decomposition of ozone.

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

[Total: 11]

12
BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

- 5 This question is about the methods, techniques and ethical issues involved in genetic engineering.

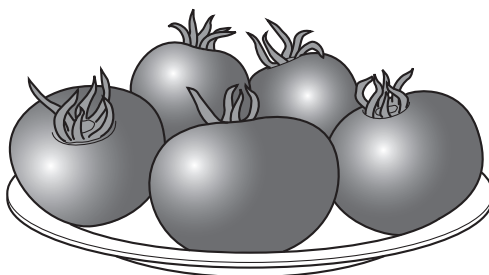
(a) Select words from the list below to complete the passage.

adenine amino acids guanine hydrogen ionic
nuclear membrane nucleus quartet ribosomes
thymine transcribed translated triplet uracil

Genetic information in plant and animal cells is stored in the Chromosomes are structures in the cell in which the organism's genetic code is stored. The code is stored in the form of a base code. The DNA bases are held together by bonds and these bonds ensure that cytosine always pairs up with When proteins are synthesised, DNA is first transcribed into RNA in which the DNA base thymine is replaced by RNA is then transported to the cell cytoplasm where the code is into protein molecules by cell organelles called [7]

(b) On Monday April 30th 2001 the following item appeared on a news website.

GM tomato to fight disease



Scientists have developed a genetically modified tomato that could be used to keep people healthy.

They believe the fruit could even help to ward off heart disease and cancer.

Using gene technology they were able to increase levels of beneficial chemicals called flavonols in tomato peel.

Flavonols are powerful antioxidants, chemicals that fight disease by neutralising harmful oxygen molecules that circulate in the body, damaging tissues and accelerating the ageing process.

Epidemiological studies can be used to assess the safety of genetically modified foods. How might a team of scientists go about showing that the genetically modified tomatoes are safe for consumption?

You should include ideas about **methodology**, types of **evidence** and possible **ethical issues** in your answer.



In your answer, you should make clear how the steps in the method are sequenced.

how you would carry out the study

.....

.....

.....

.....

.....

.....

.....

.....

.....

types of evidence

.....
.....
.....
.....
.....
.....

possible ethical issues associated with the method

.....
.....
.....
.....
.....
.....

[9]

[Total: 16]

6 This question concerns atomic structure and isotopes of phosphorus (P).

(a) Explain the meaning of the term *isotopes*.

.....

.....

.....

..... [2]

(b) (i) Complete Table 6.1 below for the isotope $^{31}_{15}\text{P}$.

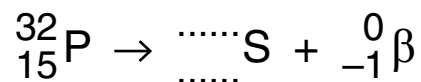
Table 6.1

sub atomic particle	number of particles
proton	
neutron	
electron	

[3]

(ii) Phosphorus-32 ($^{32}_{15}\text{P}$) decays by β emission.

Complete the equation for this process below.



[2]

(iii) Phosphorus-32 has a radioactive half life of 14.3 days.
Calculate how long it would take 1.00 g of this isotope to decay to a mass of 6.25×10^{-2} g.
Show your working.

length of time = days [3]

(iv) Suggest why a sample of phosphorus-32 would be labelled as a **biological hazard** and what precautions would need to be taken in handling a sample.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 14]

7 With fossil fuel resources running out, other possible sources of energy need to be considered in the future. This question is about some alternative sources of energy.

Many scientists believe that the long term global energy needs will require the exploitation of renewable energy resources such as the following:

- solar energy
- wind energy
- wave energy
- tidal energy

(a) Explain what is meant by the term *renewable energy source*.

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

(b) Choose **three** of the examples of renewable energy resources shown above and discuss the **advantages** and **disadvantages**, other than cost, of using these energy sources to generate a reliable energy source.

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
..... [6]

(c) In the future, scientists hope to make use of **nuclear fusion** reactors.
 Current nuclear power stations make use of the energy generated by **nuclear fission**.

(i) Explain what happens in the processes of *nuclear fusion* and *nuclear fission*.

nuclear fusion

.....

.....

.....

nuclear fission

.....

.....

..... [4]

(ii) Nuclear reactions in the centre of the Sun generate energy that is transmitted to the surface of the Earth. In what form is **most** of the energy transmitted to the Earth's surface?

.....

..... [1]

(iii) The Sun also generates cosmic rays such as high energy protons and electrons. Why are these rays potentially harmful?

.....

.....

..... [2]

(iv) What is responsible for minimising the impact of these rays on the Earth's surface?

..... [1]

(v) Elements heavier than helium can be made at the Sun's core. Complete the equation below for the formation of ${}^7_3\text{Li}$.



[Total: 17]

END OF QUESTION PAPER

PLEASE DO NOT WRITE ON THIS PAGE



Copyright Information

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations, is given to all schools that receive assessment material and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1GE.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.