OCR
RECOGNISING ACHIEVEMENT

Monday 11 June 2012 – Afternoon

A2 GCE APPLIED SCIENCE

G628 Sampling, Testing and Processing

Candidates answer on the Question Paper.

OCR supplied materials:
- Insert (inserted)

Other materials required:
- Electronic calculator
- Ruler (cm/mm)

Duration: 1 hour 30 minutes

G628

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- The Insert will be found in the centre of this document.
- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined page at the end of this booklet. The question number must be clearly shown.
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- Candidates may not bring the Pre-release Case Study into the examination room.
- 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**.
- 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 the meaning is clear;
  - organise information clearly and coherently, using specialist vocabulary when appropriate.
- A calculator may be used for this paper.
- You are advised to show all the steps in any calculations.
- This document consists of **20** pages. Any blank pages are indicated.

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

Answer **all** the questions.

Questions 1 and 2 refer to the materials supplied to your Centre in the Pre-release Case Study. You are supplied with fresh copies in the Insert.

This question is based on the article 'Silica – friend or foe?'

1 **(a)** State how the article suggests that the nodules of flint are not spread evenly through the deposits of chalk.

.....

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

(b) A group of students were studying chalk deposits near Grime's Graves.
The age of the chalk can be found by studying the fossils present.
Some of the fossils were placed in labelled sample bags for further investigation.

(i) State what should be written on the label, apart from the date and name of the collector.

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

(ii) State where the students could find details that would enable them to identify their fossil samples, apart from the internet.

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

(iii) Fig. 1.1 shows a drawing that one of the students made to record the details of a fossil that he had found.

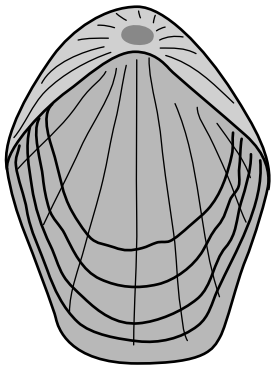

Fig. 1.1

State **two** important details that are missing, apart from the date and name of the collector.

1. .....

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

(c) The chalk deposits studied by the students, described in **(b)**, contained nodules of flint.

(i) State what is meant by the word *nodule*.

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

(ii) The students were asked to collect some flint samples for further study. They collected the samples from both heaps of loose chalk and from shallow pits.

State **two** health and safety considerations that their teachers should include in their risk assessment before this activity.

1. .....

.....

2. .....

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

(iii) The flint samples were taken back to the college.
What should be done to these samples before commencing tests on them?

.....

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

(iv) The students measured the mass and volume of each flint sample, Table 1.1. Each sample was immersed in 150 cm^3 of water in a measuring cylinder and the change to the volume was measured.

Table 1.1

sample	**A**	**B**	**C**	**D**	**E**
mass / g	105.0	127.5	140.1	156.0	175.0
volume / cm^3	40.0	46.0	53.0	59.0	66.0

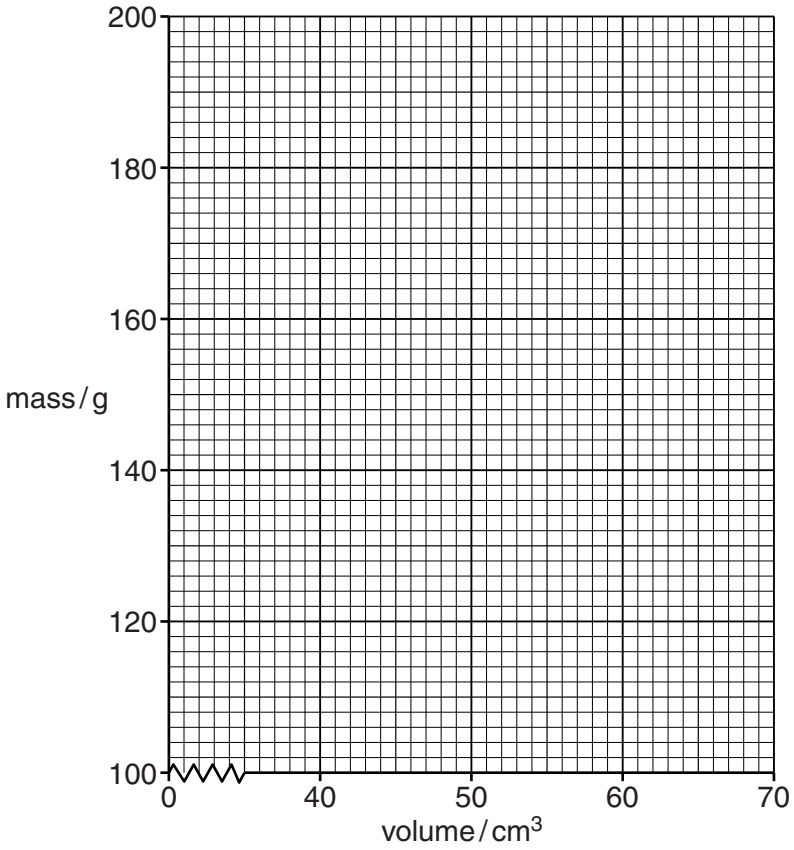

Fig. 1.2

1 Plot the values on the graph, Fig. 1.2, **omitting those for sample B**. **[1]**

2 Draw a straight line of best fit through the plots for samples **A**, **C**, **D** and **E**. **[1]**

3 Find the gradient of the straight line that you have drawn in **(iv)2**. Show how you worked out the gradient on your graph. This gradient is the density of flint.
Give your answer to two significant figures.

density of flint = …… unit = ... **[3]**

4 The volume reading for sample **B** was measured incorrectly, although its mass was correct. 150.0 cm^3 of water was placed in a measuring cylinder and sample **B** was immersed in the water.

Use the graph to calculate the volume that the measuring cylinder should now contain.

..... cm^3 **[2]**

(d) Some students researched suitable methods to analyse samples of flint for their silica content.

(i) State **three** factors that they should consider, apart from cost, in selecting a method for use in a college laboratory.

1. .....

2. .....

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

(ii) The students decided that the researched methods were not suitable for use in a college laboratory and instead, they sent the samples away for analysis.

They received the following result for one of the samples.

mass of flint taken = 6.465 g

mass of silica present = 6.401 g

Calculate the percentage of silica in this sample of flint, giving your answer to **four significant figures**.

% of silica = ... **[2]**

(e) On a visit to a Neolithic flint mine, students were asked to consider some of the problems that would need to be overcome when mining flint 5000 years ago.
A diagram of a typical flint mine pit is shown in the article, Fig. 1b.
Use this diagram to help you answer the following questions.

(i) Suggest a method by which mined flints could reach the top of the pit without the miners having to use the rope ladder. You can draw a diagram below in your answer.

.....

.....

.....

.....

.....

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

(ii) The gallery at the bottom of the pit from which flints were being dug would have had little light.
Suggest how Neolithic miners might have been able to make a simple 'lamp' using a hollowed out lump of chalk. You can draw a diagram below in your answer.

.....

.....

.....

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

(iii) Neolithic miners were at risk of galleries collapsing when they were digging out flints. Suggest a suitable method that these miners could have used to prevent such collapses.

.....

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

(f) The article describes the formation of volcanic ash when magma meets a glacier.

State what is meant by the term *magma*, as seen in the article.

.....

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

(g) Fig. 1.3 shows particles of volcanic ash viewed through a suitable microscope, at a magnification of ×500.

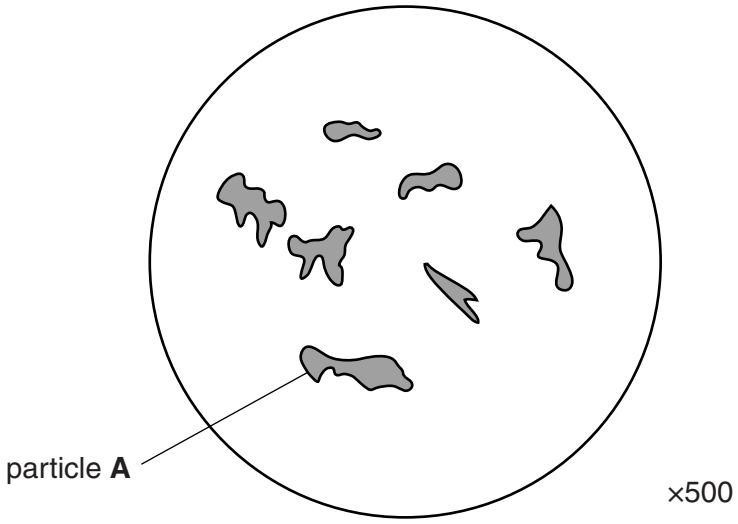

Fig. 1.3

(i) Calculate the actual maximum length of particle **A**.

maximum length = ... mm **[2]**

(ii) The average mass of the particles shown in Fig. 1.3 is 1.20×10^{-5} mg.
Scientists sampling the ash cloud decided that an ash concentration of 0.004 mg for each cubic metre of air (0.004 mg m^{-3}) was the maximum limit for planes to fly through the ash cloud safely.

Calculate how many ash particles of mass 1.20×10^{-5} mg would be present in each cubic metre of air at this maximum permissible concentration.

number of particles = ... **[2]**

(h) The plane that collected samples of volcanic ash also measured the concentration of sulfur dioxide present. Generally the denser the ash cloud, the more sulfur dioxide is present.
One method of measuring sulfur dioxide concentration is by using the infrared absorption spectrum of sulfur dioxide, Fig. 1.4.

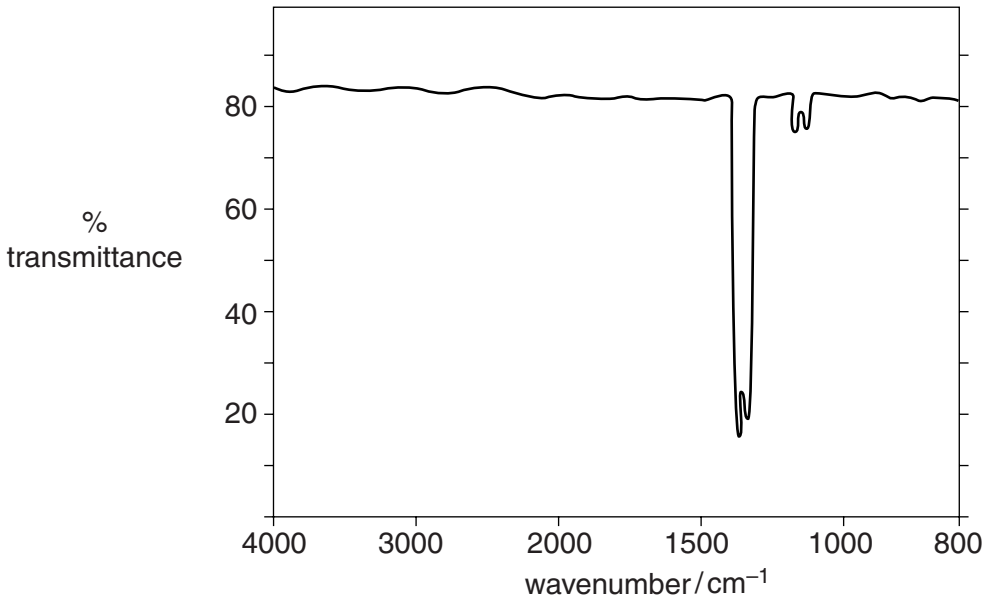

Fig. 1.4

Complete the sentences below.

(i) The 'peaks' at 1360 cm^{-1} and 1150 cm^{-1} are caused by the vibration of the

…….... . **[1]**

(ii) If the concentration of sulfur dioxide increases, the 'peaks' at 1360 cm^{-1} and 1150 cm^{-1}

…….... . **[1]**

[Total: 34]

This question is based on the article 'Salt – an essential commodity.'

2 **(a)** Fig. 2.1 shows part of a coastline with a river flowing into the Pacific Ocean. The source of the river is a freshwater spring some 20 km inland. Samples of water were collected at points **A**, **B**, **C**, **D** and **E**.

Use this diagram and Table 2a in the article to help you answer the following questions.

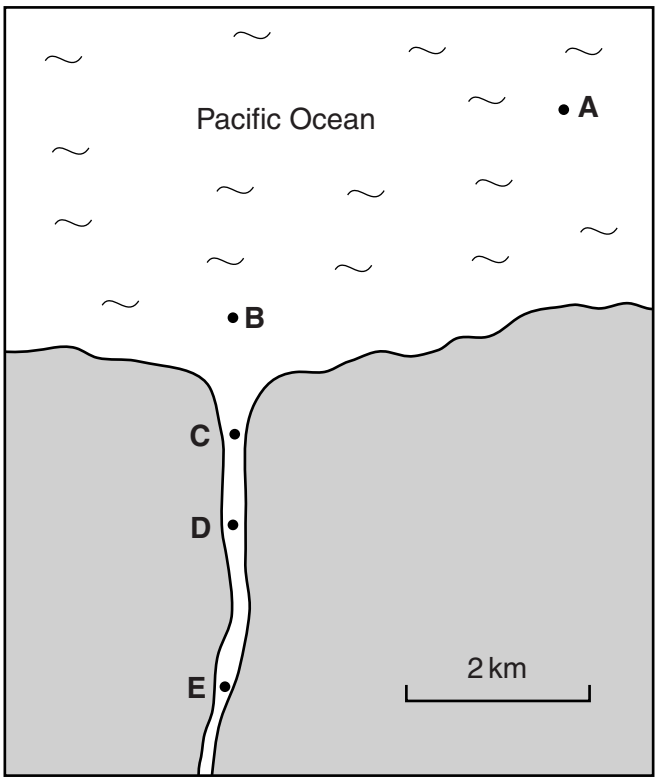

Fig. 2.1

(i) State the expected salinity value at point **A**.

..... $g\,kg^{-1}$ water **[1]**

(ii) State and explain how you would expect the salinity values to change from points **A** to **E**.

.....

.....

.....

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

(iii) The water samples were collected in jars that were then labelled and sealed.

State why it was also important to record details of these samples on paper or electronically.

.....

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

(iv) Unfortunately, one of the jars that contained a sample was opened and the lid was not replaced.

Explain how the salinity would be altered by the jar being left open for many days.

.....

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

(v) State what should be done about the result obtained from the sample described in **(a)(iv)**.

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

(vi) Suggest **two** reasons why the salinity of the sample from point **C** might vary if a further sample was taken from point **C** on a different day.

1. .....

.....

2. .....

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

(vii) There was a chance that the water samples could have been contaminated by chemical or biological toxins.

State **two** precautions that technicians should observe when handling these samples.

1. .....

.....

2. .....

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

(viii) One method of finding the salinity is to take a known mass of the solution, evaporate it to dryness and then find the mass of the residue.
The following results were obtained using seawater from the English Channel.

mass of dish + seawater	=	247.47 g
mass of dish	=	106.36 g
mass of dish + solid residue	=	110.47 g

Use these results to calculate the mass of solid residue formed and then to find the salinity of this seawater sample in $g\,kg^{-1}$ water.
You should remember that the mass of the seawater contains both water itself and the mass of the solid residue.

salinity of seawater sample = ... $g\,kg^{-1}$ water **[4]**

(ix) The equipment used in **(viii)** was cleaned before it was to be used again for another sample.
State why this process was necessary.

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

(x) Use your results from **(a)(viii)** and Table 2a from the article to estimate the density of the seawater in the English Channel.

density of seawater sample = ... $g\,cm^{-3}$ **[1]**

(xi) Unfortunately, the dish used in **(a)(viii)** was broken when the test was repeated and a smaller dish that held less seawater had to be used.
Explain why this change should not affect the salinity value obtained.

.....

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

(xii) This method of finding the salinity of seawater by evaporation is time consuming.

Use Table 2a in the article to devise another method that would be quicker but still accurate.

.....

.....

.....

.....

.....

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

(b) A geologist is looking for new salt deposits.

Use Fig. 2a in the article to explain why it is necessary to drill a number of boreholes some distances away from each other and at varying depths as part of his sampling procedure.

.....

.....

.....

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

(c) Suggest why samples of rock salt are not found on the surface of the Earth.

.....

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

(d) Rock salt crystals are largely sodium chloride but are contaminated with a small amount of an insoluble brown solid.

You are given samples of rock salt crystals that are about 2 cm across.

Devise a detailed method to obtain a pure solution of sodium chloride that contains **all** the sodium chloride present in these rock salt samples.

You should assume that normal laboratory apparatus is available for you to use.

Mention of the apparatus that you are to use should form part of your answer.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

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

(e) The experiment described in **(d)** was repeated several times and the solutions were then used to find the percentage of sodium chloride in the rock salt. The results obtained varied between 91.1% and 95.3%.
Suggest **two** reasons, apart from errors in the practical work, why these test results varied.

1. .....

.....

2. .....

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

(f) Table 2b in the article gives details about three methods for the manufacture of sodium hydroxide solution by the electrolysis of brine.

(i) State what is meant by the term *electrolysis*, seen in the article.

.....

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

(ii) State **one** advantage and **one** disadvantage of the mercury cell compared to the diaphragm and membrane cells.

advantage .....

.....

disadvantage .....

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

(iii) New plants use the membrane cell, rather than the diaphragm cell and the older technology mercury cell.
If you were recommending a plant that would use membrane cells, state **two** advantages of this method compared to the use of diaphragm cells.

1. .....

.....

2. .....

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

(g) The percentage of sodium chloride in a sample of brine can be found by titration with silver nitrate solution.
In an experiment 20.0 cm^3 of the brine was diluted 100 times with water, to give a volume of 2000 cm^3.
50.0 cm^3 of this diluted brine was found to contain 0.13 g of sodium chloride.

Use these figures to answer the following.

(i) Find the mass of sodium chloride in 2000 cm^3 of the diluted brine.

mass of sodium chloride in 2000 cm^3 = ... g **[1]**

(ii) State the mass of sodium chloride in 20.0 cm^3 of the undiluted brine.

mass of sodium chloride in 20.0 cm^3 = ... g **[1]**

(iii) Find the percentage of sodium chloride in the undiluted brine, as grams of sodium chloride dissolved in 100 cm^3 of the undiluted brine.

percentage of sodium chloride = ... % **[1]**

[Total: 39]

3 **(a)** You are a food chemist and a supplier sends you a sample of a red compound, which has been found in some imported food colouring. He believes that it is the banned substance Rhodamine B.

(i) A mass spectrum is taken of this compound and a molecular ion is seen at *m*/*e* 479. State what this information tells you about this compound.

.....

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

(ii) The mass spectrum of the compound also produces a fragmentation pattern. State how this can be used to confirm that the compound is Rhodamine B.

.....

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

(iii) Fig. 3.1 shows a thin layer chromatogram of Rhodamine B.

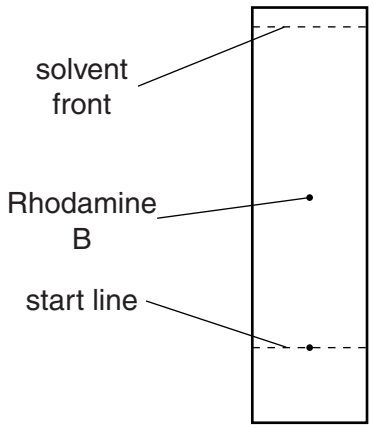

Fig. 3.1

The R_f value is calculated from the formula

$$R_f = \frac{\text{distance travelled by Rhodamine B}}{\text{distance travelled by the solvent front.}}$$

Calculate the R_f value for Rhodamine B.

R_f value = ... **[1]**

(b) Many people doubt the safety of synthetic colouring agents used in food. The current trend is to use more naturally-occurring colours. One of these is annatto, which is obtained from the seed pods of the achiote tree, *Bixa orellana*.

(i) A flow chart showing brief details of the extraction of the oil soluble form of annatto is shown below, Fig. 3.2.

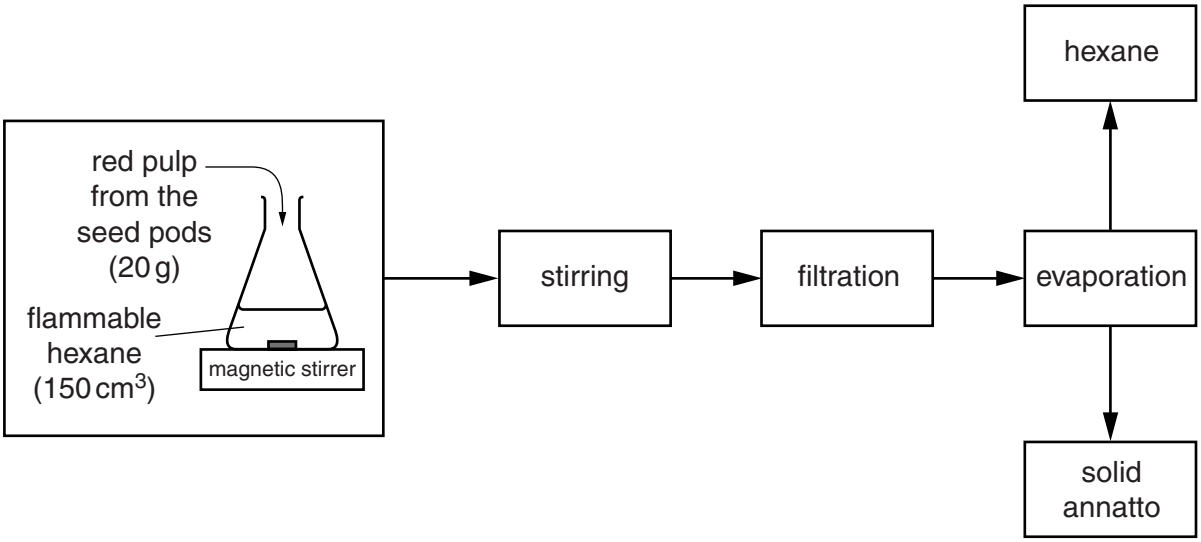

Fig. 3.2

Use the information given in the flow chart to devise a method for the preparation of solid annatto from 20 g of the red pulp from the crushed seed pods.

Your method should be shown as a series of bullet points. It should give full experimental details, including the apparatus used (with the size) and any Health and Safety requirements. You should assume that personal protective equipment is being worn and a risk assessment has been completed.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

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

(ii) The red pulp from the seed pods contains 5% of coloured materials of which 75% is annatto.

Calculate the maximum mass of annatto that should be made from the 20 g of red pulp used in **(i)**.

..... g **[2]**

(iii) In practice all of the annatto is **not** extracted from the seed pulp by the method described in **(i)**.
State **two** ways in which the method given could be modified to increase the amount of annatto extracted, without increasing the quantities used.

1. .....

.....

2. .....

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

(iv) In **(i)** the extraction of annatto was described on a small laboratory scale.
If this process is to be carried out on a larger scale, outline how the

mixture could be stirred .....

.....

mixture could then be filtered .....

.....

apparatus could be modified so that the hexane solvent was recovered for use again.

.....

.....

.....

.....

..... **[4]**

[Total: 17]

END OF QUESTION PAPER

ADDITIONAL PAGE

If additional space is required, you should use the lined page below. The question number(s) must be clearly shown.