OCR
RECOGNISING ACHIEVEMENT

ADVANCED GCE

APPLIED SCIENCE

Sampling, Testing and Processing

G628

Candidates answer on the Question Paper

OCR Supplied Materials:
- Insert (inserted)

Other Materials Required:
- Electronic calculator
- Ruler (cm/mm)

Monday 18 January 2010
Afternoon

Duration: 1 hour 30 minutes

OCE/17071

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, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- Candidates may not bring the Pre-released 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 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.

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 'Coffee – a stimulating plant'.

1 **(a)** Coffee growers need to sample their crop before harvesting the berries.

(i) Why is it important to collect berries from a number of plants when sampling?

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

(ii) State **three** factors that need to be kept constant when selecting berries for sampling.

1. .....

2. .....

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

(iii) When the grower selects berries for sampling he rejects berries that are diseased.
Why is this done?

.....

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

(iv) A number of samples from different shrubs are collected, the beans extracted, washed and dried and then put into jars.
What should be written on the label of each of these jars?

1. .....

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

(v) If the samples cannot be tested for several days what must the grower ensure?

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

(vi) When the beans of a particular variety are to be tested they are ground up and made into a drink**.**
Why is it important that the coffee granules are of equal size when comparing the drinks?

.....

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

(vii) Why is it important that the same person tastes the drinks made from different ground coffee beans?

.....

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

(b) An experiment is conducted to investigate the effect of organic fertiliser on coffee plant growth.
The plot of ground used for this experiment is 0.1 hectare in area (1000 m^2) and contains 200 coffee shrubs. Each shrub is separate from the next one and has its own growing area.

(i) Using the figures given, what is the area of ground allowed for each shrub?

area = ...m^2 **[1]**

(ii) The experiment is considering the effect of using different concentrations of fertiliser solution on the plants.
State **two** factors that need to be kept constant when using the fertiliser.

1. .....

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

(iii) Some plants just receive water and not fertiliser solution.
State why these plants receive no fertiliser.

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

(iv) State **two** factors that you would measure to obtain results so that comparisons can be made.

1. .....

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

(c) The coffee shrub is susceptible to attack by the coffee berry borer (CBB).

(i) In tests, the pesticide endosulfan has been shown to be effective at reducing CBB attack.
Use the article to state **two** risks that arise from its use.

1. .....

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

(ii) The recommended concentration when spraying coffee shrubs with endosulfan is 0.2 g of endosulfan in 1.0×10^6 g of water.
Calculate the mass of endosulfan required for each kilogram of water.

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

(d) The article states that traps to catch the CBB are proving effective.
Draw and label a trap using the information below.

- it contains a liquid that attracts the CBB
- it should be difficult for the CBB to escape once it has been caught
- the CBB is about 2.5 mm in length

[3]

(e) Tests with the *Beauveria* fungus show that it is able to kill CBBs.
State **two** advantages of this method of CBB control compared to the use of endosulfan.

1. .....

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

(f) Some students decided to find the percentage of caffeine in a sample of coffee beans.

(i) They ground the beans using a pestle and mortar.
What should they do with the apparatus before using it?

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

(ii) The method they chose used dichloromethane.
As they had not used this solvent before, what should they have done before they used it?

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

(iii) At the end of the method the students were left with a solution of caffeine in dichloromethane.
This flammable toxic solvent boils at 40°C.
Suggest a safe way of removing this solvent to leave behind solid caffeine.
You may use a labelled drawing if you wish.

.....

.....

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

(iv) The students obtained the following results but forgot to record the mass of caffeine obtained.
Use the figures to calculate the mass of caffeine that they obtained.

mass of ground coffee taken = 16.48 g

percentage of caffeine = 1.50%

mass of caffeine = ... g **[1]**

(v) A student said, "If a lot less ground coffee had been used in this experiment the percentage of caffeine obtained would not have been so accurate".
Was she correct? Justify your answer.

.....

.....

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

(vi) The caffeine obtained in this experiment was found to contain impurities.

Suggest **two** ways in which the extraction method could be modified to obtain pure caffeine.

1. .....

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

(vii) Chromatography was used to separate the impurities so that they could be identified using other techniques.
Each compound present in the impure caffeine gave a peak in the chromatogram. The area of the peaks was measured.
What can be found using these areas?

.....

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

(viii) Mass spectrometry can be used to help identify the impurities present in the caffeine.
State what the molecular ion value (m/e) will tell you about a particular impurity.

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

(g) State the meaning of the term *diuretic*, which is found in the article.

.....

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

[Total: 37]

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This question is based on the article 'Some aspects of atmospheric pollution'.

2 **(a)** In 1980 the volcano Mount St. Helens erupted forming a huge ash cloud that had serious environmental consequences.
A group of American students studied the ash produced.

(i) They measured the diameter of some ash particles that were collected at a distance of 60 km from the volcano.
Their results are shown in Table 2.1.

Table 2.1

diameter of ash particle / mm	4.80	5.10	5.20	4.90	5.50

Calculate the mean diameter of the particles.

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

(ii) Table 2.2 shows the mean diameter of the ash particles at various distances from the volcano.

Table 2.2

distance / km	mean diameter / mm
100	0.400
200	0.080
300	0.040
500	0.045
650	0.035

Plot a graph of these results using Fig. 2.1, and draw a curve of best fit through the results. **[2]**

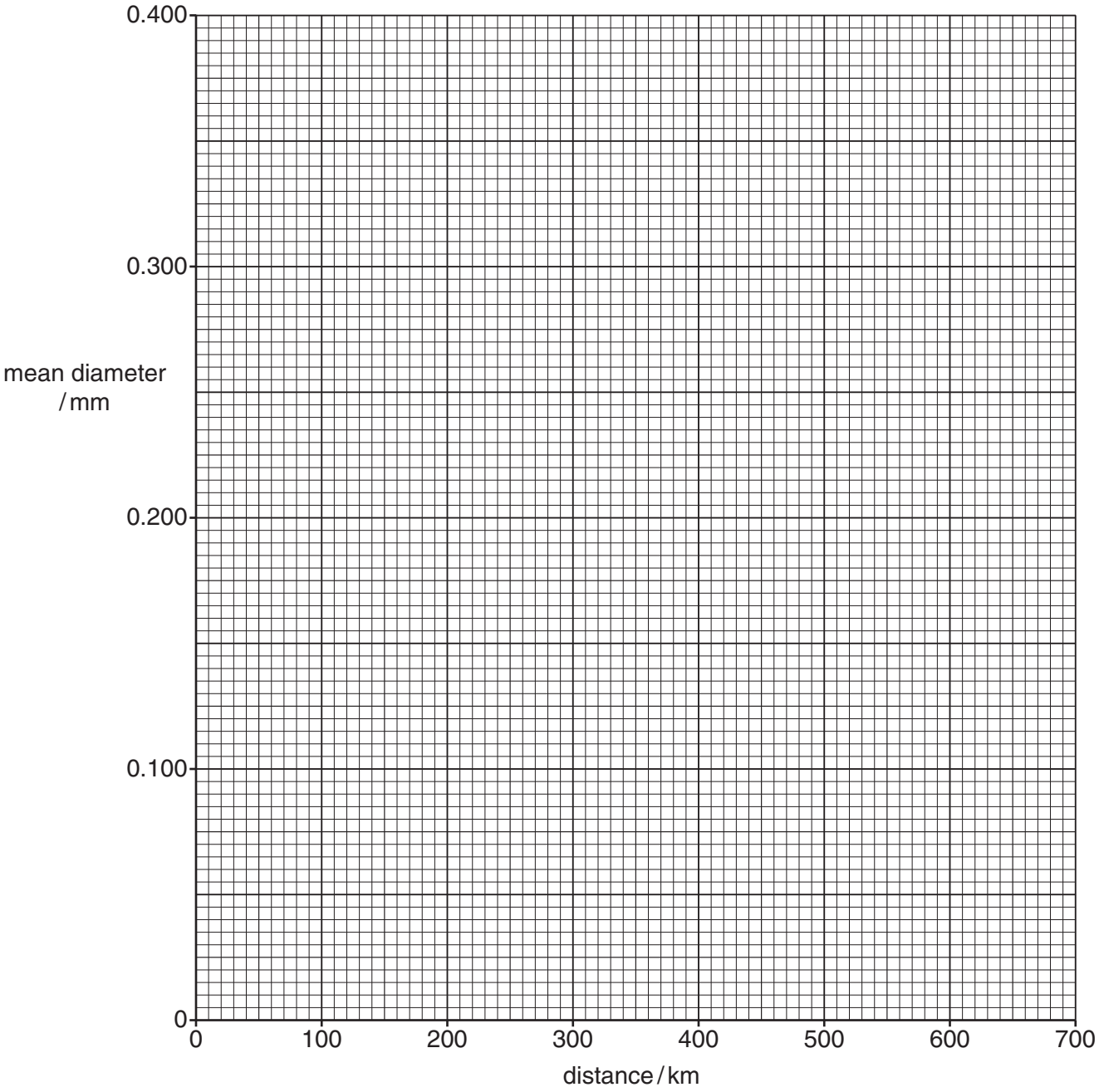

Fig. 2.1

(iii) Use your graph from **(ii)** to make **two** conclusions about how the diameter of the ash particles vary with the distance from the volcano.

1. .....

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

(iv) The students analysed the ash.
They found that it consisted of 65% silica, 18% aluminium oxide and 5% iron(III) oxide.
The remainder consisted of other minerals.
Calculate the percentage of other minerals in the ash.

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

(v) The students found that the ash contained a small percentage of soluble material.
They added 1 kg of the ash to water and discovered that 0.002 g dissolved.
Calculate the percentage of soluble material in the ash.

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

(b) The graph, Fig. 2.2, was obtained by students concerned about atmospheric pollution.
It shows the concentration of various compounds in the air during the day in a city susceptible to photochemical smog.

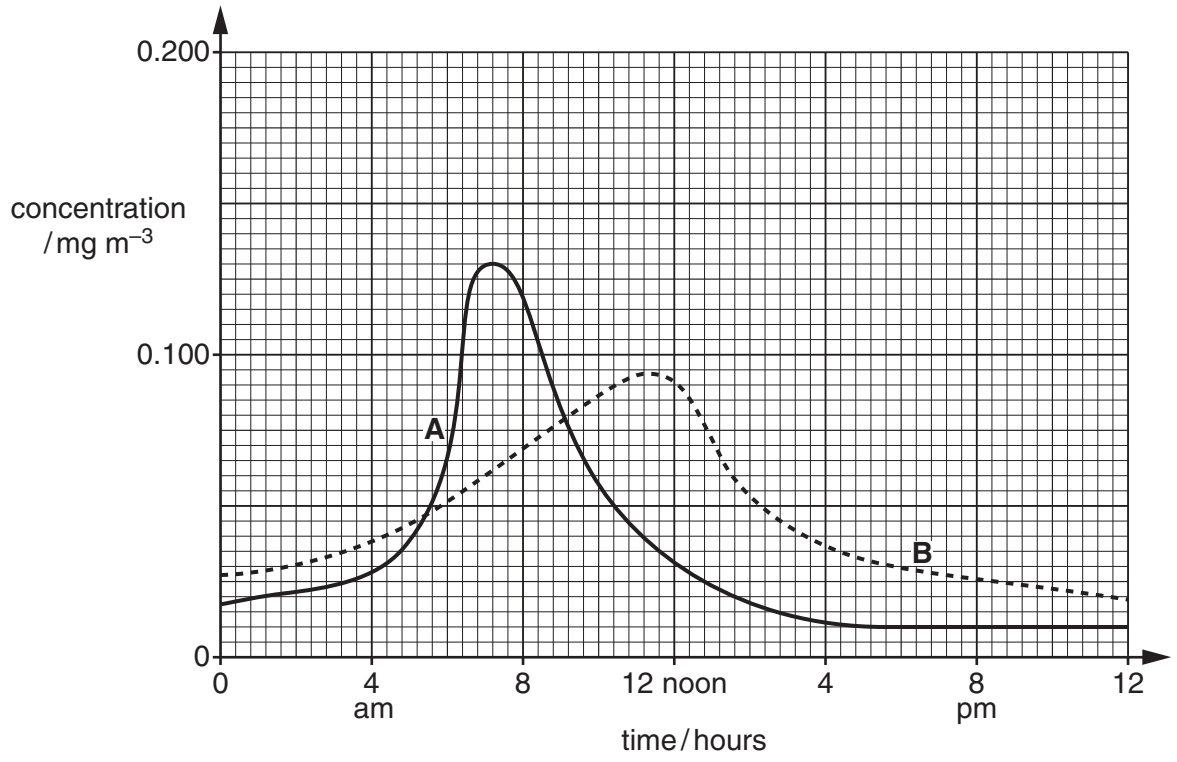

Fig. 2.2

Curve **A** shows the variation in the concentration of vehicle exhaust gases and curve **B** shows how the concentration of the components of photochemical smog varied during the day.

(i) Give **two** conclusions about the pattern of vehicle usage during the day.

1. .....

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

(ii) Suggest why the photochemical smog is most concentrated around noon.

.....

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

(c) (i) Draw and label a piece of equipment to collect solid particles from the atmosphere. Your design should show

- a filter paper to collect the particles
- a pump
- a way to stop rain getting in or for solid particles to simply fall in from above.

[3]

(ii) These results were obtained from a sampler that was collecting PM10 particles.

final mass of filter paper	=	4.6318 g
initial mass of filter paper	=	4.4590 g
sampling period	=	1440 min
flow rate	=	2.0 m^3 min^{-1}

Calculate the PM10 concentration in $\mu g\ m^{-3}$ using the formula below.

$$\text{PM10 concentration} = \frac{[\text{final mass of filter paper} - \text{initial mass of filter paper}] \times 10^6}{\text{flow rate} \times \text{sampling period}}$$

..... $\mu g\ m^{-3}$ **[2]**

(d) This question refers to a typical traditional absorption 'train' as shown in the article.

(i) State the function of the

1 flowmeter .....

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

2 silica gel in the U-tube .....

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

(ii) State why the collecting funnel needs to point downwards.

.....

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

(iii) In an experiment, 0.20 m^3 of air was passed through the solution in the Drechsel bottle and the resulting mixture analysed by ion chromatography.
The volume of the liquid in the Drechsel bottle was 200 cm^3 .
A 10 cm^3 sample of this liquid was found to have absorbed 48 μg of sulfur dioxide.

Calculate the total mass of sulfur dioxide absorbed into the liquid in the Drechsel bottle.

mass of sulfur dioxide = ... μg **[1]**

(iv) Your answer to **(iii)** gives the amount of sulfur dioxide in 0.20 m^3 of air.
Calculate the concentration of the sulfur dioxide in μg m^{-3}.

concentration of sulfur dioxide = ... μg m^{-3} **[1]**

(e) Some students visited a coal-burning power station. At this power station the flue gases are treated to remove sulfur dioxide that is produced from sulfur present in the coal.

Tests show that

- everyday 19 500 tonnes of coal are burnt
- everyday 450 tonnes of sulfur dioxide are removed
- 90% of the sulfur dioxide produced is removed.

(i) Calculate the total mass of sulfur dioxide **produced** every day.

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

(ii) The students were told that in the coal used every day there are 240 tonnes of sulfur.
Calculate the percentage of sulfur in the coal.

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

(f) Flue gases, containing sulfur dioxide, are passed through a suspension of powdered calcium carbonate.
Gypsum (a form of calcium sulfate) is made by this reaction.

The students were asked to try out this process on a small scale in the laboratory.
They used the equipment shown in Fig. 2.3, having carried out a risk assessment.

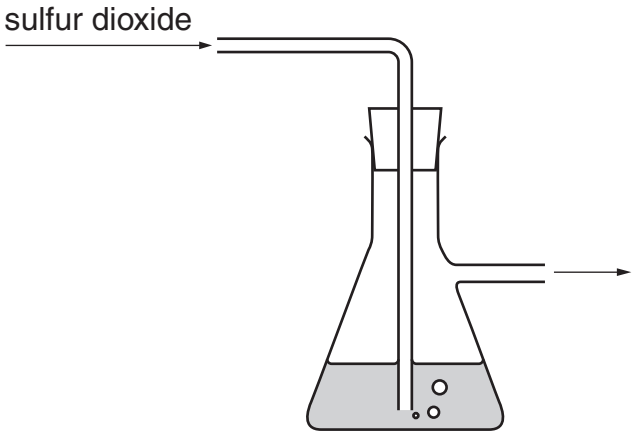

Fig. 2.3

(i) They were advised to carry out this experiment in a fume cupboard.
Use the article to state why they were given this advice.

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

(ii) They passed sulfur dioxide through the suspension until all the white solid had disappeared, leaving a clear solution.
They then passed air through the solution instead of sulfur dioxide.
Gypsum was produced as a white insoluble solid which starts to decompose at 120°C.

Describe how they would then obtain pure dry gypsum.

1. .....

2. .....

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

(iii) On heating to 200°C pure gypsum loses around 21% of its mass.
A range of 20.9 ± 0.5% is acceptable for the gypsum to be described as pure.

To check the purity of their gypsum the students heated a sample to 200°C and obtained the following results.

mass of crucible	=	15.142 g
mass of crucible + gypsum before heating	=	21.865 g
mass of crucible + contents after heating	=	20.487 g

Use the results to calculate the percentage loss in mass on heating and comment on the purity of the students' product.

.....

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

(iv) Explain why it is often better to heat the solid for a second time and weigh again.

.....

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

[Total: 32]

3 Joanne was working on alloys as part of her portfolio work.
She discovered that alloys have been used for hundreds of years and that early metal-workers had soon realised that 'mixing' metals to form an alloy sometimes produced a material that had different properties from the metals it contained.
This question is based on her report about alloys.

(a) I found that one of the earliest alloys was bronze. It is still used today as one of the medals for the Olympic games.
Bronze is made from copper and tin, together with small amounts of other metals.

(i) A sample of bronze contains 88% by mass of copper, 10% of tin and some zinc.
If a sample of bronze weighs 60 g what mass of copper is present?

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

(ii) My teacher gave me an odd shaped piece of bronze and asked me to find its density.
I was told that density is measured in g cm^{-3}.

Design an experiment to find the density of Joanne's piece of bronze, which was no larger than 2.0 cm across.

.....

.....

.....

.....

.....

.....

.....

..... **[7]**

(b) Another common alloy is brass. This contains copper and zinc.
I found the density of the brass by using the densities of copper and zinc to draw a graph.
I have shown this in Fig. 3.1.

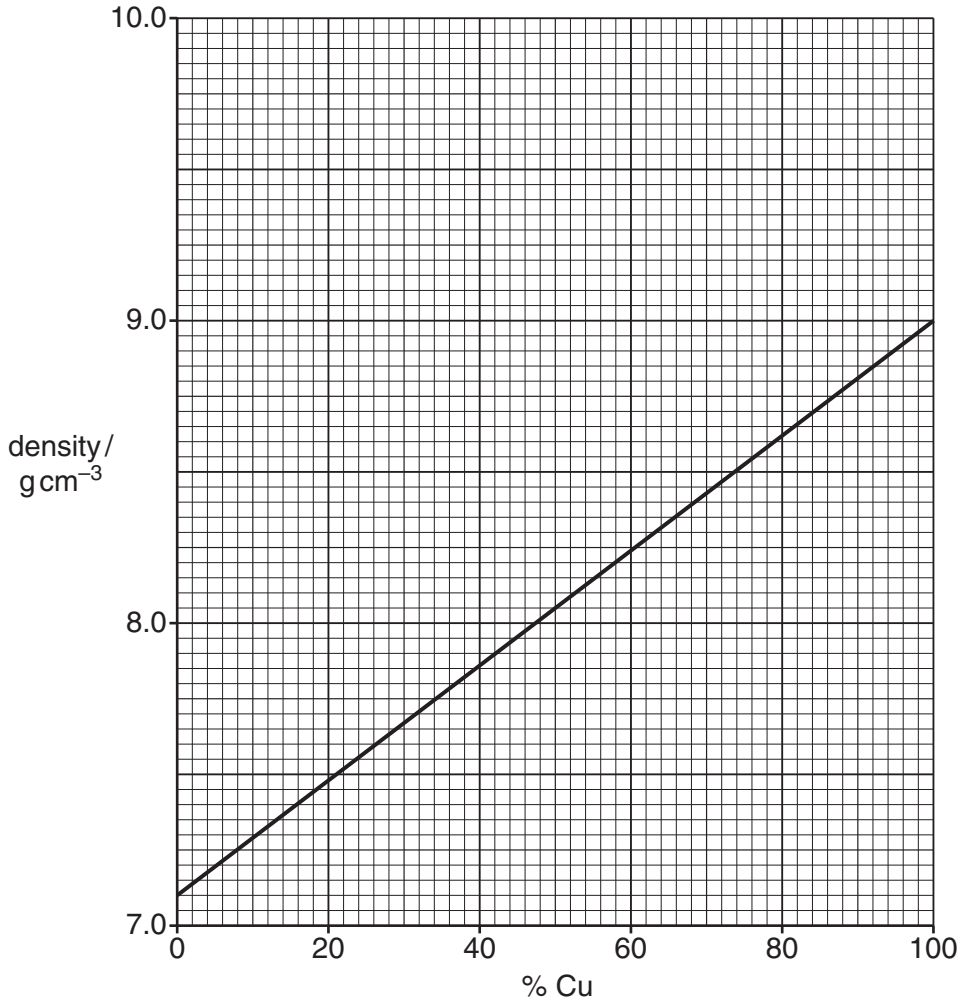

Fig. 3.1

(i) The density of Joanne's brass sample was 8.6 g cm^{-3}.
Use the graph to find the percentage of copper in the brass.

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

(ii) What is the assumption that Joanne made in drawing her graph?

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

(iii) I was asked to analyse a sample of brass. There seemed to be several different ways to find out what it contained. I could either find out how much copper was present or how much zinc was present.

State **three** factors that Joanne should consider when choosing a suitable method.

1. .....

2. .....

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

(iv) I chose to analyse my brass by reacting it with nitric acid and then measuring the amount of copper present in the solution by colorimetry.
I used nitric acid of a concentration of 2 mol dm^{-3} but the brass reacted very slowly.

Suggest **two** ways to get the brass to react more quickly.

1. .....

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

(v) When I used colorimetry to measure the amount of copper in my sample of brass I had to prepare a calibration graph. One of the points was not on a straight line.

What should Joanne do about this ?

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

(vi) My sample of brass had a mass of 3.48 g and my calculations showed that it contained 2.78 g of copper. It contained only zinc and copper.

What is the percentage of zinc in Joanne's brass?

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

(c) Another alloy that I used was monel. I found out that this contained 67% of nickel and 28% of copper. I researched its uses and found that it is very corrosion resistant and it is used in steam locomotives and in ships.
I researched books and the Internet to find out how it corroded when compared to other alloys such as steel and brass.

State **three** factors that should be kept constant when carrying out tests to compare how these alloys are affected by salt water.

1. .....

2. .....

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

[Total: 21]

END OF QUESTION PAPER

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