OCR

Monday 9 June 2014 – Afternoon

A2 GCE APPLIED SCIENCE

G628/01 Sampling, Testing and Processing

Candidates answer on the Question Paper.

OCR supplied materials:
- Insert (G628/01 – inserted)

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

Duration: 1 hour 30 minutes

* G 6 2 8 0 1 *

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- The Insert will be found inside 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.

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 'Rubber'.

1 (a) (i) Rubber trees are susceptible to a number of fungal diseases. Countries in South-East Asia enforce strict quarantine measures.

State the meaning of the term *quarantine* as used in the article.

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

(ii) Tests have shown that there are disadvantages in using a contact fungicide to control fungal diseases compared with using a systemic fungicide.

State **two** of these disadvantages.

1 .....

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2 .....

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[2]

(iii) Rubber plantation workers spray rubber trees with a toxic solution of the fungicide copper arsenate.

Suggest **two** precautions that these workers should take.

1 .....

2 .....

[2]

(b) Rubber plantation owners are concerned mainly with the production of latex for rubber but there is increasing interest in the products obtained from the seeds of the rubber tree.

Table 1a in the article lists the fatty acids that can be produced from rubber seed oil.

(i) State a technique that can be used in the laboratory to separate samples of each fatty acid from rubber seed oil.

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

(ii) The relative percentage of each fatty acid produced from the rubber seed oil has been shown in a table format (Table 1a).

Suggest a different way in which the data could be presented.

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

(iii) A plantation owner said that rubber seed oil produces mainly polyunsaturated acids.

Justify this statement.

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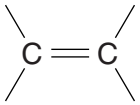
..... **[1]**

(iv) Unsaturated acids differ from saturated acids because they have one or more carbon–carbon double bonds.



The presence of these bonds can be identified by testing samples of the acids with aqueous bromine but this test needs comparatively large samples.

State an instrumental technique that shows the presence of these bonds in a small sample of unsaturated acid.

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

(c) On a visit to a rubber plantation, some students were told that there were 400 rubber trees in every hectare (100 m × 100 m). They noticed that the trees were planted evenly throughout the plantation with 20 trees in each row.

Suggest how far apart the trees were.

distance = ... m **[1]**

(d) A rubber tree produces 48 cm^3 of latex when it is tapped.

Use the article to calculate the number of rubber particles in 48 cm^3 of latex.
Give your answer to 1 significant figure.

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

(e) On standing in air, liquid latex coagulates to produce natural rubber.

(i) State the meaning of the term *coagulate*.

.....

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

(ii) In the rubber factory, the liquid latex is often coagulated by adding acetic acid.
Acids are providers of hydrogen ions (H^+).

Using information from the article, explain how the addition of acetic acid is able to coagulate the latex.

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

(f) Rubber bands are usually manufactured from natural rubber. Their sizes are based on their dimensions – length (circumference), width and thickness.

(i) A rubber band is measured and is found to have the following dimensions.

length = 18 cm width = 0.64 cm thickness = 0.08 cm

Calculate the **volume** of this rubber band.

volume = ... cm^3 **[1]**

(ii) A book states that the density of natural rubber is 1.1 g cm^{-3}.

Calculate the **mass** of the rubber band measured in **(f)(i)**.

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

(iii) A student was told to attach different masses to a rubber band to find the **extensions** that occurred. The student was not given any further experimental details.

Design an experiment to measure the extension of a rubber band as different masses are added. In your answer you should state:

- the equipment used
- how you would obtain your results
- how you would present your results.

You are advised to use a suitably labelled diagram as part of your answer.

You should assume that a risk assessment has already been carried out.

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..... **[5]**

(g) Some other students were asked to use the apparatus shown in Fig. 1.1 to find the coefficient of static friction, μ, between the rubber block and the bench.

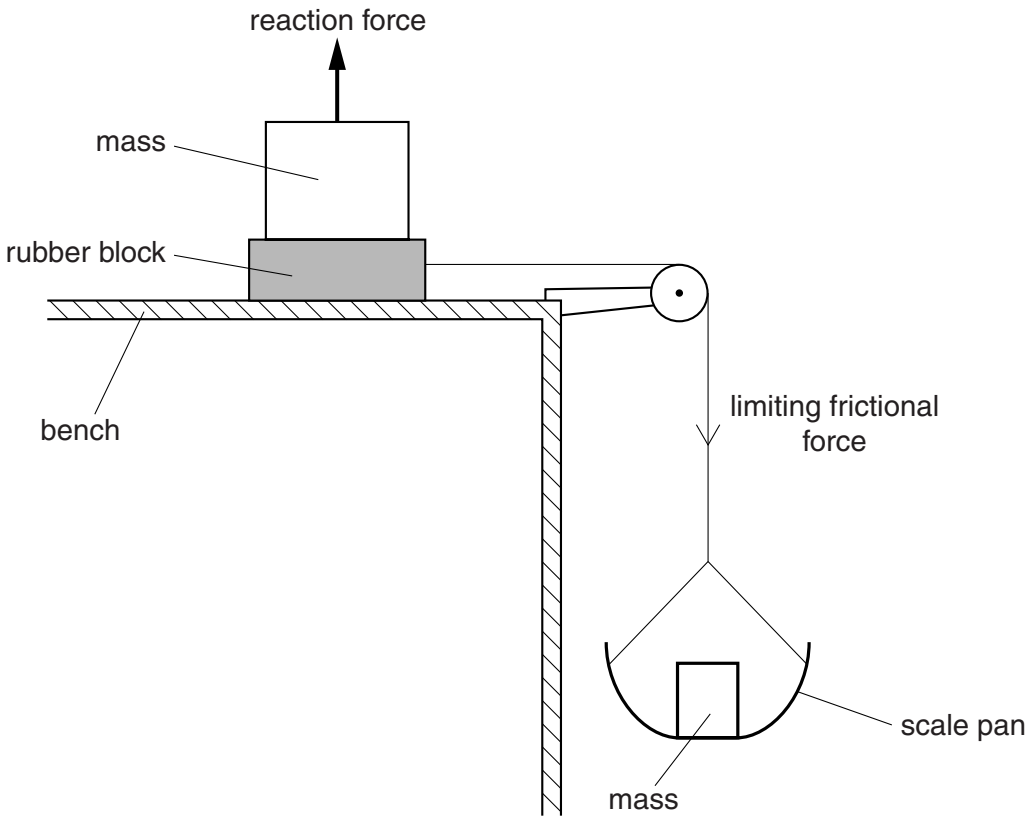

Fig. 1.1

The students added masses to the block of rubber to vary the reaction force.

They then added masses to the scale pan until the rubber block just moved. The limiting frictional force is given by the weight of the masses in the pan.

Assume that the masses of the rubber block and scale pan are negligible.

Table 1.1 shows the results.

Experiment	Reaction force/N	Limiting frictional force/N
A	2.0	4.0
B	2.8	5.5
C	3.6	7.3
D	4.2	9.6
E	5.0	10.2

Table 1.1

(i) Plot the values on the grid (Fig. 1.2).

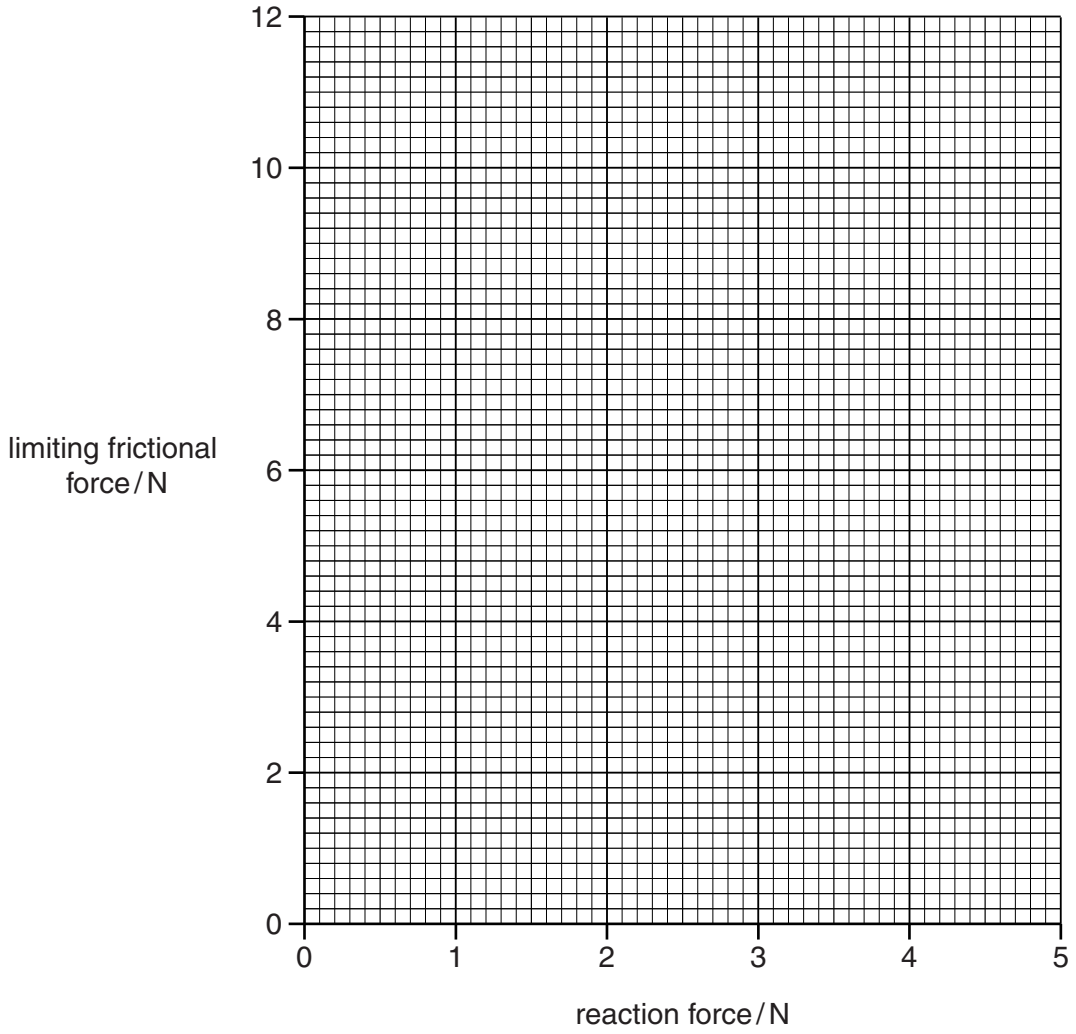

Fig. 1.2

[1]

(ii) Draw a straight line of best fit for the experiments **A** to **E** but do **not** include **D**. **[1]**

(iii) Find the gradient of your graph. This is the coefficient of static friction, μ.

μ = ... **[2]**

(iv) The result for experiment **D** does **not** fit the general pattern of the other results.

State what should be done about experiment **D** and its result.

.....

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

(h) Table 1b in the article lists some of the properties of natural and synthetic rubbers.

A manufacturer asks you to recommend the type of rubber to use for each of the following purposes.

For each purpose you should state and explain your choice of rubber.

(i) On a flat roof extension to a house.

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

(ii) Holding bundles of leaflets together when delivering them to houses.

.....

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

(iii) As a replacement for a cork in a bottle containing a dilute acid.

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

(i) Vehicle brake systems use rubber seals in their cylinders to prevent the loss of brake fluid.

Suggest **two** properties of the rubber used in the seals in vehicle brake systems.

1 .....

2 .....

[2]

(j) Recent research has shown that many plants, including dandelions, produce latex. Dandelion plants, which grow naturally, might provide a source of latex in countries with cooler climates.

Table 1.2 compares two sources of latex.

Dandelion plants	Natural rubber trees
Latex less likely to cause an allergic reaction	Latex can cause an allergic reaction
The plant is less susceptible to disease	Trees very susceptible to fungal attack
Latex polymerises rapidly	Latex polymerises slowly
A by-product from dandelions is an artificial sweetener	Seeds can be used to produce biodiesel

Table 1.2

(i) If you were a research botanist, suggest an important area of research that would help the natural rubber industry in South-East Asia.

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

(ii) Further research is needed before dandelion latex can be used for a range of purposes on a large scale.

Using the information in Table 1.2, suggest **one** area of research that would be necessary.

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

(iii) Problems could arise when collecting dandelions for the production of latex on a commercial scale.

Suggest one problem that may arise and suggest a solution to this problem.

problem .....

.....

solution .....

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[2]

[Total: 37]

This question is based on the article 'Wool'.

2 **(a)** Some students were starting a project about wool and its uses. They visited a warehouse where several types of fleece were stored before being sold to textile manufacturers.

(i) Their guide asked them why they were collecting small samples of different types of wool.

Suggest a reply, apart from merely stating 'studying wool and its uses'.

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

(ii) Use the article to state why wool samples are **not** homogeneous.

.....

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

(iii) One of the students asked how long ago the different fleeces had been obtained.

Why do you think he asked this?

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

(iv) The students also asked what had been done to the wool fleeces to make them ready for sale.

They were told that the fleeces had all been rinsed with cold water. This had removed dirt and a valuable, soluble, potassium compound. The water that had removed these materials was then filtered to remove the dirt. The dirt itself was then rinsed with a little more cold water and this water was added to the original washing water.

Suggest why this 'extra' rinsing was done.

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

(b) The students took their wool samples back to the laboratory for testing.

Their first task was to remove the lanolin from the wool by washing the wool in warm water containing detergent. The lanolin was then separated from the liquid product by using a centrifuge.

(i) Describe how a centrifuge works to separate the lanolin from the liquid present. **[3]**

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(ii) The lanolin sample obtained from the centrifuge was a pale yellow waxy solid.
The melting point of the lanolin was believed to be about 38 °C. A commercial melting point apparatus was not available.

Devise a simple experiment that can be used to find the melting point of the lanolin sample.
You can assume that a risk assessment is in place for this experiment.
It is **not** advisable to heat the lanolin directly as it is flammable.
You are advised to use a labelled diagram in your answer.

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

(c) A student had read that lanolin can contain traces of pesticides. It was decided that the lanolin sample should be sent for analysis for the presence of pesticides before the students used it further. The analysts reported that the lanolin contained traces of an organophosphorus pesticide, compound **A**.

(i) State how mass spectrometry could be used to confirm that compound **A** was present.

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.....

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

(ii) Further research found that the pesticide limit for compound **A** in purified lanolin used for skin creams was 1 part per million (ppm), or 1 mg kg^{-1}.

The analysts' report gave the following information (Table 2.1).

Mass of lanolin / g	Mass of compound A / mg
5.2	2.8×10^{-3}

Table 2.1

1 Calculate the concentration of compound **A** in the lanolin sample in mg kg^{-1}.

concentration = ... mg kg^{-1} **[2]**

2 In the method used by the analysts, the detectable limit of compound **A** was 1.0×10^{-3} mg.

Use this information and the data in Table 2.1 to calculate the minimum sample size that will give a detectable amount of compound **A**. Give your answer in **grams**.

minimum sample size = ... g **[2]**

(d) The students tested their lanolin on a volunteer. They found that if they used a lanolin 'concentration' of 2 mg per cm^2 of skin, the roughness of the skin was reduced to 50% after 2 hours, then the effect slowly declined. After 10 hours, the roughness was the same as at the start.

(i) Calculate the mass of lanolin used for a test area of skin 10 cm × 8 cm.

mass = ... mg **[1]**

(ii) Sketch the results outlined in the information above on the grid (Fig. 2.1).

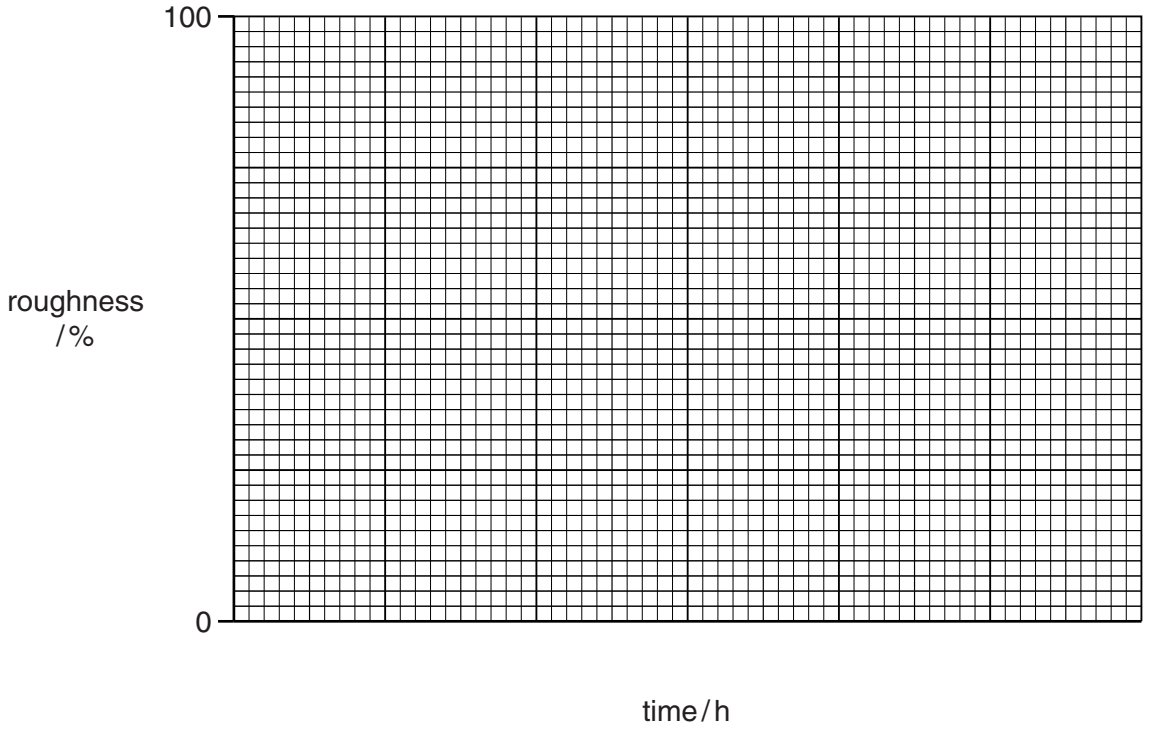

Fig. 2.1

[2]

(e) The students examined the fibres in their wool samples under a microscope. When a fibre was magnified 50 times it appeared to have a diameter of 2.0 mm.

Calculate the actual diameter of the fibre in **metres**.

diameter = ... m **[2]**

(f) The article describes two quantitative methods for analysing wool-cotton textile mixtures.

(i) Suggest **three** factors, apart from health and safety considerations, that should be considered when selecting which of these methods to use.

1 .....

2 .....

3 .....

[3]

(ii) The method of treating a wool-cotton textile with sulfuric acid was used by some students to find the percentage of wool in different textiles.

This is a summary of the method written by one of the students in her report.

Step 1 A 4.00 g sample of the wool-cotton mixture was weighed out.

Step 2 This sample was added to an aqueous solution containing 50% sulfuric acid.

Step 3 The sample and aqueous sulfuric acid were stirred together using a magnetic stirrer.

Step 4 The unreacted wool was then removed from the mixture.

Step 5 This wool was washed, dried and weighed.

Step 6 The percentage of wool in the sample was then calculated.

1 State what information is missing from **step 2**.

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

2 State what information is missing from **step 3**.

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

(iii) Some of the students had difficulty in calculating percentages. The teacher suggested using a graphical method to find the percentages.

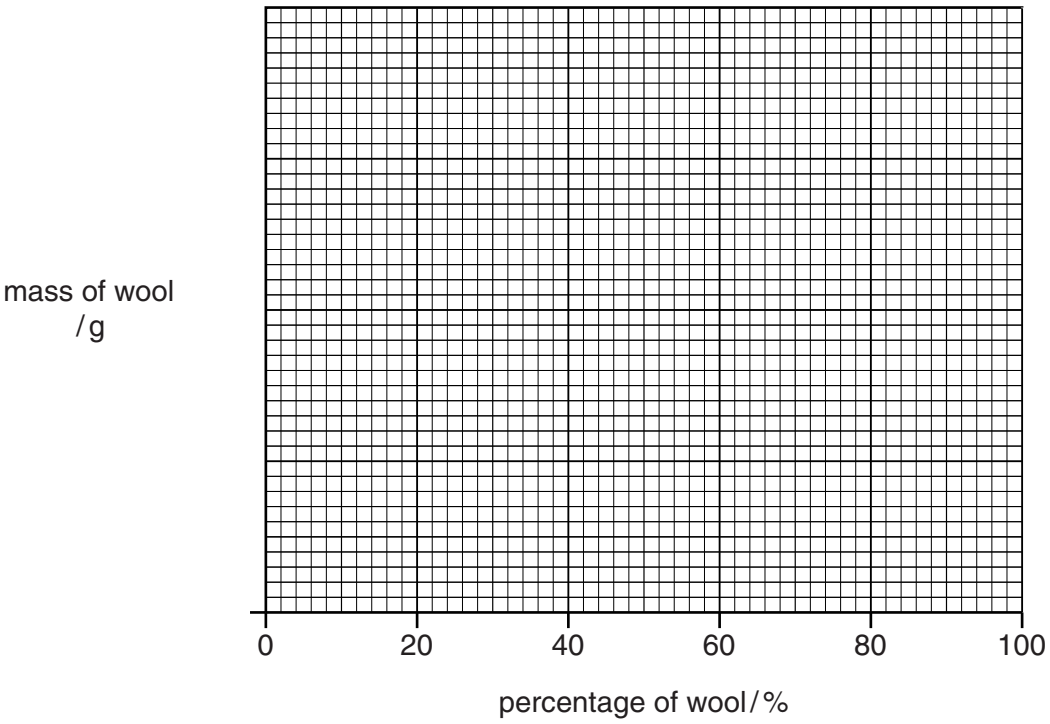

Fig. 2.2

1 Complete the grid (Fig. 2.2) given to the students by putting numbers on the y axis and then drawing a suitable line that could be used to determine the percentage of wool in their 4.00 g samples. **[3]**

2 One of the students forgot to weigh his final wool sample (**step 5**) and estimated the percentage of wool present to be 60%.

Use the graph, or other suitable method, to determine the mass of wool obtained if the student had started with a 4.00 g sample.

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

(g) The article describes the hydrolysis of wool to give a mixture of amino acids. These amino acids can then be separated by thin layer chromatography by using ninhydrin as a locating agent.

(i) State what is meant by the term *locating agent* **and** explain why it is necessary to use a locating agent in this experiment.

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

(ii) State what is measured from the chromatogram that enables an amino acid to be identified.

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

[Total: 36]

3 Roses have been grown as garden plants for hundreds of years. We often associate roses with scented summer flowers but other products from rose plants have a number of uses.

The fruits of rose plants are known as rose hips and they contain a relatively high percentage of vitamin C – up to about 1.5%.

(a) As a start to an investigation into the vitamin C content of rose hips, a teacher asked her students the following questions. Suggest suitable answers to the questions.

(i) Why should you collect more than one sample of rose hips from an individual rose bush?

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

(ii) When you collect rose hips to find the vitamin C content of a particular variety, why should you collect samples from a number of different bushes?

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

(iii) Why should you wear gloves when collecting the rose hips?

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

(iv) How should your samples of rose hips be stored when you bring them back to the laboratory for testing?

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

(v) Your samples of rose hips should be labelled.

What **three** details should you put on the labels?

1 .....

2 .....

3 .....

[3]

(vi) What should you do to your rose hips before starting work on them?

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

(b) After collecting the samples, the next stage is to extract the vitamin C from the rose hips. The students needed to use a 0.5% solution of metaphosphoric acid for this purpose. The acid sample available from the suppliers was one third metaphosphoric acid and two thirds water, by mass.

Calculate the mass of the supplied metaphosphoric acid sample that would be needed to make 1 dm^3 of a solution of concentration 0.5% by mass.

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

(c) A student reported that his rose hip sample contained 10% by mass of vitamin C.
The teacher thought that the student's value was not correct.

(i) Suggest a reason why the teacher thought the value was **not** correct.

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

(ii) State **two** possible errors that the student had made in this investigation.

1. .....

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2. .....

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

(d) Rose oil is extracted from rose petals and is used extensively in the perfume industry.

(i) The rose petals are collected in the early morning and processed the same day.

Suggest why it is better for the petals to be processed on the same day that they are collected.

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

(ii) One method of obtaining rose oil is solvent extraction using flammable hexane, which has a boiling point of 69 °C.

A modification of this method uses liquid carbon dioxide as the solvent. The rose petals are mixed with liquid carbon dioxide at a pressure of 75 atmospheres and at about room temperature. This solvent extracts a wide range of the compounds present in the petals. After extraction, the pressure can be released giving carbon dioxide gas, which can be collected and converted back to liquid carbon dioxide for further use. The rose oil, however, is left as a liquid, ready for further processing.

1 Suggest why the use of hexane as a solvent has been largely replaced by liquid carbon dioxide in this extraction.

Your answer should include comments about both solvents.

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

2 Suggest **one** disadvantage of using liquid carbon dioxide in the solvent extraction process.

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

[Total: 17]

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

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