Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

ADVANCED GCE

G628

APPLIED SCIENCE

UNIT 9: Sampling, Testing and Processing

TUESDAY 2 JUNE 2009: Afternoon
DURATION: 1 hour 30 minutes

SUITABLE FOR VISUALLY IMPAIRED CANDIDATES

Candidates answer on the question paper.

OCR SUPPLIED MATERIALS:

Insert (inserted)

OTHER MATERIALS REQUIRED:

Electronic calculator
Ruler (cm/mm)

READ INSTRUCTIONS OVERLEAF

DC (CW/SW) OV90754 10825

INSTRUCTIONS TO CANDIDATES

- **Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes on the first page.**
- **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.**
- **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 are advised to show all steps in any calculations.**
- **You may use an electronic calculator.**

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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 'Old and new products from seaweeds'.

1 After a storm, a quantity of red seaweed is washed up on a beach, Fig. 1.3.

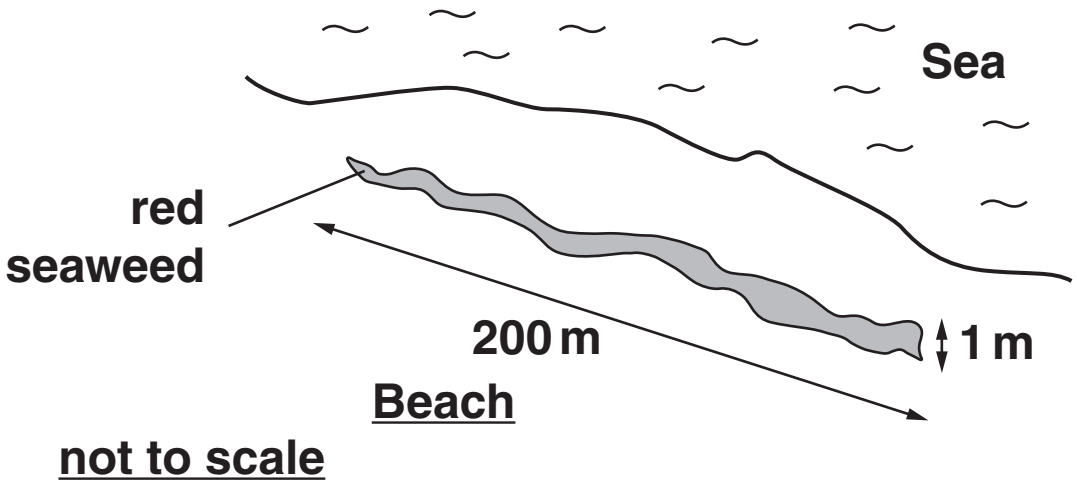

Fig. 1.3

(a) Some red seaweed is collected to test for its iodine content.

(i) Suggest <u>THREE</u> things which need to be considered when collecting a representative sample of this seaweed on one particular day.

1. _____

2. _____

3. _____ **[3]**

(ii) State and explain a problem that may occur if the samples are collected on different days.

_____

_____ **[2]**

(b) The red seaweed samples are taken to a laboratory for analysis.

(i) Suggest why the samples are washed before analysis.

_____ **[1]**

(ii) The samples are then heated in a furnace at a set temperature to produce ash.
Use the article to suggest why it is better to heat the seaweed at 500 °C rather than at 800 °C.

_____ **[1]**

(iii) After heating for ten minutes at 500 °C the seaweed ash was dark grey and still contained carbon from incomplete combustion.
Suggest what should be done to reduce the amount of carbon present in this ash.

_____ [1]

(iv) The ash is then cooled and its mass recorded in Table 1.1.
One way of telling if combustion is complete is to use the graph, Fig. 1.4.
For a result to be acceptable, the mass of the ash needs to lie within the shaded area of the graph.

Table 1.1

sample	mass of ash / g	mass of dried seaweed / g
A	2.7	9.3
B	3.3	9.9
C	3.6	12.0
D	2.3	8.7

Use the graph, Fig. 1.4, to decide which of the samples A, B or C has given unacceptable results.

_____ [1]

(v) Sample D in Table 1.1 gives a mass of ash that is outside the accepted limits.
Suggest why this may have occurred, apart from weighing errors.

_____ [1]

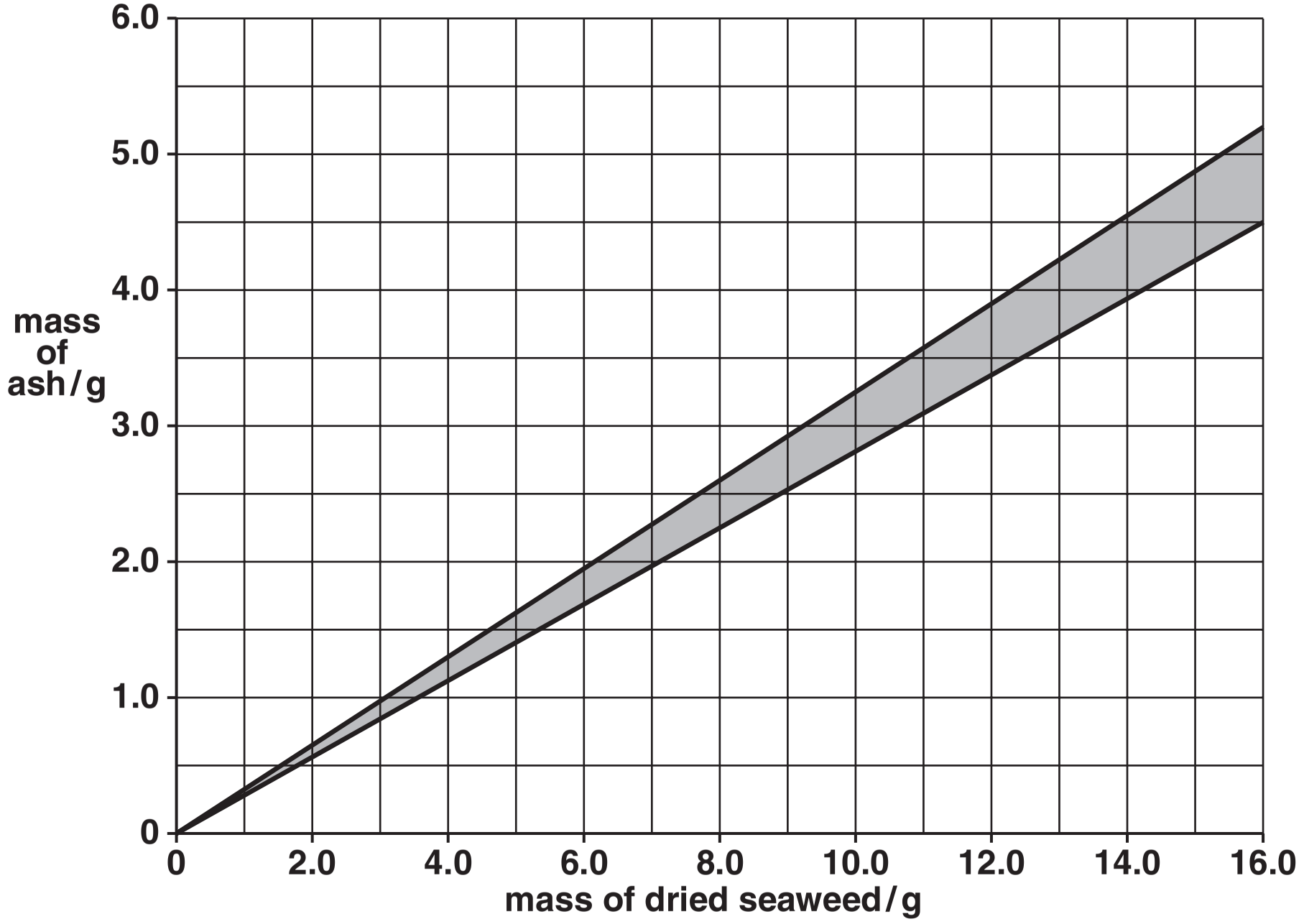
6.0
5.0
4.0
3.0
2.0
1.0
0
mass of ash / g
0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
mass of dried seaweed / g

Fig. 1.4

(c) A book stated 'treat the ash obtained from heating the red seaweed with water and remove insoluble material by filtration'.
Suggest <u>THREE</u> details that are missing from this brief instruction.

1. _____

2. _____

3. _____ **[3]**

(d) The filtrate is then concentrated by evaporation. After cooling and removal of crystallised material, the solution is treated with manganese dioxide and sulphuric acid. See Fig. 1.2 in the insert.

(i) If this method was followed by students in a laboratory, what should they do before attempting this stage?

_____ **[1]**

(ii) **Use Fig. 1.2 in the insert to identify TWO hazards of the equipment used and state how you would modify them to reduce the risks involved.**

hazard 1 _____

_____

_____

modification 1 _____

_____

_____ **[2]**

hazard 2 _____

_____

_____

modification 2 _____

_____

_____ **[2]**

(e) A group of students are asked to collect samples of the seaweed Chondus crispus, from which to obtain samples of carrageenan.

(i) State FOUR factors that they should take into account when collecting these samples.

1. _____

2. _____

3. _____

4. _____ **[4]**

(ii) State how the students could ensure that

1 the sand and salt were removed from the seaweed

_____

_____ **[1]**

2 the seaweed was completely dry.

_____

_____

_____ **[2]**

(iii) The instruction that they were given stated 'take each sample and immerse it in corrosive sodium hydroxide solution at 90 °C for 30 minutes'.

State what important detail is missing from this instruction.

_____ **[1]**

(iv) The mixture from (iii) is then filtered to remove insoluble material. An alcohol is added to the filtrate and carrageenan is obtained as the precipitate.
State why the use of a fume cupboard is recommended for this stage.

_____ **[1]**

(v) The students tried to remove the carrageenan after the addition of the alcohol but the solid blocked the filter paper.
Suggest an alternative way of separating the carrageenan from the liquid.

_____ **[1]**

(f) Carrageenan is used as a thickening agent in condensed milk.
It is important to ensure that the condensed milk has the correct viscosity.
Some students decided to compare the viscosity of several types of condensed milk that contained carrageenan.
They used the apparatus shown in Fig. 1.5.

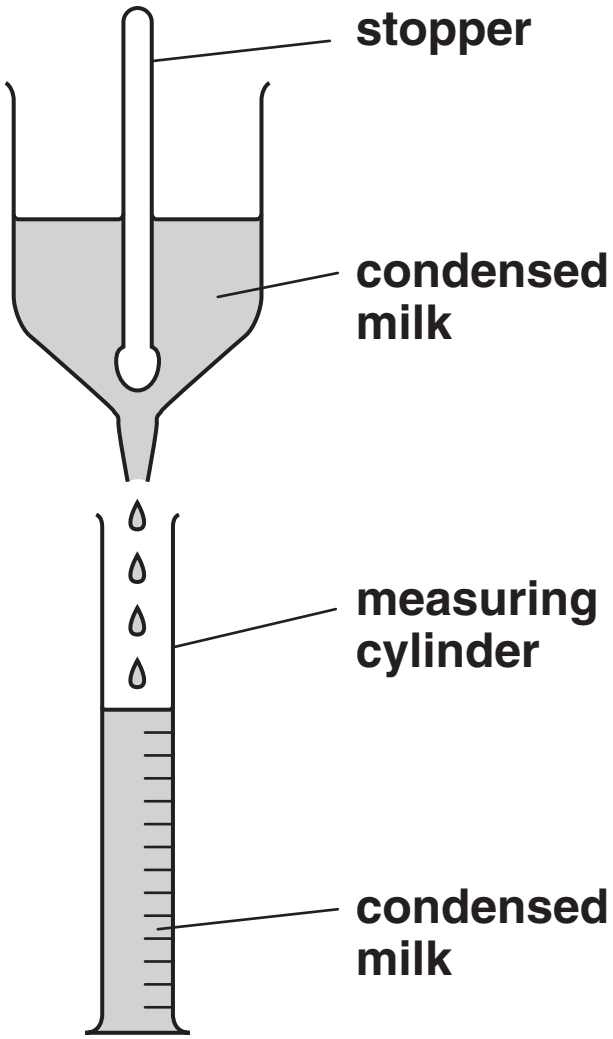

Fig. 1.5

(i) State why it is important when comparing the viscosities of condensed milk samples, that the temperature is kept constant.

_____ **[1]**

(ii) Suggest a modification to the apparatus shown in Fig. 1.5 so that the temperature of the samples can be kept constant.

_____

_____ [1]

(iii) The students found that the 'viscosity', η, of two different types of condensed milk, A and B, are related by the formula

$$\frac{\eta_A}{\eta_B} = \frac{V_B}{V_A}$$

where V_A and V_B are the volumes of liquids A and B collected in 5 minutes.

Use the formula to complete the gaps in the sentence below, using the words INCREASES or DECREASES.

'When the viscosity of the liquid

_____ , the volume of liquid

collected in five minutes _____' [1]

(iv) Use the formula in (iii) to calculate the 'viscosity', η_A, in $N\,s\,m^{-2}$, when the other values are

$\eta_B = 1.32\ N\,s\,m^{-2}$ and $\frac{V_B}{V_A} = 1.25$

_____ $N\,s\,m^{-2}$ [1]

(v) Use the article to explain why 'viscosity' values, as used in (iv), may not give direct information about the concentration of carrageenan in the condensed milk.

_____ [1]

(g) State the meaning of these terms that are used in the article.

hydrophilic _____ [1]

polymer _____ [1]

[Total: 35]

This question is based on the article 'Lead – a useful, but toxic, metal'.

2 A group of students found some lead ore on a spoil heap from a mine in Derbyshire.
They decided to find out how lead was made from the ore and the problems associated with its production.

(a) State how the article suggests that samples of lead ore are NOT homogeneous.

_____ **[1]**

(b) A number of disused lead mines in Derbyshire remain as tunnels dug into the hillside.
State why it is inadvisable to collect samples from inside these tunnels.

_____ **[1]**

(c) Suggest a way by which the students could ensure that their collected samples were not contaminated

1 by dust from the air

_____ **[1]**

2 by equipment used in testing.

_____ **[1]**

(d) A rough estimate of the percentage of lead in the sample can be obtained by finding the density of the sample and comparing this with known values. To find the density, the volume of the sample needs to be measured.

(i) Suggest a method to find the volume of an irregularly-shaped piece of lead ore. You may use a diagram if you wish.

_____

_____

_____ **[2]**

(ii) The density of a sample of lead ore is found to be 3.28 g cm^{-3}.
Use Table 2.1 to estimate the percentage of lead in the sample.

Table 2.1

DENSITY OF SAMPLE / g cm^{-3}	PERCENTAGE OF LEAD
3.00	4.0
3.14	7.0
3.23	9.0
3.38	12.0
3.57	16.0

percentage _____ [1]

(iii) State ONE advantage of using a graph instead of a table for these results.

_____ [1]

(iv) Suggest why the percentage of lead found from the table or the graph will still only give a rough idea of the percentage of lead present in the sample.

_____ [1]

(e) The students ground the samples and then proceeded to investigate chemicals which were suitable for use in froth flotation.
They found that all the chemicals were toxic and they would need to use a fume cupboard.
State TWO other factors that they should consider when choosing a chemical for this purpose, apart from cost.

1. _____

2. _____ **[2]**

(f) After separation of the galena in (e), the next stage was to smelt the galena to produce lead metal.
Use the article to state why the students were advised not to try this in the college laboratory without special facilities.

_____

_____ **[2]**

(g) The article states that zinc is added to the molten lead to remove the silver present in the lead.
A company told the students that the total amount of silver in a one tonne batch of impure lead was 1200 g. When a certain quantity of zinc was added, 85% of the silver present was removed by the zinc.

(i) Show that the mass of silver removed by the zinc is 1020 g.

[1]

(ii) Calculate how much silver remained in the lead.

_____ **g [1]**

(iii) Fresh zinc was added to the lead and this removed 85% of the remaining silver.
Calculate how much silver <u>REMAINED</u> in the lead after this second treatment with zinc.

_____ **g [2]**

(h) There has been recent concern about lead paint being used in toys.

A simple test for lead in paint is described below.

1 The technician undertakes a risk assessment.

2 Distilled water is sprayed onto the paint surface, which is then wiped with a tissue.

3 The surface is sprayed with a solution of toxic compound A.

4 A filter paper, wetted with the solution of A, is pressed onto the paint surface.

5 The filter paper is removed and dried.

6 A solution of toxic compound B is sprayed onto the filter paper.

7 If the lead content in the paint is greater than 2%, a pink colour is seen.

8 The darker the pink colour, the more lead is present.

(i) Suggest why distilled water is used and the surface then dried.

_____ **[1]**

(ii) Which important detail is missing from the FOURTH instruction?

_____ **[1]**

(iii) **What should be written on the labels of solutions A and B apart from their letters and their names?**

_____ **[1]**

(iv) **Suggest why this test is not particularly suitable for testing for lead in the paint of children's toys.**

_____

_____ **[1]**

(v) **Why would you use solutions of A and B to test the filter paper before testing the paint?**

_____ **[1]**

(i) **Lead in paint can also be detected by X-ray fluorescence spectroscopy (XRF).**
If XRF is to be used rather than the method described in (h), state TWO advantages that it must have apart from cost.

1. _____ **[1]**

2. _____ **[1]**

(j) The most common method for finding the percentage of lead in paint is by using atomic absorption spectroscopy.
You are given 3.67 g of lead acetate crystals, a supply of distilled water and a volumetric (graduated) flask of capacity 1 dm^3, as shown in Fig. 2.2.

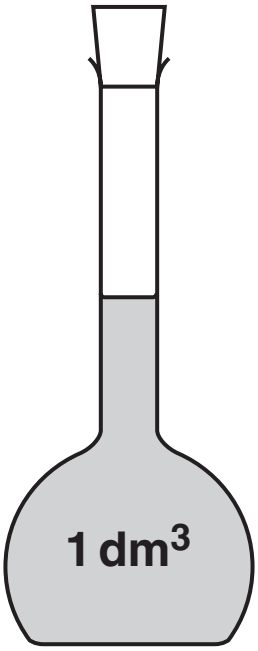

Fig. 2.2

(i) State why the solution is <u>NOT</u> made using tap water.

_____

_____ **[1]**

(ii) Describe how to make a solution of volume 1 dm^3 that contains 3.67 g of lead acetate crystals.

In this section, one mark is available for a clear, ordered answer.

_____

_____

_____

_____

_____

_____ **[4]**

Quality of Written Communication [1]

(iii) **A paint sample of mass 0.250 g is tested to find the percentage of lead present.**
All the lead in the paint is dissolved to give a solution of volume 1 dm^3.
This solution is analysed for lead using atomic absorption spectroscopy and gives an absorption reading of 0.18.

Use the equation below to calculate the concentration of lead present in mg dm^{-3} and then use your answer to find the percentage of lead present in the sample of paint.

$$\text{absorption} = 0.04 \times \text{concentration of lead}$$

where the concentration of lead is measured in mg dm^{-3}

concentration of lead _____ mg dm^{-3} [1]

percentage of lead in the paint sample _____ % [1]

(k) Lead shot are spherical pieces of lead metal. They are made by adding a little arsenic to the liquid lead (to help make the droplets more spherical). Then the molten alloy is dropped through a series of sieves.
The lead droplets produced are allowed to fall a distance of 30 m or more into water.

(i) State what is meant by an alloy.

_____

_____ **[1]**

(ii) A student measured the diameter of some lead shot, Table 2.2.

Table 2.2

sample	1	2	3	4	5
diameter / mm	1.57	2.35	2.17	1.47	1.64

Calculate the mean diameter of the shot.

_____ **mm [1]**

(iii) The buyer for the lead shot specifies that all shot should have a diameter of 2.00 ± 0.50 mm. State which sample(s), if any, in (ii) do not/does not fit this requirement.

_____ **[1]**

(iv) When a further batch of shot was made, it was seen that a large number of the shot were not spherical.
Suggest how the process could be modified to overcome this problem.

_____

_____ **[1]**

[Total: 36]

3 (a) The radioactive gas radon was discovered in the early 20th century. It is of concern because, in some areas, the amount escaping from the ground may accumulate in buildings causing a potential health risk.

(i) Suggest how radon can enter buildings.

_____ **[1]**

(ii) Suggest how two adjacent buildings can have different radon levels.

_____ **[1]**

(iii) A house is tested for radon and the results show that the concentration of radon is above the acceptable limit.
Suggest a way by which the radon concentration could be reduced.

_____ **[1]**

(iv) Suggest why radon levels for the same house tend to be lower in the summer months.

_____ **[1]**

(b) Radon levels in houses can be measured using a plastic detector, about the size of a £1 coin.
α - Particles given off by radon produce tracks in the plastic, which are later detected and measured.

(i) Before a detector is used in a house what should be written on the label?

1. _____ [1]

2. _____ [1]

(ii) Radon detectors are placed at several places in a house and left for the same length of time.
Suggest why they are

1 put at different places in the house

_____

_____ [1]

2 left for the same amount of time.

_____

_____ [1]

(iii) After exposure to radon the detectors are covered in metal foil, before sealing them in a bag.
Suggest why the exposed detectors are covered in metal foil.

_____ [1]

(iv) The metal foil is removed and the plastic radon detector reacted with 25 cm^3 of concentrated aqueous sodium hydroxide solution at a temperature of 100 °C for a period of one hour. This is to make the tracks visible.

Write a simple set of instructions for this procedure, which others can follow safely. You may include a diagram to help your answer.

In this section, one mark is available for spelling, punctuation and grammar.

_____

_____

_____

_____

_____

_____ **[5]**

Quality of Written Communication [1]

(v) The detector is then removed, washed and dried. It is then mounted on a microscope slide and viewed using a magnification of 100. A typical result for part of the slide is shown in Fig. 3.1.

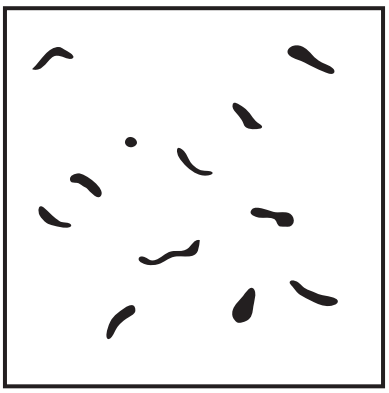

Fig. 3.1

The grid has a magnification of 100. Measure Fig. 3.1 and calculate the actual distance of its side.

_____ **cm [1]**

(vi) State the number of tracks in 1 cm^2 of the detector.

_____ **[2]**

(vii) Another set of students left the sample for 77 days.
They found that the number of tracks in 1 cm^2 of sample was 4200.
Radon levels are expressed in Becquerels per cubic metre of air (Bq m^{-3}).
Use the formula

$$\text{activity concentration} = \frac{4.0 \times T}{n}$$

to calculate the activity concentration
(T is the number of tracks in 1 cm^2 and n is the number of days exposure to radon).

_____ Bq m^{-3} [1]

[Total: 19]

END OF QUESTION PAPER