SPECIMEN

Advanced GCE

Applied Science

Sampling, Testing and Processing

Specimen Paper

G628

Time: 1 hour 30 minutes

Candidates answer on the question paper.

Supplied materials: Insert (inserted)

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name 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 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.

INFORMATION FOR CANDIDATES

- The number of marks for each question is given in brackets **[ ]** at the end of each question or part question.
- The total number if marks for this paper is **90**.
- 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.
- You may use an electronic calculator.
- This document consists of **12** pages. Any blank pages are indicated.

  [Turn over

Answer **all** the questions.

This question is based on the article 'Landfill sites as a means of waste disposal'.

1 (a) Name **one** substance obtained from burning domestic waste and suggest the environmental problem associated with it.

.....

.....

.....

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

(b) Suggest **two** advantages of removing air spaces in the domestic waste.

1 .....

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

(c) Fig. 1a in the article shows landfill gas production over a period of time.

State and explain how the percentage of carbon dioxide varies with time.

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

(d) (i) At times T_1 and T_2 in Fig. 1a, the landfill gas consists only of nitrogen, carbon dioxide and hydrogen.

Use Fig. 1a to calculate the percentage of nitrogen present in the landfill gas at time T_1.

…….% **[1]**

(ii) State, giving a reason, how the percentage of nitrogen changes from T_1 to T_2.

.....

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.....

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

(e) Use the information in the article to help you calculate the total volume of methane obtained from 300 million tonnes of waste in landfill sites.

…… m^3 **[3]**

(f) Some students visited the landfill site to remove samples of the landfill gas. They had learnt that a number of factors need to be considered when taking samples.

One of these was to consider from where to collect the samples.

Suggest **four** other factors that they should consider.

1 .....

2 .....

3 .....

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

(g) Table 1.1 shows the results, as percentages by volume, of the analysis of some samples of landfill gas from the same site.

Table 1.1

Gas	Sample			
	1	2	3	4
methane	40	37	41	38
carbon dioxide	45	45	42	42
hydrogen	10	12	10	10
oxygen	5	6	7	12

(i) Calculate the average percentage of methane in the samples.

.....

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

(ii) Give **two** reasons why Sample 4 should be repeated.

1 .....

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

(h) Some polluted water (leachate) does escape from landfill despite a clay barrier being used to prevent this escape. However, this water can be treated to kill all harmful bacteria.

Use the article to give **two** reasons why this polluted water could still be harmful.

1 .....

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2 .....

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

(i) Some students in Nigeria were given samples of leachates (water run off from landfill sites). They were asked to analyse the leachates to find the concentrations of nitrate, phosphate and sulfate ions in the liquid.

(i) State **two** sources from which they would find a suitable method to use.

1 .....

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

(ii) State **three** factors that they should consider when choosing a suitable method of analysis.

1 .....

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

(iii) They chose to separate the ions by using column chromatography and to detect them using a continuous method.

Fig. 1.1 shows the apparatus they used.

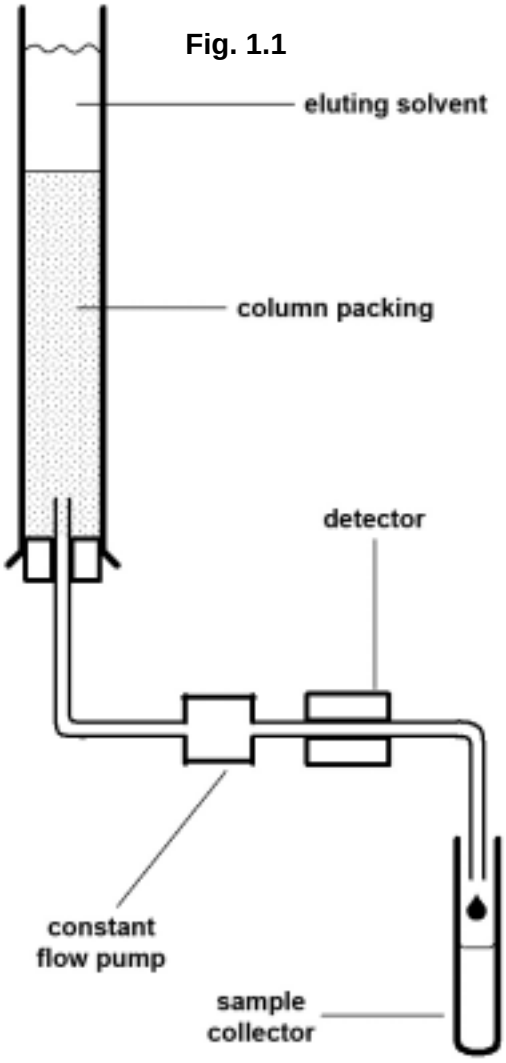

Fig. 1.1

State the purpose of the eluting solvent .....

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

(iv) The electrical signal from the detector shown in Fig. 1.1 produces a series of peaks showing the relative concentrations of each ion present, given as numbers in Fig. 1.2.

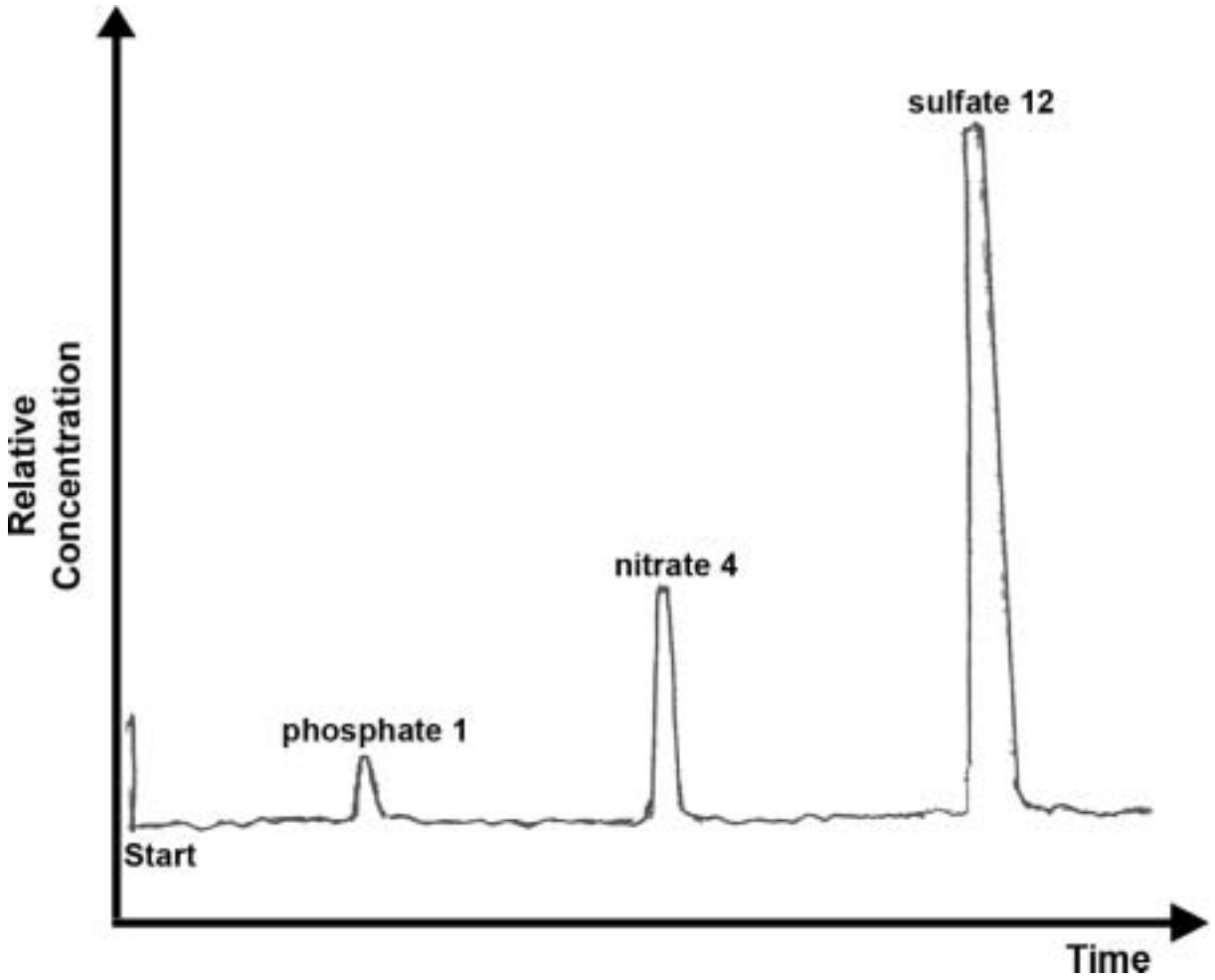

Fig. 1.2

The actual concentration of the sulfate ions was 78 mg dm^{-3}.

Calculate the actual percentage of the phosphate ions.

…… mg dm^{-3} **[1]**

(v) The students decided to repeat the method with another sample of leachate.

What should they do before using the column a second time?

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

(j) The emission of offensive smells (odour) from landfill sites is a nuisance that causes public opposition to these sites.

The 'strength' of these smells in a particular place depends on a number of factors.

One simple factor would be that the 'strength' of the smell becomes less further away from the site, because of a dilution effect.

Discuss what would affect the 'strength' of the smell and explain your answers.

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

Total [37]

This question is based on the article 'Bituminous materials'.

2 (a) A new deposit of rock asphalt has been discovered by a geologist.

(i) Explain why it is necessary to take **representative** samples when finding its bitumen content.

.....

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

(ii) State **two** things that the geologist must tell his colleagues before he leaves to collect his samples from the rock asphalt deposit.

1 .....

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

(iii) The rock asphalt outcrops as a deposit 50 m long and 6 m high.

Several samples are to be collected.

Describe from where in the outcrop these samples should be collected, giving a reason for your answer.

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

(iv) Before the samples in **(iii)** are collected, the geologist needs to assess the risks of his collecting procedure.

State **one** hazard that he should be aware of when collecting these samples.

.....

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

(v) The geologist has collected the samples and stores them in the laboratory before working with them.

What should be written on the label for each sample?

.....

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

(vi) The samples of rock asphalt were analysed for their bitumen content. Each sample was weighed and crushed. 25.0 cm^3 of a solvent was added and the mixture stirred. The mixture was then filtered and the residue washed with a little more fresh solvent. The samples of solution were then evaporated. The bitumen residues were weighed. The same procedure was used for all the samples.

I Suggest how the rock was crushed ..... **[1]**

II Suggest why it would have been a better idea to crush some rock asphalt first before weighing a sample.

.....

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

III State why the crushed mixture and solvent were stirred.

.....

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

IV State why the crushed rock in the filter paper was washed with fresh solvent.

.....

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

V The solvent chosen by the students boils at about 80 ^{o}C and is very flammable.

Describe how this solvent should be evaporated in the college laboratory.

A diagram can be used in your answer if you wish.

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

(b) Fig. 2a in the article shows the equipment used to measure the relative softness of bituminous materials.

(i) Explain why it is important to use the same force and time for each measurement.

.....

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

(ii) For one sample of bitumen the penetration of the needle was 0.4 mm.

State and explain how this value would change (if at all) if the test was run at 35 ^{o}C rather than at 25 ^{o}C.

.....

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

(c) When finding the composition of bitumen samples, method 2 (a) is used to find the percentage of **volatile** material in the bitumen.

Describe how you would choose a temperature for this experiment so that volatile decane is evaporated from the bitumen but the high boiling point black material remains.

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

(d) Method 2 (b) is used to find the percentage of ash remaining after burning off carbon containing compounds in the bitumen.

In an experiment the percentage of ash in the bitumen was found to be 0.2%.

Explain why the technician felt it better to use a sample of mass 10 g for the experiment rather than a sample of mass 1 g.

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

(e) Describe how you would advise a trained technician to carry out method 2 (c) to find the mass of insoluble material in this sample, starting from a known mass of asphalt.

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

(f) **(i)** The results in Table 2a in the article were obtained by exposing bitumen samples to ultraviolet light for a total of nine hours at a certain temperature.

Explain why it was necessary to keep the temperature constant during this test.

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.....

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

(ii) The article states that exposure to ultraviolet causes changes in the infrared absorption spectrum of samples.

State what this change in infrared absorption frequencies means for the chemical composition of bitumen.

.....

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

(iii) Use the results shown in Table 2a to describe how the hardness of bitumen and its softening point change as it is exposed to ultraviolet radiation.

.....

.....

.....

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

Total [33]

3 Many plants contain useful compounds and trace elements, which have been exploited commercially.

(a) Rose bay willow herb contains a relatively high amount of the metal manganese.

The leaves of this plant are collected, dried and then burnt at 600 ^{o}C.

After a time, all the organic material is oxidised to gases, leaving a white ash.

On strongly heating 20.0 g of dried leaves, 1.25 g of ash is obtained.

Calculate the percentage of ash produced from the leaves, to two decimal places.

……..% **[2]**

(b) A weighed quantity of the ash is then treated to give a purple solution containing manganese.

There are also impurities present which make the solution cloudy.

(i) State **one** possible method of removing this cloudiness from the manganese-containing solution.

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

(ii) The chemist **assumes** that all the manganese is now in solution.

If this assumption is incorrect, suggest how some manganese may have been lost.

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

(c) A colorimeter is used to find the concentration of manganese in the purple solution. A series of purple solutions containing known concentrations of manganese are prepared. The absorption of each solution is determined using a colorimeter. A graph of absorption against the concentration of manganese is plotted.

The graph showed that

0.60 x absorption = concentration of manganese in g dm^{-3}

(i) Describe the shape of the line graph that is obtained.

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

(ii) A sample of ash weighing 9.6 g is treated and made up to 1.0 dm^3 of the purple solution that contains all the manganese.

This purple solution is tested in a colorimeter and gives an absorption reading of 0.24.

I Calculate the concentration of manganese in g dm^{-3}.

…….. g dm^{-3} **[1]**

II Calculate the percentage of manganese in the ash.

…… % **[1]**

(d) Plants and fungi are also increasingly used to reduce pollution in the soil.

One example of this is on the site of a former timber works in Finland.

The soil on the site was contaminated with the pollutant pentachlorophenol, which is very toxic to many plants and animals.

However, treatment of the contaminated soil with a particular fungus dramatically reduced the level of this pollution in a year.

(i) State how you would minimise the risks when handling samples of this polluted soil.

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

(ii) If the soil samples are stored for two days before testing, suggest **two** precautions that should be taken if safe and reliable results are to be obtained.

1 .....

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

(iii) Before treatment with the fungus, the soil contained 800 mg of pentachlorophenol per kg of soil.

A year after treatment, the level of pentachlorophenol was reduced to 1.5% of its previous value per kilogram of soil.

Use these figures to calculate the mass, in kg, of pentachlorophenol removed by the fungus from 200 tonnes of contaminated soil.

1 tonne = 1000 kg; 1 g = 1000 mg

…….. kg **[4]**

(e) The toxic nature of pentachlorophenol has led to restrictions in its manufacture particularly because of serious health problems experienced by the workers engaged in its production.

(i) The first production method gave pentachlorophenol which was only 86% pure.

Chromatography was used to separate pentachlorophenol and the other products present.

Which technique can be used to **identify** the other products?

.....

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

(ii) The new process gave pentachlorophenol that was 92% pure.

A customer required a purity of 99%.

State **two** ways by which this purity could be achieved.

1 .....

.....

2 .....

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

(iii) A small scale process produced 5kg of pentachlorophenol.

Unfortunately the method took too long to come to completion.

Suggest **one** way of reducing the time taken for this reaction to become complete.

.....

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

Total [20]

Paper Total [90]

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

APPLIED SCIENCE G628

Sampling, Testing and processing

Specimen Mark Scheme

The maximum mark for this paper is 90.

This document consists of **14** printed pages.

Question Number	Answer	Max Mark
1(a)	**This question is based on the article 'Landfill sites as a means of waste disposal'** **Name one substance obtained from burning domestic waste and suggest the environmental problem associated with it.** Any ONE from Carbon dioxide; global warming/greenhouse effect OR carbon monoxide; toxicity OR smoke; toxicity/breathing problems.	**[2]**
1(b)	**Suggest two advantages of removing air spaces in the domestic waste.** Any TWO from Reduce space Creates anaerobic environment Prevents build up of gases. Lack of oxygen 'prevents' fires.	**[2]**
1(c)	**Fig. 1a in the article shows landfill gas production over a period of time.** **State and explain how the percentage of carbon dioxide varies with time.** % carbon dioxide initially rises as organic material is oxidised in aerobic environment % carbon dioxide starts to fall as less oxygen is present for oxidation of organic material % carbon dioxide remains steady as emission of carbon dioxide from organic material is balanced by methane production % carbon dioxide falls as organic material is used up.	**[4]**
1(d)(i)	**At times T_1 and T_2 in Fig. 1a the landfill gas consists only of nitrogen, carbon dioxide and hydrogen.** **Use Fig. 1.1 to calculate the percentage of nitrogen present in the landfill gas at time T_1.** 100 – (36 + 8) = 56 %	**[1]**
1(d)(ii)	**State, giving a reason, how the percentage of nitrogen changes from T_1 to T_2.** It decreases; As the % of carbon dioxide and hydrogen both increase.	**[1]** **[1]**

Question Number	Answer	Max Mark
1(e)	**Use the information in the article to help you calculate the total volume of methane obtained from 300 million tonnes of waste in landfill sites.**	
	Maximum % of methane is 70;	**[1]**
	Each tonne produces 400 m^3 of landfill gas	
	maximum volume of gas is $\frac{300 \times 1\,000\,000 \times 400 \times 70}{100}$	**[1]**
	$= 8.4 \times 10^{10}$ m^3 / 84 000 000 000.	**[1]**
1(f)	**Some students visited the landfill site to remove samples of the landfill gas. They had learnt that a number of factors need to be considered when taking samples.** **One of these was to consider from where to collect the samples.** **Suggest four other factors that they should consider.**	
	When	
	How often	
	How many	
	Size	
	Appreciates hazards	
	Health and safety.	**[4]**
1(g)(i)	**Table 1.1 shows the results, as percentages by volume, of the analysis of some samples of landfill gas from the same site.** **Calculate the average percentage of methane in the samples.**	
	$\frac{40 + 37 + 41 + 38}{4} = 39$	**[1]**
1(g)(ii)	**Give two reasons why Sample 4 should be repeated.**	
	% oxygen is too high/anomalous	**[1]**
	results total is greater than 100%.	**[1]**
1(h)	**Some polluted water (leachate) does escape from landfill despite a clay barrier being used to prevent this escape. However, this water can be treated to kill all harmful bacteria.** **Use the article to give two reasons why this polluted water could still be harmful.**	
	Method does not remove heavy metals/other toxins	
	The water still contains residual organic material.	**[2]**

Question Number	Answer	Max Mark
1(i)(i)	**Some students in Nigeria were given samples of leachates (water run off from landfill sites). They were asked to analyse the leachates to find the concentrations of nitrate, phosphate and sulfate ions in the liquid.** **State two sources from which they would find a suitable method to use.** Books/journals Electronic sources.	 **[1]** **[1]**
1(i)(ii)	**State three factors that they should consider when choosing a suitable method of analysis.** Any THREE from Easy Not time consuming Materials readily available Not hazardous AVP.	 **[3]**
1(i)(iii)	**They chose to separate the ions by using column chromatography and to detect them using a continuous method.** **Fig. 1.1 shows the apparatus they used.** **State the purpose of the eluting solvent.** Enables the components to be separated as they leave the column.	 **[1]**
1(i)(iv)	**The electrical signal from the detector shown in Fig. 1.1 produces a series a peaks showing the relative concentrations of each ion present, given as numbers in Fig. 1.2.** **The actual concentration of the sulphate ions was 78 mg dm^{-3}.** **Calculate the actual percentage of the phosphate ions.** 78/12 = 6.5 (mg dm^{-3}).	 **[1]**
1(i)(v)	**The students decided to repeat the method with another sample of leachate.** **What should they do before using the column a second time?** Make sure that it is clean.	 **[1]**

Question Number	Answer	Max Mark
1(j) 	**The emission of offensive smells (odour) from landfill sites is a nuisance that causes public opposition to these sites.** **The 'strength' of these smells in a particular place depends on a number of factors.** **One simple factor would be that the 'strength' of the smell becomes less further away from the site, because of a dilution effect.** **Discuss what other factors would affect the 'strength' of the smell and explain your answers.** **Band mark range:** **[5-6 marks]** Candidate demonstrates a high level of knowledge, giving an in-depth answer which considers at least 3 different factors with a detailed explanation of each. Explanations are clearly and correctly linked to the appropriate factors. There are few, if any, errors in spelling, punctuation and grammar. **[3-4 marks]** Candidate demonstrates their knowledge by describing at least two factors affecting the 'strength' of the smell with explanations. Explanations are linked to the appropriate factors. There may be occasional errors in spelling, punctuation and grammar. **[1-2 marks]** Candidate shows a limited understanding of the question with at least one factor identified but with little or no explanation. Errors of grammar punctuation and spelling may be intrusive. **[0 mark]:** no response/response not worthy of credit. **Examples:** • Prevailing wind; the smell would be stronger in the direction opposite to the wind direction • Rainfall; the 'smelly' material may be water soluble/react with water, reducing its concentration • Human factor; the sensitivity to smells varies from person to person • Topography; 'smells' may be deflected by hills or valleys.	**[6]**
	Total	**[37]**

Question Number	Answer	Max Mark
2(a)(i)	**This question is based on the article 'Bituminous materials'.** **A new deposit of rock asphalt has been discovered by a geologist.** **Explain why it is necessary to take representative samples when finding its bitumen content.** The % of bitumen varies.	**[1]**
2(a)(ii)	**State two things that the geologist must tell his colleagues before he leaves to collect his samples from the rock asphalt deposit.** Where (s)he is going How long for.	**[2]**
2(a)(iii)	**The rock asphalt outcrops as a deposit 50 m long and 6 m high.** **Several samples are to be collected.** **Describe from where in the outcrop these samples should be collected, giving a reason for your answer.** Equidistant (horizontally) Different heights So that a representative sample is collected.	**[3]**
2(a)(iv)	**Before the samples in (iii) are collected, the geologist needs to assess the risks of his collecting procedure.** **State one hazard that he should be aware of when collecting these samples.** Any **one** from Overhanging rocks Dangers of collecting from a height Loose rocks.	**[1]**
2(a)(v)	**The geologist has collected the samples and stores them in the laboratory before working with them.** **What should be written on the label for each sample?** Where they were from. Data collected.	**[2]**

Question Number	Answer	Max Mark
2(a)(vi)	**The samples of rock asphalt were analysed for their bitumen content. Each sample was weighed and crushed. 25.0 cm^3 of a solvent was added and the mixture stirred. The mixture was then filtered and the residue washed with a little more fresh solvent. The samples of solution were then evaporated. The bitumen residues were weighed. The same procedure was used for all the samples.** **I Suggest how the rock was crushed.** **II Suggest why it would have been a better idea to crush some rock asphalt first before weighing a sample.** **III State why the crushed mixture and solvent were stirred.** **IV State why the crushed rock in the filter paper was washed with fresh solvent.** **V The solvent chosen by the students boils at about 80 ^oC and is very flammable.** **Describe how this solvent should be evaporated in the college laboratory.** **A diagram can be used in your answer if you wish.**	
	I Suitable description of crushing eg. pestle and mortar.	**[1]**
	II Weighed material will be left in the mortar.	**[1]**
	III To ensure all soluble material in the bitumen dissolved.	**[1]**
	IV To ensure that no traces of bitumen solution were left on the rock particles.	**[1]**
	V Drawing/writing shows method of heating involving	
	No flames.	**[1]**
	Safe/acceptable method of evaporation	**[1]**
	Use of a fume cupboard.	**[1]**
2(b)(i)	**Fig. 2a in the article shows the equipment used to measure the relative softness of bituminous materials.** **Explain why it is important to use the same force and time for each measurement.**	
	So that the results can be compared.	**[1]**
2(b)(ii)	**For one sample of bitumen the penetration of the needle was 0.4 mm.** **State and explain how this value would change (if at all) if the test was run at 35^oC rather than at 25^oC.**	
	It would increase	**[1]**
	Since the bitumen becomes softer.	**[1]**

Question Number	Answer	Max Mark
2(c)	**When finding the composition of bitumen samples method 2 (a) is used to find the percentage of volatile material in the bitumen.** **Describe how you would choose a temperature for this experiment so that volatile decane is evaporated from the bitumen but high boiling point black material remains.** Greater than the boiling point of decane But less than the 'boiling point' of bitumen.	**[2]**
2(d)	**Method 2 (b) is used to find the percentage of ash remaining after burning off carbon containing compounds in the bitumen.** **In an experiment the percentage of ash in the bitumen was found to be 0.2%.** **Explain why the technician felt it better to use a sample of mass 10 g for the experiment rather than a sample of mass 1 g.** Errors reduced/more accurate.	**[1]**
2(e)	**Briefly describe how you would advise a trained technician to carry out method 2 (c) starting from a known mass of asphalt, to find the mass of insoluble material in this sample.** Candidates are expected to know the following steps • Add carbon disulphide, methylbenzene • Stir • Filter • Into weighed filter paper • Dry • Reweigh. **Band mark range:** **[5-6 marks]** Candidate shows a high level of understanding with a detailed account of the experiment, incorporating at least five of the steps required. Candidate presents the steps given in the correct sequence. There are few, if any, errors in spelling, punctuation and grammar. **[3-4 marks]** Candidate demonstrates knowledge and understanding of the experiment incorporating at least three of the steps required. The sequencing is mainly correct. There may be occasional errors in spelling, punctuation and grammar. **[1-2 marks]** Candidate addresses at least one of the steps required but shows limited understanding of the method. There is little or no evidence of sequencing. Errors of grammar punctuation and spelling may be intrusive **[0 mark]:** no response/response not worthy of credit.	**[6]**

Question Number	Answer	Max Mark
2(f)(i)	**The results in Table 2a in the article were obtained by exposing bitumen samples to ultraviolet light for a total of nine hours at a certain temperature.** **Explain why it was necessary to keep the temperature constant during this test.** So that the results can be compared So that only the effect of the aging caused by ultraviolet radiation is studied.	**[2]**
2(f)(ii)	**The article states that exposure to ultraviolet causes changes in the infrared absorption spectrum of samples.** **State what this change in infrared absorption frequencies means for the chemical composition of bitumen.** It indicates a change in chemical structure/different compounds.	**[1]**
2(f)(iii)	**Use the results shown in Table 2a to describe how the hardness of bitumen and its softening point change as it is exposed to ultraviolet radiation.** The bitumen becomes softer The softening point increases.	**[2]**
	Total	**[33]**

Question Number	Answer	Max Mark
3(a)	**Many plants contain useful compounds and trace elements, which have been exploited commercially.** **Rose bay willow herb contains a relatively high amount of the metal manganese.** **The leaves of this plant are collected, dried and then burnt at 600 ^{o}C.** **After a time all the organic material is oxidised to gases, leaving a white ash.** **On strongly heating 20.0 g of dried leaves, 1.25 g of ash is obtained.** **Calculate the percentage of ash produced from the leaves, to two decimal places.** $\frac{1.25\times100}{20}$; = 6.25;	**[2]**
3(b)(i)	**A weighed quantity of the ash is then treated to give a purple solution containing manganese.** **There are also impurities present which make the solution cloudy.** **State one possible method of removing the cloudiness from the manganese-containing solution.** Any TWO from Filtering Centrifuging Decanting.	**[2]**
3(b)(ii)	**The chemist assumes that all the manganese is now in solution.** **If this assumption is incorrect, suggest how some manganese may have been lost.** Some was left in the insoluble/cloudy material.	**[1]**
3(c)(i)	**A colorimeter is used to find the concentration of manganese in the purple solution. A series of standard purple solutions containing known concentrations of manganese are prepared. The absorption of each solution is determined using a colorimeter. A graph of absorption against the concentration of manganese is plotted.** **The graph showed that** **0.60 x absorption = concentration of manganese in g dm^{-3}** **Describe the shape of the line graph that is obtained.** A straight line Through the origin.	**[2]**

Question Number	Answer	Max Mark
3(c)(ii) I	**A sample of ash weighing 9.6 g is treated and made up to 1.0 dm^3 of the purple solution that contains all the manganese.** **This purple solution is tested in a colorimeter and gives an absorption reading of 0.24.** **Calculate the concentration of manganese in g dm^{-3}.** 0.60 x 0.24 = 0.144 (g dm^{-3}).	**[1]**
3(c)(ii) II	**Calculate the percentage of manganese in the ash.** $\frac{0.144 \times 100}{9.60} = 1.5\%$	**[1]**
3(d)(i)	**Plants and fungi are also increasingly used to reduce pollution in the soil.** **One example of this is on the site of a former timber works in Finland.** **The soil on the site was contaminated with the pollutant pentachlorophenol, which is very toxic to many plants and animals.** **However, treatment of the contaminated soil with a particular fungus dramatically reduced the level of this pollution in a year.** **State how you would minimise the risks when handling samples of this polluted soil.** Mention of TWO safety factors Eg gloves; mask; fume cupboard.	**[2]**
3(d)(ii)	**If the soil samples are stored for two days before testing, suggest two precautions that should be taken if safe and reliable results are to be obtained.** Any TWO from Air tight environment Suitable temperature Keep contaminants away AVP.	**[2]**
3(d)(iii)	**(iii)Before treatment with the fungus, the soil contained 800 mg of pentachlorophenol per kg of soil.** **A year after treatment, the level of pentachlorophenol was reduced to 1.5% of its previous value per kilogram of soil.** **Use these figures to calculate the mass, in kg, of pentachlorophenol removed by the fungus from 200 tonnes of contaminated soil.** **1 tonne = 1000 kg; 1 g = 1000mg** 1.5% of 800 mg = 12 mg Per kilogram is 800 -12 = 788 mg Per tonne = 788 g Per 200 tonnes = 157.6/158 kg.	**[4]**

Question Number	Answer	Max Mark
3(e)(i)	**The toxic nature of pentachlorophenol has led to restrictions in its manufacture particularly because of serious health problems experienced by the workers engaged in its production.** **The first production method gave pentachlorophenol which was only 86% pure.** **Chromatography was used to separate pentachlorophenol and the other products present.** **Which technique can be used to identify the other products?** Mass spectroscopy/NMR spectroscopy.	**[1]**
3(e)(ii)	**The new process gave pentachlorophenol that was 92% pure.** **A customer required a purity of 99%.** **State two ways by which this purity could be achieved.** Alter the method to increase the yield Develop a process to remove the impurities.	**[2]**
3(e)(iii)	**A small scale process produced 5 kg of pentachlorophenol.** **Unfortunately the method took too long to come to completion.** **Suggest one way of reducing the time taken for this reaction to become complete.** Use a catalyst/heat at a higher temperature.	**[1]**
	Total	**[20]**

Assessment Objectives Grid (includes QWC)

Question	AO1	AO2	AO3	Total
1(a)	2			**2**
1(b)	1	1		**2**
1(c)	2	2		**4**
1(d)(i)	1			**1**
1(d)(ii)		2		**2**
1(e)	1	2		**3**
1(f)	2	2		**4**
1(g)(i)	1			**1**
1(g)(ii)	1	1		**2**
1(h)		2		**2**
1(i)(i)	2			**2**
1(i)(ii)	2	1		**3**
1(i)(iii)		1		**1**
1(i)(iv)		1		**1**
1(i)(v)	1			**1**
1(j)	2	4		**6**
2(a)(i)	1			**1**
2(a)(ii)	2			**2**
2(a)(iii)	2	1		**3**
2(a)(iv)	1			**1**
2(a)(v)	2			**2**
2(a)(vi)I	1			**1**
2(a)(vi)II		1		**1**
2(a)(vi)III	1			**1**
2(a)(vi)IV		1		**1**
2(a)(vi)V	2	1		**3**
2(b)(i)	1			**1**
2(b)(ii)	1	1		**2**
2(c)		2		**2**
2(d)	1			**1**
2(e)	3	3		**6**
2(f)(i)	1	1		**2**
2(f)(ii)		1		**1**
2(f)(iii)	1	1		**2**
3(a)	2			**2**
3(b)(i)	1			**1**
3(b)(ii)		1		**1**
3(c)(i)		2		**2**
3(c)(ii)I	1			**1**
3(c)(ii)II	1			**1**

3(d)(i)	2			**2**
3(d)(ii)	1	1		**2**
3(d)(iii)	1	3		**4**
3(e)(i)		1		**1**
3(e)(ii)		2		**2**
3(e)(iii)		1		**1**
Totals	**47**	**43**	**0**	**90**