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Centre number						Candidate number				
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**OXFORD CAMBRIDGE AND RSA EXAMINATIONS  
GENERAL CERTIFICATE OF SECONDARY EDUCATION**

**A321/02**

**TWENTY FIRST CENTURY SCIENCE  
CHEMISTRY A**

**Unit 1: Modules C1 C2 C3 (Higher Tier)**

**FRIDAY 17 JUNE 2011: Afternoon**

**DURATION: 40 minutes**

**SUITABLE FOR VISUALLY IMPAIRED CANDIDATES**

**Candidates answer on the question paper.  
A calculator may be used for this paper.**

**OCR SUPPLIED MATERIALS:**

**None**

**OTHER MATERIALS REQUIRED:**

**Pencil**

**Ruler (cm/mm)**

**READ INSTRUCTIONS OVERLEAF**

## **INSTRUCTIONS TO CANDIDATES**

- **Write your name, centre number and candidate number in the boxes on the first page. Please write clearly and in capital letters.**
- **Use black ink. Pencil may be used for graphs and diagrams only.**
- **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. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).**
- **Answer ALL the questions.**

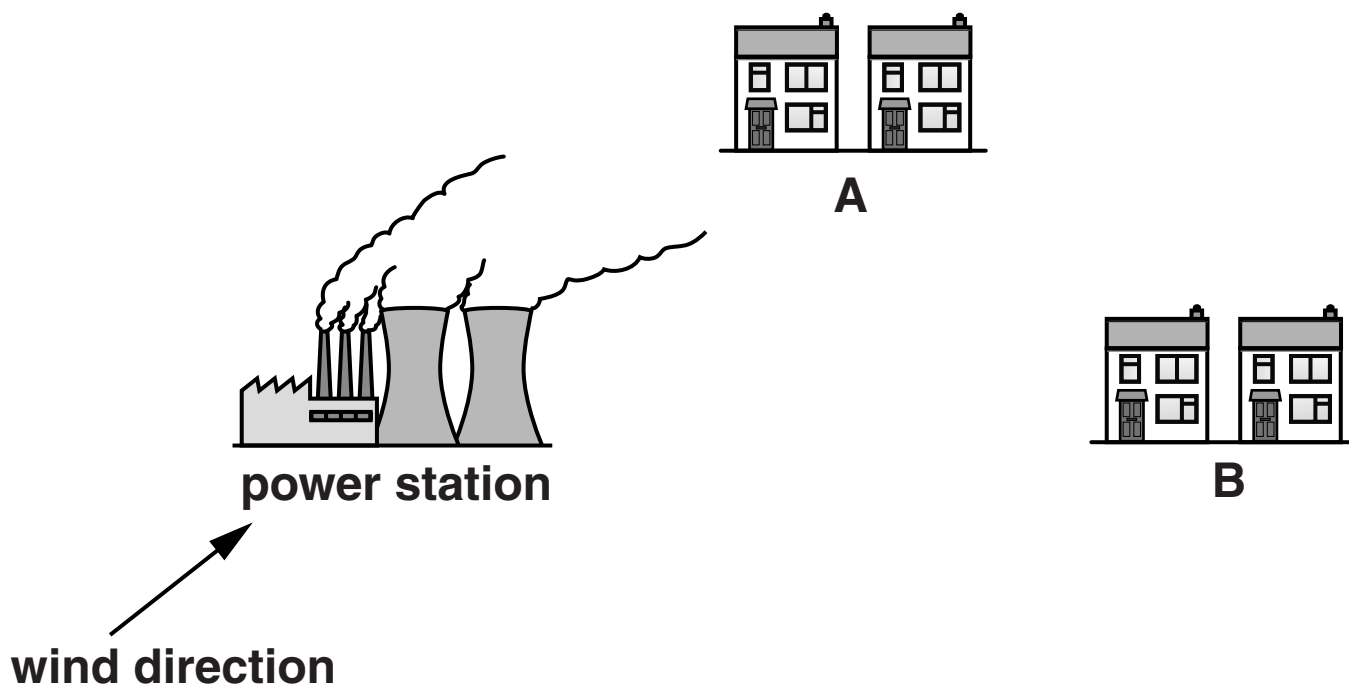
## **INFORMATION FOR CANDIDATES**

- **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 42.**

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**Answer ALL the questions.**

- 1 Scientists measure the sulfur dioxide concentration in the air at two places near to a power station that burns coal.**



**The map shows that houses at A are in the direction that the wind is blowing from the power station, but houses at B are not.**

**The scientists take five air samples at A and five air samples at B.**

Their results are shown in the table.

SULFUR DIOXIDE CONCENTRATION IN $\mu\text{g}/\text{m}^3$						
	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	BEST ESTIMATE
A	451	447	453	350	449	
B	115	102	112	106	118	111

(a) (i) Work out the best estimate for the sulfur dioxide concentration at A.

best estimate = \_\_\_\_\_  $\mu\text{g}/\text{m}^3$  [2]

- (ii) The scientists decide that there is a **REAL DIFFERENCE** between the sulfur dioxide concentration measurements at A and at B.

What information in the table supports this decision?

Put a tick (✓) in the box next to the correct answer.

The mean sulfur dioxide concentration at A is larger than that at B.

The ranges for the measurements taken at A and B overlap.

The wind is blowing towards A but is not blowing towards B.

The mean sulfur dioxide concentration for B is not within the range for A.

A is nearer to the power station than B.

[1]

- (iii) After discarding the outlier, the scientists suggest that the measurements taken at A are more reliable than those taken at B.**

**Which of these statements explains why they make this suggestion?**

**Put a tick (✓) in the box next to the correct answer.**

**The measurements at A are larger than those at B.**

**A is nearer to the power station than B.**

**The range of measurements at A is smaller than the range at B.**

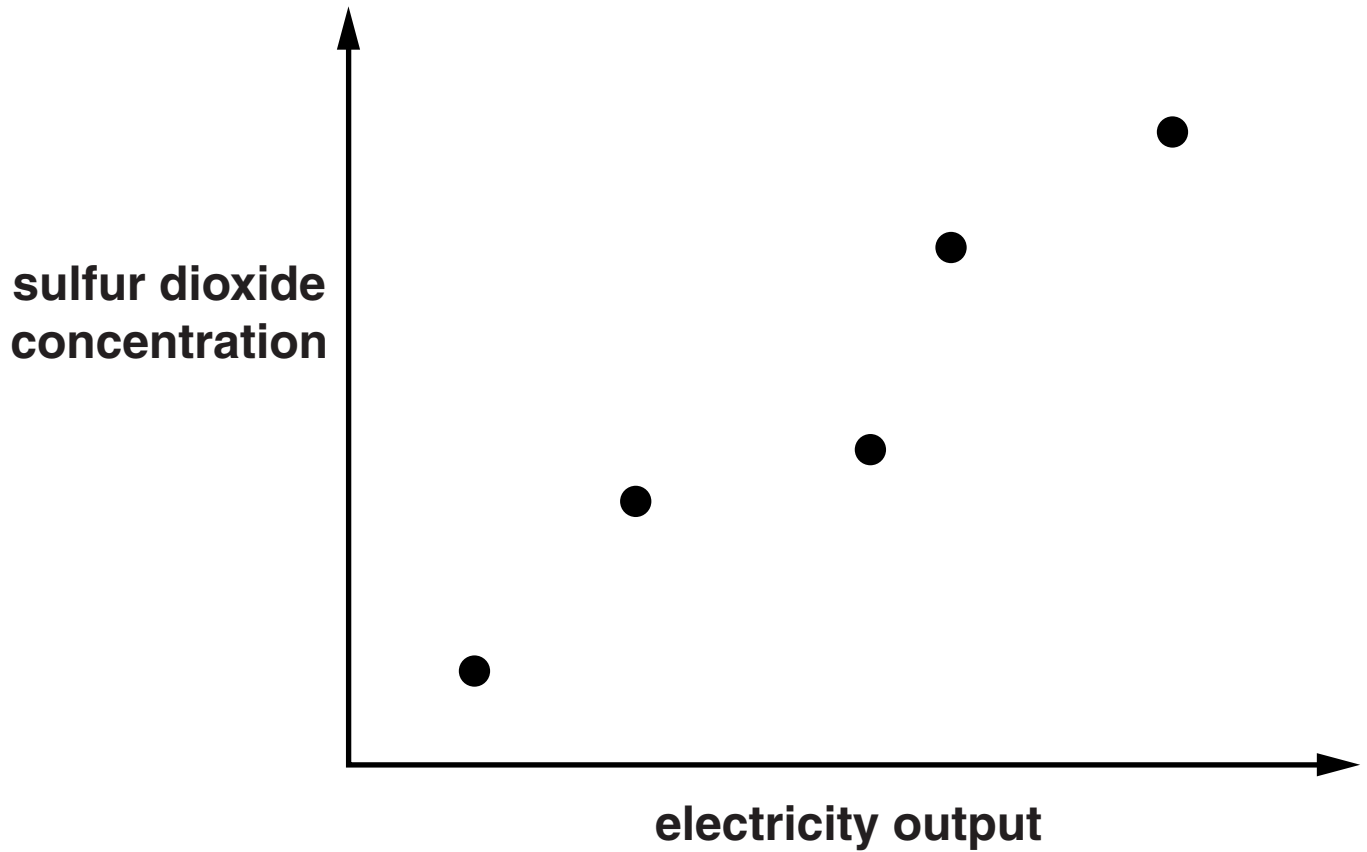
**The wind is blowing in the direction of A.**

**The best estimate for B is less than that for A.**

**[1]**

**(b) The scientists measure the sulfur dioxide concentration at A at different times.**

**They plot these measurements against the electricity output of the power station.**





**A group of people talk about the evidence in this graph.**

**ANDREW**  
The scientists only have one set of results. We cannot be sure that these are correct.

**AMY**  
As the electricity output increases the air pollution gets worse.

**JEFF**  
Air pollution is worse at A because it is in the wind direction from the power station.

**EDWIN**  
The air pollution at A is caused by the power station.

**CLARISSA**  
Coal contains sulfur compounds that make sulfur dioxide as they burn.

**(i) Who is describing a correlation?**

answer \_\_\_\_\_ [1]

**(ii) Who is suggesting that scientific claims should be replicated by other scientists?**

answer \_\_\_\_\_ [1]

**(iii) Who is explaining a CAUSAL LINK for the correlation shown in the graph?**

answer \_\_\_\_\_ [1]

**(c) Suggest TWO actions that could be taken to reduce the sulfur dioxide pollution caused by the power station.**

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**[2]**

**[Total: 9]**

**2 An investigation shows that there is a correlation between the number of cars that enter a town and the level of nitrogen dioxide in the air.**

**(a) The town council decides to charge a fee for every car with a driver but no passengers.**

**There is no fee for cars with passengers.**



**This decision reduces the air pollution in the town.**

**Explain why.**

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**[3]**

**(b) Complete these sentences about nitrogen dioxide pollution.**

**In a car engine, nitrogen and oxygen from**

\_\_\_\_\_ **react to form**

\_\_\_\_\_ .

**This gas is released from the car exhaust and**

**combines with \_\_\_\_\_ to**

**form \_\_\_\_\_ .**

**[2]**

**[Total: 5]**

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- 3 (a) Shirts can be made using cotton fibres. These fibres are made from a natural polymer.**

**Shirts can also be made using polyester fibres. These fibres are made from a synthetic polymer.**

**The table shows a Life Cycle Assessment (LCA) for each shirt over a lifetime of two years.**

<b>FACTOR</b>	<b>PER kg OF COTTON SHIRT</b>	<b>PER kg OF POLYESTER SHIRT</b>
<b>energy used in MJ</b>	<b>140.1</b>	<b>171.5</b>
<b>crude oil in kg</b>	<b>0</b>	<b>1.53</b>
<b>fertilisers in g</b>	<b>457</b>	<b>0</b>
<b>carbon dioxide given out in kg</b>	<b>5.3</b>	<b>3.8</b>
<b>water usage in dm<sup>3</sup></b>	<b>26700</b>	<b>1900</b>

**Each of the factors in the table helps to decide which type of shirt is more sustainable.**

**For each factor, which type of shirt is more sustainable?**

**Put a tick (✓) in the correct box for each factor.**

<b>FACTOR</b>	<b>TYPE OF SHIRT</b>	
	<b>COTTON SHIRT</b>	<b>POLYESTER SHIRT</b>
<b>energy</b>		
<b>crude oil</b>		
<b>fertilisers</b>		
<b>carbon dioxide</b>		
<b>water</b>		

**[2]**

**(b) The strength of fibres can be increased by cross-linking their polymer molecules.**

**Explain how cross-linking increases the strength of polymers.**

**Use ideas about the forces between polymer chains in your answer.**

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**[3]**



**(c) Poly(ethene) is a synthetic polymer.**

**Both 'cling film' food wrapping and plastic 'washing up' bowls are made from poly(ethene).**

**The outcomes of their Life Cycle Assessments are different.**

**Which of these statements explain this difference?**

**Each statement refers to the same mass of poly(ethene).**

**Put ticks (✓) in the boxes next to the TWO best answers.**

**Making cling film from the poly(ethene) uses a different amount of energy than making plastic bowls from the same polymer.**

**Making poly(ethene) for cling film causes less environmental impact than making the same polymer for plastic bowls.**

**The poly(ethene) from a plastic bowl uses up more space in landfill than the same mass of poly(ethene) from cling film.**

**Transporting cling film uses less fuel than transporting plastic bowls.**

**The poly(ethene) used for plastic bowls rots away more quickly than that used for cling film.**

**Cling film is used once and then thrown away, but a plastic bowl is used many times before being thrown away.**

**[2]**

**[Total: 7]**

**4 The table shows data about ropes made from a number of materials. Each of the ropes has the same diameter.**

<b>MATERIAL</b>	<b>BREAKING LOAD IN kg</b>	<b>SOURCE</b>	<b>WATER ABSORPTION</b>	<b>EASE OF ROTTING</b>
<b>coir</b>	<b>245</b>	<b>coconut husk</b>	<b>high</b>	<b>high</b>
<b>hemp</b>	<b>1295</b>	<b>hemp plant stem</b>	<b>high</b>	<b>high</b>
<b>nylon</b>	<b>4650</b>	<b>synthetic</b>	<b>low</b>	<b>low</b>
<b>polyester</b>	<b>2750</b>	<b>synthetic</b>	<b>low</b>	<b>low</b>
<b>poly(propene)</b>	<b>2940</b>	<b>synthetic</b>	<b>low</b>	<b>low</b>
<b>sisal</b>	<b>1225</b>	<b>sisal plant leaves</b>	<b>high</b>	<b>high</b>

- (a) In a country with no chemical industry most of the rope used is made from hemp and little from poly(propene).**

**Which statements give the best reasons for this difference?**

**Use the table to help you.**

**Put ticks (✓) in the boxes next to the TWO best answers.**

**Hemp rots more easily than poly(propene).**

**Poly(propene) rope is expensive because it has to be imported.**

**Rope made from natural material lasts longer.**

**Hemp is stronger than poly(propene).**

**Natural materials are available locally.**

**Poly(propene) absorbs less water than hemp.**

**[2]**

**(b) In their Life Cycle Assessments, the sustainability of rope made from poly(propene) and rope made from hemp can be compared.**

**Explain how.**

**Your answer should include**

- how the information from the table can be used**
- what additional information would be needed.**

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**[4]**

**(c) A company making a synthetic rope decides to use a more flexible form of the polymer.**

**How could the company increase the flexibility of the polymer?**

**Put a tick (✓) in the box next to the correct answer.**

**increase the cross linking**

**increase the polymer chain length**

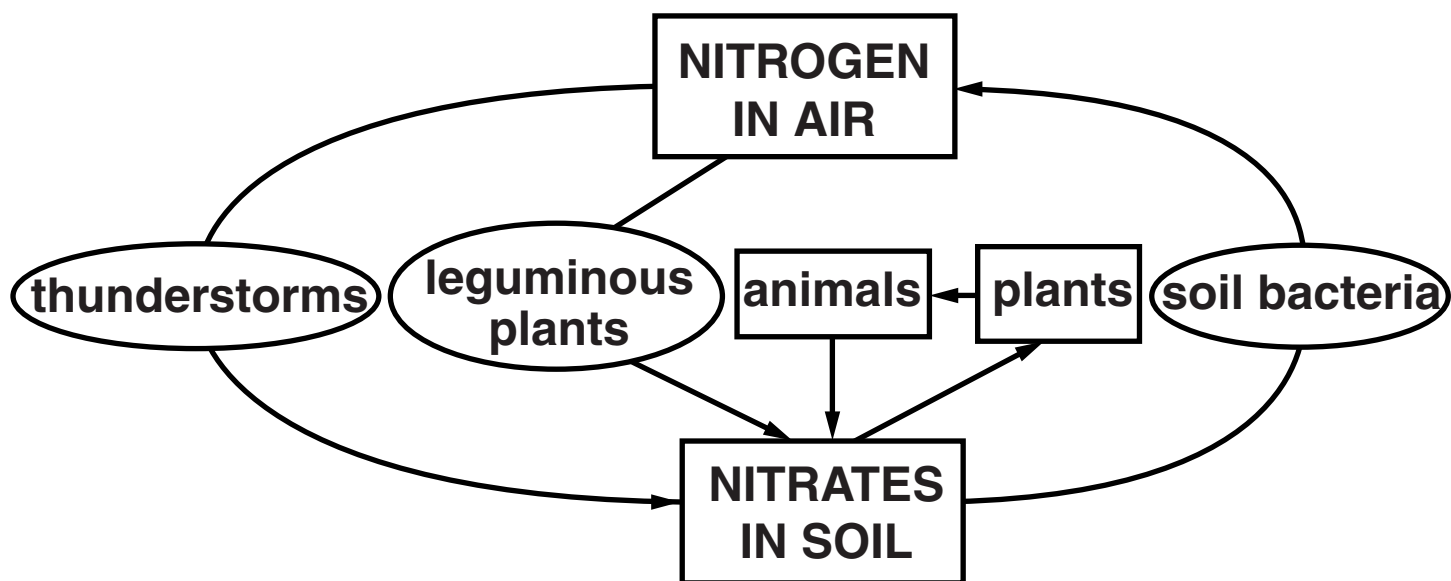
**polymerise more molecules into the polymer**

**add plasticizer to the polymer**

**[1]**

**[Total: 7]**

5 The diagram shows **NATURAL PROCESSES** taking place in the nitrogen cycle.



(a) How is nitrogen in the air changed to nitrates in soil during thunderstorms?

Put ticks (✓) in the boxes next to the **TWO** correct stages.

Nitrogen and oxygen react to form nitrates.

Nitrogen reacts with water in the rain.

Nitrogen and oxygen react to form nitrogen dioxide.

Nitrates dissolve in rain water.

Nitrogen and oxygen dissolve in rain water.

Nitrogen dioxide dissolves in rain water.

[2]

**(b) Plants obtain nitrogen by absorbing nitrates from the soil.**

**When crops are harvested this nitrogen is lost from the soil.**

**What other elements, essential for plant growth, are also lost from the soil when crops are harvested?**

**Put a ring around each correct element.**

**ARGON**

**CARBON**

**CHLORINE**

**OXYGEN**

**PHOSPHORUS**

**POTASSIUM**

**SODIUM**

**[2]**

**(c) Organic farmers return nitrogen to the soil.**

**Which statements describe how they do this?**

**Put ticks (✓) in the boxes next to the TWO correct answers.**

**They add bacteria to the soil.**

**They add nitric acid to the soil.**

**They spread synthetic fertiliser on the soil.**

**They spread animal manure on the soil.**

**They use an annual crop rotation.**

**They spray rainwater onto the soil.**

**[2]**

**[Total: 6]**



6 (a) The table lists three types of chemical.

Show which elements are present in each chemical.

Put ticks (✓) in the correct boxes.

CHEMICAL	ELEMENTS PRESENT			
	CARBON	HYDROGEN	NITROGEN	OXYGEN
hydrocarbon				
sugar				
protein				

[3]

(b) After a meal, digestion breaks down proteins into amino acids. These amino acids are absorbed into the blood stream.

Excess amino acids are broken down into a waste product.

(i) Where are amino acids broken down?

\_\_\_\_\_ [1]

(ii) What waste product is made when amino acids break down?

\_\_\_\_\_ [1]

(iii) Which organ excretes this waste product?

\_\_\_\_\_ [1]

**(c) The labels on food products show the chemicals that they contain.**

**Explain how consumers can use this information to avoid some health problems.**

**Your answer should include**

- the names of two types of chemicals listed on food labels**
- the effects these have on health.**

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**[2]**

**[Total: 8]**

**END OF QUESTION PAPER**

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