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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)**

WEDNESDAY 17 JUNE 2009: Morning

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 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 42.**

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Answer ALL the questions.

1 This question is about gases that may be found in the air.

(a) The table shows diagrams representing the molecules of three gases.

Complete the table by adding the missing names and formulas.

Use the key below the table to help you.

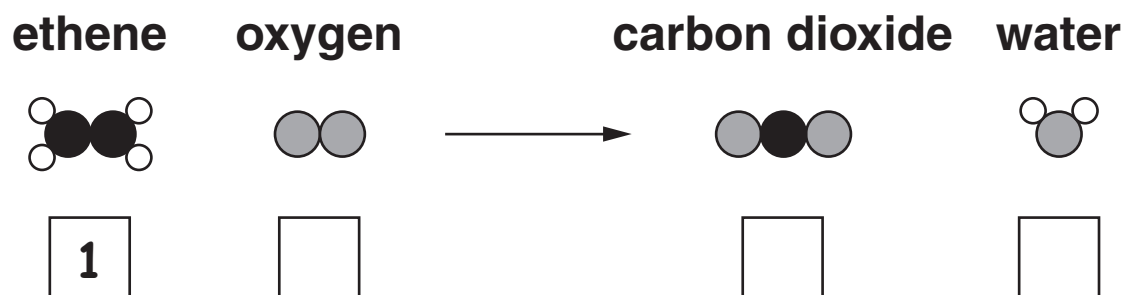
NAME	FORMULA	MOLECULE
		
		
		

KEY: ● carbon ◻ nitrogen
○ oxygen ◻ sulfur

[3]

(b) A molecule of ethene, C_2H_4 , burns in air to form carbon dioxide and water.

Complete the diagram to show how many molecules of oxygen react and how many molecules of carbon dioxide and water are formed.



[3]

[TOTAL: 6]

2 A power station burning coal releases sulfur dioxide into the air.

On most days, wind blows fumes from the power station across a nearby town.

A new device is fitted to reduce the amount of sulfur dioxide released into the air.

A scientist takes measurements of the sulfur dioxide concentration in the air.

He does this for five days BEFORE and five days AFTER this device is fitted.

He takes each measurement in the same part of the town and at the same time on each day.

These results are shown in the table.

	sulfur dioxide concentration in $\mu\text{g}/\text{m}^3$				
day of sample	1	2	3	4	5
<u>BEFORE</u> device fitted	644	578	355	613	593
<u>AFTER</u> device fitted	322	318	297	307	311

(a) Why did the scientist take measurements on more than one day before and more than one day after the device was fitted?

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

to make sure his measuring device was working

to get practice in using his measuring device

to obtain a more reliable set of results

to use one of the results as a control

[1]

(b) Look at the results taken BEFORE the device was fitted.

Sample 3 is much lower than the other four measurements.

(i) The scientist says that this result is an outlier.

Which of these statements describes why this result is an outlier?

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

This is the lowest of the five results.

This result is well outside the range of the other four results.

This result is lower than the mean of the other four results.

The other four results are all within a narrow range.

[1]

(ii) Which of these statements give the best explanations of why this result for sample 3 was lower?

Put ticks (✓) in the boxes next to the two BEST answers.

The device was fitted on that day.

There were more cars driven in the town on that day.

It did not rain on that day.

The wind changed direction on that day.

The power station burned less coal during that day.

[2]

(c) The scientist excludes the outlier and calculates the mean for each set of results.

He takes the mean values as best estimates of the sulfur dioxide concentration before and after the device was fitted.

	BEST ESTIMATE IN $\mu\text{g}/\text{m}^3$
before the device was fitted	607
after the device was fitted	311

What evidence justifies the claim that there is a REAL DIFFERENCE between the two best estimates?

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

The means for the two sets of measurements are different.

The ranges for the two sets of measurements are different.

The ranges for the two sets of measurement do not overlap.

The mean of the measurements taken before the device was fitted is almost twice the mean of the measurements taken after the device was fitted.

The mean of the measurements taken before the device was fitted is outside the range of the measurements taken after the device was fitted.

[2]

- (d) The scientist measures the mean sulfur dioxide concentration in six other towns. These towns all have a similar population size.

He also monitors the number of children treated for asthma in these towns.

TOWN	SULFUR DIOXIDE CONCENTRATION IN $\mu\text{g}/\text{m}^3$	CHILDREN TREATED FOR ASTHMA
A	539	84
B	452	73
C	328	56
D	275	49
E	182	37
F	153	33

The scientist decides that there is a CORRELATION between the mean sulfur dioxide concentration and the number of children treated for asthma attacks in these towns.

Here are five additional statements about sulfur dioxide and asthma.

- A** Similar results for sulfur dioxide levels and numbers of children treated for asthma attacks are found by other scientists.
- B** Nationally the emission of sulfur dioxide into the air has decreased over the past ten years.
- C** Sulfur dioxide is an acidic gas with a choking smell.
- D** Scientists publish an explanation of how sulfur dioxide causes asthma attacks.
- E** Nationally the number of children treated for asthma attacks has increased during the past ten years.

(i) Which statement, A, B, C, D or E supports the CORRELATION?

answer _____ [1]

(ii) Which statement A, B, C, D or E provides a CAUSAL LINK for the asthma attacks?

answer _____ [1]

[TOTAL: 8]

3 Sam and Julie want to buy a large stirring spoon for making jam.

They choose from spoons made from three different materials. These are metal, plastic and wood.

They use ideas about the Life Cycle Assessment (LCA) for each spoon to help them choose.

(a) Which of these parts of a Life Cycle Assessment will be the SAME for each type of spoon?

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

the environmental impact of making the material

the environmental impact of making the spoon from the material

the environmental impact of using the spoon

the environmental impact of disposing of the spoon

[1]

(b) Julie says that the wooden spoon is more sustainable than the other two spoons.

Which of these statements support her idea?

Put ticks (✓) in the boxes next to the THREE statements.

Metal spoons last a long time.

The supply of metal ores is finite.

Trees have to be chopped down to make wood.

More trees can be planted to replace those used for wood.

Some plastics can be recycled.

Plastics are made from crude oil, which will one day run out.

Plastics and metal spoons can be cleaned easily.

[3]

(c) The material used to make the plastic spoon is poly(ethene).

Poly(ethene) is also used to make ‘cling-film’ wrapping for food.

These two products are made from the same material. Which parts of their Life Cycle Assessments will be DIFFERENT?

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

The energy input for making the material.

The environmental impact of use and disposal of the product.

The environmental impact of obtaining ethene from crude oil.

The environmental impact of making the product from the material.

The sustainability of making poly(ethene) from ethene.

[2]

(d) In a developing country most of the rural population use wooden spoons rather than those made of metal or plastic.

Which of the following statements give the best reasons for this?

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

Wood may be available locally, but metal and plastic are not.

Wooden spoons are cheaper to import than metal or plastic spoons.

It is easy to make wooden spoons, but the technology to make spoons from metal or plastic may not be available.

Wooden spoons last longer than metal or plastic spoons.

Plastic spoons will melt in the high temperatures in developing countries.

[1]

[TOTAL: 7]

4 A company plans to make and sell garden arches.

They look at a variety of materials that could be used to make this product.

Some properties and features of these materials are shown in the table on the opposite page.

(a) Scientists working for the company make a list of design requirements for the garden arch.

A Must last a long time even when exposed to severe weather conditions.

B Must bend a little but not break in a strong wind.

C Must not break easily if knocked over.

D Must be easy to make with a shiny coloured surface which will not chip or peel off.

(i) Select TWO of these design requirements which are not satisfied by the material fired clay. Choose from A, B, C and D.

_____ and _____ [1]

(ii) Select TWO of these design requirements which are not satisfied by the material iron.

_____ and _____ [1]

(iii) Select TWO of these design requirements which are not satisfied by the material wood.

_____ and _____ [1]

MATERIAL	FLEXIBILITY	STRENGTH	DENSITY	CORROSION	COLOURING	SHAPING
fired clay (pottery)	stiff	brittle	medium	resistant	must be glazed	must be shaped and then fired in an oven
iron	stiff	very strong	high	rusts	must be painted	must be melted at high temperature then cast in a mould
PVC	very flexible	bends under load	low	resistant	dye added to polymer	can be melted at low temperature and cast in a mould
wood	flexible	bends under load	medium	rots in time	must be painted	must be cut to shape

(b) The company chooses to use PVC to make the garden arches.

They decide that the PVC they use must be stiffer.

What method can they use to make the PVC stiffer?

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

Use PVC with less plasticizer added to it.

Decrease the crystallinity of the PVC.

Melt the PVC and then cool it.

Increase the bond strength in the chains of the PVC.

Increase the chain length of the PVC.

[2]

- (c) One of the scientists suggests that they use a cross-linked polymer instead of PVC.

Which THREE statements, when taken together, explain why this cross-linked polymer is stiffer than PVC?

Put ticks (✓) in the boxes next to the correct statements.

Solid polymers are held together by the forces between the molecules.

The stronger the forces between the molecules of the polymer, the less energy is needed to push them apart.

Cross-linking makes the forces in the polymer chains stronger.

Cross-linking makes the forces between the polymer chains stronger.

PVC has strong forces in the polymer chains but weak forces between the polymer chains.

PVC has weak forces in the polymer chains but strong forces between the polymer chains.

[2]

[TOTAL: 7]

5 Look at the comments made by these two farmers.



I use intensive farming methods.
I use artificial fertilisers on my farm.
I also use pesticides and herbicides.



I farm organically.
I use manure as a fertiliser on my farm.
I do not use pesticides or herbicides.

- (a) (i) Both manure and artificial fertilisers contain compounds of nitrogen.

Why is it important for farmers to add nitrogen to the soil?

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

Adding nitrogen reduces the acidity of the soil.

Plants take nitrogen from the soil as they grow.

Plants use nitrogen in the process of photosynthesis.

Nitrogen kills pests that attack the crops.

When crops are harvested nitrogen is not replaced in the soil.

[2]

- (ii) Plants use nitrogen to make proteins. One of the other main elements in proteins is oxygen.

What are the other two main elements contained in proteins?

_____ and _____ [2]

- (b) (i) Some organically grown food may contain harmful chemicals.**

Which of these statements give the best explanations of how this may happen?

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

Some crops naturally contain toxic chemicals which cause harm if they are not cooked properly.

Harmful chemicals from manure may be absorbed into the crops.

Pesticides sprayed onto the crops may be left on the outside or absorbed into the food.

Crops may take in toxic chemicals from the air.

During storage, crops may be contaminated by a mould that produces toxic chemicals.

[2]

- (ii) **Farmers in developing countries have traditionally used organic farming methods.**

Much of the aid now given to these countries is in the form of artificial fertiliser.

Why is artificial fertiliser supplied instead of manure?

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

Artificial fertiliser is easier to make in large quantities.

Artificial fertiliser causes less damage to the environment.

Manure would be more expensive to transport.

Manure does not contain all of the nutrients that are contained in artificial fertiliser.

[1]

[TOTAL: 7]

6 Look at this label from a carton of ice cream.

	per 100 g
energy	914 kJ
protein	3.1 g
carbohydrate	28.0 g
<i>of which sugar is</i>	22.4 g
fat	10.6 g

- (a) Complete these sentences to show what happens to the protein content of this ice cream after it has been eaten.**

The protein molecules are digested into smaller molecules called _____ .

Some of these small molecules are used to make protein in the body. Those that are not used are carried by the blood stream to the

_____ where they are

broken down to form _____ .

This is excreted by the _____

in a liquid called _____ . [3]

(b) This ice cream is not a good food for a person who has type 1 diabetes.

Which THREE of these statements, when put together, explain why?

Put ticks (✓) in the boxes next to the correct statements.

In type 1 diabetes the body no longer responds to its own insulin.

In type 1 diabetes the pancreas does not produce enough insulin.

Sugar in the ice cream is quickly absorbed into the blood stream, causing a rapid rise in blood sugar level.

Excess sugar in the blood is converted to fat and stored in the body.

Excess sugar in the blood reduces the amount of insulin produced by the pancreas.

Insulin is needed to regulate the amount of sugar in the blood.

[2]

(c) Obesity is one of the risk factors for type 2 diabetes.

Despite this the number of obese people in the United Kingdom is increasing.

What do people need to consider when assessing the risk to their health of getting type 2 diabetes as a result of being obese?

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

the number of people in the United Kingdom who are obese

the chance of an obese person contracting type 2 diabetes

the number of people in the United Kingdom with type 2 diabetes

the chance of a person who is obese having cancer

the consequences of having type 2 diabetes

how the consequences of having type 2 diabetes compare with those of having type 1 diabetes

[2]

[TOTAL: 7]

END OF QUESTION PAPER

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