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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 18 JUNE 2010: 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 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. Additional paper may be used if necessary but you must clearly show your Candidate Number, Centre Number and question number(s).**

INFORMATION FOR CANDIDATES

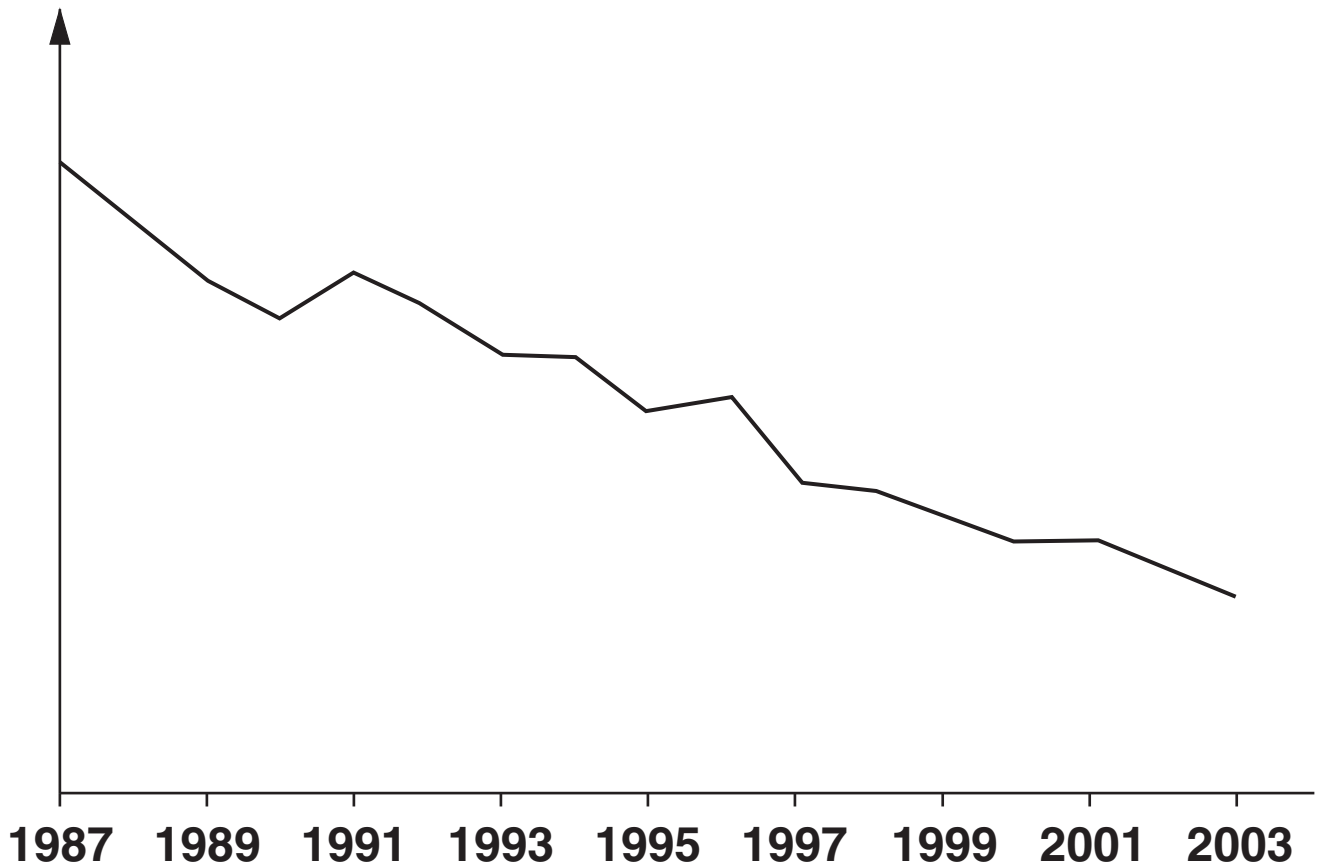
- **The number of marks is given in brackets [] at the end of each question or part question.**
- **The total number of marks for this paper is 42.**

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Answer ALL the questions.

- 1 The graph shows how the acidification of rivers and lakes caused by sulfur compounds changed between 1987 and 2003 in the United Kingdom.

acidification caused
by sulfur compounds



- (a) The graph shows that acidification caused by sulfur compounds fell from 1987 to 2003.

Which of these statements are reasons for this fall?

Put ticks (✓) in the boxes next to the TWO best reasons. [2]

There was a decrease in the number of cars sold.

More cars and power stations changed to using low sulfur fuels.

There was an increase in the number of electrical appliances in people's homes.

More cars were fitted with catalytic converters.

More power stations were fitted with devices to remove sulfur compounds from flue gases.

More people changed from driving cars to using public transport.

[2]

(b) Much of the acidification shown in the graph is caused by acid rain.

Describe how the burning of fuel in a power station leads to the formation of acid rain.

[3]

(c) Acid rain is also formed from nitrogen dioxide.

Look at these statements.

- A Air and petrol vapour enter the car engine.**
- B Nitrogen in petrol reacts with oxygen from air to form nitrogen monoxide.**
- C Nitrogen monoxide is released into the air from the car exhaust.**
- D Nitrogen dioxide is released into the air from the car exhaust.**
- E Nitrogen monoxide reacts with oxygen in the air to make nitrogen dioxide.**
- F Fuel burns in the car engine releasing heat to produce a very high temperature.**
- G Nitrogen and oxygen from air react to form nitrogen monoxide.**

Choose the FIVE statements which correctly describe how the burning of fuel in car engines results in the formation of nitrogen dioxide.

Then put the statements in the correct order in the boxes. The first one has been done for you.

A				
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[3]

[Total: 8]

2 Petrol is a mixture of hydrocarbons.

When hydrocarbons burn completely in air the products are carbon dioxide and water.

In a car engine they burn incompletely, also producing carbon monoxide.

Modern cars are fitted with catalytic converters, which decrease the amount of carbon monoxide that is released into the air.

(a) Scientists test two types of catalytic converter: an old model and a new model.

For each catalytic converter, fitted to the same engine, the scientists took several measurements of the percentage of carbon monoxide in the exhaust gas.

They used their results to get a best estimate of the percentage of carbon monoxide released from each catalytic converter.

PERCENTAGE OF CARBON MONOXIDE						
	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	BEST ESTIMATE
old catalytic converter	0.243	0.246	0.243	0.245	0.243	0.244
new catalytic converter	0.168	0.170	0.198	0.167	0.167	

- (i) Taking several measurements gives a better estimate of the percentage of carbon monoxide released than taking just one measurement.

Explain why.

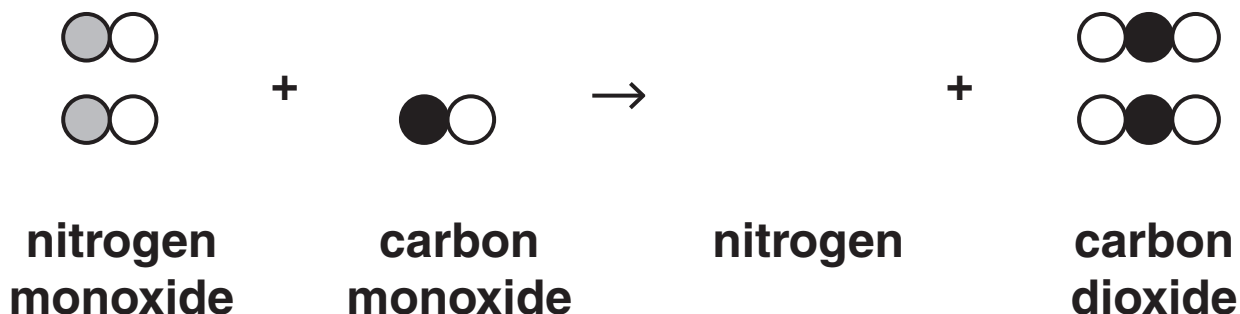
[2]

- (ii) Calculate the best estimate for the NEW catalytic converter.

best estimate = _____ % [2]

(b) A reaction taking place in each catalytic converter decreases the amount of carbon monoxide released.

The diagram shows the reactants and products for this reaction.



TWO molecules are missing from the diagram, ONE from the reactants and ONE from the products.

Put ticks (✓) in the boxes to show which molecule should be added to the REACTANTS and which molecule should be added to the PRODUCTS.

REACTANTS

PRODUCTS











[2]

[Total: 6]

3 A toy company wants to make plastic models using a polymer.

Scientists working for the company test two different polymers to find the temperature at which each polymer melts.

MELTING TEMPERATURE IN °C						
	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	MEAN
polymer A	135	137	135	134	134	135
polymer B	265	265	264	262	264	264

(a) The scientists tested polymer samples of the same size.

They used the same equipment, in the same way, each time.

Explain why it is necessary to control factors in this way.

[2]

(b) Polymer A and polymer B are both made from the same small molecules.

(i) Which statements explain why polymer A has a lower melting temperature than polymer B?

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

The forces of attraction between the atoms in each molecule of polymer A are weaker.

The forces of attraction between the molecules of polymer A are weaker.

Different atoms in the two polymers are bonded together in different ways.

Some atoms in the two polymers have stronger forces of attraction between them than others.

The higher the force of attraction between molecules, the more energy is needed to separate them.

[2]

(ii) Suggest two modifications that may have been made to polymer B to make it melt at a higher temperature than polymer A.

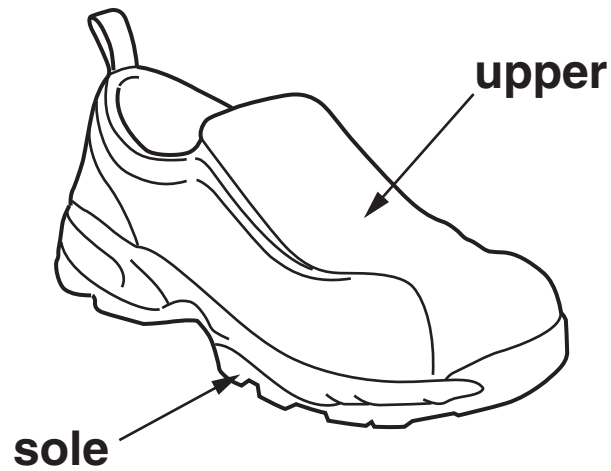
modification 1 _____

modification 2 _____

[2]

[Total: 6]

- 4 For many products, new materials have replaced the materials that were used in the past. These new materials often have better properties than the old ones.**



Soles of shoes used to be made of leather.

Soles of shoes are now usually made from polyurethane.

- (a) (i) The Life Cycle Assessment (LCA) of a shoe with a polyurethane sole is different to that of a shoe with a leather sole.**

Which of these reasons explain this difference?

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

Leather is renewable but polyurethane is not.

Leather has a more attractive appearance than polyurethane.

Leather is more expensive to buy than polyurethane.

Leather will rot when disposed of in landfill but polyurethane will not.

The manufacture of polyurethane uses more energy than the manufacture of leather.

Leather has been used for a longer period of time than polyurethane.

[2]

- (ii) A shoemaker in a developing country is more likely to use leather than plastics.

Which statements give the best explanation for this?

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

Plastics have to be imported and so are more expensive than leather.

It is easier to make shoes from leather than from plastics.

Leather is more durable, so the shoes will last longer.

Leather can be made locally from animals kept in the area.

Plastic shoes are not suitable for wearing in a developing country.

[2]

- (b) The plastic polyurethane is used to make shoe soles and the foam filling for sofas.**

The contribution made by polyurethane to the Life Cycle Assessment (LCA) of a shoe is different to that for a sofa.

Which of these statements explain this difference?

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

A sofa is likely to last a lot longer before disposal than a pair of shoes.

Manufacturing the two products from polyurethane uses different amounts of energy.

The polyurethane used in foam is made from different small molecules to that used in shoe soles.

Turning polyurethane into foam uses chemicals that are not used to make a shoe sole.

Polyurethane foam will rot quickly in landfill but polyurethane shoe soles will not.

Making the polyurethane used for foam takes more energy than making the polyurethane used for shoe soles.

[3]

[Total: 7]

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- 5 **Diabetes is a disorder that affects the way the body processes sugar.**

In a person with diabetes, less sugar is removed from the blood for storage in the liver.

The resulting high blood sugar level causes symptoms such as excessive thirst, weight loss and poor vision. When untreated, it can lead to coma and death.

There are two types of diabetes: type 1 and type 2.

- (a) Decide whether each STATEMENT best applies to TYPE 1 DIABETES or TYPE 2 DIABETES.**

Put a tick (✓) in the correct box in each row.

STATEMENT	TYPE 1 DIABETES	TYPE 2 DIABETES
cannot be controlled by diet and exercise		
is less likely to occur in young people		
is caused when the body no longer responds to its own insulin		

[2]

- (ii) People who have diabetes are told to avoid food that has a high sugar content.

Which of these statements, when taken together, use ideas of RISK AND CONSEQUENCE to suggest why they should avoid this food?

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

Only a few food items have a high sugar content.

Eating food with a high sugar content will cause a person with diabetes to have a high blood sugar level.

Avoiding food with a high sugar content helps a person to avoid getting overweight.

Both types of diabetes involve the way the body processes sugar.

A high blood sugar level may lead to serious symptoms.

When the sugar level in the blood rises, the liver stores the excess sugar.

[2]

(b) People who have diabetes may choose to eat foods that contain the sweetener sorbitol instead of glucose.

It has been suggested that eating high levels of sorbitol may cause digestive problems for some people.

Four friends talk about eating foods sweetened with sorbitol.

JASON

Foods containing sorbitol shouldn't be eaten at all.

ROSIE

There's no proof that sorbitol is harmful, so it is safe to eat.

EMMA

We're not sure whether sorbitol will cause harm to a person.

STEVE

It's best not to eat foods containing sorbitol in large quantities, to avoid any possible side effects.

Which TWO people's views, when taken together, describe how to apply the PRECAUTIONARY PRINCIPLE to eating foods containing sorbitol?

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

Jason

Rosie

Steve

Emma

[2]

[Total: 6]

6 Plants obtain nitrogen by absorbing nitrogen compounds from the soil. When crops are harvested this nitrogen is not returned to the soil.

(a) Complete this sentence to describe how plants use the nitrogen in nitrogen compounds that they absorb from the soil.

Plants use nitrogen to make small molecules

called _____ which are

then used to make natural polymers called

_____ .

[2]

(b) Some nitrogen is added to soil by natural processes that require no action from farmers.

Which two statements, when taken together, describe one of these natural processes?

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

Lightning makes oxygen and nitrogen react to form nitrogen oxides.

Plants absorb nitrogen gas from the air.

Ammonia is made from nitrogen and hydrogen.

Nitrogen oxides dissolve in rain which falls on the soil.

Ammonia is used to make nitrates to use as fertiliser.

Plants use nitrogen gas to make nitrates.

[2]

- (c) Synthetic fertilisers are not used in organic farming. Instead nitrogen compounds are added to the soil in other ways.**

One way is to add manure.

Describe and explain one OTHER organic farming method that adds nitrogen compounds to the soil.

[2]

- (d) Most farmers in the United Kingdom add synthetic fertilisers to their soil. Most farmers in developing countries add manure instead.**

Suggest reasons for this difference.

[3]

[Total: 9]

END OF QUESTION PAPER

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