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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)

MONDAY 17 JANUARY 2011: 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, 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.**
- **The Periodic Table is provided.**

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QUESTION 1 STARTS ON PAGE 4

Answer ALL the questions.

1 This question is about food additives.

(a) Complete this table about food additives.

TYPE OF FOOD ADDITIVE	PURPOSE
	keep food safe to eat for longer
	replace sugar in processed foods
emulsifiers	

[3]

(b) Labels on packets of food include the E numbers of additives.

An E number indicates that the additive has passed a safety test and been approved for use.

Despite this some people choose NOT to buy food which contains certain E numbers.

Suggest why they take this decision.

Use ideas about the PRECAUTIONARY PRINCIPLE in your answer.

[3]

(c) Scientists develop a new food additive.

It needs to be used in a safe way that is not a risk to people.

How will its use in food be controlled to make it safe?

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

The scientists who developed the new additive will decide on a safe level for it.

The use of the additive will be subject to official actions and laws.

The company making the additive will decide how much can be used.

Food manufacturers will decide how much additive is safe to use.

A scientific advisory committee will carry out a risk assessment for the additive.

[2]

[Total: 8]

2 (a) Plants need nitrogen to make amino acids and proteins.

Which three other elements are present in all amino acids and proteins?

1 _____

2 _____

3 _____

[2]

(b) Some elements move between plants, animals and the environment.

Write down TWO ways that this happens.

[2]

(c) Farmers add nitrogen compounds to the soil.

Which two statements explain why they need to do this?

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

Nitrogen is a gas so it escapes from the soil.

Plants take nitrogen compounds from the soil as they grow.

Nitrogen kills weeds that grow in the soil.

Nitrogen kills pests that attack the crops.

When crops are harvested, nitrogen is not returned to the soil.

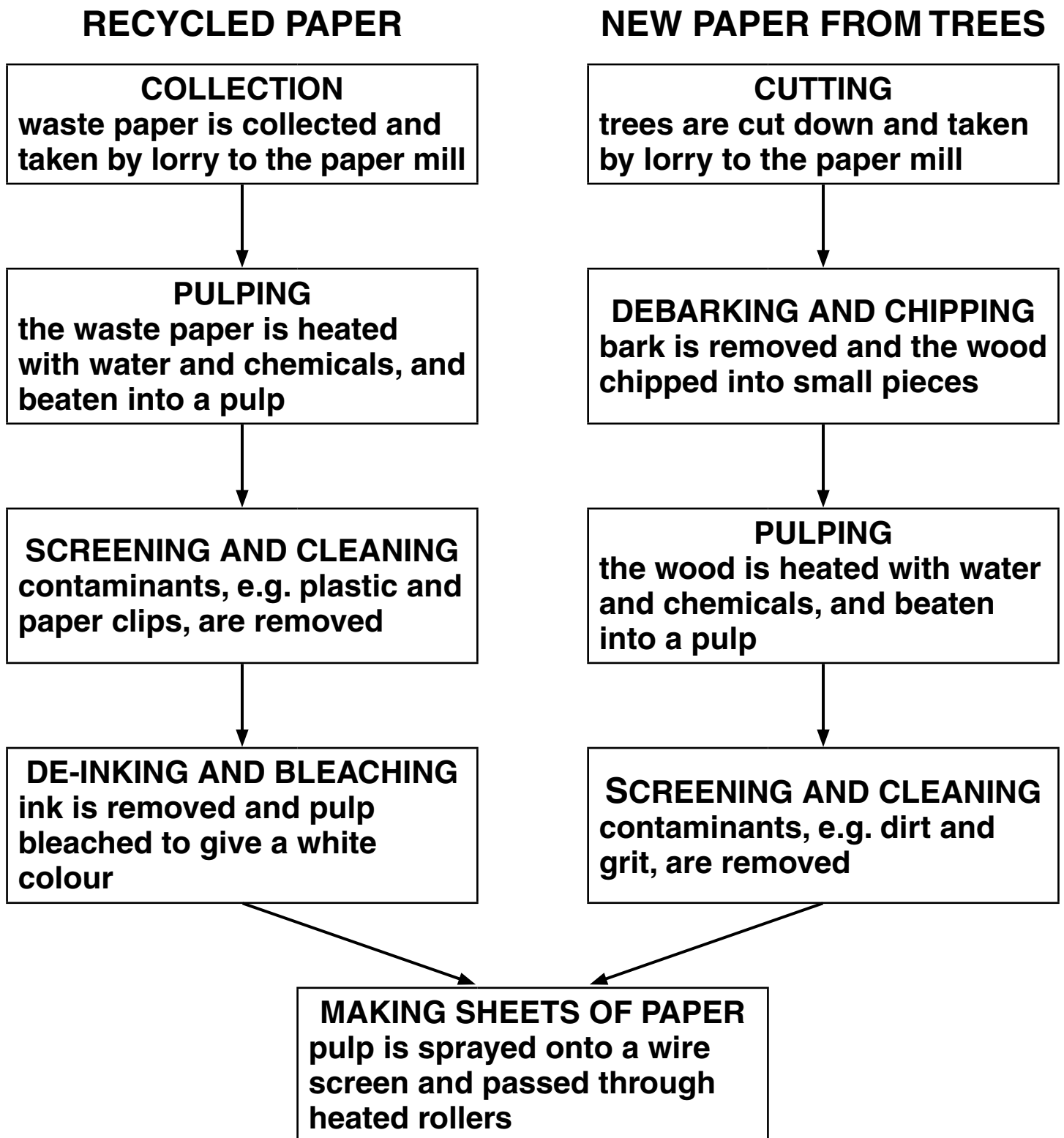
[2]

[Total: 6]

3 Newspapers are printed on paper.

Paper can be made from recycled waste paper or from trees.

The diagram shows the main steps in the production of **RECYCLED PAPER** and **NEW PAPER FROM TREES**.



(a) The sustainability of making recycled paper and making new paper may be different.

Explain how.

Use ideas from the diagram to help you answer the question.

[3]

(b) Newspapers and books can both be made from recycled paper.

Use this example to explain how the outcome of a Life Cycle Assessment will depend on the product that is made from the recycled paper.

[2]

(c) In 2007, 29% of the waste paper collected in the UK was exported to China.

Which of these statements best explain why this happens?

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

China has a higher demand for waste paper to recycle than the UK.

A large amount of energy is used to transport waste paper from the UK to China.

Recycling paper uses large amounts of water.

Recycling paper saves taking up space in landfill.

Waste paper in the UK contains more contaminants than that in China.

Waste paper can be shipped to China in containers that would otherwise be empty on the return journey after bringing imports from China.

[2]

[Total: 7]

4 This question is about chemicals from crude oil.

(a) Propane, C_3H_8 , is a fuel used for central heating in some homes.

When propane burns in a plentiful supply of air, complete combustion takes place.

propane + oxygen \rightarrow carbon dioxide + water

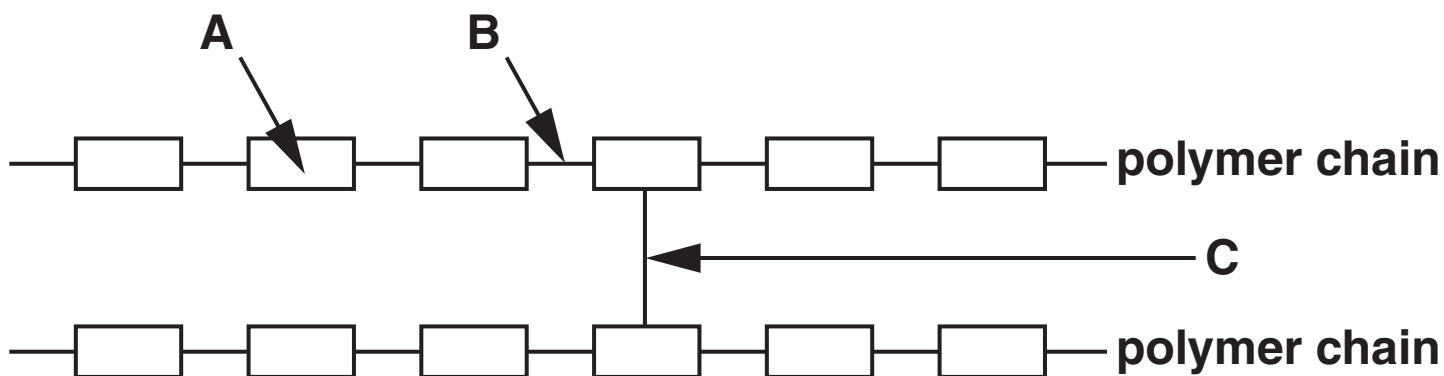
ONE MOLECULE of propane burns in a plentiful supply of air.

Complete the table to show the TOTAL number of atoms of carbon, hydrogen and oxygen in each of the products from the reaction of ONE MOLECULE OF PROPANE.

TOTAL NUMBER OF ATOMS OF EACH ELEMENT IN ALL MOLECULES OF				
	PROPANE	OXYGEN	CARBON DIOXIDE	WATER
CARBON	3	0		
HYDROGEN	8	0		
OXYGEN	0	10		

[3]

(b) The diagram shows where each of three different forces of attraction, A, B and C, are in a polymer.



(i) Which statements describe changes that increase the melting point of this polymer?

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

make the polymer chains longer

introduce more cross-links

put plasticizer molecules between the chains

make force A stronger

make force B stronger

[2]

(ii) The crystallinity of a polymer is increased.

This increases both the melting point and the density of the polymer.

Which statements explain how an increase in crystallinity causes these changes?

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

The polymer chains are shorter.

The forces within each polymer chain are larger.

The polymer chains are closer to each other.

The forces between the polymer chains are larger.

The polymer chains are arranged in a less regular way.

[2]

[Total: 7]

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QUESTION 5 STARTS ON PAGE 16

- 5 When petrol is burned in a car engine, the pollutant gas carbon dioxide is released into the air.
- (a) Car manufacturers state the amount of carbon dioxide made in the engines in their cars.

The table gives this information for different size engines fitted in the same design of car.

SIZE OF ENGINE IN LITRES	CARBON DIOXIDE MADE IN g/km TRAVELLED
1.4	158
1.6	184
2.0	207
2.6	224

Describe the CORRELATION shown by this data.

[1]

(b) A car manufacturer designs a new engine.

Scientists compare the carbon dioxide made by the new engine with that from the old engine.

Both engines are the same size.

The scientists test both engines five times. They work out that the best estimate of the carbon dioxide made by the new engine is 144 g/km.

		CARBON DIOXIDE MADE IN g/km TRAVELLED				
		test 1	test 2	test 3	test 4	test 5
NEW ENGINE	145	146	143	144	142	
OLD ENGINE	160	168	159	157	156	

(i) Show that the best estimate of carbon dioxide made by the old engine is 158 g/km.

[2]

(ii) Motorists pay car tax each year.

The tax is based on the amount of carbon dioxide the car makes.

The table gives information for annual car tax payments.

CARBON DIOXIDE IN g/km TRAVELLED	ANNUAL CAR TAX IN £
up to 100	0
101–120	35
121–150	120
151–165	145
166–185	170
over 185	210

The average lifetime of a car is 12 years.

A motorist using a car fitted with the new engine instead of the old engine would save money on car tax.

Use the table to find this SAVING during the lifetime of the car.

Show your working.

Assume that the annual car tax payment does not change.

saving = £ _____ [2]

- (iii) There are several ways that the **TOTAL** amount of carbon dioxide released from vehicles can be reduced.

Which of these statements describe some of them?

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

fitting catalytic converters

using low sulfur fuels

more people using public transport instead of cars

increasing the speed limit on motorways

having emission limits enforced by MOT testing of cars

[2]

[Total: 7]

6 This list shows pollutants found in a sample of air.

CARBON DIOXIDE CARBON MONOXIDE

CARBON PARTICULATES SULFUR DIOXIDE

**(a) Carbon monoxide causes harm to humans
DIRECTLY because it is toxic.**

**Some other pollutants cause harm to humans
INDIRECTLY.**

**Use one example from the list to explain how a
pollutant can be INDIRECTLY harmful.**

[2]

(b) Carbon monoxide reacts with oxygen to produce carbon dioxide.

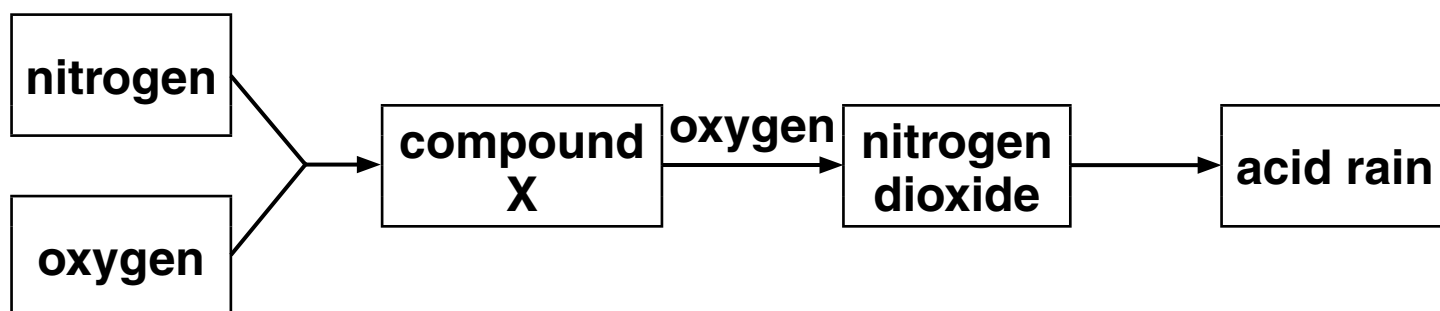
Draw a diagram to show the molecules in this reaction.

Use ● to represent an atom of carbon and ○ to represent an atom of oxygen.



- (c) The use of petrol engines in cars can lead to the formation of acid rain.

The flow chart shows how this happens.



- (i) What is the name of compound X?

_____ [1]

- (ii) What is the source of the nitrogen and oxygen that react together to form compound X?

_____ [1]

- (iii) What does nitrogen dioxide react with to form acid rain?

_____ [1]

[Total: 7]

END OF QUESTION PAPER

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