

**GENERAL CERTIFICATE OF SECONDARY EDUCATION
TWENTY FIRST CENTURY SCIENCE
CHEMISTRY A**

A321/02

Unit 1: C1 C2 C3 (Higher Tier)

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

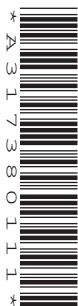
OCR supplied materials:
None

Other materials required:

- Pencil
- Ruler (cm/mm)

**Monday 17 January 2011
Morning**

Duration: 40 minutes



Candidate forename		Candidate surname	
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Centre number						Candidate number				
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INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. 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.
- Do **not** write in the bar codes.

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 printed on the back page.
- This document consists of **16** pages. Any blank pages are indicated.

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]

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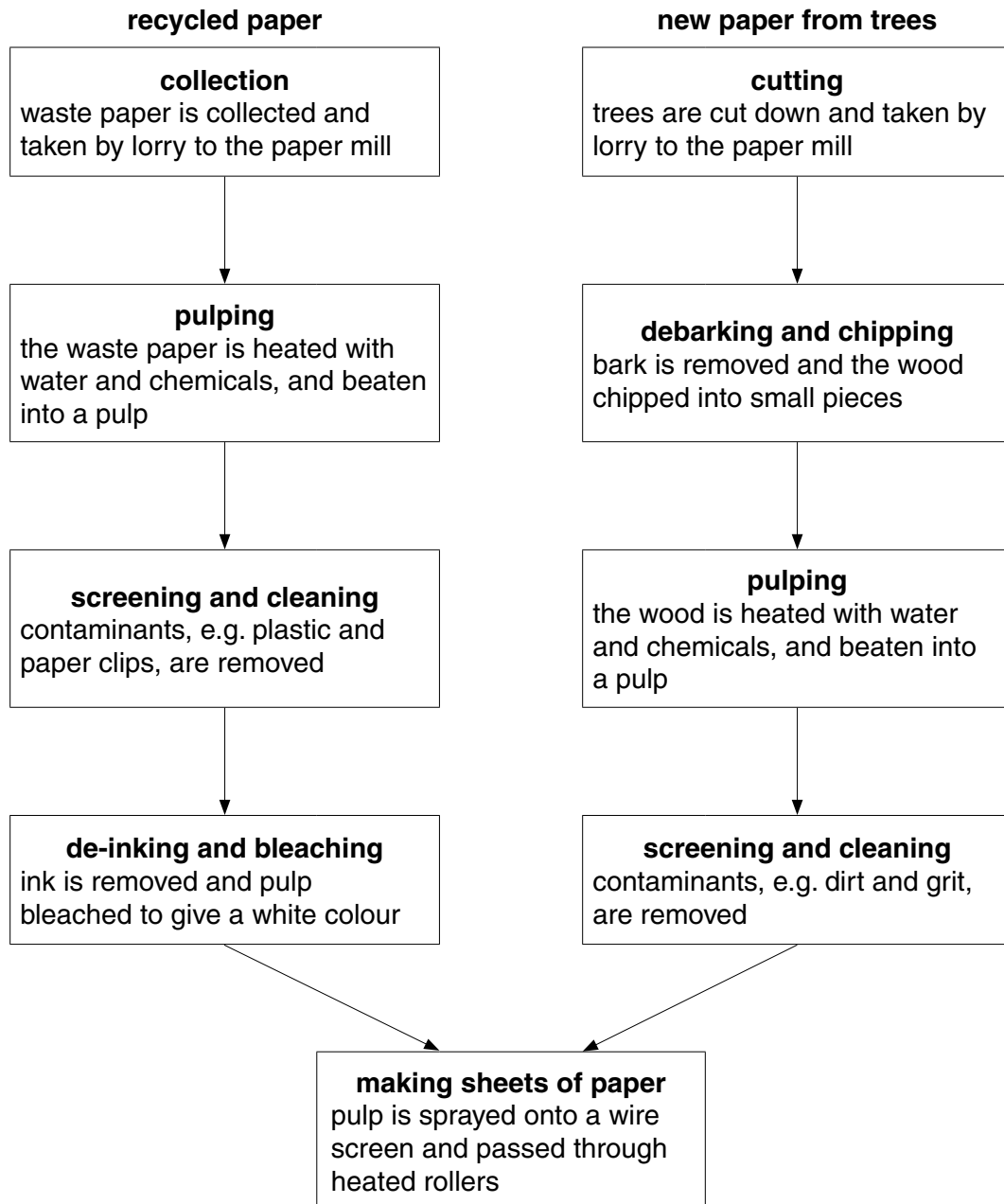
Question 3 starts on page 6

PLEASE DO NOT WRITE ON THIS PAGE

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.

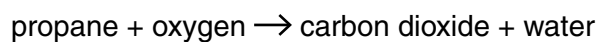
[2]

[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.



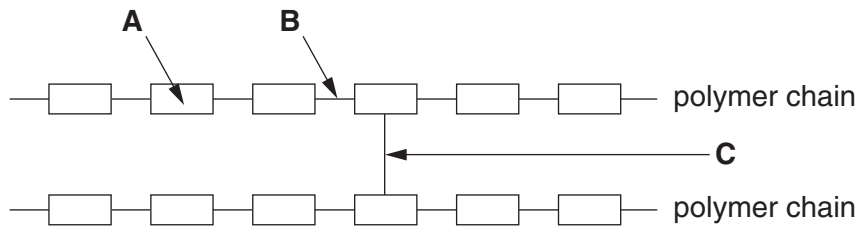
One molecule of propane burns in a plentiful supply of air.

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]

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.

.....

.....

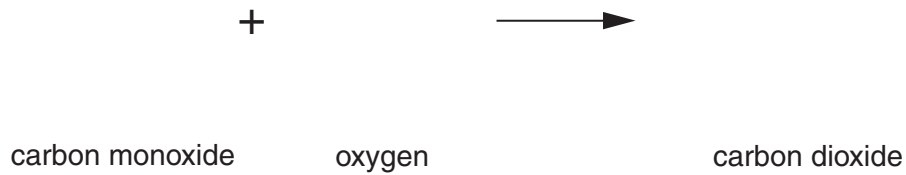
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..... [2]

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

Draw a diagram to show the molecules in this reaction.

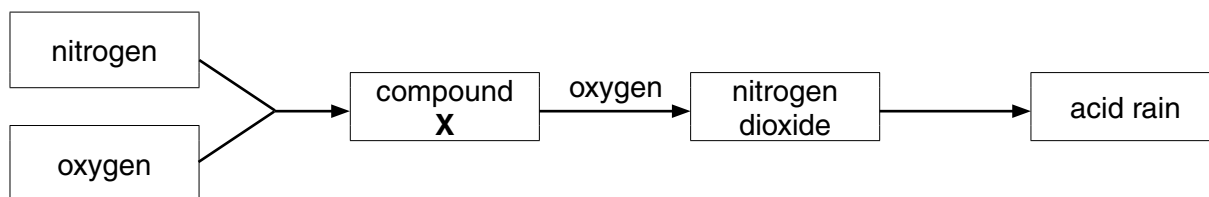
Use ● to represent an atom of carbon and ○ to represent an atom of oxygen.



[2]

(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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The Periodic Table of the Elements

		1	2	3	4	5	6	7	0										
7	Li lithium 3	9	Be beryllium 4	11	Na sodium 11	12	Mg magnesium 12	13	Al aluminium 13	14	N nitrogen 7	15	P phosphorus 15	16	S sulfur 16	17	Cl chlorine 17	18	Ar argon 18
19	K potassium 19	20	Ca calcium 20	21	Sc scandium 21	22	Ti titanium 22	23	V vanadium 23	24	Cr chromium 24	25	Mn manganese 25	26	Fe iron 26	27	Co cobalt 27	28	Ni nickel 28
37	Rb rubidium 37	38	Sr strontium 38	39	Y yttrium 39	40	Zr zirconium 40	41	Nb niobium 41	42	Mo molybdenum 42	43	Tc technetium [98]	44	Ru ruthenium 44	45	Rh rhodium 45	46	Pd palladium 46
55	Cs caesium 55	56	Ba barium 56	57	La* lanthanum 57	58	Hf hafnium 72	73	Ta tantalum 73	74	W tungsten 74	75	Re rhenium 75	76	Os osmium 76	77	Ir iridium 77	78	Pt platinum 78
87	Fr francium 87	88	Ra radium 88	89	Ac* actinium 89	90	Rf rutherfordium 104	105	Db dubnium 105	106	Sg seaborgium 106	107	Bh bohrium 107	108	Hs hassium 108	109	Mt meitnerium 109	110	Ds darmstadtium 110
133	Cs caesium 55	137	Ba barium 56	139	La* lanthanum 57	140	Hf hafnium 72	141	Ta tantalum 73	142	W tungsten 74	143	Re rhenium 75	144	Os osmium 76	145	Ir iridium 77	146	Pt platinum 78
131	Xe xenon 54	132	La* lanthanum 57	133	Ce cerium 58	134	Pr praseodymium 59	135	Nd neodymium 60	136	Pm promethium [61]	137	Sm samarium 62	138	Eu europium 63	139	Gd gadolinium 64	140	Tm thulium 65
84	Kr krypton 36	85	Rb rubidium 37	86	Sr strontium 38	87	Y yttrium 39	88	Zr zirconium 40	89	Nb niobium 41	90	Mo molybdenum 42	91	Ru ruthenium 44	92	Rh rhodium 45	93	Pd palladium 46
36	Kr krypton 36	37	Rb rubidium 37	38	Sr strontium 38	39	Y yttrium 39	40	Zr zirconium 40	41	Nb niobium 41	42	Mo molybdenum 42	43	Tc technetium [98]	44	Ru ruthenium 44	45	Rh rhodium 45
79	Br bromine 35	80	Kr krypton 36	81	Rb rubidium 37	82	Sr strontium 38	83	Y yttrium 39	84	Zr zirconium 40	85	Nb niobium 41	86	Mo molybdenum 42	87	Tc technetium [98]	88	Ru ruthenium 44
127	I iodine 53	128	Xe xenon 54	129	La* lanthanum 57	130	Hf hafnium 72	131	Ta tantalum 73	132	W tungsten 74	133	Re rhenium 75	134	Os osmium 76	135	Ir iridium 77	136	Pt platinum 78
53	I iodine 53	54	Xe xenon 54	55	Cs caesium 55	56	Ba barium 56	57	La* lanthanum 57	58	Ce cerium 58	59	Pr praseodymium 59	60	Nd neodymium 60	61	Pm promethium [61]	62	Sm samarium 62
35	Br bromine 35	36	Kr krypton 36	37	Rb rubidium 37	38	Sr strontium 38	39	Y yttrium 39	40	Zr zirconium 40	41	Nb niobium 41	42	Mo molybdenum 42	43	Tc technetium [98]	44	Ru ruthenium 44
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