

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

A323/02

Unit 3: Ideas in Context plus C7 (Higher Tier)

**Friday 28 May 2010
Morning**

Duration: 60 minutes

Candidates answer on the Question Paper
A calculator may be used for this paper

OCR Supplied Materials:

- Insert (inserted)

Other Materials Required:

- Pencil
- Ruler (cm/mm)



Candidate Forename		Candidate Surname	
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Centre Number							Candidate Number				
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MODIFIED LANGUAGE

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- 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.
- Do **not** write in the bar codes.
- 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 **55**.
-  Where you see this icon you will be awarded a mark for the quality of written communication in your answer.
- 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 based on the article ‘Which nappy is best for the environment?’

- (a) Both disposable and reusable ‘terry’ nappies contain cellulose fibres from cotton. Cotton is generally considered to be a renewable material.

Some people say that although cotton is a renewable material its use is not really sustainable because of the way that we grow it.

What information in the article supports this argument?

.....
.....
..... [2]

- (b) Many parents think that reusable nappies cause less environmental damage than disposable nappies.

Despite this, most parents use disposable nappies.

Suggest a reason why they do this.

.....
..... [1]

- (c) The article says that a Life Cycle Assessment (LCA) follows the lifetime of a product ‘from cradle to grave’.

Explain what this means.

.....
..... [1]

- (d) Use information from the article to describe and explain **one** environmental impact that is greater for reusable nappies than disposable nappies.

.....
.....
.....
..... [2]

- (e) It might be possible to use the recycling process mentioned in the article to recycle materials from **all** of the disposable nappies used in the UK.

Suggest why this would be difficult to achieve.

.....
.....
.....
.....
..... [3]

- (f) Disposable nappies contain the polymers polyethene and polypropene.

- (i) These polymers melt at low temperatures. This enables the recycled polymers to be melted and made into new products.

Use ideas about forces and energy to explain why these polymers melt at low temperatures.

.....
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.....
..... [2]

- (ii) A polymer with a lower melting point than polyethene might be easier to recycle.

Describe one method that may be used to produce a polymer with a lower melting point and explain how it does this.

.....
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.....
..... [2]

[Total: 13]

- 2 A teacher drops a small piece of sodium into a dish of ethanol.

The teacher repeats this demonstration with sodium and water, and then with sodium and the liquid alkane, hexane.

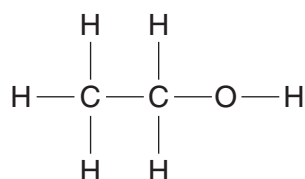
- (a) The table below is for students to record their observations while watching the demonstration.

Complete the table by writing in each empty box **what the student sees**.

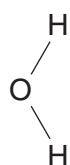
sodium + ethanol	sodium + water	sodium + hexane

[4]

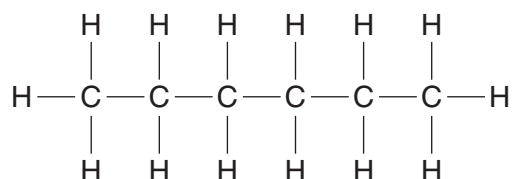
- (b) The diagrams show the structural formulae of ethanol, water and hexane.



ethanol



water



hexane

Explain the similarities and differences in the reactions of these three compounds with sodium.

.....

.....

.....

..... [2]

(c) A dilute solution of ethanol can be made by fermentation of grape juice using yeast.

(i) Why is it not possible to make a concentrated solution of ethanol by fermentation?

.....
..... [1]

(ii) Name the method used to separate ethanol from the solution, and explain how it works.

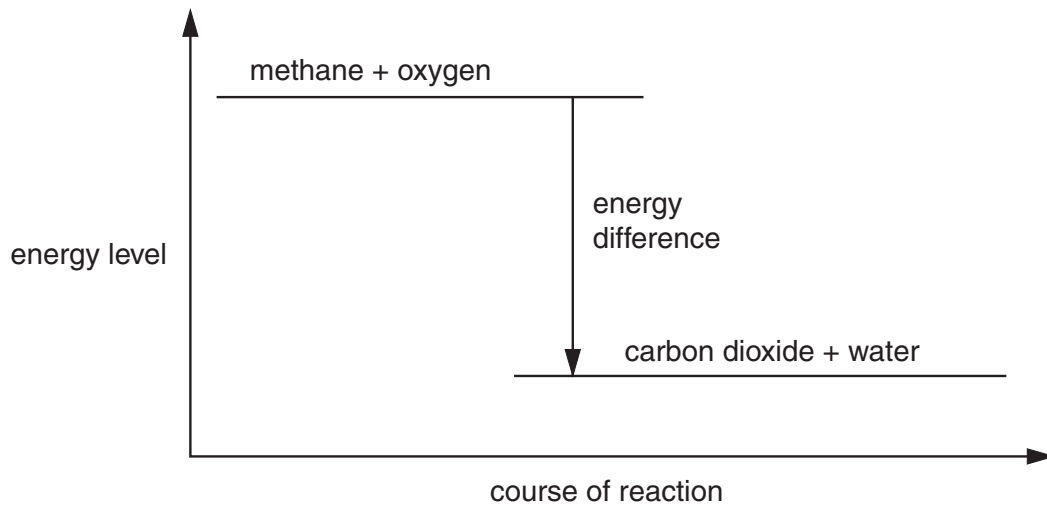
method:

explanation:

.....
.....
..... [3]

[Total: 10]

- 3 Look at this energy level diagram for the complete combustion of methane in air.



- (a) The complete combustion of methane in air is an exothermic reaction.

How does the energy level diagram show that this reaction is exothermic?

.....

.....

..... [2]

- (b) A mixture of methane and oxygen at room temperature does not react.

When a lighted match is applied the mixture burns.

The lighted match supplies the activation energy for the reaction.

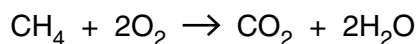
Explain what is meant by the term **activation energy**.

.....

.....

..... [2]

(c) Methane burns in air according to this equation.



The table shows the energy required to break each of the bonds involved in this reaction.

bond	energy in kJ/mol
C-H	435
O=O	498
C=O	805
H-O	464

The energy used when the bonds in this reaction are broken can be calculated as follows.

$$4 \times \text{C-H} = 4 \times 435 = 1740 \text{ kJ/mol}$$

$$2 \times \text{O=O} = 2 \times 498 = 996 \text{ kJ/mol}$$

$$\text{energy used} = 1740 + 996 = 2736 \text{ kJ/mol}$$

(i) Calculate the energy released as new bonds are made in this reaction.

$$\text{energy released} = \dots\dots\dots \text{kJ/mol} \quad [3]$$

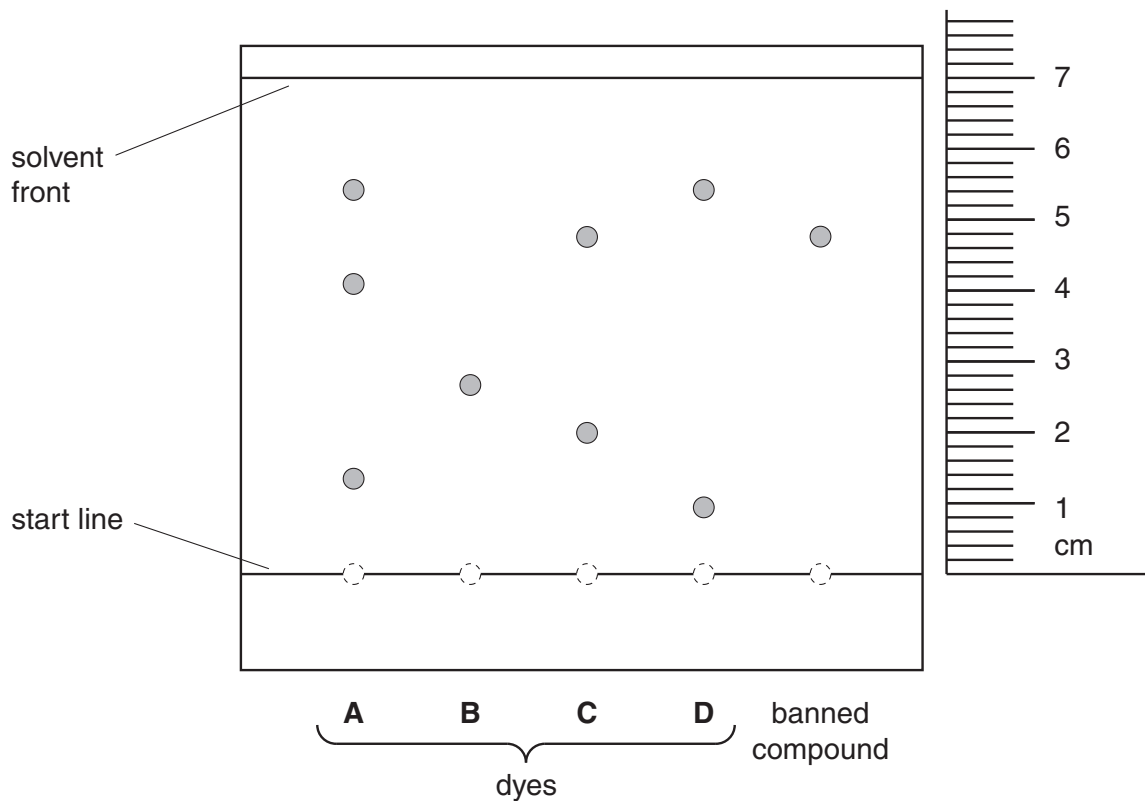
(ii) Calculate the overall energy change for the reaction.

$$\text{overall energy change} = \dots\dots\dots \text{kJ/mol} \quad [1]$$

[Total: 8]

- 4 A scientist employed by the Food Standards Agency uses paper chromatography. He tests samples of water-soluble food dyes to see if they contain a banned compound.

The resulting chromatogram is shown below.



- (a) The chromatogram shows that dye **C** contains the banned compound.

The identity of this substance can be confirmed using its published R_f value.

- (i) Calculate the R_f value for the banned compound.

You must show your working.

$$R_f \text{ value} = \frac{\text{distance travelled by solute}}{\text{distance travelled by solvent}}$$

R_f value = [2]

(ii) Suggest why R_f values are sometimes a better way to compare spots on different chromatograms than a simple visual comparison.

.....
.....
..... [2]

(b) Describe how compounds in the dyes are separated during the chromatography.

Use the terms **stationary phase**, **mobile phase** and **dynamic equilibrium** in your answer.

.....
.....
.....
.....
..... [3]

[Total: 7]

- 5 A student uses a titration with nitric acid to find the concentration of a solution of sodium hydroxide.

(a) The student has a stock solution of nitric acid containing 63 g in each dm^3 .

She uses this to make up 250 cm^3 of a standard solution containing 6.3 g in each dm^3 .

Describe how she makes up this standard solution.

($1 \text{ dm}^3 = 1000 \text{ cm}^3$)

.....

.....

..... [2]

(b) The student adds the standard nitric acid solution from a burette into sodium hydroxide solution in a flask.

She uses five 25.0 cm^3 samples of the sodium hydroxide solution.

She obtains the following titration results.

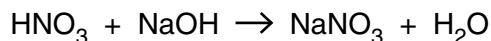
titration number	1	2	3	4	5
volume of nitric acid in cm^3	28.3	28.2	28.2	28.1	28.2

(i) The student uses the average of her titration results, 28.2 cm^3 , as the best estimate of the volume of nitric acid used.

Show by calculation that the mass of nitric acid in 28.2 cm^3 of the standard solution is 0.178 g.

[1]

- (ii) Nitric acid and sodium hydroxide react according to the following equation.



The relative formula mass of nitric acid is 63 and the relative formula mass of sodium hydroxide is 40.

Calculate the mass of sodium hydroxide in 25.0 cm³ of the sodium hydroxide solution. Then find the concentration of the sodium hydroxide solution in g/dm³.

You should show your working.

mass of the sodium hydroxide in 25 cm³ solution = g

concentration of sodium hydroxide solution = g/dm³ [3]

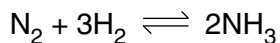
- (iii) Use the titration results to assess the degree of uncertainty in your value for the concentration of the sodium hydroxide solution.

.....

 [2]

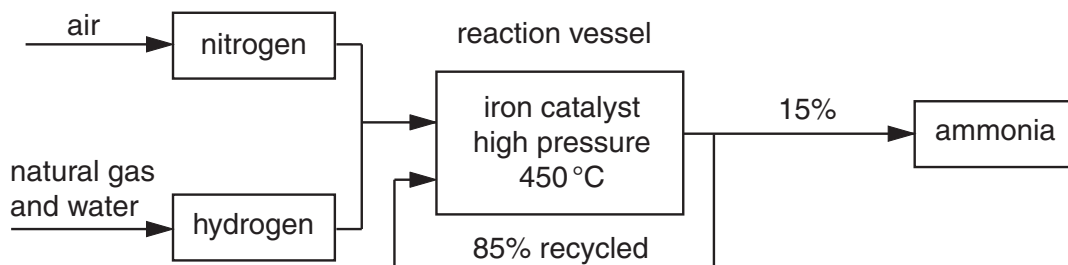
[Total: 8]

6 Ammonia is a bulk chemical made by the reaction of nitrogen with hydrogen.



The reaction is reversible, forming a dynamic equilibrium.

The diagram shows a flow chart of the Haber process for the manufacture of ammonia.



(a) Air and natural gas are used to make ammonia.

Suggest how each of these raw materials affects the sustainability of the process.

air

.....

natural gas

..... [4]

(b) The process uses an iron catalyst. A catalyst speeds up the rate of conversion of reactants to products.

Use ideas about energy to explain how a catalyst works.



One mark is for using the correct scientific terms.

.....

.....

..... [2+1]

(c) Although the reaction is reversible, all of the nitrogen and hydrogen are eventually converted to ammonia.

Use the flow chart to explain how this is achieved.

.....

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..... [2]

[Total: 9]

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 Si silicon 14	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	29 Cu copper 29	30 Zn zinc 30	31 Ga gallium 31	32 Ge germanium 32	33 As arsenic 33	34 Se selenium 34	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	45 Rh rhodium 45	46 Pd palladium 46	47 Ag silver 47	48 Cd cadmium 48	49 In indium 49	50 Sn tin 50	51 Sb antimony 51	52 Te tellurium 52	53 I iodine 53	54 Xe xenon 54
	55 Cs caesium 55	56 Ba barium 56	57 La* lanthanum 57	72 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	79 Au gold 79	80 Hg mercury 80	81 Tl thallium 81	82 Pb lead 82	83 Bi bismuth 83	84 Po polonium 84	85 At astatine 85	86 Rn radon 86
	[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[261] Rf rutherfordium 104	[262] Db dubnium 105	[266] Sg seaborgium 106	[264] Bh bohrium 107	[277] Hs hassium 108	[268] Mt meitnerium 109	[271] Ds darmstadtium 110	[272] Rg roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

1
H
hydrogen
1

relative atomic mass
atomic symbol
name
atomic (proton) number

* The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.