Surname

Other Names

Candidate Signature

AQA

General Certificate of Secondary Education
Higher Tier
January 2011

Chemistry

CHY3H

Unit Chemistry C3

H

Written Paper

Monday 17 January 2011   9.00 am to 9.45 am

For this paper you must have:
● a ruler
● the Data Sheet (enclosed).
You may use a calculator.

Time allowed
● 45 minutes

Instructions
● Use black ink or black ball-point pen.
● Fill in the boxes at the top of this page.
● Answer **all** questions.
● You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
● Do all rough work in this book. Cross through any work you do not want to be marked.

Information
● The marks for questions are shown in brackets.
● The maximum mark for this paper is 45.
● You are expected to use a calculator where appropriate.
● You are reminded of the need for good English and clear presentation in your answers.

Advice
● In all calculations, show clearly how you work out your answer.

JAN11CHY3H01

CHY3H

1 The table gives the solubility of sodium chloride in water at different temperatures.

Temperature in °C	0	20	40	80	100
Solubility in g per 100 g of water	35.6	35.8	36.3	38.0	39.4

1 (a) A student plotted Graph **A** using the data in the table.
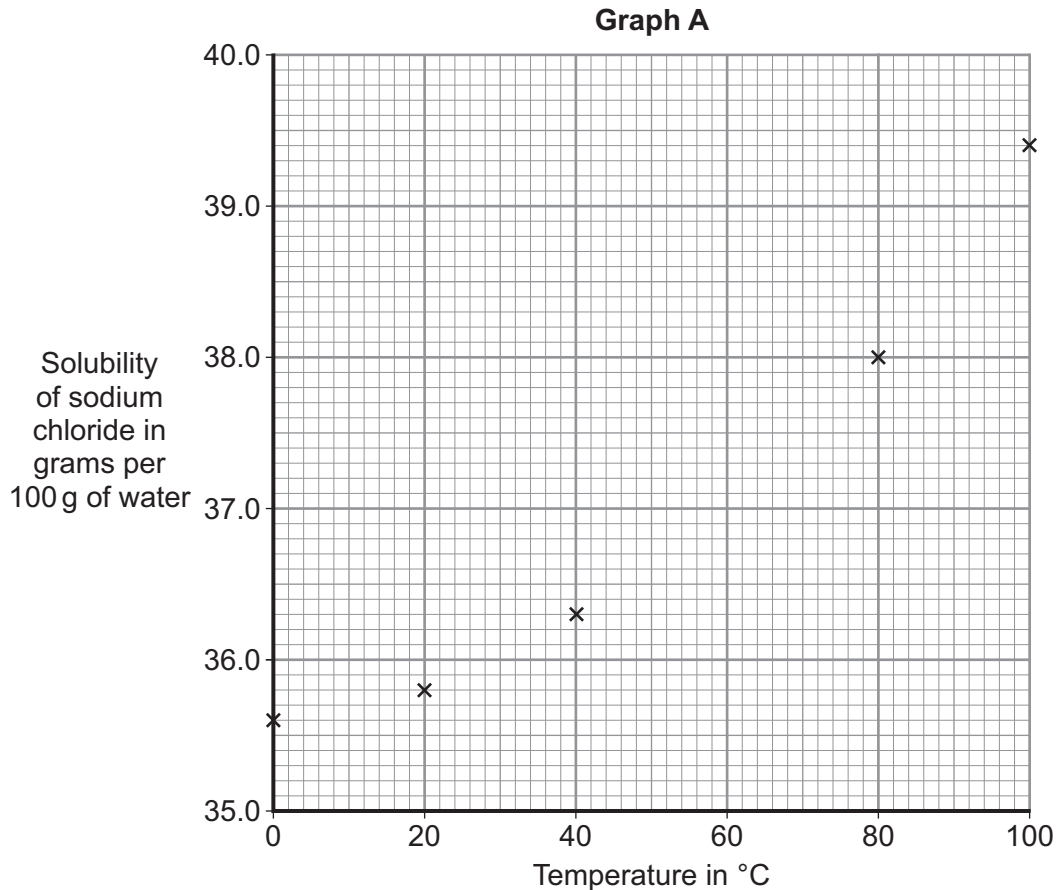
Graph A

1 (a) (i) Draw a smooth curve through all the points on Graph **A**. *(1 mark)*

1 (a) (ii) Use this graph to find the mass of sodium chloride that dissolves in 100 g of water at 60 °C.

Mass = ... g
(1 mark)

1 (a) (iii) A saturated solution of sodium chloride in 100 g of water is made at 60 °C. It is then cooled to 20 °C.

What mass of sodium chloride crystallises from the solution?

....

....
(2 marks)

1 (b) Another student plotted Graph **B** using the same data.
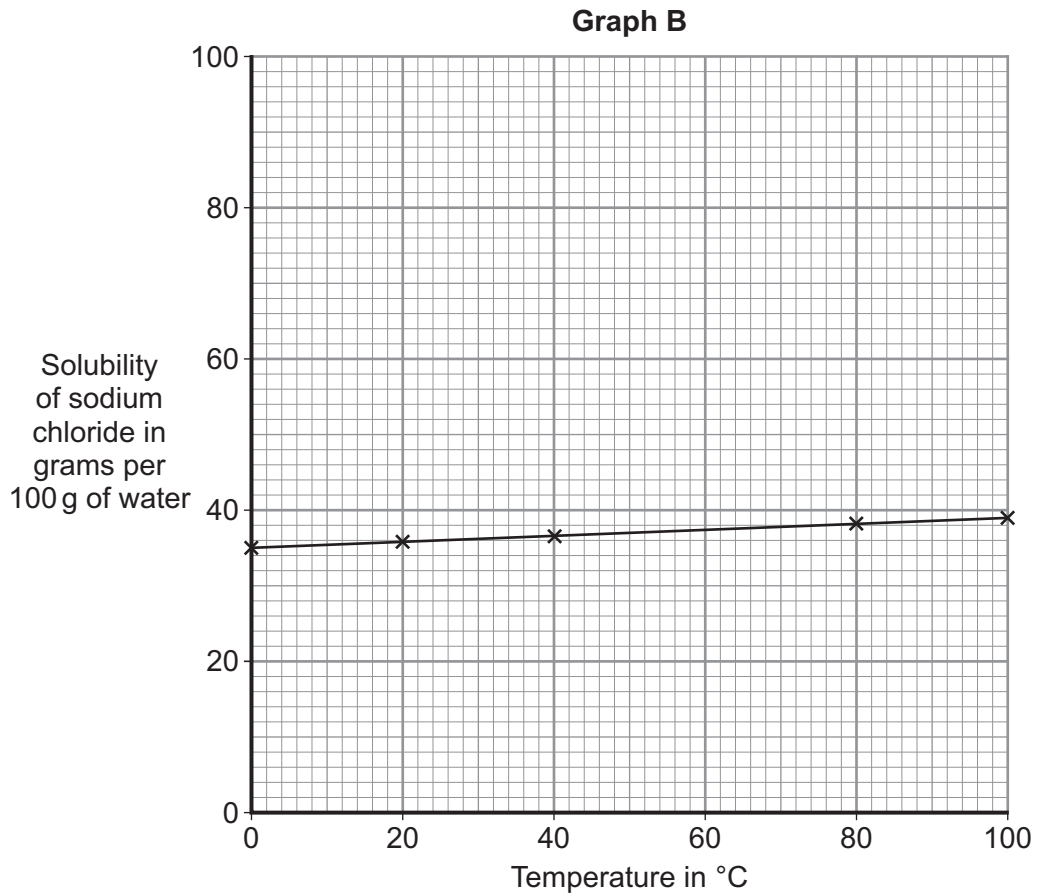
Graph B

The table shows the conclusion that each student made.

	How solubility changes as temperature increases
1ˢᵗ student (Graph A)	Very large increase
2ⁿᵈ student (Graph B)	Very small increase

Suggest why the students came to such different conclusions even though they had used the same data to plot their graphs.

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(1 mark)

2   Good quality water is essential for life.

2 (a)   In the United Kingdom, water is filtered **and** treated with chlorine to make it safe to drink.
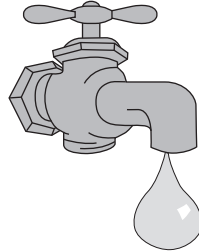
Explain why the water is:

filtered ....

....

treated with chlorine. ....

....

(2 marks)

2 (b)   Millions of people in Bangladesh drink water from wells that contain high levels of arsenic. Arsenic is poisonous.

The World Health Organisation recommends that there should be no more than 0.01 mg of arsenic per litre in drinking water.

The table gives some information about two instrumental methods of testing for arsenic.

Factor to consider	Laboratory Instrumental Method	Portable Instrumental Method
Cost of equipment	£10 000	£50
Skill level of technician	Highly skilled	Little training needed
Where test is done	Laboratory only	Anywhere
Time to prepare the instrument for the test	5 minutes	10 seconds
Sensitivity of the instrument	0.000001 mg of arsenic per litre of water	0.1 mg of arsenic per litre of water

2 (b) (i) Use the information in the table to give **two** advantages and **one** disadvantage of using the Portable Instrumental Method compared with the Laboratory Instrumental Method.

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(3 marks)

2 (b) (ii) The information about these two instrumental methods was provided by the Professional Institute of Water Engineers (PIWE). The Institute has no connection with the companies that make these instruments.

Suggest why many people would accept the views of PIWE rather than the views of the companies that make the instruments.

....

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(1 mark)

6

Turn over for the next question

Turn over ▶

3 V2 rockets were used during the Second World War.

V2 rockets were powered by liquid oxygen and ethanol. Oxygen and ethanol react to produce carbon dioxide and water.

The energy level diagram represents the energy changes during this reaction.
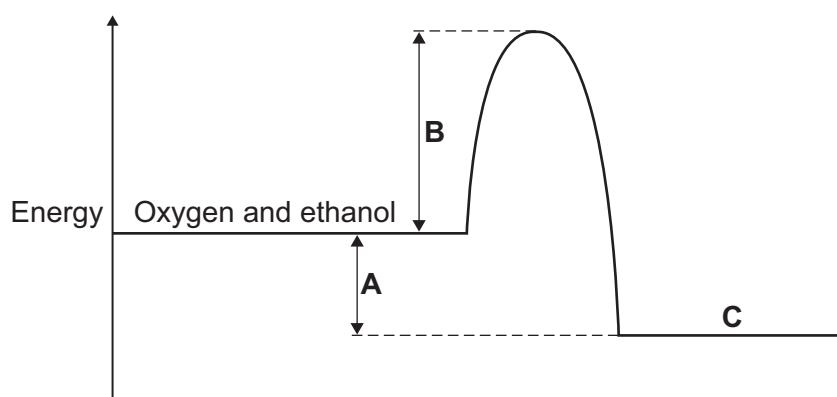
3 (a) On the energy level diagram what is represented by the letter:

A ....

B ....

C ....

(3 marks)

3 (b) What type of reaction is represented by this energy level diagram?

....

....

(1 mark)

4

4   The periodic table on the Data Sheet may help you answer these questions.

4 (a)   Many chemists have contributed to the development of the periodic table.

John Newlands was one of the first chemists who attempted to classify elements in a systematic way based on atomic weight. In 1866 he suggested that there was a repeating pattern of elements with similar properties every eighth element.
Part of Newlands' periodic table is shown below.

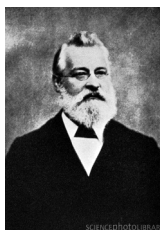| H	Li	Be	B	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca	Cr	Ti	Mn	Fe
Co, Ni	Cu	Zn	Y	In	As	Se
Br	Rb	Sr	Ce, La	Zr	Di, Mo	Ro, Ru

Many chemists in 1866 did not accept Newlands' periodic table.

4 (a) (i)   Give **one** piece of evidence which supports Newlands' ideas.

....

....
(1 mark)

4 (a) (ii) Suggest **two** reasons why many chemists in 1866 did not accept Newlands' ideas.

1 ....

....

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2 ....

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....
(2 marks)

Turn over ▶

4 (b) Chlorine, bromine and iodine are Group 7 elements.

A student investigated the reactivity of these elements.
The student added:

- aqueous chlorine to potassium bromide and potassium iodide solutions
- aqueous bromine to potassium chloride and potassium iodide solutions
- aqueous iodine to potassium chloride and potassium bromide solutions.

The student's results are shown below.

Solution	Potassium chloride	Potassium bromide	Potassium iodide
Chlorine		Solution turned orange-brown	Solution turned brown
Bromine	No reaction		Solution turned brown
Iodine	No reaction	No reaction	

4 (b) (i) Use these results to state **and** explain the trend in reactivity of these Group 7 elements.

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(2 marks)

4 (b) (ii) Complete the equation below, which represents the reaction between chlorine and potassium bromide.

$$Cl_2 \quad + \quad 2KBr \quad \longrightarrow \quad .... \quad + \quad 2KCl$$

(1 mark)

4 (b) (iii) In terms of electronic structure, state why chlorine, bromine and iodine are in Group 7.

....

....

(1 mark)

4 (c) Lithium, sodium and potassium are Group 1 elements.

Group 1 elements become **more** reactive down the group.

Explain why in terms of electronic structure.

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(3 marks)

10

**Turn over for the next question**

Turn over ▶

5 Read the information in the box and then answer the questions.

Seidlitz Powder is the name of a medicine.

Seidlitz Powder comes as two powders. One powder is wrapped in white paper and contains tartaric acid ($C_4H_6O_6$). The other powder is wrapped in blue paper and contains potassium sodium tartrate ($KNaC_4H_4O_6$) and sodium hydrogencarbonate ($NaHCO_3$).

The contents of the blue paper are completely dissolved in water and then the contents of the white paper are added.

The equation which represents this reaction is:

$$C_4H_6O_6 \text{ (aq)} + 2NaHCO_3 \text{ (aq)} \longrightarrow Na_2C_4H_4O_6 \text{ (aq)} + 2H_2O \text{ (l)} + 2CO_2 \text{ (g)}$$

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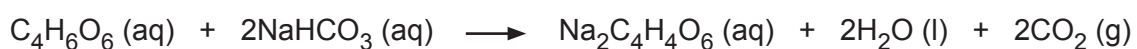
5 (a) Describe and give the result of a test to identify the gas produced in this reaction.

....

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....

(2 marks)

5 (b) One of the chemicals in Seidlitz Powder is potassium sodium tartrate ($KNaC_4H_4O_6$).

Suggest why it would be difficult to identify **both** potassium ions and sodium ions in potassium sodium tartrate using a flame test.

....

....

(1 mark)

5 (c)   Some Seidlitz Powder was bought on the Internet. However, when tested, it was found to be only magnesium sulfate.

5 (c) (i)   Describe and give the result of a chemical test to show that magnesium sulfate contains sulfate ions.

Test..

....

Result..

....

(2 marks)

5 (c) (ii)   Magnesium sulfate contains magnesium ions.

Describe what you **see** when sodium hydroxide solution is added to a solution of magnesium sulfate.

....

....

(1 mark)

6

Turn over for the next question

Turn over ▶

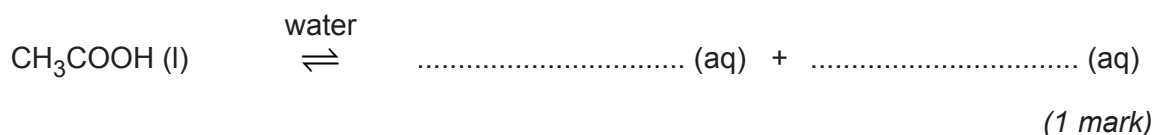**6**   This label was on a bottle of vinegar.

no additives or preservatives

MALT VINEGAR

Pure Malt Vinegar

Vinegar contains ethanoic acid, which is a *weak* acid.

6 (a) (i)   According to Arrhenius, acids are chemicals that produce hydrogen ions (H^+) in aqueous solution.

Complete the following equation to show why ethanoic acid (CH_3COOH) is an acid in aqueous solution.

$$CH_3COOH \text{ (l)} \quad \overset{\text{water}}{\rightleftharpoons} \quad \text{................................. (aq)} \; + \; \text{................................. (aq)}$$

(1 mark)

6 (a) (ii)   Explain the meaning of *weak* in terms of ionisation.

....

....

(1 mark)

6 (a) (iii) What is the Brønsted and Lowry definition of acids?

....

(1 mark)

6 (b) $25.0 \, cm^3$ of diluted vinegar were placed in a conical flask using a pipette.

The volume of sodium hydroxide solution needed to react completely with the ethanoic acid in $25.0 \, cm^3$ of diluted vinegar can be found by titration using phenolphthalein indicator.

6 (b) (i)   Why is phenolphthalein used instead of methyl orange for this titration?

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....

(1 mark)

6 (b) (ii) Describe how you would do the titration.

You should include the names of any apparatus you would use.

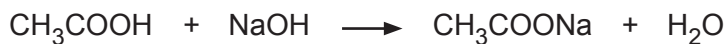...

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(4 marks)

6 (c) The ethanoic acid in $25.0\,cm^3$ of diluted vinegar reacted completely with $15.0\,cm^3$ of sodium hydroxide solution of concentration 0.10 moles per cubic decimetre.

The equation which represents this reaction is:

$$CH_3COOH \ + \ NaOH \ \longrightarrow \ CH_3COONa \ + \ H_2O$$

Calculate the concentration of ethanoic acid in moles per cubic decimetre.

....

....

....

Concentration = ... moles per cubic decimetre

(2 marks)

10

Turn over for the next question

Turn over ▶

7 Hydrogen peroxide is often used to bleach or lighten hair.

Hydrogen peroxide slowly decomposes to produce water and oxygen.

7 (a) The equation for the reaction can be represented using structural formulae.

$$2 \; H-O-O-H \longrightarrow 2 \; H-O-H \;\; + \;\; O=O$$

Use the bond energies in the table to help you to calculate the energy change for this reaction.

Bond	Bond energy in kJ per mole
H – O	464
O – O	146
O = O	498

....

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....

Energy change = ... kJ

(3 marks)

7 (b) Explain, in terms of bond making and bond breaking, why the reaction is exothermic.

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(1 mark)

4

END OF QUESTIONS

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