OCR
Oxford Cambridge and RSA

AS Level Chemistry B (Salters)
H033/01 Foundations of chemistry
Sample Question Paper

Date – Morning/Afternoon

Time allowed: 1 hour 30 minutes

You must have:
• the Data Sheet for Chemistry B (Salters)

You may use:
• a scientific calculator

First name	
Last name	

Centre number					Candidate number				

INSTRUCTIONS
• Use black ink. You may use an HB pencil for graphs and diagrams.
• Complete the boxes above with your name, centre number and candidate number.
• Answer **all** the questions.
• Write your answer to each question in the space provided.
• Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
• Do **not** write in the barcodes.

INFORMATION
• The total mark for this paper is **70**.
• The marks for each question are shown in brackets **[ ]**.
• This document consists of **24** pages.

H033/01
Turn over

SECTION A

You should spend a maximum of 25 minutes on this section.

Answer **all** the questions.

1   Which statement describes the trends of electronegativity values in the Periodic Table?

   A   Increase across a period and increase down a group.

   B   Increase across a period and decrease down a group.

   C   Decrease across a period and increase down a group.

   D   Decrease across a period and decrease down a group.

   Your answer ☐

[1]

2   Which statement explains why ammonia, NH_3, is a gas at room temperature and pressure?

   A   The bonds between the nitrogen and hydrogen atoms in ammonia are weak.

   B   Nitrogen and hydrogen have very low boiling points.

   C   The bonds between the ammonia molecules are weak.

   D   Ammonia is covalently bonded.

   Your answer ☐

[1]

3   Which statement correctly describes the boiling points of fluoroethane and iodoethane?

   A   Fluoroethane has the higher boiling point because it forms hydrogen bonds.

   B   Fluoroethane has the higher boiling point because the C–F bond is stronger than C–I.

   C   Iodoethane has the higher boiling point because it forms the stronger instantaneous dipole–induced dipole bonds.

   D   Iodoethane has the higher boiling point because the C–I bond is less polar than C–F.

   Your answer ☐

[1]

4 Which compound could be formed by a one-step reaction from 1-chloropropane?

A $CH_3CHOHCH_3$

B $CH_3CHNHCH_3$

C $CH_3CH_2CH_2OH$

D $(CH_3)_2CHNH_2$

Your answer ☐

[1]

5 A chemist wants to accurately determine the aspirin content of an aspirin tablet.

Which of the following techniques should the chemist use?

A thin layer chromatography

B melting point determination

C addition of a neutral solution of iron(III) chloride

D titration with sodium hydroxide solution

Your answer ☐

[1]

6 The reaction below occurs in the manufacture of iodine.

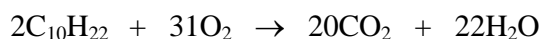$Cl_2 + 2NaI \rightarrow 2NaCl + I_2$

Which of the following statements about this reaction is correct?

A Iodine is oxidised by chlorine.

B Chloride is reduced.

C Iodide ions lose electrons.

D Chlorine is a weaker oxidising agent than iodide.

Your answer ☐

[1]

7 In a test on some liquid fuels, decane is completely burnt in air.

$$2C_{10}H_{22} + 31O_2 \rightarrow 20CO_2 + 22H_2O$$

What mass of oxygen would combine with 1 mol of decane?

A 15.5 g

B 248 g

C 496 g

D 672 g

Your answer ☐

[1]

8 What volume of 0.250 mol dm^{-3} sodium hydroxide solution should be diluted to 1000 cm^3 to make a 0.0100 mol dm^{-3} solution?

A 40 cm^3

B 50 cm^3

C 80 cm^3

D 160 cm^3

Your answer ☐

[1]

9 A student carries out a titration. Sodium hydroxide solution is transferred to a conical flask using a pipette. Methyl orange indicator is added to the flask. Hydrochloric acid is added from a burette until the indicator changes colour.

Which of the following would lead to the titre being larger than it should be?

A Rinsing the conical flask with water before adding the sodium hydroxide solution.

B Rinsing the burette with water before filling it with hydrochloric acid.

C Rinsing the pipette with water before filling it with sodium hydroxide solution.

D Adding extra drops of indicator.

Your answer ☐

[1]

10 Approximate values of the equilibrium constant for the Haber process reaction are given in the table.

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$
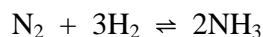
Temperature/K	K_c
298	10^4
1100	10^{-8}

(a) Which of the following statements about this reaction is correct?

A At 298 K the equilibrium position is towards the reactants.

B There will be no temperature between 298 and 1100 where $K_c = 1$.

C As the temperature is raised, more ammonia is formed.

D At 1100 K the position of equilibrium lies to the left.

Your answer ☐

[1]

(b) In a pilot plant making ammonia, NH_3, 200 cm³ of nitrogen are mixed with 300 cm³ of hydrogen.

What would be the final volume (at the same temperature and pressure) if complete reaction occurs?

A 200 cm³

B 250 cm³

C 300 cm³

D 400 cm³

Your answer ☐

[1]

11 The first reaction that occurs when an airbag is set off is:

$$2NaN_3(s) \rightarrow 2Na(l) + 3N_2(g)$$

6.5 g of NaN_3 completely decomposes.

(a) Which of the following statements is correct?

A 2.3 g of products are formed.

B 3.6 dm^3 of gas are formed (at RTP).

C 4.6 g of sodium is formed.

D The volume of nitrogen formed is 1.5 times the volume of sodium formed.

Your answer ☐

[1]

(b) Which of the following statements is correct?

A Nitrogen has an oxidation state of $+\frac{1}{3}$ in the reactant.

B Sodium ions are reduced.

C Nitrogen has an oxidation state of –3 in a product.

D Sodium has an oxidation state of +9 in the reactant.

Your answer ☐

[1]

12 The diagram below shows a molecule of cyclohexene, with a bond angle indicated.
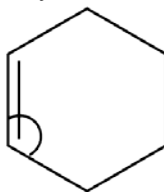
Which letter correctly describes the bond angle and shape around the bond?

A   120°, trigonal planar

B   107°, pyramidal

C   109.5°, tetrahedral

D   120°, pyramidal

Your answer

[1]

13 Alcoholic drinks are solutions of ethanol in water. Ethanol is soluble in water due to hydrogen bonding.

Which diagram best illustrates hydrogen bonding between a molecule of ethanol and a molecule of water?

A

B

C

D
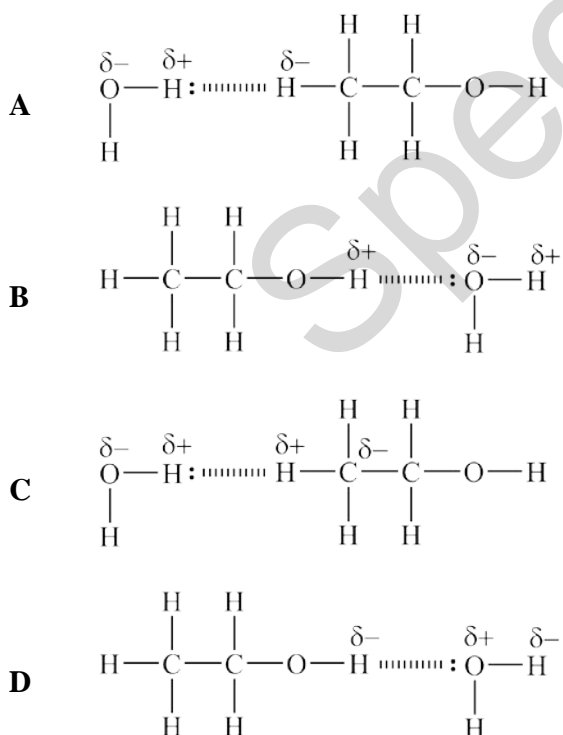
Your answer

[1]

14 Four solutions, **W**, **X**, **Y**, **Z**, are known to contain ethanol, phenol, ethanoic acid and sodium carbonate. It is not known which solution is which.

When solution **X** is mixed with solution **Z**, bubbles of gas are seen.

Drops of universal indicator solution are added to separate samples of each solution. The results of this test are shown below.

	Solution W	Solution X	Solution Y	Solution Z
Universal indicator solution	red solution	blue solution	green solution	red solution

Which solution contains phenol?

A   Solution **W**

B   Solution **X**

C   Solution **Y**

D   Solution **Z**

Your answer

[1]

15 A chemist has four solutions, labelled **A**, **B**, **C** and **D**. Each contain one of salicylic acid (HOC_6H_4COOH), ethanoic acid, phenol, ethanol or aspirin ($HOOCC_6H_4OCOCH_3$).

It is not known which solution is which.

Neutral iron(III) chloride solution and sodium carbonate solution are added separately to samples of **A**, **B**, **C** and **D**. The results of the tests are shown below.

	Solution A	Solution B	Solution C	Solution D
Neutral iron(III) chloride solution	purple colour	yellow colour	purple colour	yellow colour
Sodium carbonate solution	gas evolved	gas evolved	no change observed	no change observed

Which solution contains salicylic acid?

A Solution **A**

B Solution **B**

C Solution **C**

D Solution **D**

Your answer ☐

[1]

16 Exhaust gases from vehicle engines contain potential pollutants.

Which substance(s) could be present in the exhaust gases from a vehicle engine as a result of the incomplete combustion of a hydrocarbon?

     1:   Carbon monoxide

     2:   Particulates

     3:   Unburnt hydrocarbons

A   1, 2 and 3

B   Only 1 and 2

C   Only 2 and 3

D   Only 1

Your answer ☐

[1]

17 Which of the following gases is/are produced when hydrogen burns in air at high temperature?

     1:   Water vapour

     2: NO_x

     3:   Carbon dioxide

A   1, 2 and 3

B   Only 1 and 2

C   Only 2 and 3

D   Only 1

Your answer ☐

[1]

11

18 Chorine reacts with water to produce a solution that acts as a bleach.

$$Cl_2 \ + \ H_2O \ \rightleftharpoons \ HClO \ + \ HCl$$
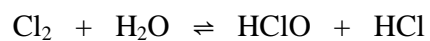
Which of the following statements is/are correct about the forward reaction:

Statement 1: Chlorine is oxidised

Statement 2: Chlorine is reduced

Statement 3: Chloric(I) acid is a product

A 1, 2 and 3

B Only 1 and 2

C Only 2 and 3

D Only 1

Your answer ☐

[1]

SECTION B

Answer **all** the questions.

19 A student has some lumps of limestone and is told that they consist of impure calcium carbonate, $CaCO_3$.

(a) The student carries out a flame test on the limestone.

Describe the procedure the student uses and give the colour of the flame that calcium produces.

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…………………………………………………………………………………………………….. **[2]**

(b) The student adds a lump of limestone with mass 0.13 g to 25.00 cm^3 of 0.100 mol dm^{-3} hydrochloric acid and stirs until the reaction is finished. The solution is then filtered.

The excess acid in the filtered solution reacts with 7.00 cm^3 of 0.100 mol dm^{-3} sodium hydroxide.

The equations for the reactions are:

$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$

$HCl + NaOH \rightarrow NaCl + H_2O$
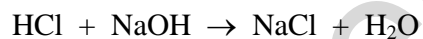
Calculate the percentage of calcium carbonate in the limestone.

percentage of calcium carbonate = **……………………** % **[3]**

(c) The student realises that the percentage of calcium carbonate should be given to two significant figures.

Suggest how the student might vary the method, using the same apparatus, to get a result that could be accurately reported to **three** significant figures.

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.... **[2]**

(d) The student suggests that an impurity in the limestone might be iron(III) chloride.

How could the student set out to show the presence of iron(III) chloride in the limestone?

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.... **[2]**

14

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20 Hydrogen chloride is made industrially by the direct combination of its elements.
In the laboratory, hydrogen chloride can be prepared by reacting sodium chloride with concentrated sulfuric acid.

Some students try to prepare hydrogen iodide by reacting sodium iodide with concentrated sulfuric acid.
Their hydrogen iodide is contaminated with a purple vapour and another gas.

Possible equations for the reactions are given below.

$$NaI \ + \ H_2SO_4 \ \rightarrow \ HI \ + \ NaHSO_4 \qquad \textbf{Equation 20.1}$$

$$8HI \ + \ H_2SO_4 \ \rightarrow \ H_2S \ + \ 4H_2O \ + \ 4I_2 \qquad \textbf{Equation 20.2}$$
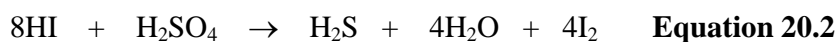
Large quantities of hydrogen chloride are used to make 'vinyl chloride', $H_2C=CHCl$, a monomer for PVC.

(a) (i) Write an equation for the formation of 'polyvinyl chloride' from vinyl chloride, using structural formulae.

[1]

(ii) Name the reagent that would react with sodium iodide to produce purer hydrogen iodide.

... **[1]**

(b) Hydrogen iodide reacts with a solution of barium hydroxide.

$$2HI + Ba(OH)_2 \rightarrow BaI_2 + 2H_2O \qquad \textbf{Equation 20.3}$$
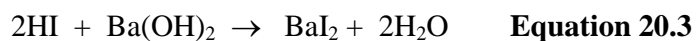
A student places 20.0 cm^3 of 2.0 mol dm^{-3} HI (aq) (an excess) in a polystyrene cup. The temperature is measured every minute. 2.0 g of barium hydroxide powder is added after two minutes. The student obtains the following results.

Time / min	Temperature / $^\circ$C
0	23.5
1	23.5
3	29.0
4	35.5
5	37.0
6	36.5
7	35.8
8	34.8
9	34.7
10	33.7

(i) Plot a graph of these results to determine an **accurate value** for the temperature rise.
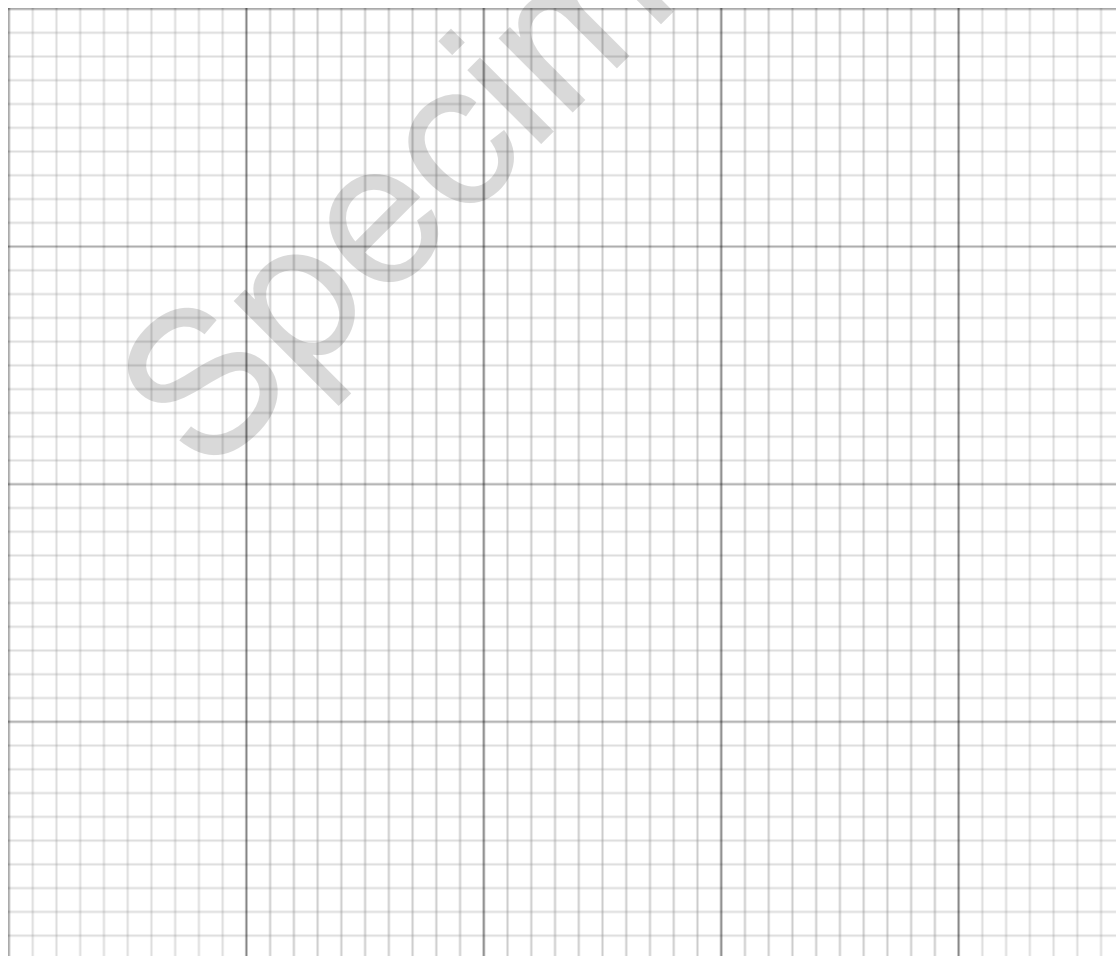
temperature rise = **………………………..** $^{\circ}$C   **[4]**

(ii) Calculate the enthalpy change of neutralisation, $\Delta_{neut}H$, for the reaction in **Equation 20.3**.

Assume that the density and specific heat capacity of the solution are the same as those for the water.

$\Delta_{neut}H$ = **……………………………** kJ mol^{-1} **[3]**

(iii) The volume of HI is measured using a burette that can be read to ±0.05 cm^3.

Calculate the uncertainty in this measurement.

uncertainty = **……………………………** %   **[1]**

21 Ozone is an essential gas in the stratosphere but harmful in the troposphere.

   (a) (i) Ozone absorbs high-frequency UV radiation in the stratosphere.

Give the equation for the reaction that occurs.

Explain why this absorption is important for human life.

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.... **[2]**

   (ii) One frequency absorbed by ozone is 1.25×10^{15} Hz.

Calculate the enthalpy of the strongest bond that can be broken by this frequency.

bond enthalpy = **...........................** kJ mol^{-1} **[4]**

   (b) Chloroalkanes produce chlorine radicals that act as catalysts in the breakdown of stratospheric ozone.

Give the equations for an initiation step and then the equations for two reactions involved in the catalytic breakdown of ozone.

Give the equation for a termination reaction.

Use the formula RCl to represent a chloroalkane.

[4]

(c) Chloroalkanes do **not** deplete ozone in the troposphere in the same way as in the stratosphere resulting in harmful tropospheric ozone.

Explain this statement and discuss the impact this has on the environment.

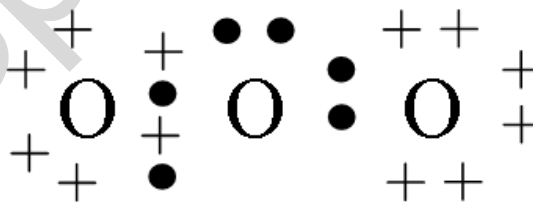...

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.... **[5]**

(d) Ozone can be represented by the *'dot-and-cross'* diagram shown below.

Give the shape of the molecule and bond angle around the central O atom.

Explain your answer.

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.... **[4]**
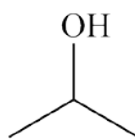
PMT

22 'Isopropyl alcohol' is used as a cleaning agent for electronic equipment.

OH

isopropyl alcohol

(a) Isopropyl alcohol can be made from the hydration of propene which requires the use of concentrated phosphoric acid. ΔH −50 kJ mol^{-1}

Bond	Average bond enthalpy kJ mol^{-1}
C=C	610
C–H	410
O–H	458
C–O	360
C–C	?

Use your knowledge of hydration and the information provided to calculate the average bond enthalpy of a C–C bond.

average bond enthalpy of C–C bond .... kJ mol^{-1}.   **[4]**

(b) The action of isopropyl alcohol as a cleaning agent depends on the intermolecular bonds formed by the compound. Isopropyl alcohol forms hydrogen bonds between its molecules.

(i) A student says that:

- isopropyl alcohol has a lower boiling point than 'propyl alcohol', $CH_3CH_2CH_2OH$
- this is because isopropyl alcohol forms weaker hydrogen bonds.

Comment on the student's statements.

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.... **[2]**

(ii) Propyl alcohol and isopropyl alcohol both have molecular formula C_3H_8O. There is one other compound with this molecular formula.

Draw the structure of the other compound with this molecular formula and describe its relationship to propyl alcohol and isopropyl alcohol.

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.... **[2]**

(c) (i) Isopropyl alcohol can be oxidised using acidified dichromate(VI).

Draw the **skeletal** formula of the organic compound formed and name the functional group it contains.

name of functional group: **..**

[2]

(ii) 2.4 g of isopropyl alcohol give 1.2 g of the product in **(i)**.

Calculate the percentage yield of this process.

percentage yield = **.............................** %   **[2]**

END OF QUESTION PAPER

H033/01