

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

Date – Morning/Afternoon

Version 2.0

Time allowed: 1 hour 30 minutes

You must have:

- the Data Sheet for Chemistry B (Salters)

You may use:

- a scientific or graphical 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.
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
- 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.

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 $\text{CH}_3\text{CHOHCH}_3$
- B $\text{CH}_3\text{CHNHCH}_3$
- C $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
- D $(\text{CH}_3)_2\text{CHNH}_2$

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?

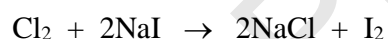
- A thin layer chromatography
- B melting point determination
- C addition of a neutral solution of iron(III) chloride
- D titration with sodium hydroxide solution

Your answer

☐

[1]

6 The reaction below occurs in the manufacture of iodine.



Which of the following statements about this reaction is correct?

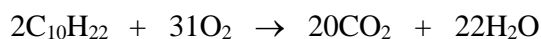
- A Iodine is oxidised by chlorine.
- B Chloride is reduced.
- C Iodide ions lose electrons.
- D Chlorine is a weaker oxidising agent than iodide.

Your answer

☐

[1]

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



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 $0.250 \text{ mol dm}^{-3}$ sodium hydroxide solution should be diluted to 1000 cm^3 to make a $0.0100 \text{ mol dm}^{-3}$ 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.

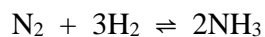
Which of the following would lead to the titre being larger than it should be?

- 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.



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?

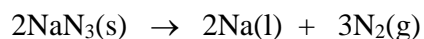
- A** 200 cm³
- B** 250 cm³
- C** 300 cm³
- D** 400 cm³

Your answer

☐

[1]

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



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?

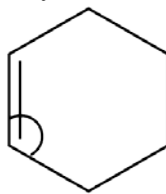
- A** Nitrogen has an oxidation state of $+\frac{1}{3}$ in the reactant.
- B** Sodium ions are reduced.
- C** Nitrogen has an oxidation state of -3 in a product.
- D** Sodium has an oxidation state of $+9$ in the reactant.

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

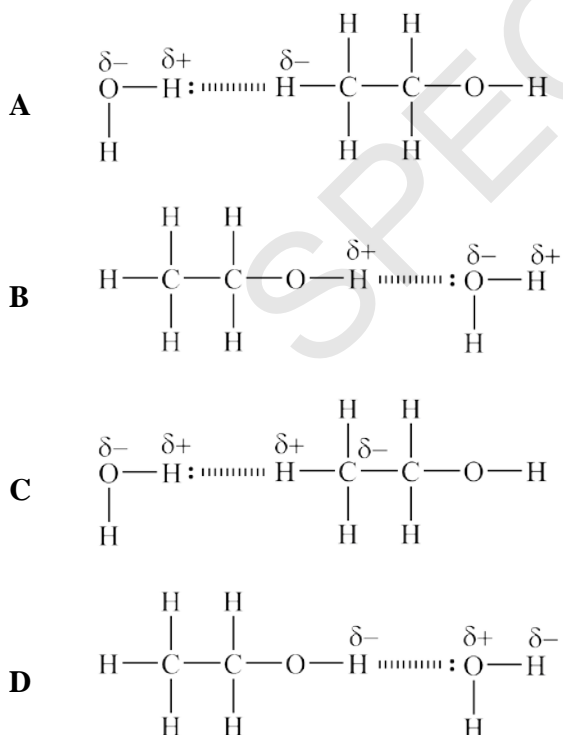
Your answer

☐

[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?



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 ($\text{HOC}_6\text{H}_4\text{COOH}$), ethanoic acid, phenol, ethanol or aspirin ($\text{HOCC}_6\text{H}_4\text{OCOCH}_3$).

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?

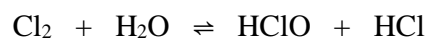
- 1:** Water vapour
- 2:** NO_x
- 3:** Carbon dioxide

- A** 1, 2 and 3
- B** Only 1 and 2
- C** Only 2 and 3
- D** Only 1

Your answer ☐

[1]

- 18** Chlorine reacts with water to produce a solution that acts as a bleach.



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.

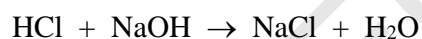
.....

 [2]

- (b)** The student adds a lump of limestone with mass 0.13 g to 25.00 cm³ 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 cm³ of 0.100 mol dm⁻³ sodium hydroxide.

The equations for the reactions are:



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.

.....

.....

.....

..... [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?

.....

.....

.....

..... [2]

BLANK PAGE

SPECIMEN

- 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.



Large quantities of hydrogen chloride are used to make 'vinyl chloride', $\text{H}_2\text{C}=\text{CHCl}$, a monomer for PVC.

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

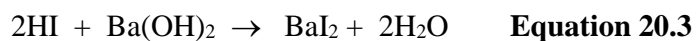
[1]

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

.....

[1]

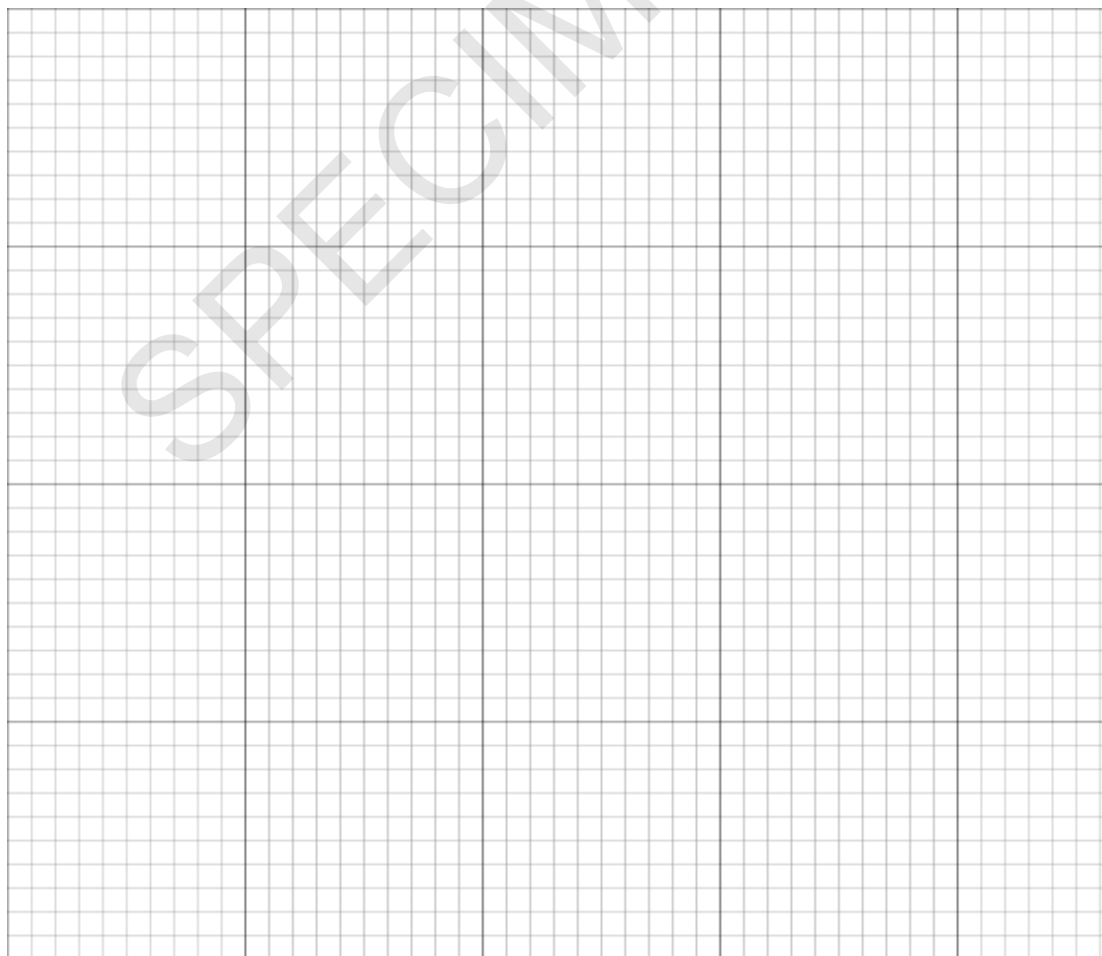
- (b) Hydrogen iodide reacts with a solution of barium hydroxide.



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 / °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 = °C [4]

- (ii) Calculate the enthalpy change of neutralisation, $\Delta_{\text{neut}}H$, 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.

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

- (iii) The volume of HI is measured using a burette that can be read to $\pm 0.05 \text{ cm}^3$.

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.

.....

 [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.

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

[illegible]

[5]

-

Explain your answer.

.....

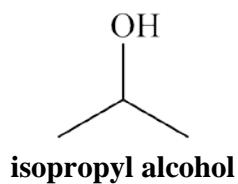
.....

.....

..... [4

[4]

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



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

Bond	Average bond enthalpy kJ mol^{-1}
C=C	610
C-H	410
O-H	460
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', $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
- this is because isopropyl alcohol forms weaker hydrogen bonds.

Comment on the student's statements.

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

(ii) Propyl alcohol and isopropyl alcohol both have molecular formula $\text{C}_3\text{H}_8\text{O}$. 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.

.....
..... [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

BLANK PAGE

SPECIMEN

SPECIMEN

Copyright Information:

OCR is committed to seeking permission to reproduce all third-party content that it uses in the assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements booklet. This is produced for each series of examinations and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1GE.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.



Oxford Cambridge and RSA

...day June 20XX – Morning/Afternoon

AS Level Chemistry B (Salters)

H033/01 Foundations of chemistry

SAMPLE MARK SCHEME

Duration: 1 hour 30 minutes

MAXIMUM MARK 70

This document consists of 12 pages

MARKING INSTRUCTIONS**PREPARATION FOR MARKING****SCORIS**

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *scoris assessor Online Training*; *OCR Essential Guide to Marking*.
2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal <http://www.rm.com/support/ca>
3. Log-in to scoris and mark the **required number** of practice responses (“scripts”) and the **required number** of standardisation responses.

YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

MARKING

1. Mark strictly to the mark scheme.
2. Marks awarded must relate directly to the marking criteria.
3. The schedule of dates is very important. It is essential that you meet the scoris 50% and 100% (traditional 50% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone, email or via the scoris messaging system.

5. Work crossed out:
- where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks
 - if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.
6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.
7. There is a NR (No Response) option. Award NR (No Response)
- if there is nothing written at all in the answer space
 - OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')
 - OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the question.
- Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).
8. The scoris **comments box** is used by your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**
- If you have any questions or comments for your Team Leader, use the phone, the scoris messaging system, or email.
9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. Annotations

Annotation	Meaning
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
()	Words which are not essential to gain credit
—	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

11. Subject-specific Marking Instructions

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

SECTION A

Question		Answer	Marks	Guidance
1		B	1	
2		C	1	
3		C	1	
4		C	1	
5		D	1	
6		C	1	
7		C	1	
8		A	1	
9		B	1	
10	(a)	D	1	
10	(b)	C	1	
11	(a)	B	1	
11	(b)	B	1	
12		A	1	
13		B	1	
14		A	1	
15		A	1	
16		A	1	
17		B	1	
18		A	1	
		Total	20	

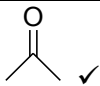
SECTION B

Question		Answer	Marks	Guidance
19	(a)	<p><u>Nichrome wire</u> dipped in sample and <u>concentrated HCl</u> then placed in blue/roaring Bunsen flame</p> <p>OR dissolve limestone in acid and put a splint soaked in the solution into blue/roaring Bunsen flame</p> <p>OR add the limestone to ethanol in a spray bottle and spray the solution into blue/roaring Bunsen flame ✓</p> <p>(Brick) red ✓</p>	2	
	(b)	<p>$n(\text{HCl}) = (25 - 7) \times 0.1/1000 = 1.80 \times 10^{-3} \text{ (mol) } \checkmark$</p> <p>$n(\text{CaCO}_3) = 1.80 \times 10^{-3}/2 = 9.0 \times 10^{-4} \text{ mol}$</p> <p>$\text{mass CaCO}_3 = 9.0 \times 10^{-4} \times 100.1 = 9.0 \times 10^{-2} \text{ (g) } \checkmark$</p> <p>$\% = 0.09 \times 100/0.13 = 69(.3) \% \checkmark$</p>	3	<p>The second mark is for the working or the answer</p> <p>ALLOW ECF on any value for first mark smaller than 0.13</p> <p>ALLOW any sig figs greater than 1</p> <p>69% scores 2 without reference to the working</p>
	(c)	<p>Use a lump of calcium carbonate weighing more than 1 g ✓</p> <p>more (or more concentrated) acid (and alkali) ✓</p>	2	
	(d)	<p>Test on filtrate (or solution in any acid):</p> <p>Fe(III) gives brown ppt with NaOH ✓</p> <p>Test on solution in HNO₃:</p> <p>AgNO₃ gives white ppt with chloride ✓</p>	2	<p>No marks for tests alone without indication of what is tested</p> <p>ALLOW 'purple/pink colour with phenol' for first mark only</p>
		Total	9	

Question			Answer	Marks	Guidance
20	(a)	(i)	$n \text{ H}_2\text{C}=\text{CHCl} \rightarrow \{-\text{CH}_2-\text{CHCl}-\}_n$ ✓	1	Formulae can be represented in any unambiguous way but 'end bonds' must be shown for the polymer. Brackets (any type) and 'n's essential
		(ii)	phosphoric acid ✓	1	ALLOW phosphoric(V) acid and H_3PO_4 IGNORE adjectives implying 'concentrated' (e.g. 'syrupy') but 'dilute' contradicts mark
	(b)	(i)	Choice and plotting of axes ✓ Accuracy of plotting points ✓ Best straight line drawn (ignoring anomalous point) ✓ Extrapolation and reading off temperature at 2 minutes (15.9 ± 0.1) ✓	4	Correct labels including units; scales chosen so that the plotted points occupy at least half the graph grid in both the x and y directions
		(ii)	Use of $m \times c \times \Delta T$ and selection of appropriate data from data sheet for c ; assumption that mass of 1 cm^3 of HI = 1 g $20 \times 4.18 \times 15.9 = 1329 \text{ (J)}$ ✓ $n(\text{Ba}(\text{OH})_2) = 2/171.3 = 0.0117 \text{ (mol)}$ ✓ $1329/(1000 \times 0.0117 \times 2)$ $\Delta_{\text{neut}}H = 57 \text{ kJ mol}^{-1}$ ✓	3	ALLOW ECF between steps and answers to 2 or more sf
		(iii)	uncertainty = $[(2 \times 0.05)/20] \times 100\% = 0.5\%$	1	
			Total	10	

Question			Answer	Marks	Guidance
21	(a)	(i)	$\text{O}_3 \rightarrow \text{O}_2 + \text{O} \checkmark$ (High freq radiation causes) skin cancer / damage to DNA / damage to skin / damage to eyes / damage to immune system / cell mutation / affects crops \checkmark	2	ALLOW $\text{O}_3 + h\nu \rightarrow \text{O}_2 + \text{O}$ (or $h\nu$ over arrow)
		(ii)	Recall and selection of appropriate constant from data sheet for $\Delta E = 6.63 \times 10^{-34} \times 1.25 \times 10^{15} \checkmark$ $= 8.29 \times 10^{-19} / 8.2875 \times 10^{-19} \text{ (J)} \checkmark$ multiply by N_A and divide by 1000 $= 8.29 \times 10^{-19} \times 6.02 \times 10^{23} / 1000 \checkmark$ bond enthalpy = 499/500 (kJ mol ⁻¹) \checkmark	4	ALLOW ECF
	(b)		$\text{RCl} \rightarrow \text{R} + \text{Cl} \text{ (initiation)} \checkmark$ $\text{O}_3 + \text{Cl} \rightarrow \text{ClO} + \text{O}_2 \checkmark$ $\text{ClO} + \text{O} \rightarrow \text{Cl} + \text{O}_2 \checkmark$ $\text{Cl} + \text{Cl} \rightarrow \text{Cl}_2$ OR $\text{R} + \text{R} \rightarrow \text{R}_2/\text{R-R}$ OR $2\text{ClO} \rightarrow \text{Cl}_2 + \text{O}_2 \text{ (termination)} \checkmark$	4	IGNORE dots on radicals ALLOW any chloroalkane formula Third equation depends on second being correct 'initiation' etc need not be labelled, unless the equations are given in a different order
	(c)		Explanation Fewer Cl atoms are formed in the troposphere than in the stratosphere. \checkmark Radiation of high enough frequency is too low in the troposphere (AW) \checkmark Ozone depletion can only occur in the troposphere when suitable catalysts are present. \checkmark Impact Tropospheric ozone contributes to photochemical smog. \checkmark Photochemical smog causes eye/nose irritation/ respiratory problems/ breathing difficulties/ damage to animals/ damage to plants/ damage to materials. \checkmark	5	

Question		Answer	Marks	Guidance
	(d)	shape: bent OR V-shaped ✓ angle $120^\circ (\pm 3)$ ✓ 3 groups of electrons / 3 areas of electron density ✓ (electrons) repel and get as far away from each other as possible ✓	4	no ECF between marking points Mark 4 th mpt separately must be in terms of the words allowed for the 3 rd mpt or 'electrons' or 'pairs of electrons' NOT 'bonds' ALLOW 'minimise repulsion' (in context of electrons or other appropriate wording) NOT 'maximum repulsion'
		Total	19	

Question		Answer	Marks	Guidance
22	(a)	$\text{CH}_3\text{CHCH}_2 + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{CH}(\text{OH})\text{CH}_3 \checkmark$ Bonds broken $610 + (6 \times 410) + (460 \times 2) + (\text{C}-\text{C})$ AND Bonds made $460 + (7 \times 410) + 360 + 2(\text{C}-\text{C}) \checkmark$ $[3990 + (\text{C}-\text{C})] - [3690 + 2(\text{C}-\text{C})] = -50 \checkmark$ $300 - (\text{C}-\text{C}) = -50$ Average bond enthalpy of C–C bond = $350 \text{ (kJ mol}^{-1}\text{)} \checkmark$	4	ALLOW Structural formula for 1MP ALLOW ECF
	(b) (i)	Student is correct (about lower bpt) (AW) but reason is fewer/weaker instantaneous dipole–induced dipole bonds (in isopropyl alcohol) \checkmark (due to) more branched/ fewer points of contact \checkmark	2	Assume isopropyl alcohol is being described unless otherwise stated. If so, allow ORA
	(ii)	$\text{CH}_3\text{CH}_2\text{OCH}_3 \checkmark$ <u>structural</u> isomers \checkmark	2	ALLOW any unambiguous formula ALLOW <u>functional group</u> isomers
	(c) (i)	 \checkmark ketone \checkmark	2	IGNORE 'carbonyl'
	(ii)	$n(\text{isopropyl alcohol}) = 2.4/60 = 0.040 \text{ (mol)}$ AND maximum mass propanone = $0.040 \times 58 = 2.32 \text{ (g)}$ OR $n(\text{propanone}) = 1.2/58 = 0.0207 \text{ (mol)} \checkmark$ $(= 1.2 \times 100/2.32) \text{ OR } (=0.0207 \times 100/0.04)$ percentage yield = $52\% \checkmark$	2	ALLOW working OR answer for 1 st mpt ALLOW 2 sig figs or more ALLOW answers between 51.7 and 52.1 to allow for rounding Correct answer with no working scores 2 marks
		Total	12	

Summary of updates

Date	Version	Change
January 2019	2.0	Addition to the rubric clarifying the general rule that working should be shown for any calculation questions