

**GCE**

**Chemistry B (Salters)**

**H033/01: Foundations of chemistry**

Advanced Subsidiary GCE

**2021 Mark Scheme (DRAFT)**

This is a DRAFT mark scheme. It has not been used for marking as this paper did not receive any entries in the series it was scheduled for. It is therefore possible that not all valid approaches to a question may be captured in this version. You should give credit to such responses when marking learner's work.

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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## 1. Annotations

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
	Benefit of doubt given
	Contradiction
	Rounding error
	Error in number of significant figures
	Error carried forward
	Level 1
	Level 2
	Level 3
	Benefit of doubt not given
	Noted but no credit given
	Ignore

2. Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

<b>Annotation</b>	<b>Meaning</b>
/	alternative and acceptable answers for the same marking point
✓	Separates marking points
<b>DO NOT ALLOW</b>	Answers which are not worthy of credit
<b>IGNORE</b>	Statements which are irrelevant
<b>ALLOW</b>	Answers that can be accepted
( )	Words which are not essential to gain credit
—	Underlined words must be present in answer to score a mark
<b>ECF</b>	Error carried forward
<b>AW</b>	Alternative wording
<b>ORA</b>	Or reverse argument

### 3. 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**.

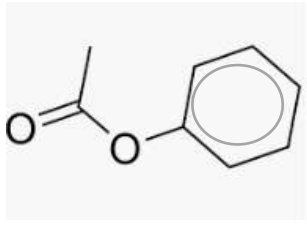
Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

## Answers to Section A

Question	Key	AO
1	A	1.2
2	B	1.1
3	C	1.1
4	C	1.1
5	C	2.1
6	C	2.1
7	D	2.5
8	C	2.5
9	B	1.2
10	C	1.2
11	D	2.1
12	B	1.1
13	C	1.1
14	B	1.1
15	C	1.1
16	A	2.6
17	C	2.2
18	B	2.1
19	D	2.6
20	A	1.1

## SECTION B

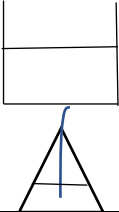
Question			Answer	Marks	AO element	Guidance
21	(a)	(i)	Group 2/Same group/ same number of outer-shell electrons ✓	1	1.1	
		(ii)	greater <b>and</b> (outer shell) electrons closer to nucleus ✓	1	2.2	
		(iii)	Ba(s) + 2H <sub>2</sub> O(l) → Ba(OH) <sub>2</sub> (aq/s) + H <sub>2</sub> (g) Formation of Ba(OH) <sub>2</sub> plus H <sub>2</sub> ✓ Correct balancing <b>and</b> ss ✓	2	1.2 2.2	<b>ALLOW</b> BaO for this mark only
	(b)	(i)	136.2 <b>and</b> 233.4 ✓	1	1.1	
	(b)	(ii)	(Identifies/test for) sulfate (ion) ✓ Add solution of barium ions/ Ba <sup>2+</sup> / barium chloride/ barium nitrate <b>AND</b> White ppt/solid. ✓	2	2x 2.7	
	(c)		(Correct): Ba <sup>2+</sup> is larger than Ca <sup>2+</sup> ✓ (Incorrect) BaCO <sub>3</sub> decomposes more readily/ higher thermal stability ✓ (Correct Chemistry): Ba <sup>2+</sup> has smaller charge density/larger size:charge ratio ✓ Distorts/polarises carbonate ion less ✓	4	4 x 3.1	<b>ALLOW</b> 'ORA' throughout <b>IGNORE</b> references to Ba <sup>2+</sup> attraction to CO <sub>3</sub> <sup>2-</sup>
			<b>Total</b>	<b>11</b>		

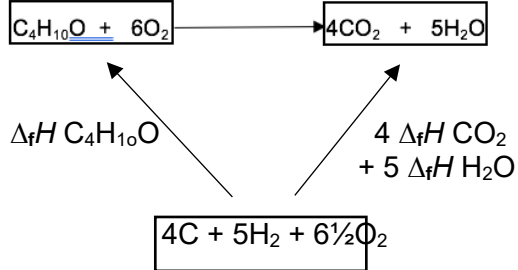
Question			Answer	Marks	AO element	Guidance
22	(a)	(i)		1	1.2	
		(ii)	amount phenol (= 15/94) = 0.16 (mol) amount ethanoic anhydride (= 24/102) = 0.24 (mol) both amounts correctly calculated ✓ Correct conclusion from shown calculations as to which is in excess ✓	2	2.8 3.2	
	(b)		(fractional) distillation ✓	1	1.2	
	(c)		$^{13}\text{CC}_5\text{H}_5\text{OH}^+$ / $^{13}\text{CC}_5\text{H}_6\text{O}^+$ ✓✓ for completely correct ✓ if + sign omitted <b>or</b> $^{13}\text{C}$ shown but it is not clear there's only one. (not both)	2	2 x 1.2	
	(d)		ethanoic acid/ $\text{CH}_3\text{COOH}$ ✓ C=O <b>and</b> 1700 or '1700 – 1725' ✓ O-H <b>and</b> 'around 3000'/2500-3300 ✓	3	3.2 3.1 3.1	
			Total	9		



Question		Answer	Marks	AO element	Guidance															
23	(a)	Bright/coloured lines on a dark/black background ✓ Electrons in energy levels ✓ (Electrons) fall (to lower levels) ✓ Emit light/ radiation/ photon ✓ Frequency <u>proportional</u> to energy change/ $\Delta E = hv$ ✓	5	5 x 1.2	<b>ALLOW</b> 'shells' Electrons must be mentioned somewhere to score MP2 <b>ALLOW</b> $E = hv$ if energy change implied or 'energy of photon'.															
	(b)	(i) <b>FIRST CHECK ANSWER LINE</b> <b>If answer = <math>5.10 \times 10^{14}</math> award 3 marks</b>  Use of $v = c/\lambda$ ✓ (= $3 \times 10^8 / 588 \times 10^{-9}$ ) = $5.10 \times 10^{14}$ (Hz) (to any sf) ✓ 3 sf ✓	3	3 x 2.2	The result of any calculation to 3 sf scores MP3															
		(ii) $E (= hv = 6.63 \times 10^{-34} \times 5.00 \times 10^{14})$ = $3.32 \times 10^{-19}$ ✓ Units ( $J \text{ Hz}^{-1} \times \text{Hz}$ ) = J ✓	2	2 x 2.2	<b>ALLOW</b> 2 or more sf Mark number and units separately.															
		(iii) IR/infrared/ radio waves ✓	1	1.1	<b>ALLOW</b> microwave															
	(c)	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th>He-3</th> <th>He-4</th> </tr> </thead> <tbody> <tr> <td>atomic number</td> <td>2</td> <td>2</td> </tr> <tr> <td>number of electrons</td> <td>2</td> <td>2</td> </tr> <tr> <td>number of neutrons</td> <td>1</td> <td>2</td> </tr> <tr> <td>mass number</td> <td>3</td> <td>4</td> </tr> </tbody> </table> <p>one mark for each column ✓✓</p>		He-3	He-4	atomic number	2	2	number of electrons	2	2	number of neutrons	1	2	mass number	3	4	2	2 x 1.1	
	He-3	He-4																		
atomic number	2	2																		
number of electrons	2	2																		
number of neutrons	1	2																		
mass number	3	4																		

	(d)	(i)	<b>CHECK ANSWER LINE</b> <b>If answer = 47.92, award 2 marks</b>  $((46 \times 8.25) + (47 \times 7.44) + (48 \times 73.72) + (49 \times 5.41) + (50 \times 5.18))/100$ <b>OR</b> $(379.50 + 349.68 + 3538.56 + 265.09 + 259.00)/100$ ✓  = 47.92 ✓	<b>2</b>	<b>2 x 2.5</b>	
		(ii)	$3p^64s^24d^2/3p^64d^24s^2$ ✓	<b>1</b>	<b>1.1</b>	<b>DO NOT ALLOW</b> capital 'D' or subscript numbers
			Total	<b>16</b>		

Question			Answer	Marks	AO element	Guidance
24	(a)	(i)	Less CO/carbon monoxide (with high weight) ✓ CO is toxic/ poisonous ✓	2	2 x 1.1	IGNORE harmful
	(a)	(ii)	nitrogen and oxygen from the air ✓ combine/react in the heat of the engine ✓	2	2 x 1.2	
	(b)	(i)	Beaker placed above lamp ✓ With 'water line' shown and <b>either</b> 'beaker (of water)' or water labelled. ✓  	2	2 x 3.3	
		(ii)	<b>CHECK ANSWER LINE</b> <b>If answer = -1300/1290/1286 (kJ mol<sup>-1</sup>) award 3 marks</b>  (Energy = 200 x 4.18 x 52/100) = 43.47 kJ ✓ Amount butan-1-ol (= 2.5/74) = 0.0338 mol ✓ Ans (= 43.47 / 0.0338) = -1286/1294/1300 kJ mol <sup>-1</sup> ✓	3	3 x 2.4	<b>ALLOW</b> 2 or more sf  Conversion to kJ can be at any stage  Sign must be correct for MP3

	(c)	<p>(i)</p>  <p>Hess cycle (element box and arrows) ✓  <math>\Delta_c H = (4 \times -394) + (5 \times -286) + 327 = -2679 \text{ (kJ mol}^{-1}\text{)}</math>          ✓</p>	2	2 x 2.6	IGNORE state symbols
		<p>(ii) One from:</p> <ul style="list-style-type: none"> <li>• heat losses</li> <li>• evaporation from wick</li> <li>• conditions not standard</li> </ul>	1	3.4	ALLOW incomplete combustion
	(d)	<p><math>\text{C}_4\text{H}_9\text{OCOCH}_3</math> ✓ + <math>\text{H}_2\text{O}</math> ✓</p>	2	2 x 2.3	<p>ALLOW any unambiguous formula for ester</p> <p>DO NOT ALLOW <math>\text{C}_4\text{H}_9\text{COOCH}_3</math></p>
			14		

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